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Trust Transfer in the Sharing Economy - A Survey-Based Approach

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Abstract

The sharing economy is experiencing explosive growth around the globe in which trust plays a crucial role and builds the foundation of the services. With the rise of the sharing economy and the increasing numbers of cross-contextual users, this research aims at the lack of trust transference possibilities across the Peer-to-Peer applications and has the goal to find out whether and how trust can be transferred between the platforms, so that new users do not have to create their reputation from scratch every time they join a new platform. First, this research provides an in-depth literature review of trust transfer theories. Secondly, a conceptual research model for the role of the imported trust in the context of the sharing economy is outlined and analysed by proposing and evaluating a questionnaire using structural equation modeling. Throughout the study, a three-dimensional scale of trust, i.e. ability, benevolence and integrity, is validated in the context of the sharing economy. The experimental study shows that both the overall and subdimensional trust in the provider is directly affected by the overall trust in the platform, the perceived reputation as well as the perceived social presence. The study also provides empirical evidence for the existence of trust transferability. The findings show that in addition to the immanent ratings, imported ratings also significantly affect the perceived reputation of the provider positively. Finally, this paper discusses further details of the trust transfer processes and broadens implications for future research.

Keywords: Sharing Economy, Trust, Trust Transfer, Reputation, Peer-to-peer

1. Introduction

> Uber, the world's largest taxi company, owns no vehicles [...] Alibaba, the most valuable retailer, has no inventory. Airbnb, the world's largest accommodation provider, owns no real estate. - (Bear, 2015)

One of the most remarkable developments of the 21st century global marketplace is indeed the rapid growth and the evolution of the sharing economy (Bert et al., 2016). Today, ordinary people can rent or short-term everything from high-end houses to cars, luxury handbags to musical instruments, designer pets to power boats. Sharing economy has established itself as a competitive sector with huge potential and thus, gained much importance in recent years. A prognosis of the consulting agency PWC showed that a potential revenue opportunity of this industry would worth 335 billion US-Dollar by 2025. As a matter of fact, Airbnb now already averages 425,000 guests per night, nearly 22 % more than Hilton Worldwide (Vaughan and Hawksworth, 2014).

If peer-to-peer marketplace is the future, it will require trust between the peers which is a crucial element because trust is the currency of the new economy (Botsman, 2012). Jack Ma, the executive chairman of Alibaba Group[1] emphasized as well that trust is the most important element at P2P marketplaces where people do not even trust face to face, especially in countries like China.

While a multiplicity of independent P2P platforms is developing, a problem has been identified – the technically independent platforms are not connected with each other, i.e. new users have to establish their reputation every time from scratch when they join a new platform (Zacharia et al., 2000), even though they have well-documented trust history on other participating platforms. The research objective of this work is to find out if, and how the trust between different sharing economy applications transfers. This article contributes by developing a model where the linkage between different platforms is proposed. E.g., a new user of Ebay would theoretically be able to link his profile of Airbnb to show his available reliability and trustworthiness, in order to create a better reputation.

The core of the research question is how would trust

[1] World Economic Forum Annual Meeting 2015

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transfer throughout the platforms in detail. E.g. Would a well-reputed Ebay seller be qualified as a trustworthy Airbnb host? And vice versa? It is obvious that more elements play important roles in this conducted research model. One may enjoy a high reputation for his expertise in one domain, while having a low one in another, e.g. Linux Guru has high reputation in Linux Forum but low reputation in Windows operations (Zacharia et al., 2000).

The main part of the study's development is derived from the established three trust dimensions - ability, integrity and benevolence as well as some trust (transfer) theories. A complete literature review of trust transfer is provided where various trust transfer situations are analysed, classified and synthesized. Subsequently in the conducted study, data of trust transfer between four selected sharing economy platforms was collected with 140 participants. The systematic approach follows a matrix combination from the "target platform" to the "origin platform". Therefore, the observation is based on the trust of the provider side (i.e., driver, host, seller, lessor). Correspondingly, the participants take the role of the consumers, i.e., car passenger, guest, buyer or renter. The reputation would be only considered based on the star-ratings.

The rest of the work is structured as follows: section 2 discusses and provides introduction for the context of this work's background with focus on the sharing economy and the trust dimensions. The next section 3 summarizes and synthesizes the previous studies of trust transfer, defines and discusses the trust transfer situation in the sharing economy with a presentation of existing trust transfer solutions. Section 4 then develops and presents the hypothesises in figure 4 regarding the "imported trust" underlying trust transfer. In section 5, the study results and the design of the conducted experiment (and a preliminary questionnaire) are presented and the research model is described. Finally, the article concludes with a discussion, limitation and implications for future research.

2. Theoretical Background

This chapter aims to provide theoretical background of the topic and comprises a literature review of three relevant aspects : the sharing economy, trust and its dimensions. The sharing economy, as the context the process takes place in, is briefly introduced in section 2.1. The definition and the dimensions of trust are then presented in section 2.2.

2.1. Sharing Economy

The term "sharing economy" is disputable. First, it has a few synonyms - Botsman and Rogers (2011) described it as "collaborative consumption", Gansky (2010) "the mesh" and Lamberton and Rose (2012) "commercial sharing systems". However, a "shared definition" lacks in the sharing economy, as Botsman (2012) put it. A variety of definitions exist. The Harvard Business Review and the Financial Times have argued that "sharing economy" is a misnomer (Eckhardt and Bardhi, 2015; O'Connor, 2016). The former one suggested the correct word in the broad sense of the term to be "*access economy*" because the market-mediated "sharing" through a company as intermediary between individual consumers is no longer "sharing" in the traditional definition at all. Rather, consumers are paying to access someone else's goods or services. Thus, the term of sharing economy in this work refers accordingly to a business model where the participants share unused resources among them via peer to peer services (Boeckmann, 2013; Kamal and Chen, 2016) and is assumed to be a synonym of the word "peer-to-peer services".

The scope of sharing economy is wide. There are sharing economy models in various types throughout different areas. To name a few examples, Blablacar [2], Uber [3] and Lyft [4] count to automotive & transportation; Airbnb [5] and Couchsurfing [6] belong to Hospitality category; Retailing also sets its foot in sharing economy with Kleiderkreisel [7] or Rent-the-runway [8]; More platforms like TaskRabbit [9] provide even human and knowledge resources in form of freelance labor to match local demand on everyday-tasks. Sharing economy enables more efficient resources being money-and-time-saving and traffic-and-pollution-reducing. In this sense, it is considered as important as the "Industrial Revolution" in terms of how people think about ownership (Botsman and Rogers, 2011) as we are currently living in a world facing problems of global warming, rising fuel prices and growing pollution (Belk, 2013).

2.2. Trust and its Dimensions

President Ronald Reagan once said famously, "Trust but verify" which is an obfuscation. Trusting means actually that you do not have to verify. The roles of trust and risk have yet to be identified and defused. Trust is risk mitigation (Green, 2015). If we could all decide purely based on faith or if we could predict others' behavior and intentions with definite certainty, then trust itself would not be necessary and required, according to Lewis and Weigert (1985).

Yet the fact is, we need trust and trust is very important, especially in the context of the sharing economy which was born with stacks of promises. The consulting company BCG listed trust as one of the three core principles of the sharing economy (trust, coverage and value). People leverage their trust for creating efficiency participating in sharing economy services. In this special case of P2P platforms and social networks, there is additionally the culture of anonymity (Nunes and Correia, 2013), and people behave differently when they are anonymous (Brogan and Smith, 2009). For this reason P2P platforms carry naturally higher risks than e.g. B2C e-commerce because there is no institutional credibility provided by a company in this case (Nunes and Correia, 2013).

[2] http://www.blablacar.com
[3] http://www.uber.com
[4] http://www.lyft.com
[5] http://www.airbnb.com
[6] http://www.couchsurfing.com
[7] http://www.kleiderkreisel.com
[8] http://www.renttherunway.com
[9] http://www.taskrabbit.com

Creating "sharing trust" in sharing economy, thus, is important but also challenging.

Companies like Airbnb have the obstacle to convince users not to fear, but to entrust complete strangers by creating a trust system including ratings and comments. Just like the trusted hotel brand Hilton which made people feel safe, sharing economy has brought people to the era trusting (and be trusted by) one another in the web of complex peer-to-peer network. Therefore, the role of trust is, as an imagined "currency", very crucial.

Trust

Trust has been the main driving force behind the human bonding and social reciprocities (Kamal and Chen, 2016). The commercial role of trust, being initially important in the context of e-commerce (Stolle, 2002; Palvia, 2009; Mui et al., 2002) has now been already frequently investigated in the context of the sharing economy, too. To name a few examples: Hawlitschek et al. (2016); de Jonge and Sierra (2016); Kamal and Chen (2016); Teubner et al. (2016); Zervas et al. (2015) and Green (2015). Besides, recent incidents such as shootings by an Uber driver (Kauzlarich, 2016) or robbery at hosted Airbnb apartment (Arrington, 2011) also reminded us on the importance of trust concerning. These incidents underlined again that trust is the key to sustain the growth and success of a world of sharing instead of owning (Botsman and Rogers, 2011). The consulting house Roland Berger emphasized that "to share is to trust. That, in a nutshell, is the fundamental principle." (Schönberg, 2014) - Trust is, despite merits, a decisive element in the context of the sharing economy and is accordingly considered as a fundamental factor in this work.

Trust has been defined as "the intention to accept vulnerability based upon positive expectations of the intentions or behaviors of another" (Rousseau et al., 1998). Deutsch (1958) defined trust with three typically consisting trust dimensions inspired from Aristotles' Rhetoric long ago: intelligence (corresponding "ability"); good character (corresponding "integrity") and goodwill (corresponding "benevolence"). Meanwhile trust contains behavioral intentions and cognitive elements where the former case deals with increasing vulnerability to each other by interdependent actors and the latter case deals with context-related beliefs about the trusted party that provide justification for the behavior (Rossiter and Pearce, 1975; Lewis and Weigert, 1985; Gefen and Straub, 2004).

The Trust Dimensions

The subdivision of trust dimensions is disputable. Some researchers agree that trust is multidimensional (Mayer et al., 1995; Rousseau et al., 1998) in consistency as mentioned, whereas few researchers believe that trust functions as a unitary concept, e.g. Rotter (1980) defined interpersonal trust as "an expectancy held by an individual or a group that the word, promise, verbal or written statement of another individual or group can be relied on". For analyzing and understanding how trust can be transferred from one entity or context to another, trust needs to be subdivided into structured clusters in this context. Therefore, this work is consistent with the multidimensional point of view. Details of the trust dimensions will be discussed in the following passages.

In table 1, table 2 and table 3, previous literature reviews of varying trust dimensionality summarized by Gefen and Straub (2004); McKnight et al. (2002) and additional summary of this work are presented in three separate tables for a better overview. They are conceptually clustered to categories. There are 19 columns describing the related dimensions and accompanying subtypes of trust which are grouped in the following categories: *(i) ability* (competence(C), expertness(E), dynamism(D)); *(ii) benevolence* (goodwill(G), benevolence(B), responsiveness(R)); *(iii) integrity* (integrity(I), morality(M), credibility(C), reliability(R), dependability(D), honesty(H)); aspects *(iv) not included* in the main categories (predictability(P), openness(O), carefulness(C), attraction(A), shared social expectations(S), belief and willingness in trustworthiness(B), positive expectation(P)). The reasons for division of the tables are both making clear this work's contribution of completion and literature updating with more recent research, since the context of the sharing economy is relatively new. Besides, it should be noted that the dimensions mentioned in the literature above are context-specific, that means the trust processes take place in different settings (Luhmann, 1979; Gefen and Straub, 2004).

As the tables show, although many trust dimensions existed in the reviewed literature through the years, the three most frequently used trusting beliefs are unequivocal to see as both of the *counts* of each table and the *final count* in the third table show — competence, benevolence and integrity. Because of the clear dominance of the final count showing involved categories along with the additional supporting statements of Gefen (1997), Bhattacherjee (2002) and Mayer et al. (1995), these three beliefs are shown as the most widely accepted and adapted and thus are decisive[10] for this work.

To be noticed is that in the research model (clarified in section 4) the three above mentioned dimensions of overall trust are yet, broken down to only two (constructs): "provider's ability" and "providers' integrity and benevolence". The first reason is that Gefen (2002a) suggested to look upon trustworthiness beliefs as "a set of interrelated beliefs" rather than as one overall assessment. The authors stated that a general bundling belief would be an "oversimplification" owing to the fact that consumer beliefs in the ability of the provider may affect shopping intentions whereas the aspect of integrity and benevolence affect purchase intentions. Although many other researchers also considered three components of trust, Ridings et al. (2002); Lu et al. (2010) suggested that in the context of the virtual community two dimensions — ability and a combined benevolence and integrity dimension, are applicable with the rationale

[10] I also want to thank Rachel Botsman for her analogue suggestion as valuable input.

that both lead to the same behavior. In addition, they are hard to be distinguished as acknowledged in preparation opinion poll letting interviewees sort the matching items and constructs. Thus, this view is adopted in this work and the dimension of integrity and benevolence belief are bundled in the practical research.

The three trust dimensions are explained as follows, according to the research of McKnight et al. (2002). Possible examples are attached to each dimension based on logical dependencies and own experience in P2P services.

(i) *Competence* means primarily ability of the trustee to do what the truster needs.

For example, an Airbnb host should be able to organize and manage the place of accommodation; An Ebay-Seller ought to know the process of selling operation and has the competence to send his items to the buyer; A Blablacar driver as trustee needs to at least have the technical ability to control the vehicle properly.

(ii) *Benevolence* stands for kindheartedness, the quality of being well-meaning and general decency as a human. A benevolent trustee is caring and motivated to act in the truster's interest. Benevolence represents one's goodwill and responsiveness whereas integrity refers to ones's morality, credibility, reliability and dependability to show that they have ethical right-mindedness.

(iii) *Integrity* demands the trustee's quality of being honest and having strong moral principles, e.g. keeping promises.

I would give some examples regarding the selected platforms. A typical character feature of a benevolent provider with integrity would be e.g. answering phone for requests, being punctual and respectful. They have normally no desire to hurt or deceive and have readiness to help in case something is wrong. Such an Airbnb renter would show the guest the house and quickly does a handover, they may also answer some (e.g. touristic) questions if they can. An Uber driver would be punctual, and he would not e.g. intentionally operate a circuitous route. A Blablacar driver would be caring and arrive at the destination place as arranged, or even drop off someone who lives on the way. An Ebay user of benevolence and integrity would describe his selling articles in an honest way and would not act with intention to defraud.

Despite of adapting the three selected trust dimensions, another popularly accepted trust dimension of *predictability* is still worth-mentioning since the definition of "trust" by Stewart (2003) is that of a trustworthy agent with "benevolent, competent, honest and *predictable* behavior in a situation. Lewicki and Stevenson (1997) found that predictability enhances trust even if the other's behavior is untrustworthy, for the reason that we can predict the ways that the other will violate the trust. For instance, Buntain and Golbeck (2015) applied this aspect for their strategy trust game by defining varying degree of trust based on identifying the behavior patterns and recognizing participants' predictability. In context of this work there are currently no clear indicators allowing trustors to establish the point. Future work could alternatively consider this dimension. Furthermore, it is to be noticed that there are still missing aspects such as cultural differences (Sia et al., 2009) which are not included in the summarized tables.

3. Trust Transfer - A Review

In this section, the process of trust transfer is analyzed based on related literature. In section 3.1, the methodology used, trust-transfer-relevant mechanisms and theories are reviewed. Subsequently in section 3.2, trust transfer in the special context of the sharing economy as well as the existent corresponding solutions are discussed separately.

3.1. Literature Review

The following passages provide an in-depth literature analysis of trust transfer. In order to examine how trust can be transferred, the trust dimensions discussed above will serve as the foundation. The literature review is structured as follows: first, section 3.1.1 gives a short summary of the methodology used for the literature-based review part. Next, section 3.1.2 presents how the trust transfer model functions with different roles. Finally, section 3.1.3 shows an overview of literature-review-based trust transfer theory classified by the source of trust transfer process.

3.1.1. Methodology of Literature Review

The literature review of trust transfer is based on the review guideline provided by Webster and Watson (2002). The broad structure of this review follows the following sequence: (1) Scoping search and planning, (2) Literature research, (3) Analysis and selection, (4) Literature synthesis.

The term "trust transfer" has been discussed in various scopes of research fields. Since the context of the sharing economy is relatively new in research, a restriction in this field would lead to a too narrow-setting boundary. The scoping search showed that although many applicable works have been found with the key variable of "trust transfer", the modern context of the "sharing economy" has not allowed me to find an established literature foundation. The object of this literature review can be observed as the second type of review papers according to Webster and Watson (2002). This is to summarize and emerge the hitherto existing related theories, expose the potential theoretical foundations and eventually, adapt the knowledge and phenomenon, if applicable, to the field of this work - the sharing economy.

A scoping search was undertaken using search results of the site of Google Scholar [11] which serves as a database of full text scholarly literature across publishing formats and disciplines. The antecedent of the topic originates from psychology whereas the most results belong to the field of e-Commerce (Ballester and Espallardo, 2008) with literature of information networks (e.g. distributed networks (Dong et al., 2007) and social networks (Golbeck, 2005). Therefore, the literature review drawn upon in this work will be, in a

[11] https://scholar.google.de (accessed on 09.11.2016)

Source	Ability			Benevolence			Integrity						Not included						
	C	E	D	G	B	R	I	M	C	R	D	H	P	O	C	A	S	B	P
summarized by Gefen and Straub (2004)																			
Anderson and Narus (1990)	x				x								x					x	
Blau (1964)	x				x		x												
Butler (1991)	x						x							x					
Crosby et al. (1990)					x		x												
Dwyer et al. (1987)	x			x															
Elangovan and Shapiro (1998)					x		x												
Ganesan (1994)	x				x				x	x									
Gefen (2000)																		x	
Gefen (2002b)																		x	
Gefen et al. (2003a)																		x	
Gefen et al. (2003b)	x				x		x												
Gefen and Silver (2000)	x				x		x												
Giffin (1967)	x	x	x	x	x		x			x	x		x			x			
Hart and Saunders (1997)	x			x	x								x	x					
Hosmer (1995)								x											
Jarvenpaa et al. (1998)	x				x		x												
Jarvenpaa and Tractinsky (1999)					x		x											x	
Kollock (1999)																		x	
Korsgaard et al. (1995)				x			x					x							
Kumar (1996)											x	x							
Kumar et al. (1995a)					x		x					x							
Kumar et al. (1995b)					x		x					x							
Luhmann (1979)					x		x												
Mayer et al. (1995)	x				x		x												
McAllister (1995)					x													x	
McKnight et al. (2002)	x				x		x												
McKnight et al. (1998)	x				x		x					x	x						
Mishra (1995)	x				x					x				x					
Moorman et al. (1993)	x						x												
Moorman et al. (1992)																		x	
Morgan and Hu (1994)							x			x									
Pavlou and Gefen (2004)																		x	
Ramaswami et al. (1997)																	x		
Ridings and Gefen (2001)	x				x		x												
Rotter (1980)											x								
Rotter (1971)													x						
Rousseau et al. (1998)																			x
Schurr and Ozanne (1985)													x						
Zucker et al. (1986)																	x		
Zucker et al. (1986)																	x		
Count	*16*	*1*	*1*	*4*	*20*	*0*	*19*	*1*	*1*	*4*	*3*	*5*	*6*	*3*	*0*	*1*	*1*	*10*	*1*

Table 1: Clustered trust dimensions in previous research - 1

nutshell, dominantly in the field of Information Systems (IS).

Approaching a systematic research as suggested by Webster and Watson (2002), a structured identification process should include major search in the leading journals, forward search and backward review.

The top journals in the leading database - the "*Senior Scholars Basket of eight Journals*" have been looked up first. The used search term was "*trust transfer*" [12]. Besides, journals published on *Communications of the Association for Information Systems* and *Journal of Information Technology Theory and Application (JITTA)* have also been reviewed by the same search term. Eighteen results were identified in total.

[12] https://aisnet.org/?SeniorScholarBasket (accessed on 08.11.2016)

Source	Ability			Benevolence			Integrity						Not included						
	C	E	D	G	B	R	I	M	C	R	D	H	P	O	C	A	S	B	P
summarized by McKnight et al. (2002)																			
Baier (1986)	x			x															
Barber (1983)	x							x											
Blakeney (1986)		x	x	x			x							x	x				
Bonoma (1976)					x				x	x	x								
Cummings and Bromiley (1996)					x		x												
Dunn (1988)				x															
Gabarro (1978)	x			x			x						x	x	x				
Gaines (1980)					x														
Heimovics (1984)		x	x		x					x									
Holmes (1991)					x	x													
Husted (1990)								x											
Johnson-George and Swap (1982)					x	x	x			x	x								
Kasperson et al. (1992)	x				x								x						
Kee and Knox (1970)	x				x														
Koller (1988)	x				x		x			x									
Krackhardt and Stern (1988)				x															
Lindskold (1978)					x					x									
McGregor (1967)					x														
McLain and Hackman (1999)	x				x														
Rempel et al. (1982)					x	x	x						x	x					
Ringand and den Ven (1994)				x				x											
Sato (1988)					x		x												
Sitkin and Roth (1993)	x																		
Solomon (1960)					x														
Thorslund (1976)	x			x				x											
Worchel (1979)				x				x											
Yamagishi and Yamagishi (1994)				x															
Zaheer and Vekatraman (1993)							x	x											
Zaltman and Moorman (1988)						x					x								
Count	*9*	*2*	*2*	*9*	*15*	*4*	*8*	*6*	*1*	*5*	*3*	*0*	*3*	*3*	*2*	*0*	*0*	*0*	*0*

Table 2: Clustered trust dimensions in previous research - 2

Continuing with the *forward search* using database of *Google Scholar*, the search terms used were "*trust transfer*" [13], "*trust transfer*" + "*sharing economy*" [14] and "*trust in sharing economy*" [15].

All of the raw "potential literature" pieces were first evaluated regarding their relevance for the review in the above defined context. The process occurred by first reading publication titles and abstract in the previous review; on the next level depending on the degree of relevance, sections such as conclusion, result and even the whole text have been studied particularly.

If the content of the literature piece was rated as rather relevant, *backward reference searching* was also involved, that is, examining the references cited in those selected articles in order to study the origins, development and experts of the themes. A second-level backward reference search has also been used, if the literature piece is frequently cited. From all the previously mentioned literature base after removing redundant content, eighty-three literature works are presented in the following review, sorted by categories.

3.1.2. Trust Transfer Mechanism

Stewart (2003) defined trust transfer as following: when a person (the trustor) bases initial trust in an entity (a person, group, or organization referred to as the target) on trust in some other related entity, or on a context other than the one in which the target is encountered, e.g. a different place or platform. The process of trust transfer is also referred to transitivity of trust (Buntain and Golbeck, 2015).

[13] The results on the previous five pages have been set as potential literature, i.e. 50 publications, later results do not match the trust transfer term in this related context any more.

[14] With six results found.

[15] Only the first page results, i.e. 10 publications were in range according to the defined research boundary.

Source	Ability			Benevolence			Integrity						Not included						
	C	E	D	G	B	R	I	M	C	R	D	H	P	O	C	A	S	B	P
Contribution of this work																			
Belanche et al. (2014)										x							x		
Buntain and Golbeck (2015)					x								x					x	x
Delgado-Marquez et al. (2013)	x										x							x	
Doney and Cannon (1997)					x		x		x			x			x			x	
Doney et al. (1998)											x							x	
Dong et al. (2007)													x						
Falcone and Castelfranchi (2012)	x																x	x	x
Fukuyama (1995)			x									x	x						
Gambetta (1988)																		x	
Gefen (2002c)	x				x		x												
Gulati (1995)																	x		x
Han et al. (2016)									x	x	x	x						x	
Larzelere and Huston (1980)					x		x					x							
Lee (2009)	x										x		x		x				x
Lee et al. (2011)					x				x			x						x	
Lin et al. (2011)	x										x		x		x				x
Lu et al. (2010)																		x	
Shan and Lu (2009)	x				x		x			x									x
Mayer and Davis (1999)	x				x		x											x	
Mishra and Morrissey (1990)	x						x												x
Stewart (2003)	x				x							x	x						
Stewart (2006)	x				x		x						x						
Stewart and Zhang (2003)	x				x							x	x						
Sun (2010)	x				x		x					x							
Venkatadri et al. (2016)	x										x	x	x					x	
Wang et al. (2013)	x				x		x												
Yang and Xu (2008)																		x	
Zand (1972)																		x	
Count	*14*	*0*	*1*	*0*	*12*	*0*	*9*	*0*	*3*	*3*	*6*	*9*	*9*	*0*	*3*	*0*	*3*	*13*	*7*
Final count	***39***	***3***	***4***	***13***	***47***	***4***	***36***	***7***	***5***	***12***	***12***	***14***	***18***	***6***	***5***	***1***	***4***	***23***	***8***

Table 3: Clustered trust dimensions in previous research - 3

Trust transfer mechanisms are established on the basis of natural neurological procedures. They are the outcome of the activation of brain areas which generates trust. Through brain activation, activity in the insular cortex (brain area that encodes uncertainty and risk) relates to situational normality perceptions in human beings (Riedl et al., 2010).

In this work, two kinds of trust transfer mechanisms are taken into account — "direct" trust transfer and trust transfer with a broker (Zacharia et al., 2000; Stewart, 2006).

Both of the two mechanisms involve up to three actors. First, the person who makes judgments on whether to trust the other is the *trustor*. In this case, initial trust in an entity or a context of the trustor is already available so that the trust can be eventually transferred. Secondly, the person whose trustworthiness is assessed by the trustor has the role of the *trustee*. Thirdly, but not necessarily, a *broker* functions as a mediator if there is one (Stewart, 2006). The underlying logic with a party is that when the trustor trusts in the third party, i.e. a mediator or broker such as a platform or person, there is also a close relationship between the trustee and the third party. The trustor's trust in the third party will be therefore transferred to the trustee (Wang et al., 2013).

To express the logic as described above and showed in figure 1 in sentences, the first case with two parties involved would be that *a trustor trusts a trustee*. An exemplary trustor in the context of the sharing economy could be the person or entity that is the potential renter or user, i.e. person who demands the asset on Airbnb. In this case, the trustee could be the owner of the asset who can be a person or entity. It has to be noticed here that also the context requirement (in this case, Airbnb) of a trust mechanism. The trust dimensions represent different specific requirements for the actors depending on the context (see section 2.2). The second situation with three parties would be that *a trustor trusts an intermediate trust broker, which is trusted by a trustee so that the trust can be transferred from the trustor to the trustee.* To illustrate, Trustcloud can be named as a representative example for the trust broker case. Specific aspects will be considered

in section 3.2.2. In the latter involving case, the third party is referred to the source of trust transfer and the trustee as the target of trust transfer (Wang et al., 2013) while in the first situation with two involved parties, the trustor is the source of trust transfer.

Both trust transfer mechanisms serve as the basis for the trust transfer theories in section 3.1.3. From another angle, more practical examples of these two models can be found in the next section.

3.1.3. Trust Transfer Theory

Stewart's definition of the cognitive process allows trust to possibly transfer from one entity or context to a separate entity or context (Buntain and Golbeck, 2015) while a *context* refers to the situation in which a target is encountered, specifically the institutional structures in the situation which will be clarified in the section 3.1.4 (Stewart, 2003). The following literature-based trust transfer theory is divided into two parts, categorized by different kinds of sources — trust transfer from an entity in section 3.1.4 and trust transfer from a context (to an entity or a context) in section 3.1.4. An overview is given by table 4. Each category will later be discussed in depth with a concept table respectively. The concept tables outline the most representative trust transfer processes and are thus only a subset of the reviewed literature. The terminology is defined according to Strang et al. (2003) and Tavakolifard et al. (2008): an *entity* is a person, a place or an object and a *context* is the set of all context information characterizing the entities relevant for a specific task with their relevant aspects.

3.1.4. Trust Transfer from an Entity

For trust transfer from an entity as the source of trust, the transitivity only occurs when a person bases initial trust in an entity on trust in some other related entity (Stewart, 2003). In this review, the definition is applicable except for the one and only case of *1.2 trust transfer from entity to context*. This chapter contains trust transfer (1) from entity to entity and (2) from entity to context. The first category is broken down into subsets: intra-channel trust transfer and others. An overview is given by table 5, where the reviewed references are sorted in alphabetic order.

Intra-channel Trust Transfer from Entity to Entity

In a special case, the transfer refers to consumer trust in one entity being moved to another related entity in the same channel which the work of Lin et al. (2011) referred to. These types of trust transfer are grouped together with the adapted term of "intra-channel trust transfer". Most of them are in the context of e-commerce (and the rest: classic product marketing), for example offline to offline (Perk and Halliday, 2003) and online to online (Stewart, 2003, 2006). In the latter case, Kollock (1999); Riegelsberger and Sasse (2001) named reputation-sharing mechanism as a fundamental trust transfer way. E.g. the online auctioneer platform Ebay is based on an unconscious process of trust transfer which is derived from trust in other participant's honest rating of one individual. The assumed initial trust leads to trust in the general reputation rating system on the platform of Ebay and thus is transferred to the individual (Komiak et al., 2008).

Stewart found out that trust is transferred from hyperlinked text on similar web pages of organizations to unfamiliar business-to-consumer websites with the known hypertext (Stewart, 2003). As a result, trust is transferred across hypertext links based on the observed, perceived interaction and comparability, sameness of the linked organizations. The fact that hyperlink affordance affects trust in the target site in the online-to-online trust transfer process has also been confirmed by Lee et al. (2014a). Additionally, in the area of social media, a parallel concept has been investigated by Pentina et al. (2013) who found out that similarity of "self-Twitter" personality (cf. "hyperlink") strengthens the transferred trust towards the platform of Twitter.

Equivalently, trust in one known online brand can be transferred to an unknown online brand by associating itself with the familiar one so that the consumer trust and purchase intention of the unknown brand can be improved (Ballester and Espallardo, 2008). Similarly, the brand marketing works in the same way by using the trust transfer process from one product to another. When one brand is well-known and has a good reputation, the corporation can take the advantage of their existing well-reputed products to promote other unknown product with the same brand. The "hyperlink" among the products can be established and more information can be provided for the new product based on the available verified facts. Moreover, potential risks of launching a brand new product can be reduced (Keller, 1993; Tulin, 1998).

The first mentioned type of transfer within the offline channel refers to the general branding strategy (Perk and Halliday, 2003). To give an instance, a consumer who trusts the product of brand A purchased in one affiliate would most likely trust a newly-released product of brand A in another retail store. One would consider McDonald's as a trustworthy consuming place everywhere on the earth by using brand trust. Another practical example of "brand extension" is to be found in the work of Aaker and Keller (1999). More information is explained in section 7.1. The authors evaluated the effectiveness of the trust-transfer process from the established brand names to their new entered products or services. Extension products could be Hard Rock Café t-shirts[16]; Brand extension service could be car-sharing services such as DriveNow (BMW und Sixt)[17], car2go (Daimler and Europcar)[18] or Multicity (PSA Peugeot Citroën mit DB Rent)[19]. Trust of the most Business-to-Consumer car-sharing services is based on and established by the brand and reputation of the service providers which is mostly an automotive OEM or a well-known car rental company (Bert et al., 2016).

[16] https://rockshop.hardrock.com/ (accessed on 31.12.2016)
[17] https://www.drive-now.com/ (accessed on 31.12.2016)
[18] https://www.car2go.com/ (accessed on 31.12.2016)
[19] https://www.multicity-carsharing.de/ (accessed on 31.12.2016)

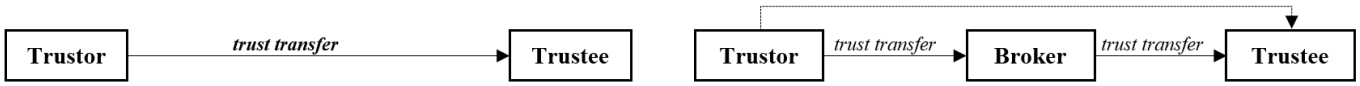

Figure 1: An illustration of two trust mechanisms from *trustor* to *trustee*.
(*Left*: trust transfer mechanism with two involved parties; *right*: trust mechanism with three involved parties.)

1. Trust Transfer from Entity
- 1.1 Trust Transfer from Entity to Entity
  - 1.1.1 Intra-channel Trust Transfer from Entity to Entity
  - 1.1.2 Other Forms of Trust Transfer from Entity to Entity
- 1.2 Trust Transfer from Entity to Context

2. Trust Transfer from Context
- 2.1 Institutional-factors-based Trust Transfer from a Context
- 2.2 Trust Transfer from Context to Entity
- 2.3 Interchannel Trust Transfer from Context to Context
  - 2.3.1 Offline to Online (web)
  - 2.3.2 Online (web) to mobile
  - 2.3.3 Offline to Offline
  - 2.3.4 Online (web) to Online (web)
  - 2.3.5 Online (web) to Offline

Table 4: An overview of the trust transfer literature review.

Referene of Study	Related trust transferred from ...	dependent variable of transfer target
1.1 Trust Transfer from Entity to Entity		
1.1.1 Intra-channel Trust Transfer from Entity to Entity		
Aaker and Keller (1999)	Trust in an existing brand with well-developed image	Trust in a different product category (as brand extension) of the same brand name
Ballester and Espallardo (2008)	Trust in one known online brand	Trust in an associating unknown brand
Keller (1993); Tulin (1998)	Trust in an existing product with good reputation	Trust in other unknown promoting product with the same brand
Perk and Halliday (2003)	Trust in one offline channel	Trust in another related offline channel
Riegelsberger and Sasse (2001)	Trust in other e-shopping-participants whose ratings will be aggregated to form one's reputation	Trust in individual with reputation rating
Stewart (2006)	Trust in similar hypertext website links of organization	Trust in similar websites with the hyperlinks
1.1.2 Other Forms of Trust Transfer from Entity to Entity		
Golbeck (2005); Katz and Golbeck (2006); Dong et al. (2007)	propagating trust values using trust transitivity	Trust across social networks for not directly connected entities
Pentina et al. (2013)	Trust in social-media brand Twitter	Trust towards "followed" brand and patronage intention
Uzzi (1996); Strub and Priest (1976)	Trust in known targets of individual entity	Trust of connected unknown target of a third party
1.2 Trust Transfer from Entity to Context		
Lee et al. (2014b)	Trust in holding mega-event or festival	Trust for event hosting country

Table 5: Sorted references of related works on trust transfer from an entity.

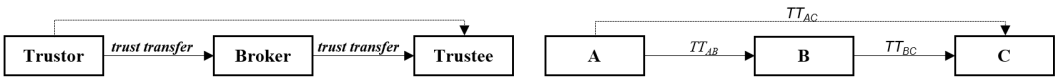

Figure 2: An illustration of trust transfer model with a mediator.
(*Left*: model discussed in section *trust transfer mechanism* (3.1.2); *Right*: transfer inference algorithm of *TidalTrust* with direct trust transfer TT from A to B (TT_{AB}) as well as B to C (TT_{BC}) following with a possible computable trust value of A to C (TT_{AC}).)

Other Forms of Trust Transfer from Entity to Entity Another forms of trust transfer from entity to entity has been researched more frequently according to Buntain and Golbeck (2015). The main context in this sub-category is the interpersonal or social network.

Trust in a known third party serves as an important basis for trust in an unknown party (Coleman, 1990). Strub and Priest (1976) and Uzzi (1996) discussed interpersonal trust-

worthiness based on how desiring drug users tried to expand their social networks to procure drugs. The latter work confirmed previous findings showing that individuals arranged their business built on third-party recommendations as a mediator. To be more precise, the model presents a trust transfer from an individual entity of known targets to another individual entity of unknown targets with a trust broker.

Correspondingly, Xing et al. (2010), Sun et al. (2002) and Marchesini and Smith (2005) proposed mathematical and computational models for this kind of calculation. The relevant model is illustrated in figure 2 where A stands for a trustor as a person, B as a mediator person connecting A and C, C as a trustee. Furthermore, the work of Dong et al. (2007) presents a basic model with formally described trust transfer formulae based on trust policies, too. The necessary constraints for mentioned trust transfer between actors in distributed decentralized networks were suggested, e.g. social network.

In the same way, Kimery and McCord (2002) aimed to apply the above mentioned trust model in the context of e-shopping by connecting a third-party assurance seal. Yet, the expected positive relationship between third-party assurance and customers' trust in an unfamiliar e-retailer is not confirmed. Nonetheless, the results from Jiang et al. (2008) supported the same kind of hypothesis that the perception of third-party certificates is related to e-shoppers' intensity of seal exposure as well as the perceived importance of the trust factors.

In the area of social media, Pentina et al. (2013) confirmed the robustness on the transference of trust from the social-media platform – Twitter to users' trust and patronage intention towards the brands using so called "social media marketing". The author also investigated on the potential culture-based differences. By the same principles with Twitter-branding as an eWOM (electronic word-of-mouth) referral, Kim and Prabhakar (2000) have predicted that a person with strong personal ties could positively affect the effect of his word-of-mouth referral and establish high-level initial trust in the field of e-commerce. This is a part of "influencer marketing" (Brown and Reingen, 1987).

Trust Transfer from Entity to Context

The least research has been found in this categorization of trust transfer from entity to context whereas the controversial (context to entity) theory frequently appeared. The context is unusual in comparison to the rest of the study. Only one literature piece was found. Lee et al. (2014b) considered, based on trust transfer theory, the impact of attitude towards a mega event on it towards the hosting country. With the example of Shanghai Expo Mega event, the authors showed that the attitude towards a mega event influences the attitude towards the event-hosting country and both aspects have a positive impact on visitors' intentions to revisit China.

Trust Transfer from a Context

Trust transfer from a context has been studied much more than the previous category. In this work, the related literature is divided into three major parts: *(i)* Institutional-factors-based trust transfer from a context; *(ii)* Trust transfer from context to entity; *(iii)* Interchannel trust transfer from context to context. In the third part, different sub-situations are taken into consideration and are respectively synthesized. An overview of related works for trust transfer from a context can be found in table 6 where the most relevant literature works are listed in afore-sorted categories.

Main Objects and Advantages

According to the related literature, trust transfer across contexts both online and offline has several advantages. Exchange of reputation and trust between domains of context can be a valuable resource for both users and existing contexts such as virtual communities (Grinshpoun et al., 2009). The main advantages are listed as following:

- The transference process of trust could reduce complexity in management of trust relationships by simplified leverage process of reputation data from multiple contexts (Neisse et al., 2006). This is especially important when the users maintain different active communities or channels in varied contexts for the reason that the received evaluations may differ (Grinshpoun et al., 2009). Also in order to produce more accurate recommendations to improve the whole process (Neisse et al., 2007), the leverage process can be a main advantage.
- Trust transference provides protection against changes of identity and first time offenders in order to enhance trust establishment (Rehak et al., 2006; Rehak and Pechoucek, 2007).
- The process offers the chance to learn policies as well as norms at runtime (Toivonen and Denker, 2004; Rehak et al., 2006).
- Users and actors of inter-contextual communities or platforms with the trust transferring mechanism are able to maintain their global or community-specific "offline reputation certificates", known as "reputation capital" (Grinshpoun et al., 2009; Labalme and Burton, 2001).
- For inter-context reputation it is also easier and more practical for the cross-contextual users, because the reputation does not have to be built from scratch on when the entity wants to join a new context (Grinshpoun et al., 2009).
- The aforementioned aspect supports faster establishment of the new context, especially regarding to virtual platforms and communities. By exporting and importing reputation data (Grinshpoun et al., 2009), trust transfer can also help to infer trust information in context hierarchies (Holtmanns and Yan, 2006) and therefore, improves performance (Rehak et al., 2006).

Institutional-factors-based Trust Transfer from a Context

Institutional-based trust is defined by McKnight et al. (1998) as the reflection of the security one feels about a situation "because of guarantees, safety nets or other structures." It deals with the structures that "make an environment feel trustworthy" such as legal protection, according to McKnight et al. (2002). This environment is important for the institution-based trust as it presents the perception of the situation. One dimension of the institution-based trust defined by McKnight et al. (2002) is structural assurance. In the commonly researched context of e-commerce, it could be legal or technological Internet protections from loss of privacy, identity and money. Another dimension is named as situational normality which represents one's belief in an environment which is "appropriate, well-ordered and favourable" (Baier, 1986). Thus, institutional-based trust transfer is part of *trust transfer from a context* (to a context or entity).

Institutional-based trust is presented in daily life as Doney and Cannon (1997) pointed out that trust for a consumer in a broad-scaled supplier firm will transfer to its salesperson so that customers usually believe in those representatives of the firm for giving true facts. Holtmanns and Yan (2006) named this kind of trust "certificate-based" trustworthiness, e.g. when we trust a banking employee with the bank account; or a police officer can check our cars. The former case has also been proven to be valid in both ways, that is, customers' trust in certain (well behaving and convincing) sales agents of a firm also refer to consumers' trust in the greater concept of the company.

The institutional-based factors have effective influence in various types of contexts. This could also be for example the "larger organization" of society: the effects on general measures of trust have been not only proven to be based on religious composition of a society (Porta et al., 1997), but also on communications infrastructure (Fisman and Khanna, 1999).

In a general context within an organization, Zaheer et al. (1998) proposed and demonstrated a strong correlation between trust in an organization and trust in an individual within the organization. Grayson et al. (2008) confirmed that trust in a broad-scoped organization such as business context, industry and system, governmental regulation or professional association rules and standards can lead to transitivity of trust in a narrow-scoped firm within this organization. The governmental public e-service has also been researched - the root of trust in the public e-services can be followed from both of trust on the public administration and on the continuance intention of the Internet (Belanche et al., 2014).

In the context of e-commerce, the referral is also known as a strong influencer of consumer behavior (Brown and Reingen, 1987). Consumers tend to transfer their trust on the general e-commerce environment to the specific merchant and website to justify purchases (Thatcher et al., 2013). Correspondingly, trust in general Internet shopping is transferred from the trust in greater Internet merchants and the general Internet shopping medium since the process is a transaction-based evidence (Lee and Turban, 2001). This kind of trust transfer based on contextually-related institutional structures, along with the trust in the intermediary e-marketplace and its feedback mechanism, lead to the trust in the community of sellers in an e-marketplace, such as Amazon (Pavlou and Gefen, 2004). Accordingly, how trust in a platform can be transferred and conducted to trust in the renter of the online environment was showed by Hong and Cho (2011).

It is also worth to mention that the extending study of Fang et al. (2014) showed that the e-commerce institutional mechanisms is controversial. A new construct of Perceived Effectiveness of E-Commerce Institutional Mechanisms (PEEIM) was introduced and it was found that PEEIM negatively moderates the relationship between trust in an online vendor and online customer repurchase intention, since it reduces the importance of trust to promoting repurchase behavior. They suggested to set a new starting point for the paradoxical role of e-commerce institutional mechanisms (Fang et al., 2014).

Finally, different perspectives were found in the e-commerce context. Sun (2010) studied, different from most of the prior research of buyers' perspective, on how online-sellers' trust transference mechanism functions. As a result, trust of sellers in intermediary, i.e. the service provider, creates trust impact on how they trust the community of buyers in online marketplaces.

The referral of institutional factors also takes place in the context of the sharing economy. The transaction process of peer-to-peer platforms is made up of special and differently detailed products or services (Han et al., 2016). In particular, in the case of Airbnb, a user has to make a purchase decision on an accommodation from an unknown host. This is reasonable that such trust in hosts may be transferred from the platform itself, according to the trust transference argument (Doney and Cannon, 1997; Stewart, 2003). To be more precise in the situation, trust in the cognitive-based Airbnb improves trust in the affect-based host, stated Han et al. (2016). The authors also considerate Airbnb's measures for preventing distrusting hosts (e.g. prohibition from lower raters or hosts low-quality condition etc.) as a stimulus to reduce the feeling of uncertainty of transaction and thus trust the platform more since it is "well-managed". Meanwhile, the same logic has also been proven from the sellers' perspective.

Trust Transfer from Context to Entity

Aside from institutional-based trust transfer from context, McKnight et al. (1998) also investigated the mechanism of this kind of trust formation. He presented how initial trust can be formed and established in new relationships where the involved parties have no prior participation with each other. On the contrary, Buntain and Golbeck (2015) considered this mechanism as not directly related to trust transfer, however, it regards one's context in new relationship as very important for high levels of initial trust. The contextual environment of one person is a hidden, yet unexpectedly crucial factor for enabling the other person to have trust without former experience. Therefore, it is categorized to *trust transfer from*

context to entity.

Based on the first knowledge of initial trust, Riegelsberger et al. (2005) enlarged the model and expanded the aforementioned institutional-based signal by including additional aspects from social and temporal context. The research found that social norms as well as reputation, together with temporal context, such as the length of interaction and expected probability if the communication will take place again, are factors involved for trustworthy behavior, too. For example, one would not have the same behavior regarding to trustworthiness in the context of an interaction which occurs to be in a crowded room, in comparison to a conversation at an important event. Likewise, if two entities are probably not going to interact again, there is less incentive to behave in a trustworthy manner than in a context with a possible repeated reunion.

In addition to the aforementioned works, trust transfer from context to entity can also been noticed in sales management (Milliman and Fugate, 1988). Salesmen use the technique of trust transfer by proofing their claims of a service or product (entity) using a verifiable evidence (context) so that the clients are more likely persuaded and therefore, have more belief and greater intention to purchase.

Interchannel Trust Transfer from Context to Context

Trust transfer from context to context (of mostly the same entity) seems to be a relatively rarely studied concept (Buntain and Golbeck, 2015), whereas this kind of inter-context transfer occurs frequently in our daily lives. Trust in one domain has an effect on trust in another one (Hong and Cho, 2011; Lu et al., 2010). Lin et al. (2011) defined such transfer of trust from one context to another also as "inter-channel" trust transfer which occurs mainly in different channels - First from offline to online and next, from online to mobile channels. As a matter of fact, most of the related recent research works seem to be based on how consumers transfer their trust in (e.g. a retailer's) physical mortar-and-brick offline store to the same firm's e-business platform; and how web-based online perception, in turn, affects mobile services in the recent years. The latter case is relatively new in the research field. In addition, other cases of offline-offline, online-online and online-offline trust transfer will also be discussed.

Offline to online:

In general, several works found out that trust in the offline brick-and-mortar form of a firm or organization positively and directly affects the perception of the firm's online merchandising portal (Kuan and Bock, 2007; Verhagen and v. Dolen, 2009; Hahn and Kim, 2009). To name two representative cases, the results of Lee et al. (2007) indicated that trust in offline bank services has a direct effect on online banking services; the customers' trust in the offline bookstore was also proven to affect their trust in the online bookstore in a positive way (Lee et al., 2011). Therefore, retailers and organizations with e-channels could increase trust on their online shopping platforms by employing this find. For those online shoppers who are not experienced, personal familiarity of a certain known brand or retail organization influences the likelihood of a first try of e-shopping experience in a positive way (Riegelsberger and Sasse, 2001). E.g. Amazon's affiliate program [20] is incorporated with this idea (Riegelsberger and Sasse, 2001) - providers and individuals are offered an incentive to link and advertise their products by earning advertising fees. Therefore, the trust potential e-shoppers would have in individuals or providers (e.g. websites, blogs) is transferred in this case to Amazon.

Stewart (2003) and Levin et al. (2002) also studied how trust in traditional shopping channels can be formated into web-based online organization (based on evidence that the Internet-based organization has a physical store). The positive research results confirmed the fact that the trust intention to buy from an online retailer would be higher, if a picture of a physical retail location is showed on the website which generates more trust.

Turel et al. (2008) looked at the aspect of e-customer service. The results supported the thesis that trust in service representative and procedure mediates trust in e-customer service. As a consequence, it triggers more intention to reuse the service.

In addition, Shankar et al. (2002) stated in their work that online trust is "intertwined" with offline trust and these two are connected. From a stakeholder's perspective, to improve online trust means developing the firm's overall performance in a more positive way, especially for multichannel organizations with multiple touch points between which trust transfer takes place. The linkage between online and offline trust transfer is thus necessarily inevitable for such multichannel marketing with consistency and commonality.

Online to mobile:

The last paragraphs addressed the trust transfer from offline to online. Extending onto the context of e-commerce on mobiles, trust in general web services, functional consistency as well as perceived "entitativity" (Lickel et al., 2000) can be transferred to trust on mobiles' word-of-mouth services (Wang et al., 2013).

The cross-context trust transfer evolved through the "mobile revolution" in recent years. The gradual development of mobile-based services makes the trust transfer in web commerce context more complex. Lin et al. (2011) investigated on the role of inter-channel trust transfer establishing trust on mobile commerce. Their results showed that higher trust in online brokerage services directly contributes to the trust in mobile brokerage service counterpart.

Shan and Lu (2009) proposed and confirmed that online trust positively influences initial trust in mobile banking and customers' perceived structural assurance of mobile banking. Regarding to trust in web-based and mobile-based payment services, Lu et al. (2011) brought to light that this kind of trust in the context works in quite the same manner as consumers transfer trust from the aforementioned Brick-and-Mortar stores to websites (Buntain and Golbeck, 2015).

[20] https://affiliate-program.amazon.com/ (viewed on 26.11.2016)

Worth noting is that all the related literature in the above mentioned online-mobile section originates from Chinese researchers. The reason may be that the Chinese market for mobile services is proceeded and making headway. More information is to be found in the listed literature.

In the following passages another inter-context trust transfer will be introduced. They comprise trust from offline to offline context (Buntain and Golbeck, 2015; Delgado-Márquez et al., 2012; Delgado-Marquez et al., 2013); trust transfer from online to online context (Grinshpoun et al., 2009; Venkatadri et al., 2016) as well as from online to offline (Botsman, 2012).

Offline to offline:

The general trust transfer in distinct offline contexts was explored based on two rounds of game playing (*Berg's investment game* and *Battleship*) using automated agents (Buntain and Golbeck, 2015). The intention was to stimulate varying degrees of human trust and to observe how trust in the initial round of game can be transferred to the second new round with a new game. By analyzing how the agents select teammates in the second round of the game, it became clear that the tendency is strongly influenced by the prior experience in the first round of the game with each teammate. (Such kind of "reciprocity influence" has already been proven by Delgado-Márquez et al. (2012). Delgado-Marquez et al. (2013) proposed and tested two robust indicators for it: the trust transfer index and the trust transfer reciprocation index.)

Buntain's result supports some intuitive decisions in our daily lives. For example, if a co-worker A of person B is reliable for B, then B may ask A to take care of her plants without any information about how A's horticultural skills are. This seems to be reasonable because despite contextual distinction, B has trust beliefs in A through prior experience. Even though the performance will be in a new context in which B has no information how A performs, B has beliefs that A is going to behave appropriately. Several works have confirmed the existence of such kind of initial trust (Jones and George, 1998; Lewicki and Stevenson, 1997; McKnight et al., 1998; Berg et al., 1995) whereas some argued that such trust comes from people's common grounds, that is, people tend to trust others (Holtmanns and Yan, 2006), e.g. for family, work colleagues, church community or from the same village, etc. In addition, such trust transfer between offline contexts has also been studied by Gulati who demonstrated that repeated relations in alliances lead to (inter-firm) trust in offline context (Gulati, 1995).

Online to online:

In context of online virtual platforms and communities Grinshpoun et al. (2009) proposed a CCR (Cross-Community Reputation) model for sharing reputation knowledge across such communities. In this study the authors attempted to apply information-sharing to online community reputation for leveraging a new state of a user in new communities so that internal trust of certain communities can be quantified, transferred and consequently, established more quickly. This idea of supporting trust building and trust transfer has also been mentioned by Eisentraut et al. (2001). The research was based on the assumption or situation that reputation information of virtual communities is very important as a part of a user's online identity. Additionally, an exchange of such information is a valuable resource for both users and communities. As a conclusion, a CCR model is created and assembled based on a detailed example of converting the reputation score from *TripAdvisor* to *Expedia* and *Booking.com* which gives motivation for ability of transferring reputation.

Similarly, Venkatadri et al. (2016) also investigated on inter-domain trust transfer from platform to platform. Their prior intention is to strengthen weak identities on separate platforms from honest users by creating a fundamental shift of online transferring identities. Assumed an honest user has multiple channels to maintain which requires a lot of energy, time and money and causes expenditures, Venkatadri et. al presented how their proposed cross-domain framework can strengthen this kind of trustworthiness (especially on young domains such as *Pinterest*) by using extensive data from other domains like *Facebook*, *Twitter* and the Email service. They concluded that the transfer to young domains such as *Pinterest* is feasible and effective: the users on the young domain could have more reputation and be whitelisted from early on while the probability of misbehavior on the domain can be reduced to 2,5% lower.

Online to offline:

Furthermore, trust transfer from online to offline context can be observed on the website "*Stack Overflow*" [21] which is a platform for programmers to post and solve technical questions. The website has a system of reputation score where users can earn reputation points by voting on and providing professional answers. The more convincing one's technical answer is, the more reputation score can be earned, and the more power the user possesses. Eventually, the reputation scores were found frequently mentioned in CVs and the headhunters were searching through the platform for needed developers with specific skills. As a result, Stack Overflow launched an invitation-only job board for purpose (Botsman and Rogers, 2011). In this case, one's trust belief in an online context is transferred to the offline environments where real jobs take place. The cross-contextual value of trust is also demonstrated by Shankar et al. (2002) and by Gal-Oz et al. (2010) on the platform of Linkedin[22] .

3.2. Trust Transfer in the Sharing Economy

Most of the time trust transfer issues have been intensively researched in the context of e-commerce, as the establishment of the Internet has given much importance to the web-based and later mobile-based business model requiring a trust transfer process as described in details (section 3.1). Although trust transfer of few virtual online-to-online contexts

[21] http://www.stackoverflow.com/ (viewed on 06.11.2016)
[22] http://www.linkedin.com/ (viewed on 06.11.2016)

Referene of Study	Related trust transferred from ...	Transfer target
2.1 Institutional-factors-based Trust Transfer from a Context		
Belanche et al. (2014)	Trust in public administration and Internet on continuance intention	Trust in the public e-servies
Doney and Cannon (1997)	Trust in a supplier firm	Trust in firm's representatives
Grayson et al. (2008)	Trust in an organization, business context in braod-scope	Trust in a narrow-scoped firm
Han et al. (2016)	trust in cognitive based Airbnb	Trust in the affect-based host
Hong and Cho (2011)	Trust in the platform itself	Trust in the renter (online environment)
Lee and Turban (2001)	Trust in Internet shopping medium as process-based evidence	Trust in Internet-shopping
Pavlou and Gefen (2004)	Trust of institutional structures; managing intermediary etc.	Trust in the community of sellers in an e-marketplace
Sun (2010)	Trust from seller in intermediary as service provider	Trust from community of buyers
Thatcher et al. (2013)	Trust in great e-commerce environment	Trust to specific merchant and website to justify purchases
2.2 Trust Transfer from Context to Entity		
McKnight et al. (1998)	Trust in institutional-based factors	Initial interpsonal trust between people without firsthand knowledge
Milliman and Fugate (1988)	Trust in verifiable proven evidence as salesman's source	Trust in salesman's argument
Riegelsberger et al. (2005)	Insitutional cues, temporal and social context	incentivized trust by behavior
2.3 Interchannel Trust Transfer from Context to Context		
2.3.1 Offline to Online (web)		
Kuan and Bock (2007); Verhagen and v. Dolen (2009)	Trust of a customer in offline stores	Trust in online counterpart and word-or-mouth services
Lee et al. (2007)	Trust of customer in the offline bank services	Trust of customer in online banking
Lee et al. (2011)	Trust in offline bookstore	Trust in online bookstore
Riegelsberger and Sasse (2001)	Familiarity of known retail organizaion	Trust for a first try online-shopping experience
Stewart (2003); Levin et al. (2002)	Trust in traditional shopping channel	Trust in online web-based organisation
Turel et al. (2008)	Trust in service representative and procedure channel	Trust in e-customer service
2.3.2 Online (web) to mobile		
Lin et al. (2011)	Trust in online brokerage services	Trust in mobile brokerage services
Lu et al. (2011)	Trust in web-based payment services	Trust in mobile-based services
Shan and Lu (2009)	Trust in online banking services	Trust in mobile banking services
Wang et al. (2013)	Trust in web services, functional consistency and perceived entitativity	Trust in mobile services in word-of-mouth context
2.3.3 Offline to Offline		
Buntain and Golbeck (2015); Delgado-Márquez et al. (2012); Delgado-Marquez et al. (2013)	Trust of an individual in a context	Trust of an individual's performance in another context
Gulati (1995)	Repeated relations in alliances	Trust in offline context
2.3.4 Online (web) to Online (web)		
Grinshpoun et al. (2009); Eisentraut et al. (2001); Gal-Oz et al. (2010)	Reputation of one community	Leveraged reputation in another online community
Jiang et al. (2008)	Trust of customer in a third-party certification	Trust in e-marketer
Venkatadri et al. (2016)	Trust in extensive social platforms	Trust established or enhanced in younger domains
2.3.5 Online (web) to Offline		
Botsman (2012)	Reputation in online community	Reputation and trust in real environment
Gal-Oz et al. (2010)	Trust and promotion from personal social network such as LinkedIn	Reputation as valuable asset for getting attractive job offer and contacts in real life
Shankar et al. (2002)	Trust in online domain and other multichannels	intertwining offline trust

Table 6: Sorted references of related works on trust transfer from a context.

has been recently reviewed, none of the literature and anecdotal evidence I found investigated the (direct) trust transfer issue based on the context of the sharing economy. As stated in the introduction, the initial situation is based on the point that users often own none or weak reputation when they register in a new independent platform, although existing trust history of other platforms could make to improve the reputation establishment more efficient. All that, therefore, leads to economic disadvantage and inefficiency. The research objective of trust transferability between different sharing economy platforms is illustrated in figure 3.

3.2.1. Trust Transfer Situation

The situation starts with the trustor (entity 1 in the illustration) who is assumed to have initial trust on trustee X (entity 2 in the illustration). This trust is described as "immanent trust" as represented. The immanent trust represents as inherent existing trust, which is intrinsic and fundamental. For example, a trustor trusts a trustee in context of Airbnb as a trustworthy host. Next we have imported trust which is introduced from a different place or context than the purposed platform. For example, a trustor who trusts the trustee in context of Airbnb fundamentally would "import" his trust towards the same trustee in the new context, Blablacar. The main issue is to answer the question how the trust transfer process works, i.e. if the same trustee is still perceived as trustworthy in the new context.

According to the trust transfer theory outlined in section 3.1.3, two main categories could be recognized and defined - trust transfer from an entity and from a context. In the context of the sharing economy as described, the trust transfer processes *from* an entity (trustor, in this case consumer of a platform) with initial trust on another entity X (trustee, in this case a provider) in a certain context A (e.g. a provider on Airbnb) *to* the same entity X in another context B (e.g. the same provider on Blablacar).

It is ambiguous how the case can be assigned to the sorted references. Two views are consolidated. On the one hand, it is about trust transfer of the same trustee person assuming two different roles in two contexts (in our example, it would

be the trustee on Airbnb and Blablacar) which indicates the classification of trust transfer from entity to (the same) entity. At this point, however, it is doubtful if the process still counts as "transfer" when the source equals the target. On the other hand, the only varying condition of the trust transfer process is the circumstance surround the trustee, thus the case can also be considered as trust transference from context to context. Moreover, since the situation has more similarity to the available inter-contextual examples at hand, it would be more suitable to assign it to the inter-contextual trust transfer.

A conclusion can be drawn that although this model is not easily classifiable at first sight, more arguments speak for the assignment to the context-context trust transfer.

3.2.2. Existing Trust Transfer Solutions

For the solution of travelable credential history, two possibilities for approach are taken into consideration: First, a direct transfer possibility from platform to platform. As mentioned in section 3.1.4, the main objective for inter-context reputation is to analyze and investigate a practical solution of directly "travelable" reputation credential-history for the cross-contextual users. Secondly, a "reputation board" from a third party ("trust authority") analyzes and offers information of entities' trustworthiness. The former case is the major discussion section of the following behavioral experiment, which will be clarified and analyzed in section 5. The latter proposal is to create an integrated centralized solution which is provided by a third party. Such solutions already have existed and are having more progress recently. Detailed information can be found later in the section.

In real life, we have institutions and companies providing software for calculating a person's credibility score. For example *SCHUFA*[23] in Germany and *FICO*[24] in America. The abbreviation *SCHUFA* actually stands for "Schutzgemeinschaft für allgemeine Kreditsicherung" (General Credit Protection Agency), yet since *SCHUFA* was founded in 1927, the name has been standing for integrity and reliability. People need and rely on such information sources to create trust by making safe and efficient transactions. The same principle can be found in the context of stock exchange - the rating (e.g. S&P or Moody's) of emitter and investment funds help to make the reliability and credit-worthiness transparent. In a digitalized world like peer-to-peer marketplaces, such credential reputation has become important as well. There are already similar services provided by different startups trying to digitize such "FICO-score" in an online version as a kind of "paypal of trust" (Botsman, 2012). An overview of the solutions found including currently inactive and active startups for "reputation dashboard" are listed in table 7. The example of the startup *Legit* will be discussed in detail later.

Schultz et al. (2001) have suggested a similar concept for firms, namely the "sticky reputation" system for ranking the reputation of a firm which should theoretically combine every information knowable about this firm and this sticky reputation should be durable and "tends to reproduce itself over time". There are different rankings by many publishers and magazines, e.g. the most well-known one by fortune Magazine's. The author emphasized the exemplary differences between various rankings (e.g. *Fortune* has as third criteria "Innovativeness" whereas *the Danish Ranking* has "price compared with quality") and proposed a more procedural and methodical solution which is manifestly a construction. Transferring it to the trust transfer model in the sharing economy, solutions like *Trustcloud*, *legit* and *whytrusted.com* which are designed to prove one's trustworthiness in P2P marketplaces based on online credibility sources, P2P transactions and social network metrics, have similar problems (Nunes and Correia, 2013). Although the exact algorithms are unknown, different settings of criteria are definitively a demerit of an independent integrated solution.

By building systems as reputation dashboards, a user's activity, ratings, reviews or comments across sites have to be aggregated, combined and calculated in order to create a universal metric for a person's trustworthiness. *Legit*, a San Francisco-based symbolic startup focusing on becoming such a credit system of the sharing economy as well as protecting and empowering users accountability, is one of the reputation ventures. They shared three of their biggest lessons after the startup joined Facebook (Barton and Boyle, viewed on 22.10.2016). They found out that many early-bird users of sharing economy were excited to try new services with little need for additional sources of trust. Additionally, marketplaces themselves want to have control over their own user experiences which weakens third party widget participation. Subsequently, as a matter of fact, the current scale of sharing economy is too small for a data sharing system like the cross-platform reputation system.

Most of the currently active startups list the usual suspects to social platforms like LinkedIn, Facebook or Twitter building the base of trust verification because a large count of real people as friends is tough to fake on Facebook. Also Airbnb users can verify themselves with a Facebook account connection and Lyft passengers and drivers must sign-up through Facebook accounts to verify their identity. The privacy-respecting aspects of such centralized trust management systems are currently on focus and have been discussed and approached by Pingel and Steinbrecher (2008). The lack of consideration is mentioned in the section 7.1.

Currently, there are no significant users of above named "reputation boards". Although the principle should function theoretically, it still seems to be difficult to persuade the market. As mentioned at the beginning of this section, the reality check of the existing trust transfer solution via third-party "trust authority" is only peripheral in this work. The suggested "direct transferring" proposal will be analyzed in the next chapter.

[23] https://www.schufa.de/en/ (viewed on 23.11.2016)

[24] http://www.fico.com/en/products/fico-score (viewed on 23.11.2016)

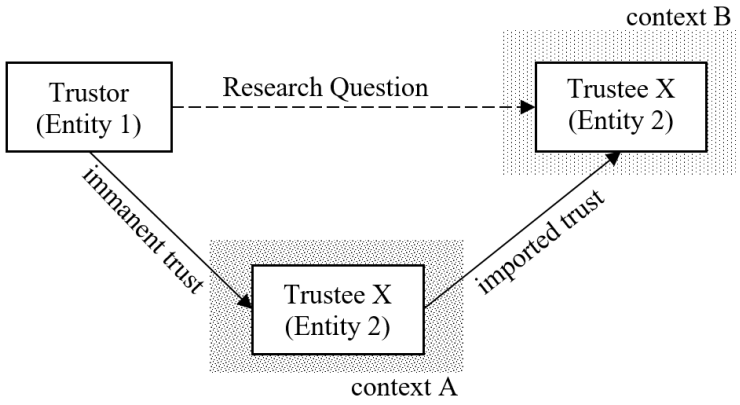

Figure 3: Depiction of the Research objective.
(Is the trust of a trustor (consumer - "entity 1") towards a certain trustee X (provider - "entity 2") transferable between sharing economy platform applications?)

4. Research Model

In section 3.2.1, the trust transfer type of the research model was defined as *trust transfer from a context* (to context). The research model of this work is depicted in figure 4 where the main hypothesises are serially numbered as H_x and other established statements are counted as consecutive capital letters. The objectives of the conducted study were (i) to verify the hypothesis, (ii) to especially examine whether imported rating could have an effect on the defined dimensions of trust scales through perceived reputation, and accordingly affects the intention to use the platforms and (iii) to confirm that trust is affected by the control variables. In the following part, the presented constructs as well as the causal relations are explained. The control variables are presented in subsection 4.1. They can be recognized by text boxes with dashed line. Some explanation based on the study design has referral to section 5.

Immanent rating. Immanent rating symbolizes the classified score by inherent built-in trust in one platform. This is represented by e.g. the cases 5, 10, 15 an 20 of the study in figure 5. More information about the study design can be found in section 5. The immanent rating represents the existing latent trust on the platform itself, including the scale of promising service and experience the users have shared for creating trust and spreading word-of-mouth reputation. Thus, the immanent rating is constituted in form of a scale, signaling the degree of trustworthiness (e.g. typically scored by five-star-system on Airbnb, Blablacar and Ebay with five being the best). The rating normally shows an aggregation of all individual ratings for a particular service provider and it is aimed to be used to inform the others about one's impressions[25]. Thus, it is logical to state that the existence of the immanent rating would improve the perceived reputation in a positive way.

[25] https://www.tripadvisorsupport.com/hc/en-us/articles/200613867-What-is-a-rating- (last accessed: 30.01.2017)

Perceived reputation. "Perceived reputation" is defined by Doney and Cannon (1997) as the extent to which buyers believe an organization is honest and concerned about its customers.

Perceived reputation is added as an additional control variable between the stages of rating and trust beliefs. The reason is based on a recent review study which showed that a five star rating wasn't the most trusted by consumers to purchase a product (PowerReview, 2015). The reason may be that there is both genuine and fraudulent review which leads one to be extremely sensitive while reviewing "too good" or "too negative" ratings - one assumes that "nothing is perfect". E.g. one would consider a five-star-rating as impossible and thus can be too effusive to be real. It remains unclear whether it is caused by deliberate manipulation or by "perfunctory rating behavior", but the researchers like Schuckert et al. (2016) mentioned to pay attention to such effects. The variable of "perceived reputation", thus, controls the aspect for the above mentioned case and captures the possible side effect.

There are also other arguments over the five-star-rating-mechanism regarding to reciprocity and collusion of the system. Slee (2013) criticized the reputation system for not discriminating among actual good and bad drivers because the system does not reflect the real experience, once reciprocal review of the reviewee is visible. Examples like Blablacar and Ebay were named: when both sides of the transaction are better off with reciprocal ratings, the rating is likely "traded".

Nevertheless, the existence of an immanent rating should bring more credibility to the virtual context than none, because the perceived reputation in the online context depends on the feedback system and the users' feedback effects on other consumers' purchasing behavior (Matsuo and Yamamoto, 2009). The rating, hence, has gained much importance since people perceive it as "social capital" or simply "reputation". Therefore, it can be hypothesized that:

G. *Immanent Rating affects perceived reputation of a platform positively.*

Start-up	Description	Status	Country
legit.co	Universal reputation system that could help sharing economy services verify whether users are trustworthy	inactive, joined Facebook	US
connect.me	Connect.Me turns the existing social networks into a personal reputation network	inactive	US
credport.org	Trust and credibility reputation is built in one place	inactive	US
fidbacks.com	Aiming to be the trust profile of the sharing economy for leveraging online reputation on peer-to-peer marketplaces	inactive	France
peertru.st	PeerTrust is building a digital identity document that helps participants in the sharing economy trust one another by knowing who they are dealing with beforehand based on a peer-validated web of trust.	inactive	Belgium
repstamp.com	RepStamp's goal is building a single reputation system for e-commerce marketplaces.	inactive	Israel
settlebox.com	SettleBox collects the online reviews and lets one use them wherever one buys, sells, lends or hires.	inactive	Sweden
tru.ly	tru.ly maximizes personal privacy by providing users with a single, verified identity on the Internet.	inactive	US
trustcloud.com	TrustCloud gives members in the Sharing Economy the tools for trust and accountability that enable better decision-making and improves every transaction. We measure one's virtuous online behaviors and transactions to build a portable TrustScore one can easily use within the Sharing Economy.	inactive	US
trustribe.com	Complete user review and verification system for marketplaces and communities.	inactive	US
virtrue.us	Virtrue provides verified personal information used in human resources, background checks, identity verification and other situations.	inactive	US
whytrusted.com	Whytrusted aggregates in one place one's public information, reviews and scores and keeps track of the online reputation trail.	inactive	Portugal
deemly.co	Reputation site, which shows the trustworthiness of users engaging in peer to peer transactions by combining ratings and reviews from multiple sharing platforms.	active	Denmark
erated.co	eRated unlocks sellers' hidden potential and presents what one's existing and new potential sellers are already doing in the competitor marketplaces in an automated data driven approach	active	UK
miicard.com	Create trust online through real proven identities, unlocking the true potential of the Internet so that we can all meet and transact with greater ease, confidence and security.	active	UK
traity.com	Traity aims to let one user own his reputation. One can use your reputation passport to become a trusted member of any community.	active	Spain
truste.com	Truste powers privacy compliance and trust by enabling businesses to use data across their customer, employee and vendor channels.	active	US

Table 7: Overview of startup solutions for "reputation dashboard" so far

In comparison to the "immanent rating", imported rating is the rating which is "brought from outside" or introduced from a different context, in this case, "imported" from other platforms. Relating to the study in section 5, this kind of rating comprises in figure 5 all bilateral cases with different destination- and origin-context. Column-wise observation

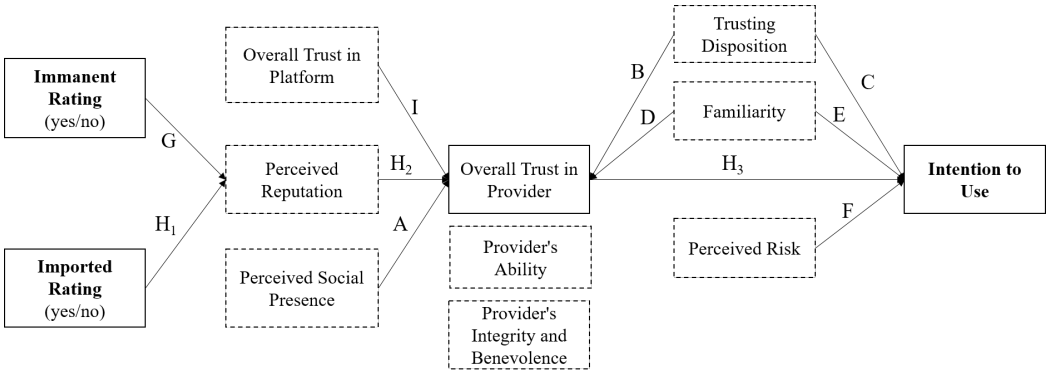

Figure 4: The research model.

represents the respective trust-receptive potential of a certain platform. E.g., the cases 9, 13, 17 represent Airbnb's imported rating (from respectively Blablacar, Ebay and Uber); similarly, trust-exuding potential of a certain platform can be observed in the rows. The effect of the imported rating is the focus of the study with the objective to find out how the imported rating affects one's perception about providers' overall trust and reputation. Following the common-sense logic, an additional piece of positive reputation information would give one more reasons to believe. Although the information is external, one is more likely to predict the trustor's behaviour in future following the other records of the trustor's positive credibility.

The credibility is a crucial predictor of the "information adoption behavior" in the context of eWOM (Cheung et al., 2009; Pan and Chiou, 2011; Sussman and Siegal, 2003). Regarding the "imported rating" as a special type of credibility (which is brought from outside) (Wang et al., 2013), the existence of imported rating should increase the perceived reputation.

Furthermore, as discussed in section 5.1, a preliminary questionnaire was conducted and the first results of the interviewees could be evaluated. The attitude towards the concept of the "imported rating" was questioned. It is conspicuous that over two thirds of participants answered the question of transferability in a positive way whereas the half of them mentioned clearly that a certain set of human qualities and features is not likely to change platform-dependently, to name a few mentioned points – character of honesty, kindness, reliability and respectfulness. It was also obvious that the strongest argument against the mechanism was the difference of requirement sets including ability (role as a renter versus role as a driver) as well as benevolence and integrity (e.g. changing environment from [online] Ebay to [offline] Airbnb).

The control variable perceived reputation could capture possible side effects as discussed before. Nevertheless, it is expected to see a positive effect on perceived reputation and subsequently on level of overall trust in provider. Thus, the hypothesis can be made:

H$_1$. *Imported Rating affects perceived reputation of a platform in a positive way.*

Reputation is a "valuable asset that requires a long-term investment of resources, effort, and attention to customer relationships" which signalizes a trust-appealing message about the customer-provider relationship (Smith and Barclay, 1997). Thus, the costs of untrustworthy behavior are considered to be higher for well-reputed firms, particularly if there is a high chance of communication among the buyers such as writing negative reviews or giving poor ratings because reputation is meant to reduce information asymmetry (Axelrod, 1984). Findings of Jarvenpaa et al. (1998) suggested that perceived reputation is an important factor in creating consumer trust in an online merchant. In the context of the sharing economy, ratings are obviously main predictors of the perceived reputation. When one provider is able to present himself with positive rating, meaning he has no intention of being fraudulent, one's perceived risk reduces and the overall trust will increase. In addition, it has been proven in the retail context that the seller's reputation is related with the buyer's trust in the seller in a positive way (Ganesan, 1994; Anderson and Weitz, 1989).

There is little reason to believe in the quality of being honest if only little reputation is perceived. In this case, there is little reason to believe in one's benevolence either because the consumer is not convinced of having responded with good service and be taken care of in a kind, helpful or generous way when the provider's perceived reputation is poor. Even though the perception people have is based on what has happened in the past, the provider's ability may also be scrutinized carefully since the users may doubt if they are dealing with competent providers when they are conscious of inferior reputation. Thus, it can be hypothesized that:

H$_2$. *A consumer's overall trust in the provider inclusive the providers' ability and combined integrity and benevolence is positively related to the providers' perceived reputation.*

The theory of Luhmann (1979) infers that trust is a prime mechanism people would utilize to reduce the additional complexity, and consequently impact consumers' decisions with the provider. Based on the theory of reasoned action

(Fishbein and Ajzen, 1975), Ajzen (1988) supported the research result stating that trusting beliefs have a positive effect on intention as performed action. In addition, this positive relationship has been confirmed by researches as well, such as McKnight et al. (1998, 2002); McKnight and Chervany (2002); Nicolaou and McKnight (2006); Gefen and Straub (2004); Gefen (2000, 2002a); Stewart (2003). It seems reasonable that strong beliefs that the vendor is of full integrity, strong competence and benevolence lead to willingness to have the intention to "depend on the vendor" because people are willing to rely on people with "beneficial characteristics" (McKnight and Chervany, 2002).

Nevertheless, the distinguishment between overall trusting beliefs and trusting intentions is necessary. Consistent with this research model, Stewart (2003) pointed out that there is a possibility that one might hold his trusting beliefs but still be "unwilling to make oneself vulnerable to the other's action" because of potential risks. The risk perception has been discussed in (Mayer et al., 1995) and is also a part of this model (section 4.1).

According to Gefen and Straub (2004), the fact that the trusted party "knows its job" reduces the uncertainty of showing inadequate ability to the trustor. In the context of the sharing economy, when there is a lack of ability such as substandard skills of car driving, the expected performance outcome will be influenced. Therefore, the ability of providers should support the positively hypothesized causal link to trusting intentions.

"Benevolence" shows the caring belief of the trustee which can be considered as an aspect of emphatic good service (Gefen and Straub, 2004). Such service generally increases customer satisfaction and retention (Gefen, 2002b) and thus reduces uncertainty of having undesirable, unpredictable behavior and affects trusting intention. Furthermore, the characteristic of "integrity" implies an honest host, seller or driver. A dishonest provider may use the personal information or even provoke physical danger (Kamal and Chen, 2016). The trusting belief in the integrity of the providers should decrease the uncertainty involved in such behaviors, because the possibility range of intolerable social behaviors is reduced. As a result, consumers are assured of their expected outcomes (Gefen and Straub, 2004).

H_3. *The trusting intention to use a platform grows with augmentation of consumer's overall trust in providers inclusive their (1) ability and (2) integrity and benevolence.*

4.1. Control Variables

Overall trust in platform. The overall trust in the platform is proposed to positively impact the overall trust in the provider. "When a situation feels safe, we tend to believe that those in the situation have trustworthy attributes" (McKnight et al., 1998). This can also be applied in the context of the sharing economy. This implies that when we have trust beliefs in a greater institution (e.g. P2P platform), we incline to have positive trusting beliefs in the smaller units. The positive relationship between trust in platforms and trust in providers were already found (Han et al., 2016; Son and Benbasat, 2006; Chen et al., 2009) and confirmed (Möhlmann, 2016) in several prior studies. In section 3.1.4, the research of McKnight et al. (2002) already inferred that a consumer who is comfortable with the general web situation, the security and roles of the structure that provide good assurance, is more likely to have high trusting beliefs in a specific vendor because of the contextual security feeling. For example on Airbnb.com, every registered user has to accept the general terms of the platform which enables systematic verification and revises distrustful users (Mittendorf, 2016). Hence, this contextual assurance of "legal, regulatory, business, technical environment" and security feeling can also be applied to the specific context of this work (McKnight and Chervany, 2002).

I. *The overall trust in provider is positively related to overall trust in platform.*

Perceived social presence. The context of the social presence is an important characteristic of trust (Blau, 1964) because trust is built through constructive interactions with other people (Blau, 1964; Fukuyama, 1995; Luhmann, 1979). Gefen (2002a) defined that social presence should build trust through the perception of personal, social and sensitive human presentation. "Social touch" such as a profile with a smiling face added to a website or personalized email and website communication increases trust beliefs of users (Gefen, 2002a). The same can be applied to the existence of genuine profile pictures, personal information description or other ways of expressing human sensitivity and warmth. Reciprocally, low social presence transmitting "cold-shoulder" messages does not build trust (Blau, 1964). A trustor does not have the belief in a provider's benevolence and integrity if the service seems not to be as expected. As a consequence, trustors have few reasons for believing in good service in that case. Also, the ability of the provider will be questioned if the website seems to be irresponsive. Therefore, the causal link can be hypothesized as following:

A. *Higher social presence perceived from the platform increases the overall trust in a provider consisting of ability as well as integrity and benevolence.*

Disposition. The Disposition to trust has been studied and suggested as an important control variable by a broad selection of literature. It represents one's general consistent tendency or propensity to trust or the willingness to depend on others across situations and persons (McKnight et al., 2002; Rotter, 1971). However, this definition does not refer to a person's trait. Rather, disposition to trust is a generalized trend which could possibly add colors to one's interpretation and actors of situations. Thus, it can influence an individual's overall trusting beliefs and intention towards a provider (Nicolaou and McKnight, 2006). Individuals usually enter a relationships with a certain degree of "initial trust" (Meehan, 2000; Rotter, 1980; Mayer et al., 1995) depending on one's faith in humanity (Gefen and Straub, 2004), one's cultural background (Blau, 1964) and one's "socialized trusting stance" (Rotter, 1980; Meehan, 2000). Accordingly, this kind of initial trust is based on one's life socializing experience that forms the trust disposition degree of one person (Gefen

and Straub, 2004). As Bigley and Pearce (1998) and Rotter (1971) proposed, the direct effect of disposition to trust on trusting beliefs should be the strongest when both the overall trust (in the institutional context) and the specific provider are unfamiliar to the truster.

Furthermore, disposition to trust also reflects the general optimism (Uslaner, 2000) which brings individuals to think positively and therefore, have trust in the provider. However, impact of such trust disposition on trusting beliefs could be mediated to a great extent if one has sizeable experience with institution-based trust (Nicolaou and McKnight, 2006). Nonetheless, it is the willingness to have general trust without justifying it on prior experience with the particular party (Gefen and Straub, 2004). Also, the hypothesis was strongly supported by the results of McKnight et al. (2002) and Nicolaou and McKnight (2006). Overall, the causal factors can be expressed as:

B. *Trusting disposition positively affects users' overall trusting beliefs in peer-to-peer providers.*

C. *Trusting disposition positively affects users' intention to consume the peer-to-peer service.*

Familiarity. McKnight et al. (2002) and Gefen (2000) claimed that trusting beliefs differentiate from familiarity. Familiarity is defined as an understanding based on previous interactions, experiences, and learning of what, why, where and when others do what they do, according to Luhmann (1979). Familiarity gives one an understanding of the current actions of other people or of objects (Gefen, 2000). In the context of this work, familiarity describes an activity-based cognizance found on previous experience of the platform interfaces and learning of the utilization methods. Meanwhile, familiarity reduces uncertainty by establishing a structure (Luhmann, 1979) which would impact the overall trust in provider as well as the corresponding intention in a positive way. In the case of using sharing economy platforms, familiarity is also assumed to reduce complexity through the structure and interaction of the interface and involved procedures. Subsequently, Gefen (2000) stated that familiarity provides a framework within which specific affirmative expectation from the trustee can be made. Confirmation of such favourable expectations increases users' trust in providers. Conclusively, a better understanding of the interface and context through the platform (i.e. increased familiarity) would consequently improve people's ability to maintain their trusting belief.

D. *Increased degree of familiarity with a peer-to-peer platform and its procedures increase overall trust beliefs in providers.*

E. *Increased degree of familiarity with a peer-to-peer platform and its procedures increase users' willingness to use the service on the platforms.*

Perceived risk. The idea of taking risk into consideration in the context of the sharing economy has been discussed by Hawlitschek et al. (2016) who stated that sharing involves procedural risks. The risk theory of Sitkin and Pablo (1992) and Keil et al. (2000) proposed that risk perception will negatively affect willingness to perform a risky behavior. Furthermore, Ajzen (1985, 1991) propounded the theory of planned behavior, suggesting that a user has purchase intention of a process which is perceived as low risky, even if his attitude towards the provider is not highly optimistic and vice versa. The theory substantiates the impact of perceived behavioral control on the use intention. Jarvenpaa et al. (2000) and Gefen et al. (2008) already found that B2C perceived risk negatively affects intention to transact with a Web vendor. In the sharing economy context, the perceived risk associated with the booking process may reduce users' perception of control (Jarvenpaa et al., 2000) which may influence their willingness to book on the platforms. Perceived risk is hence considered as an attitude-shaping independent and direct influence on the "intention to use". On account of this, the causal link F is presented as:

F. *Reduced perceived risks associated with booking process on sharing economy platforms increase the users' intention to purchase the service.*

5. Methodology: Study Design

As discussed in the last sections, trust contexts, i.e. platforms of independent peer-to-peer applications, are technically not connected. A new user of a platform has to create his platform-dependent trustworthiness from scratch when joining it, even if the user has established well documented trust and credibility history on other platforms in other contexts. The study design in this work has the main goal to find out how trust transfer functions in detail differentiating the trust dimensions' ability, integrity and benevolence by connecting the "reputation score" of four selected representative P2P platforms together. In order to study the trust and reputation transfer process between P2P platforms, a large-scale online-survey as well as a preliminary survey as a completive assisting preparation have been conducted.

The selection of these platforms was not systematic and thus is also discussed in the limitation section 7.1. However, there are certain criteria which support the choice. In June 2015, Airbnb reported that it was on track to hit $900 million in revenue by the end of 2015. Based on that estimate and Slice's report, the company could be hovering near $1.7 billion in revenue (Love, 2016). The most successful sharing economy platform soars 89% of growth while the hotel industry has a growth rate of 19%. While Airbnb has over 2,000,000 listings in 34,000 cities and 191 countries, Uber is currently active in over 66 countries and over 507 cities worldwide (status 11.2016). This fact justifies the selection of these two platforms. As for Ebay, half of the participants in the preliminary survey mentioned that they would first think of Ebay when it comes to sharing economy. Additionally, BlaBlaCar is the world's largest long-distance ridesharing community (Wauters, 2015) and is popular in the local region of Germany. These arguments round up the justification for the selection of the platforms in this research.

The following passages explain the methodology used in this work respectively for both conducted surveys - the small-

scaled preliminary survey for preparation in section 5.1 and the large-scaled online survey in section 5.2 .

5.1. Preliminary Questionnaire

The preliminary survey based on several open questions is about participants' experience of sharing economy platforms as well as the users' general attitude towards them. Additionally, possible potential of trust transfer in the relevant context has been asked to be evaluated. This process gives the research a basic impression of users' attitude, ideas and thoughts by analyzing 28 participants' free-text answers using Google form [26] in an explorative way. This is a qualitative survey. Aspects that are new or special have helped to develop and expand the research model and consequently take more perspective into consideration. Selected representative results of the preliminary survey are briefly presented in the following paragraphs.

The online preliminary questionnaire received 28 complete open-text answers within four days (from Oct 17 2016). The group includes 43% of male and 57% of female with an average age of 24 (comprising 21-30 year-olds). The educational level is at least Abitur where Bachelors and Masters are nearly equally distributed. All of the participants knew about platforms Airbnb and Ebay; 96% (86%) of them knew Blablacar (Uber). 61% of the partakers have already used the service of Airbnb as consumer whereas half of them have already experienced Ebay as both provider and consumer. The general trust towards selected P2P platforms is overall very positive with 98% affirmative answers (78% definitive trust; 18% conditional trust). This aspect reflects on the answer of the question if one would accept an offer on one P2P platform in spite of empty reputation record: 68% would accept the offer (with 61% conditionally) regardless of unavailable rating record. This infers the importance of both "trust disposition", "familiarity" and the "overall trust in platform" which are elements of the research model. Participants have emphasized that in this case the way of communication as well as the profile description (with profile picture and enough seriousness of the profile as well as depiction of the listing) would play a role for deciding whether the provider is trustworthy. Perceived social presence is also, thus, constructed within the research model for such effects.

The top five features of trustworthy providers covering 81% of all nominated qualities are ranked as following: well-ratedness (good reputation) 28%; honesty and transparency 26%; reliability and seriousness 18%; good communication 14%; controlled by the platform 7%. Some of the mentioned aspects are categorized and described in the research model, such as providers' integrity and benevolence.

The opinion of trust transferability between different platforms was also a question. The corresponding answers can be approximately divided into three evenly distributed groups: yes; no; and conditionally yes. This diverging answer makes the research even more meaningful to find out if the principle could work. There are mainly two alluded points: half of the participants mentioned diverse requirements of personal qualities caused by different features of the platforms (e.g. driving versus hosting); however, a quarter of participants argued that general personal qualities such as honesty and reliability are transferable. The diverse beliefs build an initial ground of impression of others' options about trust transfer.

5.2. The Online Survey

The large-scale online survey with (expected: 400, actual: 139) participants is conducted and processed for collecting trust-transfer data between the four selected well-known sharing economy platforms mentioned above. The quantitative model will be evaluated empirically later. The measurement is based on 44 survey items using seven-point Likert scales. All the items of the constructs are adapted from adequate templates of available and specific items from related works. The content was validated by carrying out a sorting assessment with 8 judges who were no involvers of the research. Certain items were reconsidered and revised after getting feedback.

Voluntary participants were recruited via the pool of Karlsruhe Decision & Design Lab (KD2Lab). The survey items were presented in German language.[27] As incentive, a prize including 2 x 50 Euro and 20 x 20 Euro was raffled among all participants completing the survey who needed to enter their email address at the end of the survey voluntarily if they wanted to take part in the lottery. It was clearly disclaimed that the email address would not be matchable with their answers in the questionnaire.

In the questionnaire, the 44 items are distributed and presented in 6 blocks of 4-8 questions each. The sequence of blocks and the items varies randomly. At the beginning, a short introduction passage was available for explaining the presented situation.

In this study, trust transfer scenarios are simulated with the four mentioned P2P platforms – Airbnb, Blablacar, Ebay and Uber. The Matrix presented in figure 5 shows the systematic combination of the platforms. Every treatment from number one to twenty is assigned to a *platform of origin* (trust transfer from...) and a *platform of destination* (trust transfer to...). The first four cases are defined as the lower baseline, since there is no trust transfer origin, i.e. the user has no previous rating. The "upper baseline" presents the cases of immanent trust. The rest of the cases are scenarios of imported trust. Altogether there are $k^2 + k$ treatments with k as the number of the platforms. Here we have twenty treatments. They are also shown as a network graph as illustrated in figure 6. The number of the survey's participants should be, hence, at least about $20(k^2 + k) = 400$ for $k = 4$.

[26] https://docs.google.com/forms/d/e/1FAIpQLSea1NhiR0sCoK3TqyeenPZ1iuXZKv9TGgL1ZzeEf5hLl6L_yQ/viewform (viewed on 27.11.2016)

[27] The constructs along with their respective items are presented in the Appendix.

FROM \ TO	N/A	airbnb	BlaBlaCar	ebay	UBER
N/A	1	2	3	4	
airbnb	5	6	7	8	
BlaBlaCar	9	10	11	12	
ebay	13	14	15	16	
UBER	17	18	19	20	

lower baseline

upper baseline

Figure 5: Matrix of Treatments - The study's trust transfer scenarios.
(N/A: no rating available; black marked diagonal: upper baseline; grey-marked row: lower baseline.)

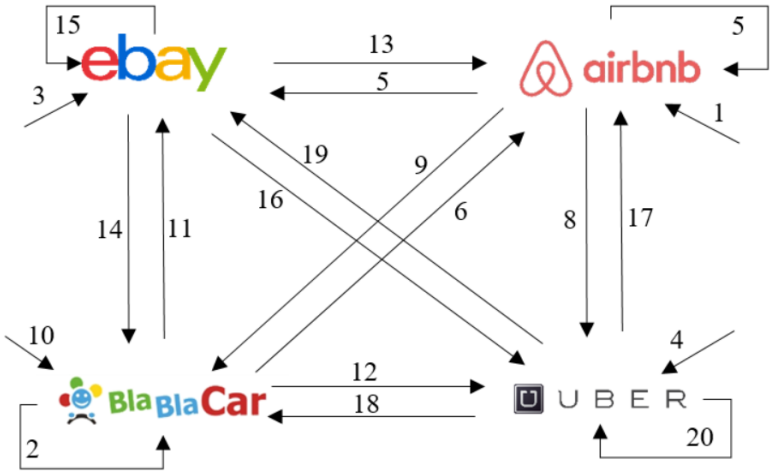

Figure 6: Network Graph - The Study's trust transfer scenarios.

The survey's focus is put on the provider side, i.e. renter, host, seller and driver. The assignment to the treatment is automated and randomly generated. To demonstrate, two examples will be clarified here. The two exemplary screenshots of the respective survey interfaces are listed in Appendix. For example, the fourth case represents the following situation: the user is new on the Uber platform and does not have any rating yet. He has no other reputation record, either. On base of this initial situation, the inquiry will be filled in. Another example can be explained with the sixth treatment. In this case, the survey participants take the role of a Blablacar consumer. The Blablacar driver is also a new user and has no rating history. However, the (connected) available reputation of the same provider on Airbnb is shown. The participant is then asked to complete the survey after being clarified.

Worth mentioning is also the selection of the construct design. The two primary ways of "within-subject" and "between-subject" designed experiments were in sight. Advantages and disadvantages to each approach were analyzed. "Within" design has a stronger "demand effect" which can make the results furious because each individual is exposed to more than one of the treatments being tested and the certain pattern or intentions recognized could change participants' behavior consciously or not (Rosenthal, 1976; White, 1977). According to Charness et al. (2012), although "within" analysis has clear advantages like independent internal validity on random assignment and alignment with most theoretical mindsets, in environments where a participant has to only "face a single decision", a "between" design has more external validity. Additionally, due to the limit of time this research is based on "between" construct design. Nevertheless, the designed "within" items are displayed in the Appendix giving an idea of an alternative solution. The favoured items used in the construct are presented in the

Appendix.

6. Study Results

1200 participants were invited via email. The survey was available from Feb.02.2017 to Feb.10.2017 and with that was accessible for 9 days. Overall, 397 people took part in the survey until Feb.10.2017 11:00 A.M. GMT+1 and that implies to average 20 participants per treatment. Due to time reasons, only the first 139 sets of data until Feb.03.2017 13:00 P.M. GMT+1 were considered in the following data analysis. To ensure the data quality, 2 of the completed data were excluded for the reason that they did not pass the attention controlling question. Moreover, the subjects that took less than 2'58 or more than 12'28 minutes for the survey completion were excluded. In conclusion, there are 130 sets of data in total which were taken into account with an average completion time of 5 minutes 40 seconds.

The female and male rate are respectively 22% (N=29) and 78% (N=101). The female is underrepresented at KIT, according to the official KIT statistics.[28] The participants' Age ranges from 19 to 35 with mean 24.11 and median 24.00 years. The education level is high due to the universitarian environment. Of all of the participants, 45% own Abitur, 46% a Bachelor degree, 9% a Master or Diploma degree. The research model was examined using PLS (SmartPLS software). PLS combines a factor analysis with multiple linear regressions to estimate the parameters of the measurement model (item loadings on constructs) together with those of the structural model (regression paths among the constructs) by minimizing residual variance (Gefen, 2002a). Subsequently, the *t*-values and the *p*-values are estimated using bootstrapping method. Figure 7 and figure 8 show the result of the main research models along with the statistical significance level. The former one has a unitary trust construct: "overall trust in provider", whereas the latter one deals with the two constructs of the trust dimensions explained in section 2.2. Coefficients supported at a 0.001, 0.1, 0.05 and 0.1 level are shown with triple, double, single asterisk and a plus sign, respectively. In the Appendix, the research model without the statistically insignificant paths is evaluated and showed.

The analysis shows that the perceived reputation was affected by the source of the rating, i.e. whether the rating is immanent or imported. The moderate value of R-squared (41%) is considered to be acceptable since the perceived reputation should mostly be affected by the reputation (e.g. rating score) itself. Furthermore, 67% and 56 % of variation in "overall trust in provider" and "intention to use" can be substantially and moderately explained.

Cronbach's alpha, a measure of internal consistency reliability, is well above the conventional limit of 0.7 (Nunnally, 1978) for almost all constructs. Only for "perceived risk", it falls short of the limit with values of 0.629. Yet no value falls below 0.6 which would indicate a lack of reliability (Henseler et al., 2009). The results are presented in the Appendix.

As of the discriminant validity as another aspect of construct quality criteria, it serves for analysing relationships between latent variables. Its assessment has the goal to ensure that a reflective construct has the strongest relationships with its own indicators, in comparison with than any other construct in the PLS path model (Hair et al., 2014; Fornell and Larcker, 1981). The results of the research model is presented in table 8. The square of AVE (average variance extracted) in the diagonal of the table is constantly greater than other correlations between the constructs with the latent variables in the lower triangle area. Thus, the discriminant validity has been established. The results of the cross-loadings also support the discriminant validity, which appear in the Appendix.

A goodness of fit measure for PLS-SEM (structural equation modeling) can ensure the avoidance of model misspecification (Henseler et al., 2014). The bootstrap-based SRMR does a similar job as a Chi-square test (Dijkstra and Henseler, 2015). As an absolute measure of model fit criterion, the standardized root mean square residual (SRMR) allows assessing the average magnitude of the discrepancies between observed and expected correlations (SmartPLS, assessed 10.2.2017). The SRMR is defined as the difference between the observed correlation and the model implied correlation matrix. The SRMR of the model has a value of 0.071 whereas a value less than 0.10 or 0,08 is considered a good fit (Hu and Bentler, 1998). Additionally, the value of Normed Fit Index (NFI) should result in values between 0 and 1, where the closer the NFI to 1, the better the fit (SmartPLS, assessed 10.2.2017). NFI values above 0.9 usually represent acceptable fit (Lohmöller, 1989). The result of this research model is 0.79 which falls closely below the critical value. This can be explained by the low complexity of the model, because the more parameters in the model, the better and larger the NFI result (SmartPLS, assessed 10.2.2017). The NFI value of the same model without statistically insignificant paths (Appendix) is 0.83 which is higher. Overall, the model seems to have acceptable fitness measures.

With the respect of statistical significance, the data analysis shows that the paths from familiarity, perceived risk and trusting disposition are statistically insignificant, which can not confirm the hypothesized results in accordance with the literature. Both the overall trust in the provider and trust in the subdimensions of the provider are affected by the overall trust in platform, perceived reputation as well as the perceived social presence. The intention to use or purchase is positively affected by both of the overall and subdimensional trust in provider. Furthermore, both immanent rating and imported rating affect the perceived reputation in a positive way.

[28] KIT Statistics: 72% Male; 28% Female (https://www.kit.edu/downloads/Statistik_SS2016.pdf July 2016)

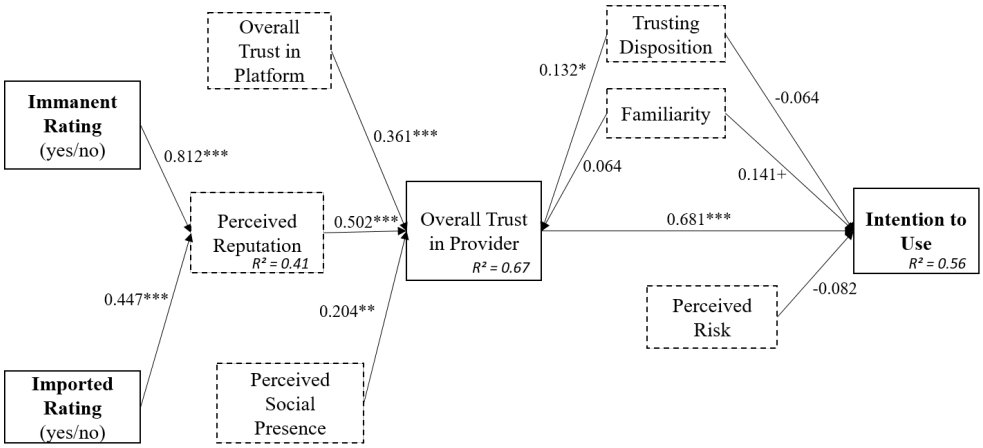

Figure 7: Findings of the study (Overall Trust): path coefficients
(*Statistical Significance Level*: *** p<.001, ** p<.01, * p<.05, + p<.1)

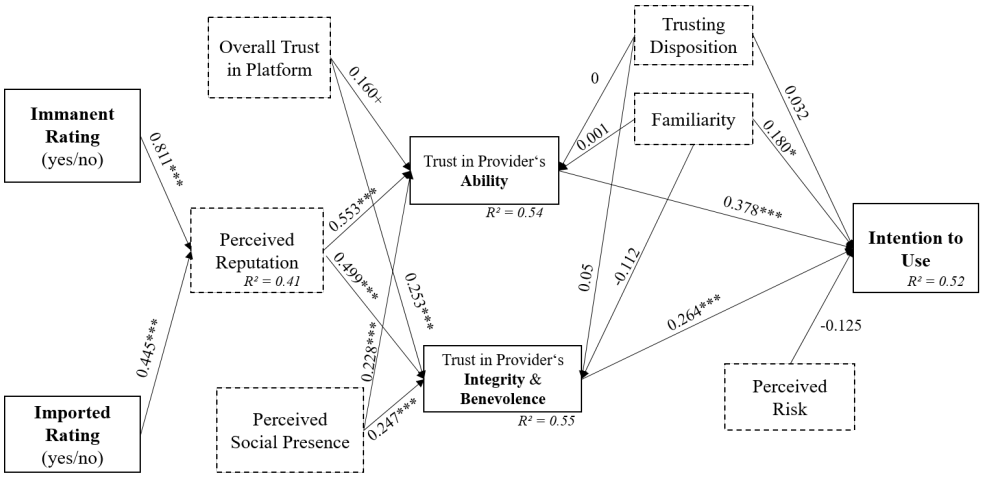

Figure 8: Findings of the study (Trust dimensions): path coefficients
(*Statistical Significance Level*: *** p<.001, ** p<.01, * p<.05, + p<.1)

	FAM	IMM	IMP	INT	TPL	TPR	REP	RSK	PSP	DTT
Familiarity (FAM)	**0.963**									
Immanent Rating (IMM)	-0.112	**1.000**								
Imported Rating (IMP)	0.061	-0.617	**1.000**							
Intention To Use (INT)	0.286	0.266	0.069	**0.969**						
Overall Trust in Platform (TPL)	0.549	-0.110	-0.037	0.452	**0.822**					
Overall Trust in Provider (TPR)	0.207	0.287	0.012	0.732	0.493	**0.826**				
Perceived Reputation (REP)	0.056	0.536	-0.055	0.626	0.118	0.661	**0.852**			
Perceived Risk (RSK)	-0.130	-0.194	0.009	-0.472	-0.336	-0.567	-0.431	**0.760**		
Perceived Social Presence (PSP)	0.148	0.192	-0.060	0.424	0.342	0.576	0.445	-0.222	**0.839**	
Trusting Disposition (DTT)	0.105	0.052	0.064	0.233	0.282	0.388	0.216	-0.217	0.254	**0.838**

Table 8: Fornell-Larcker Criterion

7. Discussion

This study contributes to the trust transfer theory by refining the models offered by previous research from the context of e-commerce, by expanding and conducting a model testing the trust transferability in the context of the sharing economy and by including three dimensions of trust to the

model.

As discussed in section 2.2, trust is claimed as very crucial in the context of the sharing economy. The study upholds this thesis and shows that 52% - 56% of the variance of consumer intentions to purchase were explained by the elements of trust in the provider. Moreover, the results showed that the construct of the overall trust in platform not only directly affects the overall trust in provider as confirmed by literature (Han et al., 2016), but also has direct impact on the trust in provider's ability and integrity & benevolence. The direct effect on the subdimensions implicates for practitioners that users' overall trust in the platform is important, because the more positive the overall trust in the platform is, the more trust consumers will have in the peer's ability and integrity & benevolence.

The data were analysed to differentiate between female and male users as well as between experienced and inexperienced users. However, no effects were observed.

The study results also reinforced the multidimensional trust, especially the two dimensional construct design in an online context, as Ridings et al. (2002) and Lu et al. (2010) suggested. It was showed that users' trust in providers' ability and a combination of benevolence and integrity are significant antecedents of the intention to use in the context of the sharing economy.

With respect to the control variables, it is worth noting that also the perceived social presence affects the trust in provider's ability positively, even though the profile pictures in the study were blurred consciously, in order to avoid a possible major influence. This can be explained by the possible semblance of an interpersonal interaction (Gefen, 2002a) and the general perception of social presence factors in a website, e.g. the fact that there is one profile picture and there is a description structure.

The main goal of this research model was to develop and find out if trust can transfer from different platforms of the sharing economy and how it functions in detail. The first question can be answered by the findings of the first main hypothesis. The findings show that not only the existence of immanent ratings directly affect the perceived reputation, but furthermore, it is also related to the existence of imported ratings. The path coefficient of 0.447 shows a positive link for H_1, though the selected platforms generally require different competence and expertise. How trust in details works can be answered by a first draft of the trust transference score matrix in figure 9.

Due to the relatively small data sets (N=130) and a treatment number of 20, the matrix can only be interpreted with caution. A further research with more data sets should be done, in order to determine more accurate results of the trust transfer performance. In the matrix, a simplified average score of "overall trust in provider" (TPR) is calculated with the quantity of participants in the brackets. A first glance at the matrix offers an average value of 4.2 out of 7 among the imported results, which supports a positive overall transference performance.

In total, the platform with the best trust-exuding potential is Airbnb, which serves as the platform with the least trust-receptive potential simultaneously. This can be explained first by the degree of personal interaction on a physical level of a hosting experience. In comparison, P2P virtual transaction platforms do not require physical transactions and only has risk factors of monetary loss or possible loss of reputation score (Kamal and Chen, 2016); P2P riding sharing services involve more risk factors such as life risk (Kamal and Chen, 2016), but the time of the sharing service is limited. At Airbnb, there is a greater potential risk, both monetary and physically. Along with the issues of privacy and intimacy people require to feel comfortable when living elsewhere, it seems to require the most trusting factors of all four platforms and thus, is the most difficult to exude to and the most trustworthy platform to transfer the reputation from.

As of the first four treatments which represent the lower baseline, the first study results show that when there is no previous rating available, one would have the most trusting belief in Ebay and the least in Uber. The explanation could be that there is low risk, namely only limited monetary loss on Ebay. In spite of recordless trust history, Airbnb and Blablacar still scored 3.2 and 3.6. This could be resulted by a strong overall trust in the platforms' infrastructures itself or a positive influence of perceived social presence. With the respect of Uber, the degree of availability in Germany is still low and the sample shows that the most of the users do not have experience with this specific service. Thus, a reasonable explanation is the situation of unfamiliarity.

7.1. Limitations

Several limitations of the work presented need to be mentioned and discussed. First of all, the use of students from Karlsruhe Institute of Technology as surrogates might not represent all the potential users in the sharing economy. Though the age class is identified as a main user group of the sharing economy services (Vaughan and Hawksworth, 2014), additional research should examine whether these results apply equally well to other users for ensuring the generalizability of the observations. Subsequently, the voluntary participation of the survey might possibly implicate to the inherent response bias. The sample selection might already be biased regarding the context of the sharing economy. It is quite possible that both familiarity with the target platforms and the trust beliefs work differently with inexperienced users.

The selection of the four platforms used in the survey was not systematic. The results might be different when choosing other platforms. Hence, a construct of fitness should be added in the future research. Details will be explained in section 7.2. In addition, only star ratings were considered in the survey as transferable reputation. Other measures such as review text, comments or linkage of social media sites were not concluded in the design.

There are also many contingencies that will indirectly but undoubtedly affect the level of trust, according to Gefen and Straub (2004). For example, the branding, size of purchase

to [B]… / From [A]…		TO				Ø
FROM	N/A	3,2 (9)	3,6 (7)	4,1 (7)	2,9 (3)	3,5
	airbnb	4,5 (9)	5,0 (7)	4,3 (7)	4,6 (10)	4,6
	BlaBlaCar	4,4 (4)	4,8 (8)	3,4 (9)	4,5 (6)	4,3
	ebay	3,2 (3)	5,3 (2)	3,3 (1)	3,5 (7)	3,8
	UBER	3,8 (6)	4,0 (6)	4,8 (10)	5,5 (9)	4,5
	Ø	3,8	4,5	4,0	4,2	

Figure 9: "How does trust transfer?" – Matrix presentation of the overall trust score

(booking), previous history with the e-provider, the professional appearance of the website, article written about the company, placement of ads for the site and the speed of loading for the site etc. None of these possible factors were addressed in this work. Additional research is needed to sort out such effects.

Moreover, the privacy problems while providing and possibly transferring reputation between different communities were not taken into account, as investigated by Pingel and Steinbrecher (2008). The trust transfer mechanism is based on the rating-score visibility of all platforms. By doing this, privacy problems come into light. One might not wish to publicize his real property location, what car he owned and the destination of his shared riding at the same time. Additional research is needed to investigate this aspect.

7.2. Future Research

This work has implied two indications for the future research. First, since this work's trust transfer only bases on the star ratings, textual comments and other forms of feedback and reputation system should also be included in the design. They also have an impact on trust perception, according to the results of the exploratory preliminary survey. Another reason for taking other measures into consideration is that bilateral reviewed platforms like Airbnb were claimed to be overrated, as Dellarocas and Wood (2008) and Bolton et al. (2013) pointed out. A more complete analysis of the reputation system would give a better overview.

Secondly, a construct of fitness could be included in the future research. This is inspired by the study of brand extensions (Aaker and Keller, 1999). The context of trust transfer and the fit construct will be introduced in the following.

As mentioned in section 3.1.4, one of the most representative examples of "trust transfer from an entity" is the transfer process from available trust on existing (original) product of a known brand to a new product of the same brand. Firms use established brand names to facilitate the desire to enter new markets with less cost. The study focuses on the total consumer evaluation of brand extensions while my work prioritizes the specific aspect of trust leverage and transfer. Being consistent with the trust definitions, leveraging a strong brand name can reduce the risk of introducing a product in a new market since consumers have knowledge about the established brand and are familiar with it. Likewise, there is a risk of image damaging association when the extension is wrong.

Aaker and Keller considered the fit (between the original and extension product classes) as an important factor to a brand extension. The role of "fit" or "similarity" of the product classes could impact consumers' perceived quality of the brand and subsequently, enhance the attitude towards the extension. Three measures for the dimensions of fit were developed. The two demand-side perspectives, "Complement" and "Substitute" consider the economic product usage. An example could be a brand which produces downhill skis. As a complementary extension, it could provide ski clothing. A substitute extension is to provide ice-skates. The third dimension which has also been diagnosed as one of the main reasons for low-rated extensions, is the most relevant for this work – "Transfer", which reflects consumers' perceived ability of brands providing in the first (original) product class to make a new product in the second (extension) product class. It is about if the consumers think that the facilities and skills of a firm (used for the original product) would be transferable effectively in making the extension successful. That also means, negative reaction would come upon if it is incongruent, i.e., the observing firm does not appear to be competent in the stretching area.

In this paper's research model, though the difference between the selected platforms (especially regarding the required ability) has been mentioned, the aspect of "fit" is not considered in the research model yet. In the future, this could be constructed separately measuring the perceived similarity and transferability between the origin and target platforms. Since the dimension of trust has been divided into two: (1) ability and (2) benevolence and integrity, especially the aspect of the first dimension would be required to mea-

sure the degree of fit. If the human characteristic of benevolence and integrity is shown to be transferable, the ability transfer would be the biggest hurdle. E.g., proposing that the providers of the ride-sharing platform Blablacar and the P2P taxi platform Uber both have the ability requirement of driving skills, would it be more likely to transfer the trust between these "similar" platforms?

8. Conclusion

This research has given a starting point for studying the trust transfer process by providing a literature review of the trust transfer theories and conducting an empirical test of the process in the context of the sharing economy and P2P platforms. The literature review provided a categorical view clustered by the sources of trust (entity and context). The research model also reinforced that trust consists of a set of beliefs (McKnight et al., 2002), which resulted to be directly affected by the overall trust in the platforms as well. This was a new suggestion at how trust in peer-providers can be increased. The main goal of the study was to find out whether and how trust can be transferred between platforms in the context of the sharing economy. The results of the research model consisted with the hypothesis by providing empirical evidence of the positive effect of imported trust on the perceived reputation. Future research should focus on the detailed transference mechanism by adding a construct of fitness as well as taking other reputation elements such as textual comments into consideration.

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The Impact of the Gig-Economy on U.S. Labor Markets: Understanding the Role of Non-Employer Firms using Econometric Models and the Example of Uber

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Abstract

In this work, I provide quantitative responses to the questions of how the size and the growth of the gig-economy can be measured and how labor markets respond to the exposure to online platforms using data on non-employer firms from the U.S. Census Bureau and on the staggered market entry of Uber in different U.S. metropolitan areas. I find that non-employer firms experienced a growth by 60 % between 1999 and 2014 adding almost 9 million non-employer firms to the U.S. economy. I show that non-employer firms are tightly linked to the rise of independent work and are highly effected by the emergence of online platforms. Uber triggers an increase of 20 percentage points in non-employer firms relative to employment in the transportation sector 4 years after entering local labor markets. Furthermore, Uber's market entry is associated with a 0.05 - 0.07 increase in non-employer share in the transportation sector. I demonstrate that the growth of non-employer firms between 2005 and 2014 is correlated with the growth in alternative work arrangements measured at the industry and state level by Katz and Krueger. I find that the rise of non-employer firms is not mechanically driven by differential industry or regional growth and that the number of gig-economy workers are at highest where unemployment is at highest. My results highlight the impact of the gig-economy on labor markets and provide evidence that the use of non-employer firms is relevant for measuring the gig-economy.

Keywords: Gig-Economy, Online Platform Economy, Labor Market, Non-Employer Firms, Uber

1. Introduction

> "An approximate answer to the right question is worth a great deal more than a precise answer to the wrong question." - John W. Tukey

Technology and the emergence of online platforms have changed the way in which people work, enabling a variety of on-demand services and creating new digital task marketplaces. Workers are able to earn income from their time, expertise or effort through platforms such as Uber, TaskRabbit, Handy or Lyft.

These online platforms facilitate matching and direct transactions between customers and labor force bringing birth to a major socio-economic trend falling into a range of activities known as the "gig-economy". The gig-economy is a technology-influenced evolution of work that has called into question nations' core beliefs about the work place in society and how to best divide responsibility among workers, businesses, and government.[1] Understanding the prevalence and implications of the gig-economy can help states and governments develop policies and support the communities, the businesses, and the workforce of tomorrow's labor markets. But the questions of how to measure the exact size and growth of the gig-economy have plagued researchers for years.

This work intends to provide quantitative response using information on non-employer firms combined with the case of Uber and state-of-the-art econometric techniques to help address certain shortcomings of administrative data and measure labor activity in the gig-economy. In the following introduction, I picture the origin of my motivation based on previous research, and describe my approach to address the hypotheses I drew up on the current issues related to the gig-economy.

1.1. Motivation and Related Work

A growing number of American workers earn income outside of traditional employee-employer relationships through self-employment and business ownership. According to the

[1] Cf. Smith and Page (2016).

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U.S. Department of Treasury, 16.8 million individuals reported having earned a profit and paid self-employment tax in 2014, representing a 32 percent increase from 2001.[2] The almost 17 million self-employed workers represented 12 percent of all tax filers with earnings. A study from Farrell and Greig (2016) shows that the number of individuals using online-labor platforms has increase 54-fold since 2012 reaching a 0.4 % of the U.S. workforce. These individuals derive one third of their income from online platforms, and even more so when their non-platform income drops.[3] Why do individuals increasingly use these online platforms? Is this a structural trend? Are platforms increasing total labor supply and lowering unemployment, or simply shifting individuals from traditional jobs to online platform jobs? And how well suited is the existing tax records data to accommodate and measure this evolution, are all still open questions.

There has been much research on the rise of the so called "gig-economy", a state of work enabled by online platforms and characterized by temporary positions filled by independent contractors on a short-term basis.[4] However, existing observations provide little evidence of the true significance and manifestation of this alternative work arrangement on labor activity.[5] Accurate measurement of the gig-economy is important for understanding current labor market trends. These trends have important implications for the income, health insurance coverage, and retirement security of self-employed workers. Fox (2014) argue that existing surveys and administrative data are not well suited to capture new forms of labor, and hence cannot be used to address these questions.

On the one hand, it is hard to clarify the sector and its meaning due to the changing nature of work, worker's rights and the controversy about legal, fiscal and social aspects of services provided via online platforms.[6] On the other hand, its size and impact has been difficult to measure due to the complexity of the concept, the relative recent developments and the limited amount of available data on employment of the gig-economy.[7] Public institutions are not in a position to gather data and the U.S. government stopped surveying "contingent workers" after 2005, which means that no comprehensive database exists on workers in the gig-economy.[8] Katz and Krueger (2016b) using a new dataset from the Census Bureau argue that all of the net employment growth in the U.S. economy between 2005 and 2015 can be attributed to the rise of independent work.[9] This has resulted in a debate over the true significance of this new form of work relationship. On one side, some critical claims utilizing aggregate self-employment statistics conclude that evidence of a revolution is hard to find and some proponents, on the other side, working with company data or proprietary information captured size and impact at a national level. [10]

It appears however that inconspicuous data made available by the Census Bureau on "non-employer firms" in combination with self-employed statistics and company data can shed additional light on the gig-economy and how the entry of online platform influences labor markets.

1.2. Objectives and Approach

The objective of this thesis is to understand the origins of the rise of the gig-economy, its impact on labor markets, and the role of non-employer firms. In order to achieve these overarching objectives, this work is pursuing a subset of goals.

After unveiling the nature of the gig-economy and determining its stakeholders, characteristics, and the current implications in labor markets, the first goal is to provide record of the rise of non-employer firms as an integral part of the gig-economy and a clear testimony of their suitability to be considered a proxy for alternative work arrangements. This can be achieved with administrative data on non-employer firms made available by the U.S. Census Bureau, and data on contingent workers captured by the U.S. Bureau of Labor Statistics (BLS) as well as in a recent survey lead by Katz and Krueger (2016b). Comparing the rise of alternative work arrangements with non-employer firms using ordinary least squared methods will help identify the relevance of non-employer firms in the gig-economy.

The second goal of this work is to provide an understanding of the effect of online platforms on non-employer firms and extend findings to a relevant level for labor markets. The aim is not to quantify the precise evolution and growth of independent work inside the gig-economy, but rather deliver evidence of an apparent movement of non-employer firms in online gigging due to the exposure to online platforms. To do so, I use the paradigmatic case of Uber's geographical expansion in the U.S. at commuting zone level and draw on data published in a company report. Estimating the change in non-employer firms with differences-in-differences techniques will aid understanding the role of non-employer firms and the impact of online labor-platforms by metropolitan area.

The final sub-goal of my thesis builds on the previous parts of my analysis on non-employer firms by measuring labor supply elasticities to changes in the exposure to online platforms. In particular, this is carried out in two stages: first, I investigate how the change in non-employer firms varies in state and industry by decomposing the growth accordingly. And secondly, I consider non-employer-firms and the staggered entry of Uber in different areas in the U.S. to estimate the associated employment response using data from

[2] Cf. Jackson et al. (2017).

[3] Cf. Farrell and Greig (2016).

[4] See among others Hall and Krueger (2015); Katz and Krueger (2016a); Burtch et al. (2016); Gierten and Spiezia (2016); Hathaway and Muro (2016); Harrigan et al. (2016); Codagnone et al. (2016); Chen et al. (2017); Jackson et al. (2017).

[5] Cf. Codagnone et al. (2016).

[6] Cf. Codagnone et al. (2016).

[7] Cf. Hathaway and Muro (2016).

[8] The Bureau of Labor Statistics (BLS) has announced to resume the survey of contingent workers to be published in 2017.

[9] Cf. Katz and Krueger (2016a).

[10] Cf. Burtch et al. (2016).

the Local Area Unemployment Statistics (LAUS). I perform this analysis for firms in industries that have been particularly impacted by online platforms, such as the taxi and the passenger ground transit industries.

This work also aims at providing evidence of the significance of non-employer firms to assessing further socio-economic issues arising from the evolution work in the gig-economy. It will, in turn, help understand the gig-economy's impact on labor market activity at geographical and industry specific levels. The purpose of these sets of analyses is to reflect on how future studies should be considering non-employer firms to assess how the dynamics in independent work relates with working relationship, contractors' situation, and other aspects of labor markets.

1.3. Indications and Hypotheses

As many studies have been dealing with the question how to measure the gig-economy, this work uses a sparsely tapped and valuable source of data to give an approximate but meaningful answer. Knowing that most non-employer firms are self-employed individuals reporting incomes from an unknown source irrespective of whether or not they hold a job, it appears the suspicion that they could shed light on the rise of the gig-economy. At this point, the research question that needs to be addressed is how to provide evidence that non-employer statistics is a suitable piece of data to compensate the scarcity of information on alternative work arrangements that represent the sole available element on labor supply in the gig-economy.

My first assumption states that non-employer firms can be used as a proxy for alternative work arrangements. In order to verify this assumption, I draw up the following hypothesis followed by the corresponding null hypothesis.

> H1: Non-employer firms increase more in states/sectors where the increase is largest in alternative work data from 2015 Katz and Krueger compared to CPS CWS data from 2005.
>
> H0: There is no increase in non-employer firms in states/sectors where alternative work arrangements' increase is the largest.

Before any further research utilizing non-employer statistics is carried out on the impact of the gig-economy, the question that one shall pose is how can be shown that the data is relevant and to what extent is it impacting gig-work. This is why the next essential part of this work is to test the relevance of non-employer firms for the gig-economy by assessing the effect of Uber as a practical example of an online gig-platform, which at the same time shall estimate the magnitude of impact on local labor markets. My assumption is that non-employer firms are a relevant proxy for alternative work arrangements and an integrated part of the gig-economy affected by the emergence of online labor-platforms.

> H1: Non-employer firms increase more in metropolitan statistical areas or counties where Uber enters the market.
>
> H0: There is no increase in non-employer firms after Uber's market entry

Having verified the relevance of non-employer firms as a proxy for alternative work arrangements and given evidence of alignment with other research, I would like to take advantage of this data to analyze the impact of the change in non-employer firms on labor market supply in the gig-economy.

My third presumption is that the gig-economy is cannibalizing jobs within same industries or within same states, which I wish to verify by testing the following hypothesis.

> H1: The change in non-employer firms from the taxi industry is different from the change in non-employer firms from other industries after Uber comes into the market.
>
> H0: The change in non-employer firms from the taxi industry is comparable to the change in other industries after Uber enters the market.

Finally, I expect the gig-economy to contribute to a decline in unemployment and not to take away jobs from employer firms. This can be investigated with the hypothesis stated below.

> H1: The change in non-employer firms varies with the levels and changes in unemployment.
>
> H0: The change in the share of non-employer firms has no effect on the unemployment rate

Testing these sets of hypotheses will help understand the role of non-employer firms as an integrated part of the gig-economy and the impact of online labor-platforms on labor market activity on geographical and industry specific levels.

2. Setting: The Rise of the Gig-Economy and Implications for U.S. Labor Markets

As indicated in the introduction, this thesis' setting addresses the labor implications of the so-called gig-economy also known as the sharing economy, the collaborative economy or the on-demand economy.[11] As it is often not clear what these terms refer to and what forms of working activities and entanglements are induced by this fairly new economic phenomenon, the following chapter has the major objective to put all relevant implications of labor activities into perspective of the gig-economy and demarcate the scope of this work.

2.1. The Online Platform Economy or the Gig-Economy?

Online platforms allow people to work and make money through the intermediary of a digital service handling issues such as customer matching and payment resolution. Despite

[11] Cf. De Stefano (2016); Kessler (2015); Katz and Krueger (2016a).

outward similarities in how these services look and operate, they encompass a wide range of behaviors and characteristics. A young professional who occasionally smoothens his income by renting out his apartment on Airbnb is much different from a blue-collar who works for a ride-hailing service in between other obligations. And each of these examples is in turn vastly different from sites like Addeco that connects businesses with highly skilled freelance workers or eBay that offers an online-market for goods.[12] Ultimately, a clear distinction between online platform economy and gig-economy is necessary. An overview of selected online platforms is tabulated in appendix Table 1.

The online platform economy encompasses all economic activities involving an online intermediary that provides a platform by which independent workers or sellers can sell discrete services or goods to customers and facilitates peer-to-peer transactions.[13] The literature distinguishes two subareas of the online platform economy.[14] The first is characterized by capital platforms, such as eBay or Airbnb, which connect customers with individuals who rent assets or sell goods peer-to-peer. And the second subarea, which is understood as the gig-economy, is marked by labor platforms, such as Uber or TaskRabbit, connecting customers with freelance or contingent workers who perform discrete projects or assignments. This definition of labor platforms is consistent with the definition asserted by Harris and Krueger (2015) and the McKinsey Global Institute (2016), which describes the gig-economy "as an online marketplace for contingent work in which online platforms facilitate the sale of personal tasks".[15]

The gig-economy is understood to include two types of work: "crowdwork" and "on-demand work".[16] Crowdwork is defined as work executed through the internet, connecting customers and workers, which both can either be organizations or individuals, on a global basis. It is also referred to as online labor markets (OLMs), which allow the remote delivery of electronically transmittable services such as the development of a website, the creation of a logo or various other tasks that can be crowdsourced.[17] In on-demand work, jobs are assigned through a mobile application and are related to more traditional low skilled work activities such as transport, cleaning, or delivery. It is referred to as mobile labor markets (MLMs), where the matching and transaction processes are digital but the delivery of the services is physical and requires direct local interaction. One of the major differences among these two areas of the gig-economy is that crowdwork jobs can be executed anywhere in the world while on-demand work matches online supply and demand that are executed locally.[18] Accordingly, considering these two parts together in a common analysis can be perilous. Because the study object of this work implicates only local level labor market, the part of the gig-economy related to crowdwork is excluded.

The distinction between the gig-economy and sharing economy is that a gig-economy can encompass work that has nothing to do with digital applications or intermediary platforms, while the sharing economy exists within the virtual world. For example, a worker who holds several part-time jobs – possibly offering driving services through a digital application, working at a coffee shop, and playing in a band – is participating in the gig-economy but not necessarily in the sharing economy.[19] They would be considered as participating in the sharing economy if any of these gigs were facilitated by a digital application provided by an intermediary platform.[20]

2.2. Worker Classification and Labor Markets in the Gig-Economy

By definition, individuals earning money through online labor-platforms such as Uber are not employees of those companies and are not listed on official forms. The lines between employment classifications in the gig-economy are very blurry. In order to analyze its implications thoroughly, I must first settle on the definitions of gig workers and other types of independent workers.

At the highest level of classification, the Bureau of Labor Statistics (BLS) lumps non-traditional workers under the banner of contingent work which enclose all those who do not expect their current job to last, i.e. those who work on an non-permanent or temporary basis and those who have alternative work arrangements, i.e. those who do not have an implicit or explicit contract for ongoing employment.[21] Additionally, the BLS includes the following as alternative employment arrangements: workers employed by a temporary help agency, by a contract company, on-call workers, freelancers or independent contractors. An employment arrangement may be defined as both contingent and alternative, but this is not automatically the case because contingency is defined separately from the four alternative work arrangements. Independent contractors are individuals who report they obtain customers on their own to provide a product or service as a contractor, independent consultant or freelancer.[22] On-call workers report having certain days or hours in which they are not at work but on standby until called to work. Temporary help agency workers and contract firms workers are paid by help agencies and contract firms.

Other studies use broader definitions, like a 2015 paper published by the U.S. Government Accountability Office that included both self-employed individuals not included in

[12] Cf. Telles (2016).
[13] Cf. Becker & Rajwani (2016).
[14] Cf. Harris and Krueger (2015); McKinsey Global Institute (2016).
[15] This definition is used by Farrell and Greig (2016).
[16] Cf. De Stefano (2016).
[17] Cf. Codagnone et al. (2016).
[18] For more details on the dissimilarities and other features of the sub-areas of the gig-economy see De Stefano (2016).
[19] Cf. Becker & Rajwani (2016).
[20] Cf. Farrell and Greig (2016).
[21] Cf. Bureau of Labor Statistics (2005).
[22] Independent contractors and freelancers are synonyms. While the term independent contractor would be used to designate the tax and employment class of this type of worker, the term freelancing is most common in culture and creative industries.

the BLS surveys and part-time workers. The OECD refers to non-standard work (NSW), which excludes full-time permanent employment and includes self-employed, temporary and part-time workers.[23] Still other studies have included those people who utilize contingent work and freelancing to supplement their income from regular employment. This is a broader definition that indicates both independent and salary work without distinguishing, which job is primary and which is secondary. [24]

Implicitly, these nontraditional workers are self-employed individuals all of which have existed long time before the rise of online service platforms. An individual is self-employed if the longest job held during the previous year was self- employment; or if the longest job held during the previous year was wage and salary and they report some self-employment income from other work.[25] They engage in a wide variety of economic activities, providing contract or consulting labor, earning non-platform-based or gig-economy income. Many earn income from both wages and self-employment work arrangement. [26]

The BLS' preferred term, contingent worker, aligns well with that definition of the gig-economy. However, it refers to temporary forms of uncontracted employment that have existed long before the emergence of online platforms. To understand how the characteristics and activities of gig-workers have changed over time, I provide a categorization of individuals with earnings from non-standard work arrangements based on the source of earnings, and whether the individual engages on online-platforms. Using these criteria, I can identify selected groups of gig-economy workers with similar characteristics (see equations below).

$$\begin{aligned}\text{Gig Worker} &= \left\{\begin{array}{c}\text{Temporary Contractors}\\ :\\ \text{Independent Contractors}\end{array}\right\} + \left\{\begin{array}{c}\text{Uber}\\ :\\ \text{TaskRabbit}\end{array}\right\} \\ &\quad + \{\text{Local Customers}\} \\ &= \begin{array}{c}\text{Alternative Work}\\ \text{Arrangement}\end{array} = \begin{array}{c}\text{Intermediary}\\ \text{Platform}\end{array} \\ \text{Gig Worker} &= \begin{array}{c}\text{Alternative Work}\\ \text{Arrangement}\end{array} + \begin{array}{c}\text{Intermediary}\\ \text{Platform}\end{array} + \begin{array}{c}\text{Local}\\ \text{Customers}\end{array}\end{aligned}$$

A different category of workers, which have not yet been often contemplated with regards to the gig-economy because they do not report as individual entities, is looming with similar characteristics as alternative workers. The category I refer to comprises non-employer firms. What the government calls businesses whose owners are the only employees are mostly run by one self-employed individual operating unincorporated businesses (known as proprietorships), which may or may not be the owner's principal source of income.[27] A non-employer business, as defined by the U.S. Census Bureau, is one that has no paid employees, has annual business receipts of $1,000 or more ($1 or more in the construction industries), and is subject to federal income taxes.

There is certainly a grey area between non-employer firms and gig-workers. However, both include alternative work arrangements and the majority of non-employer firms are self-employed individuals as are gig workers if not misclassified in tax reports. With this in mind it can be assumed that there may be some correlation between the two classifications of workers and the gig-economy.

2.3. Measuring the Gig-Economy

Accurate measurement of the magnitude and the growth of the gig-economy is important for understanding current labor market trends. These trends have extensive implications for the income, health insurance coverage, and retirement security of self-employed workers.[28] While self-employment offers certain advantages, workers turning away from traditional work arrangements will no longer receive substantial employee benefits, labor protections like overtime pay and minimum wages, training and skills development, and tax benefits that operate through the employee-employer relationship.[29] Hence, understanding the implications of the impact of the gig-economy on the changing workforce is an important step not only for workers wealth and benefit but also for administrations towards improving labor and tax policies.

Existing surveys and administrative data are not well suited to capture new forms of labor, and the new nature of work arrangements makes it difficult to monitor.[30] The data on the activities of self-employed is collected infrequently and is often incomplete. It is hard to clarify the sector and its meaning due to the changing nature of work, worker's rights and the controversy about legal, social and fiscal aspects of services provided via online platforms.[31] The gig-economy is fragmented as each individual works on a contract or freelance basis, and thus may use several services, have many clients and work variable hours over time without clear affiliation to a company, a sector, a tax class or social security. It also spans multiple industries. Self-employers not only encompass gig workers but also other forms of self-employed workers. Another insecurity arises from the fact that individuals reporting self-employment income in surveys also file a tax return that report employee wages.[32] In addition, some

[23] Cf. Gierten and Spiezia (2016).

[24] For a good review of non-standard and contingent work arrangements see Bernhardt (2014), Jackson et al. (2017), Abraham et al. (2016) and Gierten and Spiezia (2016).

[25] Cf. Abraham et al. (2016).

[26] Cf. Jackson et al. (2017).

[27] https://www.census.gov/epcd/non-employer/view/define.html

[28] Administrations and public agencies rely on labor market information such as employment-population ratio, multiple jobholding rate, labor market dynamism, real wages and earnings distribution, and productive inputs to improve recommendations on labor policies.

[29] These benefits include, though are not limited to, health insurance and retirement coverage, tax compliance and administration, and protections under labor, occupational safety, and discrimination laws.

[30] Cf. Fox (2014), Abraham et al. (2016); Codagnone et al. (2016).

[31] Cf. Codagnone et al. (2016).

[32] Abraham et al. (2016) show that a large share of individuals who report being an employee in response to surveys also file a tax return that reports self-employment earnings rather than wages.

workers earn income from both wages and self-employment, but do not report their self-employment status in surveys.[33]

As online platforms - the digital marketspace-providers of the gig-economy - are private companies, they are not required to disclose employee numbers, or revenue. Public institutions are not in a position to gather data. The Bureau of Labor Statistics (BLS) used to release the Contingent Work Supplement (CWS) to the Current Population Survey (CPS), which provided periodically information on contingent workers and other self-employed contractors including gig employment.[34] However, they ceased surveying contingent workers after 2005, which means that no continuous database exists on workers in the gig-economy.[35] This has resulted in a race among researchers to find the most accurate measurement of the magnitude and growth of the gig-economy to compensate the poorly or incomplete data provided by households survey and federal statistics. In 2015 Katz and Krueger updated in a similar survey to the RAND American Life Panel (ALP) the data from the CPS CWS with additional information on workers' use of online platforms in the quest for customers.[36] This work became a prominent data collecting survey specifically designed to measure alternative work arrangements relevant for the gig-economy.

Gig workers might also show up in federal statistics, in household survey responses on self-employment activity and in administrative data from tax reports to the Internal Revenue Service (IRS) and the Social Security Administration (SSA) such as the 1040 Schedule C (sole proprietorship business), the 1040 Schedule SE (self-employment), and the 1099 MISC (box 7 non-employee compensation).[37] However, most of the past research using these sources struggled to prove the adequacy of the data to measure the gig-economy.[38] Abraham et al. (2016) show discrepancy between IRS and survey data and attempt to reconcile them. Chen et al. (2017) estimate the value of flexible work from Uber data. Mas and Pallais (2017) estimate the value of flexible work from survey data. Jackson et al. (2017) uses IRS data to show that all of the increase in self-employment is due to sole proprietors who have little or no business-related educations, and who therefor appear to almost exclusively provide labor services.

As mentioned in the introduction just a few studies have considered using non-employer firms for measuring the size of the gig-economy. Hathaway and Muro (2016) show the growth and geographical spread of non-employer firms in the passanger ground transit and rooming industries.[39] In another paper published by The Future of Work Initiative, Holtz-Eakin et al. (2017) used non-employer establishment data to measure the overall growth of the gig-economy workforce. However, the insecurities in measuring the exact size of this labor pool have remained high and no evidence about the adequacy has been provided. This metric is not perfect. One reason is that non-employer firms include any self-employed person with no employees regardless of whether they earned income driving for Uber or mowing their neighbors' lawns and thereby creating a risk of misclassification. Furthermore the metric captures only those individuals who declared that income to the IRS.

2.4. The Rise of Alternative Work in the Gig-Economy

As described in the previous section, the different approaches found in literature to measure the size of the gig-economy are manifold. Some retrieve data on tax reports and other administrative information, other use statistical data captured by household surveys or company owned data, and others carry out their own surveys. While most studies provided estimations of the size of the gig-economy at one point in time, just a few were able to measure the evolution over time. Nevertheless, most of those who did estimate a trend found a considerable rise in self-employment workers or other alternative work arrangements.

The 2015 survey by Katz and Krueger (2016b) shows that the share of workers involved in alternative work arrangements increased from 10.7 % to 15.8 % from 2005 to 2015.[40] A striking implication of this estimate is that all of the net employment growth in the U.S. economy appears to have occurred in alternative work arrangements. In particular, the findings show that nearly 16 % of all workers are engaged in alternate work arrangements and that those who provide services through online intermediaries only account for 0.5 % of the total workforce. Even though, it appears that the level of individual workers using intermediary platforms to find customers is quite infinitesimal when compared to traditional contingent work, Katz and Krueger noted that the online intermediaries are growing at an impressive rate. They also discovered that alternative work arrangements increased in size in all of the four categories over the ten-year period between 2005 and 2015.[41] Independent contractors, the largest subcategory of alternative work arrangements, grew from 6.9 % to 8.4 %. The percentage of on-call workers increased from 1.7 % to 2.6 %. Workers in temporary-help agencies comprised 1.6 %, up from 0.9 % in 2005. Finally, workers at contract firms accounted for 3.3 %, an increase from a 0.6 % share.

Another study conducted in late 2015 by JP Morgan Chase Institute show that the number of individuals using

[33] Cf. Abraham et al. (2016).

[34] See chapter 3.1.

[35] Secretary of Labor Tom Perez announced in January 2016 that the Bureau of Labor Statistics (BLS) will resume the survey on contingent workers every two years starting in May 2017 including supplementary questions designed to capture technology-enabled gig work. See Donovan et al. (2016)and https://blog.dol.gov/2016/01/25/innovation-and-the-contingent-workforce.

[36] Katz and Krueger (2016a).

[37] Cf. Abraham et al. (2016).

[38] For the following see Cf. Abraham et al. (2016).; Chen et al. (2017); Mas and Pallais (2017); Jackson et al. (2017).

[39] Cf. Hathaway and Muro (2016).

[40] For the following see Katz and Krueger (2016a).

[41] For a more detailed insights into the evolution of alternative work arrangements prior to 2005 see Bureau of Labor Statistics (2005).

online labor-platforms has increase 54-fold since 2012 reaching a 0.4 % of the U.S. workforce (which is in line with Katz and Krueger's 0.5 % of the total workforce).[42] Interestingly, these individuals derive one third of their income from online platforms, and even more so when their non-platform income drops. Furthermore, the analysis estimated that 1 % actively earn income from some type of online platform in a given month and that 4 % had participated in one of these platforms over a three-year period. The findings also show that although labor platforms are growing more rapidly than capital platforms, the capital platform market is still significantly larger.

More recently, Abraham et al. (2016) has shown that estimates of self-employment from households survey and administrative data differ in both level and trend.[43] Data collected from tax reports by the IRS on self-employment are ranging between 12 % and 17 % with an upwards trend compared to a range of 6 % to 8 % and a downward trend with information gathered through household survey such as the Current Population Survey (CPS) and the American Community Survey (ACS). This discrepancy shows the importance for a more specific and adequate measure to understand changing work activities in the gig-economy.

Using non-employer statistics, Hathaway and Muro (2016) discover that over the past 20 years, the number of gig-economy workers measured with non-employer firms has increased by about 27 % more than payroll employees. The change is even more severe in certain industries, like ground transportation, where the number of gig-economy workers increased 44 % more than payroll employees. Hathaway and Muro (2016) found evidence of a change in the numbers, and the potential for a realignment of the role of non-employer firms in the gig-economy.

3. Data and Frameworks: Building Datasets and Frameworks with Non-Employer Statistics

The main analytical goal of the study is to assess the role of non-employer firms in the gig-economy by the mean of quantitative methods. This shall help to better understand the gig-economy's impact on labor markets and measure labor dynamics and other economic issues to change in the exposure to online labor-platforms. As a paradigmatic example of an online-platform, I chose the case of Uber's expansion in the U.S., which presents a quasi-natural treatment for single labor markets. To carry out this research, a comprehensive dataset is needed with historical data on gig-workers on the one hand and on the staggered entry of Uber on the other. This section details the construction of the longitudinal datasets and the econometric frameworks used in the statistical analyses of my thesis.

3.1. Data Sources and Construction of Datasets

Existing surveys and administrative data are not well suited to capture new forms of labor, and hence cannot be used to provide quantitative response.[44] The Bureau of Labor Statistics (BLS) offered the Contingent Work Supplement (CWS) to the Current Population Survey (CPS), which provided information on independent workers and other self-employed contractors including gig employment in the year 2005. This data was updated in 2015 by Katz and Krueger in a similar survey to the RAND American Life Panel (ALP). Drawing on raw data from multiple sources, I utilized data described in these subchapters in order to estimate and understand the influence of online intermediary-platforms on labor markets. My investigations rely on three types of data sources. First and foremost, administrative data which is extracted from tax reports or other declarations and made available by federal institutions such as the U.S. Census Bureau. Administrative data provides information that can help address certain shortcomings of survey-based measures, which appear to underestimate self-employment activity.[45] The second type of data source is survey data collected by government agencies such as the Bureau of Labor Statistics (BLS). And the third source stems from corporate statistics, in this case provided by Uber Technologies Inc in a statistical report. A detailed overview of all data sources can be found in appendix Table 2.

None of the raw data sets described above are in a form amenable to statistical analysis, which makes necessary purging, formatting, and recoding of the data before new variables can be defined. The raw data on non-employer firms, employer firms and alternative work arrangements, for instance, is not formatted in a one-to-one table. Indeed, some observations are tabled in form of aggregated data such as the number of established non-employer firms which are arranged on a county level, a state level and a national level in the same column. Furthermore, to be able to merge data from administrative sources and from surveys, I adapted the variables and their associated values to match within all data sets.

Unlike survey data, using administrative data, which does not ask specifically whether respondents are employees or contractors, is particularly challenging as information on individuals is limited and not as targeted. Federal institutions such as the Census Bureau doesn't publish these numbers in very user-friendly form, but I was able to get the raw data, utilizing the numbers in a beneficial manner from some other government surveys, and deliver a remarkably detailed picture of what activities the unincorporated self-employed are involved in.

3.1.1. Non-Employer Statistics

The starting point for my data construction and the key element in my primary analyses is the non-employer statistics which originates from statistical information obtained

[42] Cf. Farrell and Greig (2016).
[43] Cf. Abraham et al. (2016).
[44] Cf. Fox (2014); Jackson et al. (2017).
[45] Katz and Krueger (2016a); Abraham et al. (2016).

through business income tax records that the Internal Revenue Service (IRS) provides to the U.S. Census Bureau.[46] A non-employer firm is what the government refers to businesses whose owners are the only employees. Most are run by one self-employed individual but non-employer firms also comprise independent contractors, on-call workers, temporary help agency workers and workers provided by contract firms.

The non-employer statistics provides the only annual source of comprehensive data on the scope, nature, and activities of U.S. businesses with no paid employees at detailed industrial (NAICS codes) and geographical level (counties), which is the relevant level for labor markets.[47] The data is captured from 1999-2014 and is made available on the U:S. Census website.[48] It is worth mentioning that the comparability of the data over time may be affected by changes in industry classifications, methodology, and geographic definitions. However this issue in most part, especially given the scope of my work, is not relevant for the purposes of my research and, thus, was not addressed in the analysis.

The goal of extracting information from this source is to obtain a data set of non-employer firms by state and industry sector in the U.S. from 2005 to 2014 and use it to demonstrate the relevance of non-employer firms as a proxy for alternative work arrangements or independent work during this time span with constrained data availability.

The raw data set encompassing the number of non-employer firms was appended for the years between 1999 and 2014 and recoded in order to obtain a data set with the following variables: number of non-employer firms by state, industry, and year. I then created a state- and industry-specific identifier (state*industry) i.e. the Cartesian product of the variable state and industry, which a is an indicator variable grouping state and sector and specifying each industry sector in each state with a single and defined indicator. This indicator variable is crucial to observe and run the analyses at within single industry sectors in each state.

The different industries are characterized with the 4-digit code from North American Industry Classification System (NAICS) and are fully included in the data set. This leaves the freedom of trimming it into a 2-digit code to cluster broader industry sectors or to subtract specific industries such as the taxi and limousine industry when creating new variables and considering Uber-driver specific labor markets. Duplicate industries in manufacturing, and transportation and warehousing looming in the data set were merged together to avoid double counting.

The resulting dataset consists of 5 variables comprising the number and total sales of non-employer firms between 1999 and 2004 and 3264 observations[49] corresponding to each consolidated industry in each U.S. state. The information on non-employer establishments is the main subject of my analyses and is crucial for three steps of my research. First and foremost, it will help demonstrate its relevance as a proxy for independent workers and alternative work arrangements which represent the major piece of labor supply in the gig-economy. Secondly, this relevance will be underscored by using non-employer firms to show the impact of Uber's market entry, as an example for an intermediary gig-platform, on single metropolitan labor markets. And lastly, it will serve as a proxy for further investigations on the role of unemployment in the gig-economy and other labor economic questions.

The use of non-employer firms is a helpful proxy for self-employment and alternative work arrangements; however, as most administrative data this information is less useful for identifying the nature of work or the types of activities that people take on in self-employment.[50]

3.1.2. Current Population Survey - Contingent Workers Supplement 2005

Another key source of data relevant for analyzing changes in the labor market due to exposure to online-platforms is the Contingent Workers Supplement (CWS). This is a supplement to the Current Population Survey (CPS) which in turn is a household survey conducted periodically by the Bureau of Labor Statistics.(BLS).[51]

The CWS collects data on contingent and alternative employment arrangements and provides information on the type of employment arrangement workers have on their current job and other characteristics of the current job. Contingent workers are persons who do not expect their jobs to last or who reported that their jobs are temporary. They do not have an implicit or explicit contract for ongoing employment. Alternative employment arrangements include persons self-employed as independent contractors, on-call workers, temporary help agency workers, and workers provided by contract firms. The raw data can be downloaded from the BLS website.[52]

The BLS gets its self-employment aggregate data from a monthly survey of 60,000 American households conducted by the U.S. Census Bureau (which is the same survey that generates the unemployment rate). Respondents are asked, whether they were employed by government, by a private company, a nonprofit organization, or whether they were

[46] When the Census Bureau receives information through administrative records that a business has no paid employees, then the business becomes part of the potential non-employer universe.

[47] Non-employer statistics use 2012 NAICS code.

[48] Census (2016).

[49] From an initial raw data set of 1,737,135 observations. However caution should be exercised as the observations do not correspond to the number of non-employer firms but rather to the number of industries appended throughout all U.S. counties in which non-employer firms are counted.

[50] Specifically, the wide range of self-employed activities includes consultants, real estate agents, construction workers, housekeeping services.

[51] The Current Population Survey is a monthly survey of about 60.000 households conducted by the for the Bureau of Labor Statistics.(BLS) and the primary source of labor force statistics for the population of the United States. It provides a comprehensive body of data on the labor force, employment, unemployment, persons not in the labor force, hours of work, earnings, and other demographic and labor force characteristics.

[52] https://catalog.data.gov/dataset/current-population-survey-contingent-worker-supplement.

self-employed in the previous week.[53] In addition to contingent workers, the survey also identified those workers who have alternative work arrangements. An employment arrangement may be defined as both contingent and alternative, but this is not automatically the case because contingency is defined separately from the four alternative work arrangements (1) independent contractors, (2) on-call workers, (3) temporary help agency workers, (4) workers provided by contract firms.

The CWS is a relevant source of data in consideration of the changing nature of work and especially the gig-economy. Unfortunately the BLS has stopped collecting information on contingent and alternative work relationships in February 2005. In the absence of more recent data and in view of the rise of new labor economies the BLS has announced to resume the survey in 2017. Estimating the link between the change in non-employer firms and the rise of alternative work arrangements requires a longitudinal dataset with comparable historical information. This data from the 2005 survey on alternative work arrangements with 63,600 observations, however is cross-sectional and therefore provides only information at one point in time. This is why I built a dataset linking both CPS CWS data with the RPCWS from 2015 described in the next subsection. In order, to obtain matching information with the other sources, I recoded the industry nomenclature from Census code to NAICS code and consolidated the latter at a 2-digit level. I then merged duplicate industries occurring in the raw data to avoid divided and distorted results. In order to separately investigate the different subcategories of alternative work arrangements, I created separate variables from the respondents' responses on the number of self-employed contractor, on-call workers, contractors, and temporary workers filed by state and industry. These were consolidate into a variable yielding alternative work arrangements, which consists of all of the above.

To obtain more meaningful results, I created separate ratios for each single work arrangement mentioned above as a percentage to the total of observations by industry and state. The resulting dataset consists of eight variables reflecting ratios of work arrangements and 240 observations for each consolidated industry and in each U.S. state.

3.1.3. Rand-Princeton Contingent Worker Survey (Katz and Krueger 2015)

To fill the void created by the absence of recent data on contingent and alternative workers, Katz and Krueger have conducted the RAND-Princeton Contingent Worker Survey (RPCWS) in October and November 2015.[54] The RPCWS is a version of the BLS's CWS with additional inquiries to gather more information on work arrangements including questions on whether individuals worked through an intermediary such as Uber, Avon or TaskRabbit and whether they sold goods or services.[55] The sample was collected randomly using a compilation of methods and has been aligned to the CPS through a set of survey weights.[56] The survey weights account for the fact that self-employed workers were over-represented in the RPCWS compared to the CPS CWS. I made use of this weighted dataset which has been made available for federal institutions and accredited researchers on the ALP website since November 2016.[57]

This survey being a sequel of the CPS CWS, makes it an essential source of data for further research on alternative work arrangements. It provides a second set of data points in the year 2015 which will allow the observation of change in time and a comparison with the change of non-employer firms in the 10 years period between 2005 and 2015. This cross sectional data collected through random sampling in a national survey consists of 2,760 observations of individual workers restricted to those who did any work during the week prior to the survey.

To turn this raw data into valuable and ordered information, I proceeded analogous to the construction of the CPS CWS dataset, i.e. transforming survey data on individual workers into ratios of the different subcategories of work arrangements to total observations by industry and state obtaining 141 observations and 8 variables. Having a set of variables reflecting the same information (the ratios of work arrangements to total employed by industry and state) in 2015 as ten years earlier with the CPS CWS data, I merged both datasets adding up the number of observations to 315. I then, generated the indicator variable "state*industry", grouping state and sector into a single state- and industry identifier, as executed with the non-employer firms data. As a next step, I computed the change in share of alternative workers between 2005 and 2015 by state*industry for each subcategory respectively. With this, I have an identical observation variable and longitudinal data in both the dataset on non-employer firms and the one on alternative workers allowing me to make comparisons in change over time and across industries and states. If I can provide the evidence that the increase in non-employer firms between 2005 and 2015 is strongest in states and industries where it is strongest in alternative work arrangements, I will be able to show that non-employer firms are a good proxy for alternative workers and validate my assumption.

3.1.4. County Business Patterns

Using proportions in science, economics, and business as well as in other disciplines makes results more meaningful

[53] Cf. Fox (2014).

[54] Cf. Katz and Krueger (2016a).

[55] A copy of the questionnaire is available online and can be downloaded from https://alpdata.rand.org/index.php?page=data&p=showsurvey&syid=441

[56] The RPCWS sample is described here: https://alpdata.rand.org/index.php?page=panelcomposition and weighting procedures are described at: https://alpdata.rand.org/index.php?page=weights. See Katz and Krueger (2016a) for more details on the robustness of the survey.

[57] https://www.census.gov/data/datasets/2015/econ/cbp/2015-cbp.html

as they offer more information than simple numbers and put the given information into perspective. In order to interpret results in a relative context but also to weight disproportional data and align it with previous work, it is essential to include further information on employer firms.

The County Business Patterns (CBP) is an annual series that provides subnational economic data by industry including the number of establishments with paid employees. The data items are extracted from the Business Register (BR), a database of all known single and multi-establishment employer companies maintained and updated by the U.S. Census Bureau. CBP covers more than 6 million single-unit establishments and 1.8 million multi-unit establishments.

Employer firms provided with the CBP needs to be included to balance out disproportions in non-employer firms and alternative work arrangements and to adjust the change for other trends in the labor market. It also allows to carry out regressions with ratios and relative numbers of employment characteristics and provide comparable results. In terms of dataset construction, I firstly appended the raw data encompassing the number of non-employer firms for each year between 1999 and 2014 and kept industry information on a 2-digit NAICS code level to maintain an adequate degree of clarity. Some industry values appearing twice were merged to avoid duplicates; NAICS code 31, 32, and 33 were merged as "manufacturing", 44 and 45 merged to "retail trade", and 48 and 49 to "Transportation and Warehousing". To focus on the relevant sectors for the gig-economy and put aside industries such as agriculture, mining, utilities, and construction which are not relevant or not element of the contingent workers survey, I also consolidated the industries "manufacturing = 1", "retail and wholesale trade = 2" and "Services[58] = 3". As a result, I obtain a dataset of all U.S. establishments with paid employees by state, industry and year which enables me to generate new variables and apply weights on the regression estimates.

3.1.5. Uber Statistics Report

As a key part of my analysis, I use the case of Uber's expansion in the U.S. to test if and to what extent non-employer firms are relevant in the gig-economy and to estimate the impact of online platforms on labor markets. Founded in 2009, Uber is a mobile smartphone application that allows consumers to submit a trip request, which is then routed to Uber drivers who use their own cars to fulfill the request. In this work I refer to UberX, which is Uber's low-cost ride-hailing option and the first service offered when expanding into new areas. Estimating the link between the exposure of non-employer firms to online-platforms, requires a longitudinal dataset with information on the time and place of Uber's market entry. Data on Uber's expansion by city are retrieved directly from a statistics report made public in 2016.[59] The data collected from the corporate owned website uber.com shows the launching of Uber's activity by city over the years since the first launch of their service UberX in San Francisco in 2010. The staggered entry of UberX in different Metropolitan Statistical Areas (MSA's) in the U.S. offers a quasi-natural experiment to instrument for local labor market's exposure to online platform, and study their impact not only on employment across sectors as in this work but other economic patterns.

Uber's data is not entirely precise, i.e. it is not clear what counties or geographical areas are included in the designated cities. Non-employer firms are not necessarily located in the city where they operate, i.e. an Uber driver can provide his or her service in the designated city but live in the nearby county.

In order to investigate the overall impact of Uber's entry and rule out the difference in years it is necessary to singularize the time of market entry into a unified scale variable. For the purpose of unifying Uber's market entry across the country, I converted the data relative to the year of launch in each respective city. This converted scale characterizes the year of entry with "year 0", the years prior to entry with the respective difference i.e. "year -1", "year -2", and the years following Uber's market entry with "year 1", "year 2".

The variables post and pre are dichotomous treatment variables indicating each relative year of Uber's entry in a given county. Consistent with prior studies examining the effect of Uber's entry on a local area, I focus on UberX, as opposed to other service, due to the significantly larger network of drivers.[60] As a next step, I generated a binary variable specifying whether Uber was present in a city (valued as "1") or not (valued as "0") to distinguish market places with Uber treatment from those without. I then associated the city with the county codes of the according metropolitan area which reflects adequately the commuting zone level of labor markets. This poses challenges in two cities, where the metropolitan area is not congruent with the county area from the administrative datasets.[61] The revised dataset containing Uber's year of entry by metropolitan area with the according counties was merged with non-employer firms and employer firms (CBP) data. For the purpose of matching employer firms and non-employer firms operating within the same industry as Uber-drivers, I created a respective variable subtracting all firms that are not assigned to the industry of "Taxi and Limousine Service" classified with the NAICS code

[58] The pool "services" comprises all of the following trades which are identified with a specific NAICS code "Transportation and Warehousing", "Information", "Finance and Insurance", "Real Estate and Rental and Leasing", "Professional Scientific, and Technical Services", "Management of Companies and Enterprises", "Admin, Support, Waste Management, and Remediation Services", "Educational Services", "Health Care and Social Assistance", "Arts, Entertainment, and Recreation", "Accommodation and Food Services", "Other Services and Public Administration".

[59] Cf. Uber (2016); Burtch et al. (2016).

[60] Cf. Burtch et al. (2016); Greenwood and Wattal (2017).

[61] While some cities illustrated in the data are distinctively distinguishable, others like Twin Cities and Rockies are not. Twin Cities is referring to the metropolitan area built around the cities of Minneapolis and Saint Paul. The designation "Rockies, CO" couldn't be associated to any county and was left out of the data.

"4853" and "Other Transit and Ground Passenger Transportation" classified with the NAICS code "4859". These two industry descriptions are assumed to be the most relevant for ride-hailing work enabled by Uber. Once having created this set of variables with firms and independent workers within the latter industries I refer to as the taxi or the Uber industry, I generated three new ratio variables; the first being the share of taxi-non-employer firms to all taxi employees, the second variable describes the taxi-non-employer firms as a share of all employees, and the last one indicates the share of non-employer firms to all firms. Similarly to the above mentioned unification of the differences in years, created a lagged variable of each of these ratios and a lagged logarithmic variable for the number of all employees which is supposed to respond to large difference in values in comparison to the other variables. For additional investigations, I created a pre entry and post entry variable aggregating all values before and after Uber's treatment of the economy. The dataset now consists of variables with values for the 3 years prior to Uber's market entry and the 4 years post market entry.

The final analysis dataset for the investigation on Uber's impact on non-employer firms contains 42.095 observations for each point in time between the years 2002 and 2014 and throughout states and counties with 14 variables on the number of employer and non-employer firms inside the taxi and ground passenger industry respectively. With this, I can carry out the analysis on the role of non-employer firms in the gig-economy and the impact of gig platforms on labor markets.

3.1.6. Local Area Unemployment Statistics

An important concern that stems from the rise of the gig-economy is whether online platforms have had a positive impact on unemployment. In order to investigate that question, I utilize unemployment data from federal statistics. The Local Area Unemployment Statistics (LAUS) program provides annual average estimates of labor force, employment, unemployment, and the unemployment rate for about 7,500 subnational areas. The concepts and definitions used by the LAUS program are the same as those used in the Current Population Survey (CPS). The areas include Census regions such as states, metropolitan areas, combined areas, small labor market areas, and counties.[62]

These estimates are key indicators of local economic conditions and are used by various federal programs to help determine the distribution of funds to be allocated to each eligible area. In the context of my work, I will use the data to investigate the change in unemployment associated with the rise of non-employer firms to understand the impact of online gig-platforms on labor force. The raw data is composed of three main variables: the number of employed individuals, unemployed individuals and the labor force by FIPS code and year. Based on these variables, I computed the unemployment rate. Unfortunately, the data doesn't contain information on unemployment across different industries which limits the possibilities of investigations.

3.2. Analysis Data, Specifications and Variable Definitions

The outcome of the data construction described in the previous chapter is a set of six separate panel data that can be merged into several constellations depending on the intended research application.[63] Based on these constructed sets, I created four new analysis datasets, each of them with a precise sequential purpose within my research approach. A summary of the final analysis datasets and their containing variables, which are created with data management techniques, is tabled in appendix Table 3.

The first set of panel data contains information on non-employer firms, alternative work arrangements from CPS CWS and RPCWS, and on employer firms sorted by state, industry, and years for 2005 and 2015. It aims at testing my first hypotheses - that non-employer firms increase more in states and industries where the increase is highest in alternative work - by estimating the correlation between non-employer firms and alternative work arrangements, and thereby filling the void of data shortage on self-employed and alternative workers between 2005 and 2015.

The second set of panel data comprises the staggered entry of Uber and the number of non-employer firms and employer firms sorted by county, industry, and year for the period between 2006 and 2014. This time frame not only allows investigating the effect of Uber in the years after its market entry in 2010 but also the prevailing conditions in the labor market 4 years prior to its launch. Showing the association between the rise of non-employer firms and Uber's expansion will help test my second hypothesis that non-employer firms are a relevant proxy for alternative work in the gig-economy and help estimate the magnitude of the gig-economy's impact on labor markets.

The objective of the third set of panel data is to understand the growth decomposition of non-employer firms, which can explain the dependence of the rise in non-employer firms on industry and labor supply dynamics. It is formed by merging non-employer firms and employer firms around a cluster of 23 industries sorted by state and years. With this dataset I aim to show that the gig-economy is cannibalizing jobs within same industries and within same states causing little to no spillover.

My last analysis dataset consists of a set of variables on unemployment, employer and non-employer firms, as well as time variables on Uber's local market entry sorted by county and year. The main purpose of this longitudinal dataset is to test my assumption that the rise of non-employer firms and thereby the gig-economy is contributing to a decline in unemployment and not taking away jobs from employer firms.

[62] LAUS data can be downloaded online: https://www.bls.gov/lau/data.htm.

[63] Panel data (also known as longitudinal or cross-sectional time-series data) is a dataset in which the behavior of entities are observed across time. Panel data allows to control for variables you cannot observe or measure like variables that change over time but not across entities. This is, it accounts for individual heterogeneity.

It also aims to assess the impact of the gig-economy on unemployment or vice-versa.

In all of the above datasets, I generated different types of variables such as observation variables, indicator variables, control variables, and dummy variables that are essential in the estimations described hereafter. For the purpose of putting non-employer firms in perspective to the entirety of employees, I created the variable non-employer share (NonempShare) which is defined as the ratio of the total number of non-employer firms to the total employment (sum of non-employer firms and employees) by each state and industry in a given year (in short: non-employer firms as a percent of all employees).

$$\text{NonempShare} = \frac{\text{Nonempfirms}}{\text{Nonempfirms} + \text{Employees}}$$

Considering this ratio enables the observation variable to be adjusted to externalities and global fluctuations in the labor market and makes non-employer share the key variable of my analysis.

I then created the variable state*industry i.e. the Cartesian product of the variable state and industry, which is an indicator variable grouping state and sector and specifying each industry sector in each state with a single and defined indicator. This indicator variable is crucial to observe and run the analyses within single industry sectors in each state. The share of alternative work arrangements computed with CPS and RPCWS data determines the ratio of alternative work arrangements to total employers. The share of non-employer firms is now computed as the number of establishments with no employees to the sum of non-employer firms and employer firms from the CBP data by state*industry from the Census data. The change of both ratios can now be determined by means of a lagged variable. The difference in the 10-year lagged variable and the corresponding ratio provides the change in share of non-employer firms.

In order to itemize my analysis, I also created different variants and different subcategories of non-employer share such as the share in alternative work arrangements, in self-employed contractors, in on-call workers, and in temporary agency workers. The breakdown of alternative work arrangements into its different subgroups for a separate estimation aims to answer the question which subgroup has the greater effect on the dependent variable.

The variables have been standardized so that the variances of dependent and independent variables are equal to 1. Therefore, standardized coefficients refer to how many standard deviations a dependent variable will change, per standard deviation increase in the predictor variable. For univariate regression, the absolute value of the standardized coefficient equals the correlation coefficient. Standardization of the coefficient is usually done to answer the question which of the independent variables has a greater effect on the dependent variable.[64]

[64] Cf. Allen (1997).

3.3. Econometric Frameworks

Each step of the analysis uses state-of-the-art econometric frameworks to test the hypotheses on the relevance of non-employer statistics for independent work in the gig-economy. My focus in the first step is on showing the correlation between non-employer statistics and alternative work arrangements (and self-employed contractors) which should indicate the suitability of the number of non-employer firms as a proxy for the extent of independent work. The second part of the analysis aims to underscore that hypothesis and, with a natural experiment, measure the magnitude of impact of Uber's staggered market entry in U.S. metropolitan statistical areas (MSA) on non-employer firms. In a third step, I decompose the change in non-employer firm prevalence between and within state and industry sector to estimate the impact the rise of independent workers on labor dynamics. Furthermore, to identify whether the rise of the gig-economy is driven by the availability of unemployed workers and thus new job allocation, I measure the correlation of unemployment dynamics and non-employer firm prevalence. This analysis addresses the proposition that by lowering barriers to entry in certain sectors, platforms allow people to work when they would otherwise be unemployed, thereby enabling them to smooth income.

3.3.1. Correlation between growth in non-employer firm prevalence and growth in alternative work

Starting with the first set of regressions I aim to measure the correlation between the change in non-employer firm prevalence and the change in alternative work arrangements captured by Katz and Krueger in the 2015 Rand-Princeton Contingent Work Survey (RPCWS) compared to the 2005 CPS. While many approaches in the research literature are applied to address the problem of the shortage of information on gig workers, just a few have considered using the number of non-employer firms to illustrate the labor effects of this new economy. The prior analyses cannot leverage the relevance of this data for filling the information gap between 2005 and 2015. Thus, the first part of my analysis is to show the relevance of non-employer firms as a proxy for independent workers.

Here, I use ordinary least squares (OLS) regression. The first set of regressions employ a panel dataset suitable for multivariate modeling (with and without fixed effects). The variables in question are by their standard deviation by year to equalize the range of data variability.[65] This is important for multivariate analysis and makes it easier to read and compare results from the regression ensuring that all variables are on the same scale.[66]

In the first model, the dependent variable is the ratio of non-employer firms to total employees, referred as to non-employer share (cf. chapter 3.2). I introduce a weight on the

[65] The standardization applies to the share and the difference in the following three variables: alternative workers, non-employer firms, and self-employed contractors.

[66] Cf. Stock and Watson (2006).

total number of employees to balance for the disproportionate representation of the survey data and to be consistent with the prior research literature. This analytical weight is also applied to make statistics computed from the data more representative of the population since the datasets are built on administrative and survey data and to take into account that the outcome is an aggregated share. To check the robustness of the results I ran all the following regressions both with and without the weights.[67]

The dependent variable is likely to be related to both current and lagged values of the independent variable that might change over time. Thus, using fixed-effects (FE) models on my panel data is appropriate in this setting because it is necessary to control for all time-invariant differences, so the estimated coefficients of the models cannot be biased because of omitted variables.[68] However, to stay prudent I ran the regressions with and without the fixed effects to verify the magnitude of the effect. Fixed effects are employed to take out heterogeneity among the states and to detrend all variables in time.

The econometric framework assuming correlation between non-employer share and labor force share engaged in alternative work by Katz and Krueger and CPS data is regression estimated as follows:

$$(NonempShare)_{s,j,t} = \beta_0^* + \beta_1^* X_{s,j,t} + \alpha_{s,j} + \gamma_t + \epsilon_{s,j,t} \quad (1)$$

where $(NonempShare)_{j,t}$ is the standardized dependent variable observed in time t (2005 or 2015) at the state*industry level j which in the model groups the variable industry and state into the single dimension state*industry.[69] This framework is applied to a set of individual regressions that are executed with a variation of fixed effects and weights and with two different variables separately. In one set of regressions the independent variable $X_{j,t}$ is defined as the share of alternative work arrangements $(AltWorkShare)_{j,t}$ and in the second set as the share of self-employed contractors $(SelfEmpShare)_{j,t}$. α_j are unobserved individual fixed effects[70] that help remove the bias caused by omitted time-invariant variables such as state and state*industry which are applied separately. γ_t represents time-period (yearly) fixed effects which is included in all regressions. β_0^* is the intersect, β_1^* the standardized regression coefficient, and $\epsilon_{j,t}$ is the standard error, which in this case equals the standard deviation of the sampling distribution of the coefficient.[71] The model uses robust standard errors, also known as White errors, to correct for biases introduced by heteroskedasticity.[72] For the model-based interpretation, we must assume that $X_{j,t}$ and $\epsilon_{j,t}$ are uncorrelated ($E[X_{j,t}|\epsilon_{j,t}] = 0$) As the independent variable in the above regression equation, I employ, first, the labor force share of alternative workers and, second, the share of self-employed contractors. Self-employed contractors are a large subset of alternative workers. The described framework is a regression that by analogy estimates for the same dependent variable the individual effect of both the share in alternative workers and the share in self-employed contractors as a major subset of alternative workers. The latter measures the effect of the share of workers who claim to be self-employed in the CPS and Katz-Krueger surveys on the prevalence of non-employer firms in a state*industry. This multivariate framework allows variations in the regression models on weights and fixed effects in order to check the robustness of the analysis.

The last set of regressions aim to show that non-employer firms can be used as a proxy for the extent of independent work. They estimate the relationship between the change in non-employer share from 2005 to 2015 and the change in the number of alternative workers, as well as the change in the number of self-employed contractors in that same time period. This framework addresses my first hypothesis, that the number of non-employer firms increases more in states and sectors where the increase is largest in the 2015 Katz and Krueger data compared to the outcome data from the 2005 Contingent Work Supplement. The corresponding linear regression with fixed effects is modelled as follows:

$$(\Delta NonempShare)_{s,t} = \beta_0^* + \beta_1^* X_{s,t} + \alpha_s + \gamma_t + \epsilon_{s,t} \quad (2)$$

where the independent variable $(\Delta NonempShare)_{s,t}$ is the difference in non-employment share between 2005 and 2015, the dependent variable $X_{s,t}$ is, in one case, the difference in alternative workers from 2005 to 2015 $(\Delta AltWorkShare)_{s,t}$ and, in the other case, the difference in self-employed contractors $(\Delta SelpEmpShare)_{s,t}$ in that same timeframe. Both sets of regressions are estimated with and without a fixed effect α_s for state s and with a time fixed effect γ_t.

A subset of additional analyses have been carried out on other categories of alternative work arrangements such as on-call workers, temporary agency workers, and contractors. The underlying frameworks are not further specified since these categories of workers are not relevant for the scope of my work.

[67] Weights on the number of employees are only included in the model whenever fixed effects of state*industry are applied.

[68] When using FE, I assume that something within the industry or state*industry may impact or bias the outcome variables and it is necessary to control for this. FE remove the effect of those time-invariant characteristics so I can assess the net effect of the independent on the outcome variable.

[69] The state*industry variable is a Cartesian product of the variable state and industry which serves as an identification variable giving each industry in each state an specific value.

[70] Characteristics of state and industry that do not change over time.

[71] In order to avoid confusion, the standardized regression coefficients are denoted with an asterisk in order to distinguish them from unstandardized coefficients.

[72] The traditional approach would be to test for the presence of heteroscedasticity using, for example, White's test. If heteroscedasticity is found then one would report robust SE, usually White SE which has become common practice in economics. Robust SE are typically larger than non-robust standard errors, so the practice can be viewed as an effort to be conservative. See http://www.anderson.ucla.edu/faculty/jason.snyder/the-intuition-of-robust and Dougherty (2011).

3.3.2. Pre and post effects of Uber's market entry on non-employer share

Aiming to understand the effects that online intermediary platforms have on independent work and test the relevance of non-employer firms for measuring the gig-economy's impact on labor markets, I developed a set of econometric frameworks that uses the example of Uber's staggered market entry in the U.S. These frameworks address the underlying hypothesis that non-employer firm prevalence increases more in counties where Uber comes in.

The primary econometric specification I employ is a multi-site entry differences-in-differences (DID) relative time model. Intuitively, this regression model allows to conduct a quasi-natural experiment using secondary data since the treatment, i.e. the entry of Uber X, is applied in different locations at different times, in plausibly exogenous manner. The strategy behind the DID method amounts to comparing the change in non-employer firms before and after the entry of Uber in counties where Uber is providing services and other counties where not.[73]

The longitudinal nature of the data allows me to examine the existence of pre-treatment trends in non-employer firms activity. This data structure further enables to include location (county) and time (relative years) fixed effects, which effectively control for static heterogeneity across counties, as well as any unobserved temporal trends (e.g. seasonality) or shocks (e.g. change in regulations). Acknowledging that correlations between independent variables and residuals exists, I clustered counties making the estimate of the standard error more conservative. I employ a relative time model, as opposed to a traditional DID estimation, because it enables to evaluate the parallel trends assumption. The key assumption of the DID estimation is that there is no pre-treatment heterogeneity in the trends of treated and untreated groups. If trends in the dependent variable differ across the two groups, this presents a problem, as it implies that the untreated group cannot serve as a valid control, i.e. reflection of what would have happened in the absence of treatment. Extensively used in literature, this estimation incorporates a second set of time dummies that indicate the chronological distance between an observation period t, and a timing of treatment in county c.[74] Thus, this approach not only allows to ensure that there is no pretreatment heterogeneity (in trends) between the treated and untreated counties, it also helps determine how long it takes for significant effects to manifest following treatment. The econometric framework measuring the effect of Uber's market entry on non-employer firms is a DID regression estimated as stated below which was run both with post-treatment control variables and without

$$\begin{aligned} Y_{c,t} = \beta_0 &+ \beta_1 (Post)_{c,t} + \beta_2 (Post * 2010NonEmpShare)_{c,t} \\ &+ \beta_3 (Post * EmpGrowth0610)_{c,t} \\ &+ \beta_4 (Post * NonEmpGrowth0610)_{c,t} \\ &+ \alpha_c + \gamma_t + \epsilon_{c,t} \end{aligned} \tag{3}$$

where the dependent variable $Y_{c,t}$ is the share of taxi non-employer firms in all taxi employees in county c and time t; $(Post)_{c,t}$ is a post-treatment dummy which is equal to "1" if the observation is in a county where Uber is active and "0" if not; and where the post treatment control variables 2010NonEmpShare are the share of non-employer firms in 2010; EmpGrowth0610 the logarithm of the employment growth from 2006 to 2010; and NonEmpGrowth0610 the logarithm of the non-employer firm growth from 2006 to 2010. These treatment dummy variables have the beneficial effect of controlling for the change in employment that is unrelated to Uber's entry in the economic model. α_c is the county fixed effect, γ_t is the time fixed effect, $\epsilon_{c,t}$ is the error term, and β_0 to β_4 are the regression coefficients.

To gain more insight in the way non-employer firms have been affected by Uber in single years before and after their market entry, I developed a second difference-in-differences (DID) regression model. The underlying economic frameworks assuming pre- and post-effects of Uber's market entry is a difference-in-differences regression estimated as follows:

$$\begin{aligned} Y_{c,t} = \beta_0 &+ \sum_{t=-3}^{t=-1} \beta_{t+4} (Pre)_{c,t} + \sum_{t=0}^{t=4} \beta_{t+4} (Post)_{c,t} \\ &+ \beta_2 (Post * 2010NonEmpShare)_{c,t} \\ &+ \beta_3 (Post * EmpGrowth0610)_{c,t} \\ &+ \beta_4 (Post * NonEmpGrowth0610)_{c,t} \\ &+ \alpha_c + \gamma_t + \epsilon_{c,t} \end{aligned} \tag{4}$$

where all variables and subscripts remain the same as in the previous framework except for the treatment dummy which is now divided into a pre-treatment dummy–equal to "1" if the observation is prior to Uber's entry in counties Uber has later entered and to "0" otherwise –and a post-treatment dummy, equal to "1" if the observation is after Uber has entered a county and equal to "0" otherwise. This estimation was carried out both with and without post-treatment effects.

To ensure comparability of the pre- and post-entry effects and investigate more dependent variables, I build two sets of regressions where I add control variables to the regressions in order to adjust the regression for the staggered market entry of Uber and consider effects in the change in number of CBP employees.[75] These control variables also ensure that the co-

[73] Cf. Waldiger (2015); Card and Krueger (1994).

[74] Cf. Autor (2003); Bapna et al. (2015); Chan and Ghose (2014); Greenwood and Wattal (2017); Burtch et al. (2016)

[75] Controlling for a variable is the attempt to reduce the effect of confounding variables (correlated to the dependent and the independent variable) by holding these variables constant for calculations made about the effect of the independent variable on the dependent variable.

efficients on the variables of interest do not suffer from omitted variable bias (OVB).[76] Thus, once conditioned on control variables, the regressing variables and the error term are which uncorrelated which secures unbiased coefficients of regression. This helps ensure the regression coefficient can be interpreted as the best estimate of Uber's impact.

For this purpose, I ran two separate DID regressions with three different dependent variables, estimating the following equations:

$$\begin{aligned} Y_{j,c,t} =& \beta_0 + \beta_1 (Post)_{j,c,t} \\ &+ \beta_2 (Post * 2010CountyEmp)_{j,c,t} \\ &+ \beta_3 (Post * EmpGrowth0610)_{j=1,c,t} \\ &+ \alpha_{j,c} + \gamma_{j,t} + \epsilon_{j,c,t} \end{aligned} \tag{5}$$

$$\begin{aligned} Y_{j,c,t} =& \beta_0 + \sum_{t=-3}^{t=-1} \beta_{t+4} (Pre)_{j,c,t} + \sum_{t=0}^{t=4} \beta_{t+4} (Post)_{j,c,t} \\ &+ \beta_2 (Post * 2010CountyEmp)_{j,c,t} \\ &+ \beta_3 (Post * EmpGrowth0610)_{J=1,c,t} \\ &+ \alpha_{j,c} + \gamma_{j,t} + \epsilon_{j,c,t} \end{aligned}$$

$$\text{with } Y_{j,c,t} = \begin{cases} \text{j=1: share of taxi non-empl. firms to all taxi employees} \\ \text{j=2: share of taxi non-employer firms to all firms} \\ \text{j=3: share of non-employer firms to all firms} \end{cases} \tag{6}$$

where the independent variables $(Pre)_{j,c,t}$ and $(Post)_{j,c,t}$ are time dummies with the value of "1" if the observation is before/after Uber's entry and "0" otherwise, and the post treatment control variables $(Post * 2010CountyEmp)_{j,c,t}$ and $(Post * EmpGrowth0610)_{j,c,t}$ are controlling for the change in employment.[77]

By analogy to the previous frameworks, α_c represents county fixed effects γ_t year fixed effects. The unobserved time-invariant differences between pre and post variables being correlated with the independent variables makes the fixed effects model for county and year a prudent choice. This last set of DID regression models was also performed on a more detailed industry breakdown of the dependent variables distinguishing between shares in the taxi and limousine service industry (NAICS 4853) and shares in the ground transportation service industry (NAICS 4859).

Inserting a proxy for independent work such as non-employer firm prevalence in the regression remains just a proxy and just one variable. There is still some heterogeneity between treatment and control groups that is captured by the error term and is correlated with my treatment indicator. The question of impact and magnitude can be addressed but exact correlations can't be estimated since the error is unobservable.

3.3.3. Impact of the rise of non-employer firms on unemployment rate

In the quest to better understand the impact of independent work on labor supply and the drivers of the gig-economy, I decided to take advantage of the constructed dataset on non-employer firms to analyze whether online labor-platforms are helping individuals out of unemployment or cannibalizing jobs from employer firms. The hypothesis is that the rate of unemployment declines with growth in the number of non-employer firms.

The frameworks I developed to shed light on this matter are based on the same methods as for examining the effects of Uber's market entry on non-employer firm prevalence. Furthermore, I performed a set of OLS regressions to show the causality of the proliferation of non-employer firms with the unemployment rate.

The OLS regression estimating this correlation is described as follows:

$$\begin{aligned} Y_{c,t} =& \beta_0 + \beta_1 (NonEmpShare)_{c,t} + \\ & \beta_2 (Post * EmpGrowth0610)_{c,t} \end{aligned} \tag{7}$$

where the dependent variable $Y_{c,t}$ is the unemployment rate, and the independent variable the share of non-employer firms among all firms in the county at year t. The control variables composed of the dummy element Post and a growth part with terms for logarithmic growth in employment, in non-employer firms, and in labor force from 2006 to 2010. As in the previous frameworks they are supposed to correct endogeneity problems by removing unwanted effects correlated with the denominator of the dependent variable.

4. Results: The Role of Non-Employer Firms in the Gig-Economy

In this section, I investigate how data on non-employer firms are related to the gig-economy and how it impacts labor markets. I show that non-employer firms can be used as an adequate proxy for independent work and treat them as such to test their relevance in the case of Uber's market entry. In the next analyses, I employ a panel differences-in-differences (DID) model approach[78] to answer the primary

[76] A characteristic of control variables is that the expected value of the error term with all the variables included is the same as it would be with just the control variables. $(E[\epsilon_{i,t}|x_{1,t}, x_{2,t}, ...] = E[\epsilon_{i,t}|x_{1,t}, ...])$. Control variables are variables that are related to the dependent variable and their effects need to be removed from the equation in order to correct endogeneity problems and avoid biased regression coefficients. See Dougherty (2011).

[77] Note that the control variable employment growth from 2006 to 2010 is only included in the regression with the share of taxi non-employer firms to all taxi employees as dependent variable (j=1).

[78] Differences-in-differences is a quasi-experimental technique used to understand the effect of a sharp change in the economic environment. It is used in conjunction with natural experiment in which nature does the randomization. In this investigation the model is composed of cross-sectional difference after Uber entry and a time-series difference within the industry and state.

questions about if and to what extent the entry of Uber has impacted independent work, while controlling for differences across time, state and industry. The resulting estimates allow me to evaluate the relative impact on different metropolitan areas across time and industry. After establishing this method and central findings, I examine the growth decomposition of non-employer firms to better understand the drivers of the rise in independent work and connect the results to the prediction of my theoretical approach. Finally, I present an approach to measuring aggregate effect of independent work on unemployment and explore how gig worker characteristics correlate with employment dynamics.

4.1. The Rise of Non-Employer Firms

Non-employer firms have undergone strong growth in the last decade. The U.S. economy added almost 9 million non-employer firms between 1997 and 2014, representing an increase of 60%. By comparison the total U.S. payroll employment increased by 16 million, which is an increase of 12 %. This observation aligns with the rise in self-employment measured by Katz and Krueger (2016b) as well as with more current research from Jackson et al. (2017) who show that self-employment's increase is essentially due to sole proprietorships providing labor services.[79]

Looking at trends over time, I find that the number of both non-employer firms and employer firms have increased at a similar and nearly steady rate from 1997 until 2007 and as shown in Figure 2 a major shift occurs in 2008. Non-employer firms' considerable growth continues along the trend line whereas the number of employer firms from the BDS experiences a significant drop of almost 7.5% in only 3 years. The same discrepancy can be witnessed when overlaying the number of non-employer's and employer's employees (see appendix Figure 3). However, the latter picks up again after 2010. This major shift, which is essentially related to the financial crisis in 2007, has somehow not affected non-employer firms. With this in mind, the question can be raised whether some job holders have spilled over to self-employment, which has been made easier due to online platforms, and if the recent pick-up has come from entrepreneurial activity.

A plot of employer firms' share in total employment in Figure 1 underpins the legitimacy of these questions. Employment has moved away from employer firms starting in 2001 and reaching an ultimate low in 2011. On the other hand, the share of non-employer firms among total firms has experienced an even stronger opposite effect increasing by 2 percentage points between 2005 and 2010 (see appendix Figure 4). The trend in non-employer share aggregated over all industries and states between 1999 and 2014 shows a steep ascent between 2000 and 2005, raise the share of non-employers in the total workforce from around 12 % to nearly 15 %. This increase may be caused by the appearance of the first platforms enabling contractors and freelancers to provide services over the internet. The second ascent occurs in 2009 when online labor platforms such as Uber first entered the marketplace. This rise of 1.5 percentage points in only one year brought the share of non-employer firms to 16.5 % where it stabilized until 2014.

[79] Cf. Jackson et al. (2017).

4.2. Tight Link between the Rise of Non-Employer Firms and Alternative Work

The considerable increase in non-employer firms on one side and the rise of alternative work arrangements described by Katz and Krueger on the other, suggests that both are somehow related. If this is true and if the correlation points in the same direction, it would suggest that non-employer firms are a suitable proxy for the lack of information on alternative work arrangements between 2005 and 2015. They can help measure the gig-economy and the magnitude of its implications.

In fact, my findings show that the increase in the number of non-employer firms is tightly linked to the rise of alternative work arrangements. The OLS regressions demonstrate that a one standard deviation higher share of alternative work arrangements at the state and industry level between 2005 and 2014 is associated with a 0.3 increase in the non-employer share. Nearly 48% of the increase in non-employer share is explained by the change in the share of alternative workers (see appendix Table 4). This finding is highly significant ($p \leq 0.001$) and is sufficient to suggest that non-employer firms are a good proxy for independent workers described by alternative work arrangements.

Looking at self-employed contractors, who represent a large share of the individuals working in the gig-economy and compose a subgroup of alternative workers, we recognize that the correlation is even stronger with a 0.4 standard-deviation-increase in the change of non-employer share for each standard deviation increase in the share of alternative workers. The significance remains equally high ($p \leq 0.001$). The increase in non-employer firms is explained by 51 % of the rise of self-employed contractors. This shows that the change in the share of non-employer firms and the change in the share of self-employed between 2005 and 2015 are highly correlated. According to this, the logical conclusion is that data on non-employer firms are an even better proxy for self-employment than for all alternative work arrangements. Indeed when looking at the correlations between non-employer share and the share of other component groups of alternative work arrangements such as on-call workers, temporary agency workers, and contractors, we observe that the relationships are not significant or even in the opposite direction (see appendix Table 5).

Furthermore, the regression explains that in 2015 for each standard deviation increase in alternative work arrangements share–as well as self-employed share–non-employer share rises by 0.6 standard deviations. This estimation is explained by about 40 % of the data. If however the fixed effects are incorporated in the model, over 91 % of the share

in non-employer firms is explained by the share of alternative work or self-employed contractors. The correlation is however weaker with a standardized regression coefficient of 0.13 for alternative work arrangement share and 0.15 for self-employed share.

As a consequence of these results, the null hypothesis which assumes no increase in non-employer firms in states and sectors where alternative work arrangements' increase is the largest, can be rejected with a high probability. Thus, the findings are in favor of my initial hypotheses that non-employer firms increase more in states and industries where alternative work arrangements increase the most. And as matter of fact, the percentage of non-employer firms to all employees increase more when self-employment rises. This shows that the number of individuals having reported working as self-employed in the Contingent Work Surveys in 2005 and 2015 is strongly correlated with the number of individuals registered as non-employer firms.

Showing this correlation in the first part of my analysis was therefore essential to provide evidence of the relevance of non-employer firm data to compensate for the shortage of information on independent work, clearing the way for further investigations. As long as more detailed information on independent work is lacking, the results of my analysis suggest that non-employer firms data can be used as a proxy and help measure the size of gig-work activity and furthermore assess the implications on relevant economic issues.

4.3. Effects of Uber's Market Entry on Non-Employer Firms

In the interest of achieving the highest possible degree of statistical significance, it is not without reason that Uber was chosen to demonstrate the relevance of non-employer firms for the gig-economy. Uber made it easier for individuals to work independently and leads the list of online platforms in terms of prevalence and first market entry. Considering the launch of Uber in Metropolitan Statistical Areas (MSAs) as a quasi-natural experiment for local labor markets, we can conclude that non-employer firms are affected by this economic treatment. If this is the case, it would provide evidence that non-employer firms are relevant for measuring the gig-economy and observing implications for labor markets. The constructed dataset obtained from non-employer statistics contains information on the number of non-employer firms at a county level. This offers the opportunity to investigate at a commuting zone level, which is the significant level for labor markets and the gig-economy. The Difference-in-Differences regressions carried out to test whether non-employer firms increase more in counties where Uber comes in shows that Uber entry triggers an increase in the number of non-employer firms relative to employment in the transportation sector. The share of non-employer firms increases when becoming an independent worker is easier. In fact, the entry of Uber in a new metropolitan area is associated with a 7 % to 12 % increase in the share of non-employer firms in the transportation sector (see appendix Table 6). The overall coefficient of determination ($R^2 = 0.712$) of the underlying regression expresses that 71.2 % of the change in the share of non-employer firms in the transportation sector is explained by the entry of Uber in the respective metropolitan area. Intriguing is the consideration of each year around the launch of Uber's services (see appendix Table 6, column 2). We can recognize that before Uber came into a local market, only little to no statistical relationship could be witnessed; all regression coefficients on year dummies are approximately zero and all are insignificant. After Uber's market entry, however, the correlation and the significance of Uber's entry on non-employer firms got stronger from year to year with an increase of 2 % in non-employer firms share in the first post-entry-year and 21 % increase and a p-value of less than 0.001 in the fourth year after market entry. One possible reason for this steady growth could be the adoption time of potential labors to use this new intermediary platform due to its subordination to network effects. A second reason could also be the entry of similar platforms such as Lyft in the post-years of Uber's market entry which increases the number of options for independent workers. These findings are obtained when computing the change in non-employer share of the transportation sector in yearly increments to the time-to-market of Uber in the respective metropolitan area.[80]

Having taken out the difference to control the change in employment and equalize the observations along their common dimensions (compare column 2 and 4 in Table 6), we realize that the effect of Uber's entry is even stronger with an average of a 6 % increase (compared to 2 %) in non-employer share in the taxi sector one year after Uber's entry rising to a 24.6 % increase (compared to 21 %) four years after the launch and a significance level of $p \leq 0.001$. These results demonstrate clearly that after 2010 when Uber, one of the first intermediary gig-platform in the transportation sector, entered local markets the share of non-employer firms increased significantly over the years. This finding is graphically well illustrated in Figure 8, which shows the regression coefficients on each relative year (relative to Uber's market entry) dummy for non-employer share in the taxi industry. From this graph can be read the percentage change of non-employer share in the taxi industry from one year to another in the 3 year period before and 4 years after Uber entering the labor market. Only four years after the launch of this newcomer disrupting the taxi industry, the graph shows a nearly 20 percentage point-increase compared to the time of market entry and records a steady growth of non-employer firms in that same time period. Splitting the taxi industry into its two components taxi and limousine service (NAICS 4853) and ground transportation service (NAICS 4859) we can observe a difference in the impact of Uber (see appendix Figure 9). While the taxi and limousine service branch is affected negatively, the ground transportation service sector experiences a significant increase. This contrast in the results may be explained by a sum of stacked phenomena. The first being a partial spillover from the taxi branch to ground transportation services, i.e. that Uber has incited taxi drivers to work as

[80] I have only considered the metropolitan areas in which Uber is operative and included in each area the corresponding counties at commuting level.

independent workers for individual preferences leading them to register as non-employer firm in the ground transportation service instead of the taxi and limousine service sector. At this point it must also be pointed out that false or misleading reporting of individuals can occur in both directions which can increase or counteract to this phenomenon. Considering the higher rate of change in ground transportation services (NAICS 4859) compared to taxi service sector, there must also be another source of inflow coming from other industries or labor markets that leads to a higher increase of this sector.

When jumping deeper into the matter and considering the non-employer share of the taxi sector not only among employees in the taxi industry but among all employees, the results are even more distinctive. The level and rate of increase are of course not as high as within the same industry since it is diluted, however the effect is still remarkable. Table 7 shows the results for both dependent variables, taxi non-employer firms as a share of all employees and non-employer firms as a share of all firms. With a rise of nearly fourteen times in the growth rate of taxi non-employer firms' share in all employees from 0.04 % in the year of entry to 0.6 % the fourth year after, my findings show clearly that where Uber has entered, the trend is noticeable even across broad industries. Figure 10 in the appendix illustrates the sharp increase in coefficients in the years after market entry. Considering the same coefficients for the non-employer share, displayed in column 3 and 4 of the same table and plotted in appendix Figure 11, it is clear that the rise of non-employer firm prevalence relative to all firms in the aftermath of Uber's launch is less sharp. However, it is still noticeable and goes beyond the consideration of ride-hailing platforms and encompasses other intermediaries that have popped up in other industries. Looking at the plots of the average non-employer firm ratios by year relative to Uber's entry, we recognize a similar pattern (see appendix Figure 12). More results of this analysis are illustrated in the appendix, which, on account of their secondary importance for the scope of this work, have not necessitated further interpretation. These may, however, be relevant for further research.

With the results presented above, I was able to verify the initial hypothesis that the number of non-employer firms increases more in metropolitan areas where Uber comes in, and consequentially reject the null hypothesis of no increase. Accurate measurement of non-employer firms is shown to be important for understanding the magnitude and the impact of the gig-economy. Many studies have used administrative data for this purpose. Researchers from University of Maryland and the U.S. Census Bureau have used self-employment data to analyze levels and trends of the gig-economy stating that they should expand the analysis with non-employer firms.[81] The only researchers having utilized non-employer firms to try tracking the gig-economy were Hathaway and Muro (2016). Having provided evidence for the relevance of non-employer firms in measuring the impact of online-labor platform such as Uber, one can now utilize this source of information for investigations on economic issues.

4.4. Growth Decomposition of Non-Employer Firms

So far my findings suggest that the rise of non-employer firms is an adequate proxy for compensating the shortage of information on independent work and relevant for measuring the impact of Uber's market entry as an example for online labor platforms on gig worker's activity. In the light of the conclusion drawn from these findings, it is necessary to scrutinize the decomposition of the change in non-employer share.[82] The intention is to rule out the influence of driving forces stemming from Other state and industry characteristics. If the change in non-employer share is driven by a specific industry or state with a historically higher sensitivity or disposition to more non-employer firms it could mislead and distort the explanation of the growth in non-employer firms. The one question that needs to be answered to understand the decomposition of growth is the following: is the change in non-employer share due to the expansion of industries or states with historically more non-employer firms? To do so, I decomposed the difference in non-employer share into (1) between-state-sector growth, (2) within-state-sector growth, and (3) a covariance verifying the validity of the analysis. Furthermore, I carried out the analysis at different industry levels characterized by the 2-, 3-, and 4-digit NAICS code to gain more detailed findings. In order to witness interim development during 2000 and 2014, I split the time frame into two periods. The results are illustrated in Table 8.[83] The decomposition of the change in non-employer share between and within state-sectors shows that the rise of non-employer firms is not driven by differentials in sector or state growth. This can be seen in the three columns "Total Change", "Between", and "Within" displayed in the table. The "Within" column shows the negligibility of both cross-industry and inter-state spill-overs in independent worker growth, with values around zero. The covariance can be used to verify that the difference in share for the corresponding period equals the sum of the "Between", the "Within", and the "Covariance" columns thus validating the conformity with the total change. These findings helps to understand that the rise of the gig-economy is not driven by a specific industry such as the transportation sector spilling over into other industries or a specific State with favorable conditions for independent workers. On the contrary, the rise of independent workers is not influenced by cross-industry nor inter-state spill-overs.

This analysis measuring labor supply elasticities between states and industries to changes in the exposure to online platforms with the example of Uber, indicates that the rise of non-employer firms is not mechanically driven by differential industry or regional growth. In view of the conclusion drawn from these findings, we can use the constructed

[81] Cf. Abraham et al. (2016).

[82] Share of non-employer firms to total employment.

[83] A more detailed table with NAICS 3- and 4-digit industry levels is accessible in appendix Table 9.

dataset matching non-employer firms and alternative work arrangements with other administrative data to shed light on the implications arising within the labor market.

4.5. Unemployment and the Impact of Non-Employer Firms

One of the most important domestic issues economists and governments have to deal with when making decisions on labor policies is the level of unemployment. In general, the question is less about the consequences of unemployment but rather about the causes for unemployment and the economic mechanics that maintains a low unemployment rate. Having in mind that employment or work arrangements based on the traditional employee-employer relationship have declined in the last decade (see appendix Figure 14 and Figure 16), and self-employment or independent work measured in both alternative work arrangements and non-employer firms has recorded a significant increase[84], the result that the emergence of online platforms is reallocating workers in one direction is not surprising. When looking at data on unemployment, we recognize a similar trend as with employment. Unemployment rate has skyrocketed in the years after the financial crisis to a record high of nearly 10% since the beginning of the second millennium and dropped back to 6 % after 2010 (see Figure 15). Certainly, this trend is highly correlated with the 2007 financial crisis, but nonetheless the decline in unemployment may also have been affected by the digitization of work. Falling back on the case of Uber and isolating the trend of unemployment rate in metropolitan areas where Uber is operating, we observe the same drop as in the whole U.S. labor market (see Figure 17). This premise raises two fundamental questions underlining the impact of online platforms on labor dynamics: by lowering barriers to entry in certain sectors and offering income opportunities for low skill services, are platforms allowing people to work when they would otherwise be unemployed? By improving the match between supply and demand are platforms increasing total labor supply and lowering unemployment, or simply shifting individuals from traditional jobs to online platform jobs?

Knowing that we can now use non-employer firms to assess socio-economic matters and labor-related impact of the gig-economy, I examined the correlation between the rise of non-employer firms and the evolution of unemployment rate. The findings are illustrated in Table 10 and show that contrary to my initial assumption the unemployment rate is positively correlated to the rise of non-employer firms. In fact, each percentage point change in non-employer share is associated with an 0.08 increase in percentage change in unemployment rate. This well-fitted estimate indicates that about 88% of the increase in unemployment rate is explained by the rise of non-employer firms. However, examining Uber's impact on unemployment rate, shown in Table 11, only a weak correlation with a low significance in year four after market entry can be detected.

[84] Cf. Katz and Krueger (2016a); Chapter 2.4 and Chapter 4.1.

The results of estimating a regression are plotted by year in Figure 18, which shows the correlation between the dependent variable unemployment rate and the predicting variable non-employer share for each year between 2006 and 2014. It clearly shows the weak correlation between these two variables preventing me from rejecting the null hypothesis that the change in the share of non-employer firms has no effect on unemployment rate. Thus, there is no evidence that the gig-economy is contributing to a decline in unemployment since the unemployment rate is increasing with the rise in non-employer share. A variety of explanations can be posited for the positive correlation of non-employer firms and unemployment rate. One arguable explanation is that unemployment raises the likelihood that workers transition to independent work as opposed to a traditional employment relationship and therefore the share of non-employer firms increases in counties and industries where unemployment is high. It changes the perspective of the guiding question, which is no longer about the correlation between non-employer share and unemployment rate but rather a causality issue. Is unemployment increasing because of the gig-economy or is the gig-economy prevailing because of the high unemployment rate? This reasoning suggests that non-employer firms are not the cause for a higher unemployment rate. It is more likely that whenever high joblessness prevails, workers with little bargaining power and few options for traditional employment turn to self-employment indicating a weak labor market. This counterintuitive explanation would be in line with a recent paper published by Katz and Krueger built on their previous work on alternative work arrangements.[85]

5. Conclusion

5.1. Summary

For the past several years there has been much research done on the rise and the significance of the so called "gig-economy", work activities enabled by online platforms and characterized by temporary positions filled by independent contractors on a short-term basis. However, existing studies provide little evidence of the magnitude and the manifestation of its impact on labor markets. Public institutions such as the Bureau of Labor Statistics (BLS) have ceased tracking data on alternative work arrangements and other agencies are not well positioned to capture information. Some researchers have tried to fill the void by using tax records information on self-employment, others have worked with company data or even carried out own surveys.[86] In this work, I provide quantitative responses to the questions of how the size and the growth of the gig-economy can be measured and how labor markets respond to the exposure to online platforms using data on non-employer firms from the U.S.

[85] Cf. Katz and Krueger (2016b).

[86] See among others Katz and Krueger (2016a); Burtch et al. (2016); Gierten and Spiezia (2016); Hathaway and Muro (2016); Abraham et al. (2016); Chen et al. (2017); De Stefano (2016); Jackson et al. (2017).

Census Bureau and on the staggered market entry of Uber in different U.S. metropolitan areas.

I begin by describing the contextual setting of the research subject and illustrating the scope of work. First, I define the online platform economy as economic activities involving online intermediaries that are marked by four characteristics: (1) they provide a digital market space that connects workers or sellers directly to customers, (2) they allow people to work on a flexible basis,[87] (3) they pay on a piecerate basis for a single task or good at a time, and (4) they intermediate or facilitate payment for the good or service. I then distinguish between labor and capital platforms. Labor platforms, such as Uber, connect customers with contingent workers who perform discrete tasks or projects while capital platforms, such as Airbnb, connect customers with individuals who rent assets or sell goods peer-to-peer. Both are very distinct from each other. As independent work activities only occur through the intermediary of labor platforms, I narrow down my definition of the gig-economy to work activities facilitated by online labor-platforms and further distinguish between crowdwork and on-demand work. Both are different in the location where the work can be carried out. While crowdwork can be done remotely or digitally like designing a website, on-demand work can only be carried out at a local level, like a ride-hail service. Finally, I define gig workers as individuals in an alternative work arrangement earning income by providing services to a customers in a local area acquired through the intermediary of an online labor-platform.

After unveiling the difficulties in measuring the size and the change of the gig-economy workforce, I describe the construction of my datasets and the econometric frameworks used in my analyses. I then proceed with documenting the trend in the rise of non-employer firms and discover a strong growth. The U.S. economy increased by 60% adding almost 9 million non-employer firms between 1997 and 2014. By comparison, the total U.S. payroll employment increased by 16 million which represents a growth by 12%. In order to evaluate the role of non-employer firms as part of the gig-economy, I then build the observation variable "non-employer share" defined as the percentage of non-employer firms to all employees, which becomes the key element of my analyses.

In a first stage, I build on previous research by Katz and Krueger (2016b) who provide new survey data on alternative work arrangements to show the relevance of non-employer firms as a proxy for the rise of independent work. By means of ordinary least square estimations, I compare the rise in non-employer firms to the rise of alternative work arrangements and show that non-employer firms increase most where the increase is largest in alternative work data from 2015 Katz and Krueger compared to BLS data from 2005. Indeed, one standard deviation higher change in alternative work arrangements is associated with a 0.3 to 0.4 increase in the change in non-employer share at the industry*state level. This provides evidence that the growth of non-employer firms between 2005 and 2015 is correlated with the growth in alternative work.

In a second stage, I grasp at data on the staggered entry of Uber in local markets and use differences-in-differences techniques to show the significance of non-employer firms in the emergence of online platforms. I find that non-employer firms are tightly linked to the rise of independent work. Uber triggers an increase of 20 ppt in non-employer firms relative to employment in the transportation sector 4 years after entering local labor markets. Uber's entry is also associated with a 0.05 to 0.07 increase in non-employer share in the transportation sector. This proves that the rise of non-employer firms is tightly linked to the workforce evolution in the gig-economy which increases when becoming independent is easier.

I also explore whether the change in non-employer share is due to the expansion of industries or due states with historically more non-employer firms. For this, I decompose the change in non-employer share into tree terms (1) between industry sector or state growth term, (2) within industry sector or state growth term, and (3) a covariance term. I find out that the rise of non-employer firms is not mechanically driven by differential industry or regional growth. This also means that there are no spillovers of non-employer firms from one industry to another or one state to another along the growth of independent work.

Finally, I investigate whether the gig-economy has had a positive impact on employment by improving the match between supply and demand. With the help of administrative data from the Local Area Unemployment Statistics (LAUS), I examined the correlation between the rise of non-employer firms and the evolution of unemployment rate and surprisingly found that the unemployment rate is, albeit only slightly and insignificantly, positively correlated to the rise of non-employer firms. In fact, each percentage point change in non-employer share is associated with a 0.08 percentage point increase in unemployment rate. In the transportation sector, Uber's market entry indicates that unemployment raises the likelihood that workers transition to independent work as opposed to a traditional employment relationship and therefore the share of non-employer firms increases in counties and industries where unemployment is high. This reasoning suggests that it is more likely that whenever high joblessness prevails, workers with little bargaining power and few options for traditional employment turn to self-employment.

5.2. Inferences

This work's findings contribute to both the literature on patterns in the gig-economy's workforce and research issues on labor market evolution. At the same time, it offers a new perspective of the available data that can be considered to investigate trends in independent work and the implications of

[87] Recent industry reports indicate that online platform economy workers vary their hours considerably. In any given week, 65 percent of Uber drivers change the number of hours by more than 25 percent. See Hall and Krueger (2015).

the gig-economy on socio-economic issues. My results highlight the catalyzing effects of online labor-platforms on independent work as integral part of these new work activities. The gig-economy's size does not appear overwhelming, but its growth is remarkably rapid. In recent years non-employer firms, a proxy of independent workers in the gig-economy, have started growing much more quickly than before the advent of much of the current online platform services.

While the gig-economy may create accessible, flexible, and convenient work opportunities for contractors, it may also be operating outside of various economic stabilizers such as labor market regulations, work legislation, tax policies, insurance coverage, and social benefits.[88] Since most gig-economy workers are considered independent contractors, not employees, they do not qualify for basic protections like overtime pay and minimum wages, or other employment benefits such as mandatory workplace training and social security. This challenges stakeholders and policymakers to prioritize economic stabilizers as they relate to a growing number of non-standard work arrangements. Without data on how online platforms are affecting work activities, policymakers are flying blind into the gig-economy. Understanding the magnitude and implications of the collaborative economy can help develop policy standards and support the workforce of tomorrow's labor markets. With this work, I provide quantitative responses to help understand the gig-economy and bring a new pool of workers to the forefront of the debate that suits the nature of the evolution of labor markets.

Future studies with non-employer firms data have already been announced.[89] As I was able to show that non-employer firms are a good proxy for independent workers, this thesis now allows the reflection on how future studies should be considering non-employer firms to obtain a better understanding of the occupational change in work behavior and labor markets in the gig-economy. Information captured by household surveys or in administrative data on gig workers is poor and incomplete. Knowing that non-employer statistics can fill the lack of information on independent work, researchers are now given a new source of data to obtain a better picture of the trends in gig workers activities. Thus, this work wipes out one of the major insecurities arising from the gig-economy, which is the inability of measuring its magnitude and growth. Researchers and other interested parties, also have the data availability to gain insights that go beyond the scope of this work. While my analyses is limited to a defined research question and a set of publicly available knowledge, federal institutions and other researchers have their own related research projects for which they can use the datasets created in the course of this thesis.

Non-employer firms are far from being a perfect measure because they are not entirely congruent to workers in the gig-economy. By nature, employment in the gig-economy is impossible to measure using traditional statistics, as there is no specific measure of individuals using online platforms for gig work. However, non-employer firms are a useful proxy and until governmental institutions design more targeted measures to monitor the growth of gig employment, the Census Bureau's non-employer firms may be the best measure available.

5.3. Outlook

This thesis was carried out at the Finance Faculty of the MIT Sloan School of Management as part of a broader ongoing research project on independent work, reported income, and the effects of the online platform economy on labor markets. One objective of this research was to provide new tabulations that will inform the ability of non-employer firms data to track and detect new patterns. This analysis helps identify and assess how the dynamics in alternative work arrangements relates with working relationship, contractors' situation, and other aspects of labor markets due to the exposure to online platforms. The second objective of the research project, is to understand why individual use these new types of employment. Some possible reasons could be (1) the change in risk management preferences by workers, (2) technology improvements that allow for efficient allocation of human capital, or (3) regulatory arbitrage that allow firms to reduce labor cost.

In order to investigate these explanations the next steps would be to take advantage of the findings on non-employer firms and identify the drivers of the rise in independent work on both the supply and demand side of the labor market. A starting point would be to understand the effect that online platforms have on independent work income. In this context a first hypothesis should be that platforms allow individuals to divide and reshuffle their labor across various employers more efficiently. Individuals might be enticed to do so either to maximize their income or to mitigate labor income risk across various employers. The second explanation could be addressed by hypothesizing that technology allows for a better time allocation, leads to a cut in coordination costs, and lowers barriers to entry in certain sectors. The third explanation should be investigated by testing if the firms providing online platforms are doing so to arbitrage regulation and lower their labor costs. Another question that is worth investigating with non-employer firms data is the preferences of individuals in the gig-economy which could be explained by identifying the correlation with socio-demographic patterns. To quantify the relevance of each of these hypotheses, further longitudinal data can be used such as income reported on the 1099 MISC form and made available by the IRS or employment insurance and minimum wage data obtained from the Bureau of Labor Statistics among others. With this, one can also further examine the aggregate effect of online platforms on resource allocation, labor supply, and entrepreneurial activity.

Labor markets are being disrupted by technological advancements resulting in the polarization of income distribution and job destruction due to automation and other

[88] Cf. Hargrove and Mazerolle (2016).
[89] Cf. Abraham et al. (2016).

trends.[90] I believe that studying the effect of online platforms on the efficiency of labor markets using real economic experiments is crucial to understand the structural trends affecting our economies and a diligent way to nurture evidence-based decision making for the healthy socio-economic development of our workplace and society. How digital technologies are reforming our work activities will continue to be a key question for policymakers and an exciting motivation for researchers.

[90] Cf. Autor (2015).

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Effects of fiscal R&D incentives on R&D expenditure

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Abstract

Special tax incentives aiming to foster research and development (R&D) investment are widely spread among the members of the Organisation for Economic Co-operation and Development (OCED). I investigate the effect such tax incentives have on business R&D investment. Fiscal R&D incentives can be categorized as input-oriented tax incentives such as tax credits, super deductions and accelerated depreciation, and as output-oriented incentives such as patent box regimes. In the first part of my thesis I provide an overview over the methodology of the B-Index, a measure for the generosity of input-oriented tax incentives. Calculations of the B-Index for 33 OECD-countries and China from 1991 to 2014 show an overall trend towards an increase in the generosity of input-oriented fiscal R&D incentives. In the second part of my thesis, I create a panel with country-level data on business R&D investment provided by the OECD. I test reactions to changes in R&D tax incentives and find a positive effect of input-oriented R&D tax incentives, but no significant impact of output-oriented R&D tax incentives. A more detailed analysis on the industry-level shows that the results are driven by effects on business R&D investment in the manufacturing and services sector.

Keywords: R&D, tax incentives, B-Index, taxation, OECD

1. Introduction

Research and development (R&D) investment does not only create advantages for the investing companies, but also for the public through so-called technological spillovers.[1] However, empirical evidence shows that business R&D expenditure is below the social optimum. Reasons for that are externalities that influence the profitability of the R&D investment.[2] Therefore, to profit from the knowledge spillover effects, governments have an incentive to stimulate private R&D investment. While direct funding like government grants and subsidies decreased over the past few decades, the generosity of indirect support via fiscal R&D incentives increased.[3] More and more countries started to introduce input-oriented fiscal incentives to promote R&D investment. In recent years, output-oriented fiscal R&D incentives also grew in popularity.

This thesis serves two purposes. Firstly, it aims to make the data on R&D incentives and on the B-Indices, which measure the generosity of input-oriented R&D incentives, available for other researchers. Data on the total B-Index has been published by the OECD for individual years. Ernst and Spengel (2011) give an overview over R&D tax incentives and total B-Indices for 20 European countries between 1998 and 2007. Thomson (2013) presents background data and measures separated by type of cost for 26 OECD countries for the period 1980-2006. This thesis continues this work and provides the B-Indices for an extended country sample and updated period of time as well as all formulas and variables used for the calculations. In this first part, a quali- tative analysis is conducted, investigating the development of fiscal R&D incentives. Secondly, this thesis also extends the existing empirical research on the effectiveness of the tax measures. The quantitative analysis executed in the second part uses empirical methods and includes a cross-country study on the effect of fiscal R&D incentives on R&D investment in different industries. Existing empirical studies mainly investigate the effect of the introduction of fiscal R&D incentives within one country; studies that include several countries, observation years and types of tax incentives are rare.[4]

The structure is as follows. Chapter 2 gives an overview over the main types of fiscal input- as well as output-oriented R&D incentives. In addition, the B-Index as a measure for the

[1] See e.g. Griliches (1992), pp. 43-44.
[2] See e.g. Nelson (1959), p. 304, Arrow (1962), pp. 616-619.
[3] See Westmore (2013), p. 11.
[4] Please refer to chapter 4.1 for examples of cross-country studies.

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generosity of input-oriented R&D incentives is introduced. In chapter 3, the existing fiscal R&D incentives for 33 OECD countries and China for the period from 1991 to 2014 are displayed and qualitatively analyzed. Chapter 4 gives a brief review on previous studies on the effects of the B-Index on R&D investment. This is followed by the introduction of data used in the quantitative analysis and the results of the empirical study. The last chapter concludes.

2. Fiscal R&D incentive models: Basic concepts

2.1. Input-oriented R&D tax incentives

Legislators use different ways to implement tax incentives to promote R&D. Input- oriented incentives target a company's R&D investment and reduce the marginal costs of the R&D projects. They take the form of tax credits, super deductions (also referred to as enhanced or extra allowances) or accelerated depreciation. As of 2014, 29 of the 34 countries included in this thesis provide at least one of those incentive schemes.[5]

Tax credits reduce a company's tax liability. A pre-defined percentage of the R&D expenditure incurred can be directly offset against the tax due. Super deductions and accelerated depreciation on the other hand reduce a company's tax base. In case of the super deduction, an enhanced allowance on top of the usually deductible amount of expenditure can be claimed. Under this scheme, e.g. in the Czech Republic the tax base can be reduced by up to double of the amount of costs incurred. With accelerated depreciation, the depreciation rates for fixed R&D assets are enhanced. The capitalized expenditure can be deducted faster, which leads to a lower tax base in the affected periods.[6]

A special form of fiscal R&D incentive applies to the wage withholding tax for R&D personnel. The wage withholding tax payable by the employer is lowered. The company still withholds the full tax amount from its employees wage payments, but pays only a fraction to the state. As a result, the R&D labor costs for the company are reduced.[7]

The R&D tax incentives mentioned above are calculated based either on current costs, or on capital expenditure, or both. Current costs include labor expenditure and other current costs, such as expenditure on consumable material. Capital expenditure is composed of expenditure on machinery and equipment and expenditure on buildings. Some countries do not allow for the expenditure to be included at once. Instead, they only allow to add the depreciation costs to the basis. In general, acquisition cost for land is not allowed to be included in the basis for any of the observed tax incentive schemes.

Another feature of the tax incentives is their link to either the volume or the increment of R&D expenditure. In case of a scheme based on volume, the incentive applies to the total amount of R&D expenditure incurred by a company. In contrast, incremental schemes aim at increases of the company's R&D expenditure. If an incremental scheme is applied, companies can only profit from a tax reduction if the expenditure in the current period exceeds a base amount. The definition of this base amount differs from scheme to scheme. E.g. Ireland allows a tax credit for R&D expenditure exceeding the R&D expenditure of the company in the fixed base year 2003. Other countries like Australia, Greece and Japan calculate a moving average of the R&D expenditure of up to five previous years. At times, the USA offered three mutually exclusive credit regimes, each with its own definition for the relevant base amount.[8]

Part of the fiscal R&D incentives are also limited by floors and/or caps. In the first case, tax relief is only granted if the R&D expenditure exceeds a certain value (e.g. for the Finnish super deduction EUR 15,000). In the second case, fiscal R&D incentives are capped at a certain value (e.g. for the Italian tax credit in 2010 EUR 50 million) or limited by a percentage of the tax liability (e.g. for the Japanese tax credit from 1991 to 1998 10% of tax due before the credit).

Some of the R&D tax incentives differentiate depending on firm size; e.g. smaller companies benefit from more generous rates or the scheme is limited to enterprises that meet certain employment or turnover criteria.

2.2. B-Index: Definition and methodology

To calculate the generosity of input-oriented R&D tax incentives, the OECD[9] calculates tax subsidy rates based on the benefit cost ratio at which an R&D investment opportunity becomes viable after tax (B-Index).[10] Several studies also rely on the B- Index as a measure for R&D tax support.[11] The measure represents the tax component of the user cost of capital which was introduced by Jorgenson (1963). McFetridge and Warda (1983) adapted the user cost of capital to R&D investment and introduced the B-Index model. As a marginal concept, the B-Index is an indicator for marginal investment decisions, e.g. the scope of an investment (as opposed to discrete investment decisions, e.g. a corporation's location decision).[12]

The B-Index model is limited to the corporate income tax regime, i.e. personal income taxes and several other taxes that might apply as well as grants and subsidies are disregarded. It is also assumed that the companies generate sufficient taxable income to fully utilize the R&D tax incentives in the current year (no tax exhaustion); therefore carry-forward

[5] Germany, Mexico and New Zealand currently do not have or revoked previously existing input- oriented tax incentive schemes. Denmark and Poland offer restricted R&D incentives that are only applicable to a limited range of companies fulfilling certain conditions.

[6] See CPB et al. (2014), p. 50.

[7] See Ernst and Spengel (2011), p. 8.

[8] See Taxand (2009), pp. 29-32 for a short overview over the three schemes.

[9] See OECD (2017).

[10] See Warda (2001), p. 192.

[11] See e.g. Falk (2006), Corchuelo and Martínez-Ros (2010), Ernst and Spengel (2011), Westmore (2013), Bösenberg and Egger (2017).

[12] See Bösenberg and Egger (2017), p. 43.

or carry-back provisions do not apply. In addition, the corporate income tax rates and incentives applicable to the top eligible income are considered. Ceilings and floors that limit the claim on R&D tax incentives are disregarded for reasons of simplicity.[13]

The measure is calculated as the net present value (NPV) of income which covers the initial R&D investment and taxes:[14]

$$b = \frac{1-A}{1-\tau} \tag{1}$$

with τ = corporate income tax rate

A = NPV of all R&D incentives applicable

A consists of the sum of the individual NPVs (A_n) of four types of R&D costs: current costs which are sub-divided into labor (A_L) and other current costs (A_{OC}) and capital expenditure which is sub-divided into machinery and equipment (A_{ME}) and buildings (A_B):

$$A = \sum w_n * A_n = W_L * A_L + w_{OC} * A_{OC} + w_{ME} * A_{ME} + w_B * A_B \tag{2}$$

with w_n = weight attributed to expenditure type n

w_L = weight attributed to labor costs

w_{OC} = weight attributed to other current costs

w_{ME} = weight attributed to machinery and equipment costs

w_B = weight attributed to costs for buildings

Each A_n is a combination of the NPVs of the depreciation of the expenditure as well as the NPVs of the tax credits, super deductions and reductions of wage withholding tax that are available in addition:

$$A_n = d_d^n * a_d^n + d_{tc}^n * a_{tc}^n + d_{sd}^n * a_{sd}^n + d_{wwt}^n * a_{wwt}^n \tag{3}$$

with d_d^n = weight attributed to expenditure type n

d_d^n = value of expenditure subject to depreciation in t=0

d_{tc} = value of expenditure subject to tax credit in t=0

d_{sd} = value of expenditure subject to super deduction in t=0

d_{wwt}^n = value of expenditure subject to wage withholding tax tax reduction in t=0

a_d^n = NPV depreciation

a_{tc}^n = NPV tax credit

a_{sd}^n = NPV super deduction

a_{wwt}^n = NPV wage withholding tax reduction

The value of d equals 1 if the tax incentive is calculated based on the full amount of the expenditure. In case of R&D expenditure on machinery and equipment or buildings, R&D tax incentives can be calculated based on the amount of the depreciation instead. Then, d is calculated as follows:

$$d_d^{SL} = \frac{1}{T} * [1 - (\frac{1}{1+r})^T] * \frac{1+r}{r} \tag{4}$$

$$d_d^{DB} = d * \frac{(1+r)}{d+r} \tag{5}$$

with d_d^{SL} = d, if the basis is the depreciation of assets with a straight-line schedule

d_d^{DB} = d, if the basis is the depreciation of assets with a declining-balance schedule

r = discount rate

T = useful life of asset

The respective values for the NPVs of the depreciation and input-oriented tax incentives are each calculated based on the individual regulations in place.

The NPV of the depreciation, a_d^n, equals 1 if the expenditure can be immediately deducted (which applies to the majority of countries for current costs[15]). If the R&D expenditure has to be capitalized, the straight-line or the declining-balance method are possible. The formulas assume that assets are depreciated at the beginning of the period.

$$a_d^{SL} = \frac{1}{T} * [1 - (\frac{1}{1+r})^T] * \frac{1+r}{r} * \tau \tag{6}$$

$$a_d^{DB} = d * \frac{(1+r)}{d+r} * \tau \tag{7}$$

with a_d^{SL} = NPV straight-line depreciation

a_d^{DB} = NPV declining-balance depreciation

Tax credits are either granted before taxes, and therefore subject to corporate taxation (e.g. Canada), or after taxes (e.g. Austria):

$$a_{tc}^{non-tax} = tc \tag{8}$$

$$a_{tc}^{tax} = tc * (1-\tau) \tag{9}$$

[13] See Warda (2001), p. 193-194.

[14] See Warda (2001), p. 192.

[15] Only in a few countries research and/or development costs cannot be immediately expensed. For example in the Czech Republic, Ireland, Poland or Portugal the capitalization of R&D expenditure is mandatory if certain conditions are fulfilled. In the Netherlands, Slovak Republic only development expenditure is subject to mandatory capitalization. Other countries like Greece, Italy and Luxem- bourg allow an option, while R&D costs are regarded as non-capitalisable in Austria and Germany. See Endres et al. (2007), pp. 291-295.

with $a_{tc}^{non-tax}$ = NPV non-taxable tax credit
a_{tc}^{tax} = NPV taxable tax credit
tc = tax credit rate

The super deduction directly reduces the taxable income:[16]

$$a_{sd} = sd * \tau \tag{10}$$

with sd = super deduction rate

If the tax credit or super deduction is based on an incremental scheme with a k-period moving average as a base for the increase in R&D expenditure, the respective NPVs are multiplied by the following:[17]

$$1 - \frac{1}{k}\sum_{k=1}^{K}(1+r)^{-k} \tag{11}$$

with K = number of periods used for calculation of average

In case of the reduction of the wage withholding tax, the rate does not reduce the payment of corporate income taxes, but wage withholding taxes instead:

$$a_{wwt} = wwt * \tau_{wwt} \tag{12}$$

with wwt = reduction rate wage withholding tax
τ_{wwt} = wage withholding tax rate

The preceding formulas rest on the assumption that the investment is financed by retained earnings.[18]

2.3. Output-oriented R&D tax incentives

In contrast to the types of R&D tax incentives discussed in the preceding paragraph, states also aim to foster innovation by influencing the taxation of the output of R&D processes. From 1973 until 2010, Ireland exempted patent royalty income for domestic R&D.[19] As of 2014, 8 out of the 34 countries considered in this thesis offer a so-called intellectual property (IP) box[20] that provides a reduced tax rate on the income generated through the exploitation of successful innovations in the form of patents.[21] Other research activity which cannot be patented but may generate higher spillover effects is not rewarded.[22] The national regimes differ with respect to qualifying IP and income as well as the treatment of past and current R&D expenditure. The application of IP boxes can lead to a substantial reduction of the cost of capital of the R&D investment, therefore making it more favorable than a comparable financial investment. [23]

Empirical evidence suggests that output-oriented R&D incentives impact the number and location of patents rather than the amount of R&D expenditure.[24] Until today, an effect on R&D investment could not be empirically confirmed.[25] Therefore, IP boxes and their specific design will not be addressed in detail in this thesis.

3. Fiscal R&D incentive schemes in the OECD

3.1. Overview over existing input- and output-oriented R&D incentives

This chapter presents an overview over existing systems and a qualitative analysis across countries and time. Within the OECD, a magnitude of fiscal R&D incentives are in place. Table 1 and Table 2 give an overview over the input- respective output-oriented R&D incentives that are or were available from 1991-2014 in 33 OECD countries and China. For the purpose of this thesis, only incentives that are available to all firms are included. Incentives aimed solely on SMEs are not considered, and in case of different rates the top rates are applied. Floors and caps are disregarded.

The information displayed in Table 1 originates from various sources. The major part was derived from the IBFD (1991-2004) and the IBFD Country Analyses. The data was completed and verified with research results from Ernst and Spengel (2011) and Thomson (2013) as well as with the global guides from the OECD (OECD (2013), OECD (2015)), EY (EY (2010),EY (2013), EY (2014)), PwC (PwC (2012), PwC (2014), PwC (2016)), Deloitte (Deloitte (2011), Deloitte (2012), Deloitte (2014)), Taxand (Taxand (2009), Taxand (2011)) and various national sources.

In the column “Capitalization of R&D expenditure” only countries are shown were research as well as development expenditure are subject to mandatory capitalization without further requirements like e.g. special cost documentation. In the columns “Tax Credit” and “Super Deduction”, italic and bracketed crosses represent the less favorable scheme if a country offers several mutually exclusive R&D tax incentives. A more detailed version of Table 1 can be found in the appendix (Table A - 1).

In 1991, 17 out of 34 countries had input-oriented incentive schemes implemented. Six countries offered tax credits, three super deduction and eleven accelerated depreciation. In 2014, in 29 out of 34 countries fiscal R&D incentives are available. The number of countries offering tax credits (now

[16] In 2006, Belgium introduced a notional interest deduction (NID) regime. The NID rates are includ- ed in the B-Index similarly to the calculation of a super deduction.
[17] See Bloom et al. (2002), p. 5, Thomson (2013), p. 4.
[18] See Ernst and Spengel (2011), p. 18.
[19] See IBFD (1991-2004), IBFD (2005-2014).
[20] Comparable regimes are also referred to as patent, innovation or knowledge development box.
[21] See IBFD (1991-2004), IBFD (2005-2014).
[22] See Alstadsæter et al. (2015) p. 3.
[23] See Evers et al. (2015), p. 514.
[24] See e.g. Karkinsky and Riedel (2012), Griffith et al. (2014), Bradley/Dauchy/Robinson (2015).
[25] See also De Rassenfosse (2015), p. 15, Alstadsæter et al. (2015), pp. 2-3.

Table 1: Input-oriented R&D incentives in the OECD, 1991-2014; Source: IBFD (1991-2004), IBFD (2005-2014), Thomson (2013), Ernst and Spengel (2011), own research.

Country	Year	Capitalisation of R&D exp.	Tax Credit Vol.	Tax Credit Incr.	Super Deduction Vol.	Super Deduction Incr.	Acc. Depr.	Reduction WWT
AT	1991-1999				x			
	2000-2005				x	x		
	2006-2010		x		(x)	(x)		
	2011-2014		x					
AU	1991-1995				x		x	
	1996-2000				x			
	2001-2011				x	x		
	2012-2014		x					
BE	1991-2005				x		x	
	2006				x		x	x
BE	2007-2014		(x)		x		x	x
CA[26]	1991-2013		x				x	
	2014		x					
CH18	1991-2014							
CL	2013-2014		x				x	
CN	2008-2014				x			
CZ	2005-2013				x			
	2014				x	x		
DE	1991-2014							
DK	1991	10 yrs					x	
	1992-1997						x	
EE	1993-1999	5 yrs						
	2000-2014						x[27]	
ES	1991-2014		x	x			x	
FI	1991-2012						x	
	2013-2014				x		x	
FR	1991-2003			x				
	2004-2007		x	x				
	2008-2014		x					
GB	1991-2001						x	
	2002-2012				x		x	
	2013-2014		x		(x)		x	
GR	1991-2004						x	
	2005-2012					x	x	
	2013-2014				x		x	
HU	1991-1996						x	
	1997-2004				x		x	
	2005-2011		x		x		x	
	2012-2014				x		x	

(Continued)

Table 1—continued

Country	Year	Capitalisation of R&D exp.	Tax Credit Vol.	Tax Credit Incr.	Super Deduction Vol.	Super Deduction Incr.	Acc. Depr.	Reduction WWT
IE	1991-2003						x	
	2004-2014		x	x			x	
IL	1994-2014						x	
IS	2011-2014		x					
IT	2007-2009		x					
	2010		x		x			
	2011-2014		x					
JP	1991-2002			x				
JP	2003-2014		x	(x)				
KR	1991-1997		x	x				
	1998-2014		(x)	x				
LU	1998-2014						x	
MX	1991-1996						x	
	1997-2001			x			x	
	2002-2009		x				x	
NL	1991-1993	5 yrs						
	1994-2006	5 yrs						x
	2007-2011							x
	2012-2014				x			x
NO	2003-2014		x					
NZ	2009		x					
PL	1991-2014							
PT	1997-2003		x	x				
	2005-2014		x	x				
SE	1991-2014							
SI	1994-2001						x	
	2006-2008				x			
	2009-2014				x		x	
SK	1991-2014							
US	1991-2014			x				

16 countries) and super deductions (now nine countries) increased considerably while the amount of accelerated depreciation remained nearly the same (now twelve countries). Two countries also implemented an incentive targeting wage withholding taxes (Belgium and the Netherlands). Only five out of the 34 countries observed (Switzerland[28], Germany, Poland, Sweden and the Slovak Republic) never offered any kind of input-oriented R&D incentive.

In most countries, R&D tax incentives were subject to several adjustments over the observed period of time. In Belgium, Spain and Korea the rate and basis applicable were changed up to eight times since the introduction of the respective schemes. Canada, Finland, France, Ireland, Norway and the USA on the other hand show more stability in their R&D incentive tax system. In those countries the input-oriented incentive schemes lasted more than ten years before changes were made.

In general, fiscal R&D incentives grew more popular over the years. Regarding the design and continuity of the input-oriented R&D incentive schemes a great variety can be observed in the sample.

The data on IP box regimes in Table 2 was mainly compiled from the IBFD country analyses and Evers et al. (2015).

[28] For Canada and Switzerland only incentives on the state level are taken into account. On the pro- vincial/ cantonal level, additional incentives exist.

Table 2: Output-oriented R&D incentives in the OECD, 1991-2014; Source: IBFD (1991-2004), IBFD (2005-2014), Evers et al. (2015), own research.

Country	Year	Incentive
BE	2007-2014	80% reduction of tax base
ES	2008-2014	60% reduction of tax base
FR	2000-2010	15.495% tax rate
	2011-2014	16.245% tax rate
HU	2003-2014	50% reduction of tax base
IE	1973-2010	0% tax rate
LU	2008-2014	80% reduction of tax base
NL	2007-2009	10% tax rate
	2010-2014	5% tax rate
PT	2014	50% reduction of tax base
GB	2013-2014	10% tax rate

The introduction of output-oriented R&D incentives mainly started post-millennial; the systems grew in popularity over the years. As of 2014, eight of 34 countries offer regimes with significantly reduced tax rates or a reduction of the tax base for eligible intellectual property income. Ireland stands out as the only country which discontinued its system where eligible income was fully tax exempt; it was in place from 1973 until 2010.

3.2. Overview of B-Index

As already mentioned in chapter 2.2, the B-Index serves as a quantitative measure of the generosity of the R&D tax incentive system of a country. Table 3 shows the values of the B-Indices for all the years and countries considered in this thesis[29]

The B-Index is calculated based on the formulas listed in chapter 2.2 and the data on input-oriented R&D incentives displayed in Table 1.[30] The discount rate is held fixed at 10% across all countries and years.[31] The cost types are weighted with w_L=0.6, w_{OC}=0.3 , w_{ME}=0.05 and w_B=0.05. This standard is commonly used for the calculation of the B-Index[32] and is a simplification of the weights determined in industrial surveys.[33] It is assumed that the R&D investments are conducted in-house in the resident country of the corporations. R&D incentives available on a sub-national level[34] or subject to size limits, i.e. fiscal incentives aimed at SMEs, are not modeled. As for the depreciation schedules, if no specific rules apply straight-line depreciation with a useful life of 7 years for machinery and equipment and 40 years for buildings was assumed.

3.3. Qualitative analysis

As the B-Index measures the generosity of a country's R&D tax system, it reflects the changes in the input-oriented R&D incentives, depreciation rules and tax rates. A B-Index of 1 implies that a corporation has to generate 1 unit of before-tax income to break even for the additional investment. For values greater than 1, companies have to earn more income than the 1 unit invested to compensate for the tax burden. If the B-Index lies below 1, the favorable tax treatment leads to a situation where a corporation has to earn less than the initial investment to break even.[35] E.g. in 2003, a German company would have had to earn EUR 1.03 million to offset an additional R&D investment of EUR 1 million while an Austrian company only would have had to generate EUR 0.88 million to break even.

In Figure 1, the mean values of the B-Indices, differentiated by the four cost types (machinery and equipment (ME), buildings (B), labor (L), other current costs (OC)) are displayed.[36] The B-Indices concentrate on the fiscal R&D incentives relevant for the respective cost type, as the majority of incentive schemes do not apply to all R&D expenditure incurred by a company.

Overall, the B-Indices drop considerably over time. The total mean value decreases by 0.15 from 0.99 in 1991 to 0.84 in 2014.

The mean B-Indices for buildings show substantially higher values compared to every other cost type. For buildings, the mean amounts to 1.35 in 1991 while the mean for

[29] Table A - 4 in the appendix shows the components of the B-Index attributable to the separate ex- penditure types.

[30] A more detailed version of Table 1 is displayed in the appendix (Table A - 1). Please also refer to the appendix for the depreciation schedules (Table A - 2) and the corporate income tax rates (Table A - 3) used for the calculation.

[31] This is consistent with Warda (2001), p.193 and Thomson (2013), p. 5.This is consistent with Warda (2001), p.193 and Thomson (2013), p. 5.

[32] See e.g. Warda (2001), p. 189, Ernst and Spengel (2011), p. 29, Thomson (2013), p. 4.

[33] See e.g. Cameron (1996), p. 216.

[34] This is relevant in the case of Canada and Switzerland, where some of the states respective cantons provide fiscal R&D incentives in addition to incentive schemes on the national level.

[35] See Warda (2001), p. 190.

[36] For the underlying values, please refer to Table 3 in the preceding chapter and Table A - 4 in the appendix.

Table 3: Total B-Indices in the OECD, 1991-2014; Source: Own calculations.

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
AT	0.95	0.95	0.95	0.94	0.94	0.94	0.94	0.94	0.94	0.88	0.88	0.88
AU	0.72	0.72	0.79	0.79	0.76	0.76	0.89	0.89	0.89	0.90	0.87	0.87
BE	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
CA	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.83	0.83
CH	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
CL										1.01	1.01	1.01
CN											1.02	1.02
CZ			1.04	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02	1.02
DE	1.05	1.05	1.05	1.04	1.04	1.05	1.05	1.05	1.04	1.04	1.03	1.03
DK	1.18	1.00	1.00	1.00	1.00	1.00	1.00	1.02	1.02	1.02	1.02	1.02
EE			1.10	1.06	1.06	1.06	1.06	1.06	1.06	1.00	1.00	1.00
ES	0.70	0.70	0.70	0.70	0.70	0.65	0.65	0.65	0.65	0.48	0.69	0.69
FI	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
FR	0.91	0.92	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.92	0.92	0.92
GB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90
GR	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.02	1.02	1.01	1.01
HU	1.03	1.03	1.03	1.02	1.01	1.01	0.97	0.97	0.97	0.81	0.81	0.81
IE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IL				1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.00	1.00
IS	1.04	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01	1.01
IT	1.04	1.05	1.05	1.05	1.05	1.05	1.05	1.03	1.03	1.03	1.03	1.03
JP	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01	1.01	0.98	0.98	0.98
KR	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.88	0.88	0.88	0.88	0.88
LU	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.01
MX	1.02	1.02	1.02	1.02	1.02	1.02	0.97	0.97	0.97	0.97	0.97	0.55
NL	1.10	1.10	1.10	1.04	1.04	1.04	1.04	1.01	1.03	1.03	1.04	1.04
NO	1.04	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
NZ	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
PL	1.04	1.04	1.04	1.04	1.04	1.04	1.03	1.03	1.03	1.02	1.02	1.02
PT	1.02	1.02	1.02	1.02	1.02	1.02	0.83	0.83	0.83	0.84	0.65	0.66
SE	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
SI				1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
SK			1.04	1.03	1.03	1.03	1.03	1.03	1.03	1.02	1.02	1.02
US	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
AT	0.88	0.88	0.92	0.92	0.92	0.92	0.92	0.92	0.88	0.88	0.88	0.88
AU	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.48	0.48	0.48
BE	1.01	1.01	1.01	0.75	0.74	0.74	0.62	0.62	0.62	0.62	0.60	0.60
CA	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.82	0.82	0.82	0.82	0.88

(Continued)

Table 3—continued

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
CH	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
CL	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	0.65	0.66
CN	1.02	1.02	1.02	1.02	1.02	0.84	0.84	0.84	0.84	0.84	0.84	0.84
CZ	1.02	1.02	0.68	0.72	0.72	0.76	0.78	0.79	0.79	0.79	0.79	0.77
DE	1.03	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02
DK	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
EE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ES	0.69	0.60	0.60	0.60	0.64	0.68	0.68	0.68	0.68	0.68	0.68	0.68
FI	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	0.81	0.86
FR	0.92	0.85	0.85	0.79	0.79	0.94	0.94	0.94	0.94	0.94	0.94	0.94
GB	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.91	0.91	0.91	0.91
GR	1.01	1.01	0.92	0.92	0.93	0.93	0.93	0.93	0.93	0.93	0.64	0.64
HU	0.81	0.84	0.77	0.75	0.71	0.71	0.71	0.72	0.72	0.80	0.80	0.80
IE	1.00	0.97	0.95	0.94	0.92	0.91	0.90	0.85	0.84	0.83	0.82	0.81
IL	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IS	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	0.76	0.76	0.76	0.76
IT	1.03	1.03	1.03	1.03	0.87	0.87	0.87	0.87	0.87	0.71	0.71	0.71
JP	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
KR	0.91	0.91	0.91	0.91	0.91	0.83	0.77	0.91	0.91	0.91	0.91	0.91
LU	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
MX	0.56	0.57	0.58	0.59	0.60	0.60	0.60	0.58	0.58	0.58	0.58	0.58
NL	1.04	1.04	1.03	1.02	0.96	0.96	0.96	0.96	0.94	0.90	0.88	0.88
NO	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
NZ	1.02	1.02	1.02	1.02	1.02	1.02	0.82	1.02	1.02	1.02	1.02	1.02
PL	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
PT	0.66	1.01	0.66	0.66	0.67	0.67	0.67	0.51	0.49	0.47	0.47	0.47
SE	1.02	1.02	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01
SI	1.01	1.01	1.01	0.95	0.96	0.96	0.96	0.96	0.96	0.80	0.81	0.81
SK	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
US	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02

machinery and equipment amounts to 1.05 at the same point in time. The main reason for this are the unfavorable depreciation rules for buildings, as the majority of countries limits the annual depreciation to a depreciation time over ten to 50 years. Only six out of 34 countries grant accelerated depreciation for buildings at some point in time. Here the applicable useful life varies between five years or immediate deduction. Because the B-Index formula also relies on the concept of the time value of money, depreciation expenditure is worth more the sooner it is deductible from the tax base. Therefore, the longer the government sets the period of time over which the invested amount has to be depreciated, the higher the resulting B-Index (and the more expensive the investment) gets. In general, the useful life of buildings determined for tax purposes decreased over the years. This results in declining B-Indices. In addition, only twelve out of 34 countries grant input-oriented fiscal R&D incentive schemes that apply to the full expenditure or the depreciation on buildings. Eight of those countries introduced their regimes after 2001, leading to a further decline in the mean value of the B-Index for buildings. Overall, the B-Index drops from 1.35 in 1991 to 1.15 in 2014.

For machinery and equipment, the R&D incentive regimes are more favorable. 15 out of 34 countries allow for depreciation over three years up to immediate deduction, as opposed to normal schedules with a useful life between three to 20 years. Here, input-oriented R&D incentives are available in 21 out of 34 countries. The majority of the regimes (15 of 21)

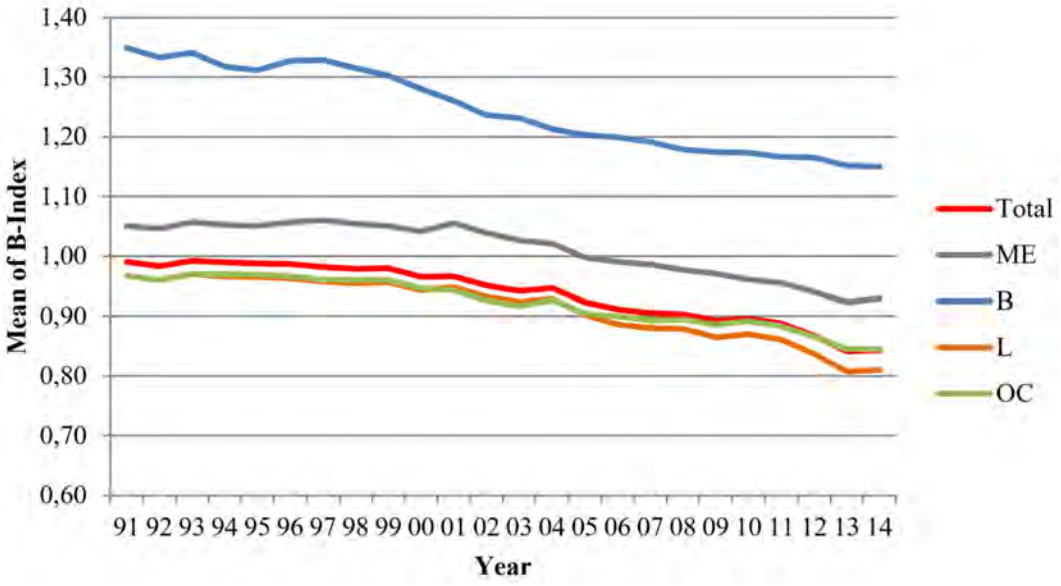

Figure 1: Development of B-Indices by cost type in the OECD, 1991-2014; Source: Own presentation.

was introduced after 2001, resulting in a decreasing mean B-Index in the subsequent years. In 2014, the mean B-Index for machinery and equipment amounts to 0.93 compared to 1.05 in 1991.

Considered over the whole time period, the mean B-Indices for labor and other current costs are always located below the 1.00-line. Only three countries require mandatory capitalization for R&D costs in the earlier years of the sample; from 2007 onwards this expenditure can be immediately deducted.[37] With 25 out of 34 countries offering fiscal R&D incentives, the majority of the regimes do not differentiate between labor and other current costs but do apply to current costs in general. However, in particular since 2006 the two curves disentangle. In 2005, the mean B-Indices for labor and other current costs are equal, nine years later the mean B-Index for labor amounts to 0.04 less than the mean B-Index for other current costs. The main reason for this development are the introduction of the wage withholding tax reduction in Belgium in 2006, the limitation of the Italian tax credit to R&D wages in 2012 and the introduction of the super deduction for R&D wages in Finland from 2013 onwards. Altogether, the B-Indices follow the trend of declining values with a B-Index for current costs of 0.97 in 1991 and B-Indices for labor and other current costs of 0.81 and 0.85 in 2014.

Figure 2 shows the development of the total B-Indices of the sample considered in this thesis.[38] Although it is difficult to differentiate the development of the B-Index of an individual country in the graph, Figure 2 gives an impression of the diversity of input-oriented fiscal R&D tax incentives across time as well as across countries. The volatility of the B-Indices reflects the variety of the underlying R&D tax regimes.

Only ten out of 34 countries remain in the area with a B-Index equal to or above 1. The five countries that do not offer any fiscal R&D incentives (Switzerland, Germany, Poland, Sweden and the Slovak Republic) account for half. Denmark, Estonia, Israel and Luxembourg offer accelerated depreciation schedules for R&D assets which reduce the B-Index down to 1 if the assets can be immediately depreciated. As there are no other input-related R&D incentives available, the respective B-Indices do not drop below the 1.00-line. In the case of the US a tax credit is available for the full period of time, but according to the calculations this tax advantage does not fully compensate for the disadvantages of the applicable depreciation schedules. If the ten countries in the top are excluded, the mean value of the total B-Index descends sharply by 0.2 from 0.97 in 1991 (compared to 0.99) to 0.77 in 2014 (compared to 0.84).

In all the other countries offering tax credits, super deductions or wage withholding tax reductions corporations benefit from a favorable tax treatment where the break-even point lies below the initial investment of 1. Depending on the generosity of the fiscal R&D incentive schemes, the B-Indices range between 0.97 and 0.47.

In the following, selected countries will be considered more in detail. Figure 3 depicts the development of the total B-Index in Portugal, Australia and France.

The graph clearly reflects the tax policy changes in Portugal over the years. Depreciation schedules remain constant over the whole period. In 1997, the tax rate was reduced from 39.6% to 37.4%. In addition, a new tax credit scheme was introduced with a volume credit of 8% and an incremental credit of 30% on current costs. This lead to a drop in the B-Index from 1.02 to 0.83. Subsequent reductions in

[37] Please refer to chapter 2.2, footnote 15 for further information about the capitalization of R&D expenditure and the assumptions made in this thesis.

[38] For the underlying values, please refer to Table 3 in the preceding chapter.

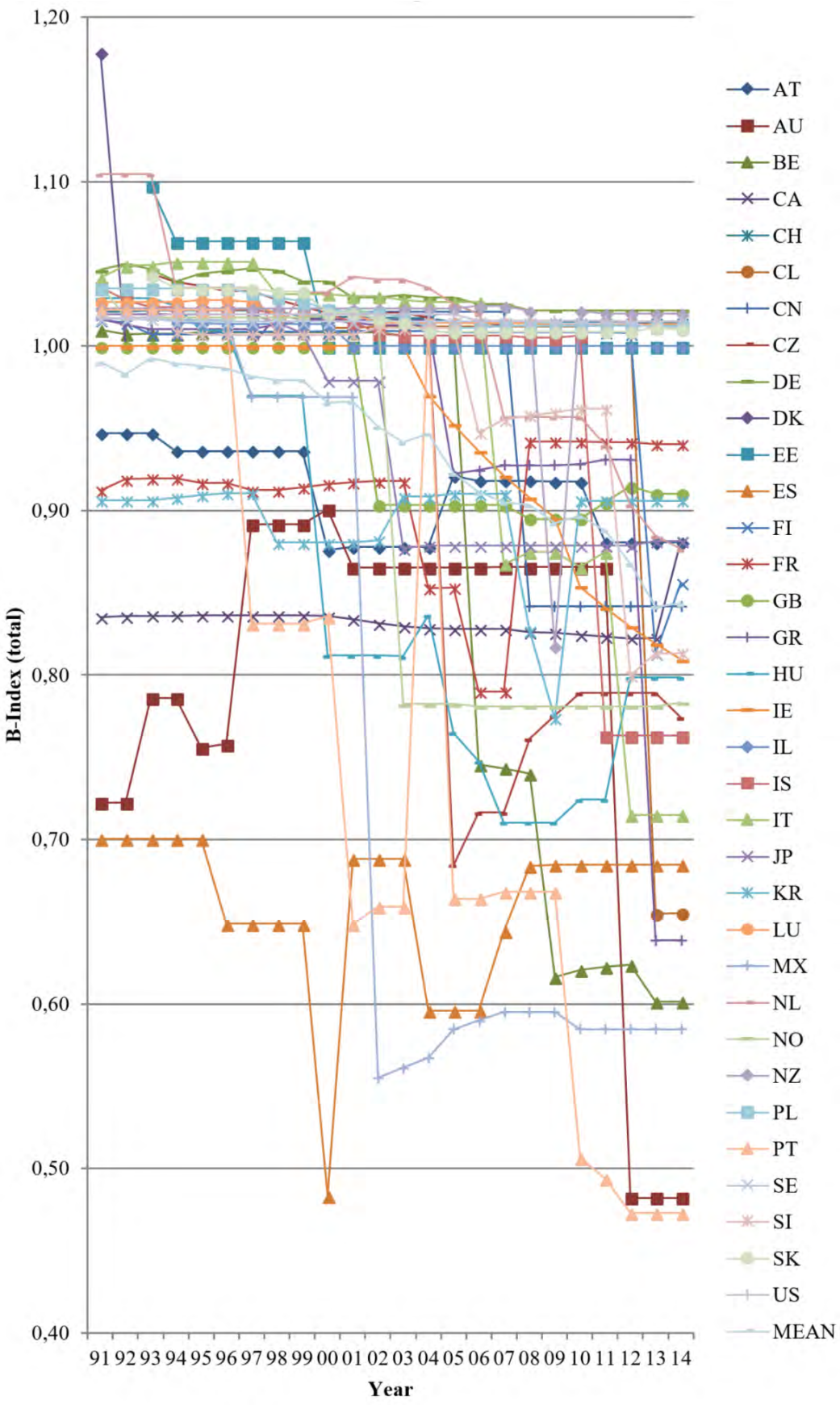

Figure 2: Development of B-Indices (total) in the OECD, 1991-2014; Source: Own presentation.

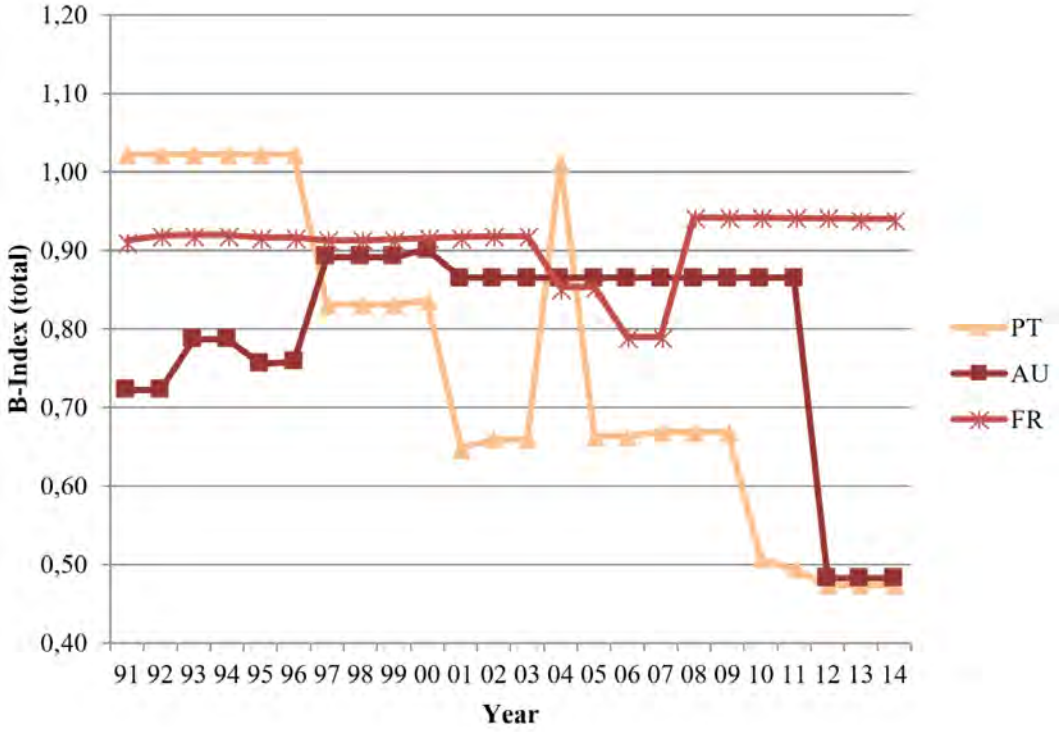

Figure 3: Development of B-Indices (total) in selected countries, 1991-2014; Source: Own presentation.

the corporate income tax rate to 35.2% in 2000 resulted in a slight increase to 0.84. In 2001, the tax credit rates were increased to 20% and 50%, resulting in a B-Index of 0.65. Further reductions of the corporate income tax rate to 33% in 2002 slightly increased the B-Index to 0.66. A high peak in 2004 (B-Index: 1.01) marks the reduction of the tax rate to 27.5%. and the abolishment of the tax credit regime. A similar scheme, now expanded to expenditure on machinery and equipment, reduced the B-Index again to the former level at 0.66. In 2007, the tax rate further decreased to 26.5% (B-Index: 0.67). In the following years, increases in corporate income tax rates (from 28.5% in 2011 to 31.5% from 2012 onwards) and tax credit rates (32.5% and 50% in 2010) let the B-Index decline to a value of 0.47 for 2012 to 2014. This makes the Portuguese tax credit in its form from 2012 onwards the most generous fiscal R&D incentive regime in all countries and years considered in this thesis.

Over the time period observed, the depreciation rates for machinery and equipment in Australia were subject to small changes in 1996 and 2007, which had no considerable effect on the B-Index. This is due to the assumed cost structure, as depreciation of machinery and equipment and depreciation of buildings only account for 5% each in the B-Index formula. From 1991 to 1997, Australia had a volume incentive scheme in place with a super deduction of 50% on current costs and the expenditure on machinery and equipment. Tax rate changes in 1993 (from 39% to 33%) and 1995 (from 33% to 36%) caused variations in the B-Index from 0.72 to 0.79 to 0.76. In 1997, the super deduction rate was cut in half to 25%, resulting in a jump in the B-Index by 0.13 to 0.89. A tax rate reduction in 2000 from 36% to 34% further increased the value to 0.9. The tax rate was again reduced in 2001 to 30%, but at the same time a 75% incremental regime was added to the super deduction, overcompensating for the tax rate change and setting the B-Index to 0.87. The B-Indices remained stable over the following years, until in 2012 the super deduction regime was abandoned and a tax credit scheme was introduced. The 40% tax credit resulted in a reduction of the B-Index down to 0.48.

In other countries where a super deduction regime was replaced by a tax credit scheme (Austria in 2006, Belgium in 2007, United Kingdom in 2013) the B-Index stayed constant or increased slightly. Therefore the substantial reduction in the Australian case cannot be generalized. Whether or not a super deduction regime is more or less favorable than a tax credit regime always depends on the design of the regimes before and after the change with regards to basis, rate and additional factors like the tax rates.

At first sight, France differs from all other countries in the sample. It is the only country where the development of the B-Indices shows a slight upwards trend, as displayed in Figure 3. The figure indicates three major changes. From 1991 to 2003, France applied an incremental tax credit regime with a 50% rate for current costs and the depreciation on machinery and equipment and buildings. In 2004, the tax credit was divided into a volume part of 5% and an incremental part of 45%, leading to a drop in the B-Index from 0.92 to 0.85. The tax credit rate change from 5% to 10% and 45% to 40% in 2006 further decreased the B-Index to 0.79. In 2008, an exclusively volume-based scheme was introduced. Under

the new regime, companies can claim a 30% tax credit for expenditure up to EUR 100 million, above this threshold a 5% tax credit is available. Due to the assumptions made when calculating the B-Indices, the 5% rate is applied here,[39] thus leading to an increased B-Index of 0.94. If the 30% rate were applied, the value of the B-Index from 2008 to 2014 would amount to 0.55, thus following the overall downwards trend throughout the sample.

As can be seen from the precedent examples, changes in the tax rate have a small impact on the B-Index. Decreasing tax rates lead to slightly increasing B-Indices and vice versa. A possible explanation could be that the value of the output-oriented fiscal R&D incentives decreases with decreasing tax rates. For example in case of a double deduction, at a 40% tax rate a company saves 40 cents on every dollar invested. If the tax rate is reduced to 30%, the tax savings drop to 30 cents on every dollar invested. Alterations regarding the tax incentive regimes tend to have a much bigger influence, depending on the size of the changes. To evaluate whether changes in the tax system have a positive or negative impact on the B-Index of a country all variables have to be taken into account as a change in tax rates can be overcompensated by simultaneous changes in the incentive regime.

It is also important to keep the methodology of the B-Index and the underlying assumptions in mind when considering the calculated values. E.g. for Canada and Switzerland, sub-national fiscal R&D incentives are disregarded, which tends to result in an overestimate for the respective B-Indices. In turn, where companies are bound by ceilings, B-Indices might be overestimated. In addition, the B-Index only includes input-oriented R&D incentives. Countries that do not offer tax credits, super deductions, accelerated depreciation or reductions of wage withholding taxes might incentivize corporate R&D activity with other measures, like direct grants or output-oriented measures.

All in all, over the years a significant increase in the generosity of input-oriented fiscal R&D incentives can be observed across all cost types. Due to the negative effect of depreciation rules, the values of the B-Indices for buildings and machinery and equipment lie above the values of the B-Indices for labor and other current costs. The majority of countries have an overall B-Index below 1. Within the sample, the development of the B-Indices is subject to sizable variations. This applies to comparisons across time as well as across countries. The B-Indices remain roughly constant over time only for a small fraction of the countries considered, where most of those countries do not offer any input-oriented R&D incentive at all.

4. Quantitative analysis of the effectiveness of fiscal R&D incentives

4.1. Literature review

Input-oriented R&D tax incentives have existed for a long time, therefore numerous empirical studies have been conducted that investigate their effects and effectiveness with regards to the promotion of R&D investment. Among those, a few use the B-Index introduced by Warda (2001) as a main independent variable of interest.

Guellec and de la Potterie (2000) investigate the effect of several measures of government funding, among them the B-Index as a proxy for fiscal incentives. Their study covers 17 countries for the 1983-96 period. They find a significant negative impact of the B-Index on privately funded R&D. The negative impact increases with a one-year time lag. However, the effect gets substantially smaller and insignificant for a time lag of two and more years. They conclude that fiscal incentives have a rather short-term impact.

Falk (2006) studies the factors influencing business-sector R&D intensity in a panel of 21 OECD countries from the time period 1975 to 2002. As dependent variable, he uses five-year averages of the total expenditure on R&D in the business sector as a percentage of GDP, aggregated at country level. The B-Index as a measure for the overall generosity of R&D tax incentives is included as one of the main independent variables of interest. He finds significant negative effects of the B-Index on R&D expenditure in the business sector. This indicates that an increase in the generosity of fiscal R&D incentives (which leads to a decrease in the B-Index) leads to an increase in the amount companies spend on R&D investment, especially in the longer term.

In a study analyzing firm-level data for Spanish companies based on a 2002 survey, Corchuelo and Martínez-Ros (2010) investigate the effectiveness of fiscal R&D incentives in Spain. R&D spending over sales represent the dependent variable, R&D technological effort. The independent variable B-Index approximates the benefits a firm expects from its R&D investment. They show that the fiscal R&D incentives have a positive effect on R&D technological effort, with significant values for large firms.

Ernst and Spengel (2011) conduct a study covering 19 EU-countries plus Norway for the time period of 1998 to 2007 and firm-level data on patent applications. They use the number of patent applications to approximate the firm-specific scale of R&D investment. The yearly B-Indices are calculated for each country as a measure for the tax incentives in the R&D phase. For a binary choice whether to invest in R&D or not, they find a significant negative effect of the B-Index, i.e. a positive effect of fiscal R&D incentives in the investment probability.

Westmore (2013) carries out a macro-economic study that includes 19 OECD countries for the time period of 1983 to 2008. When investigating the relationship between business R&D expenditure (aggregated at country-level) and the B-Index he finds a significant negative effect. The impact is found to be substantially larger in the long run compared to the short run.

In summary, all studies find a significant negative impact of the B-Index on R&D investment. The empirical evidence therefore indicates that input-oriented fiscal R&D incentives increase the amount companies invest in their R&D projects. Output-oriented R&D incentives started to grow in popular-

[39] Please also refer to Table A - 1 and the related notes in the appendix.

ity over the last decade. Given the rather brief period of time IP boxes existed, empirical evidence on their effects is rare. Studies in this field mostly concentrate on the relationship of IP boxes and the number of patent applications as well as the location of patents. Ernst and Spengel (2011) find a negative effect of tax rates on the number of patent applications and suggest that decreasing tax rates will lead to increasing patent applications. Bradley et al. (2015) also find a significant increase in patent applications after the introduction of IP boxes. However, they note that a major part of this development could be tied to the patenting of already existing innovations that had not been patented before (as opposed to new innovations). Evers et al. (2015) find that IP boxes lead to a substantial reduction in effective average tax rates (EATRs) and, depending on the design, reduce the cost of capital of R&D projects. However, they suggest that the incentivisation to increase real R&D investment may be obstructed by tax planning strategies via the movement of mere book profits. Karkinsky and Riedel (2012) suggest that, overall, multinationals tend to locate patents in low-tax countries. This finding is supported by Griffith et al. (2014), who add that the sensitivity to tax policy changes varies depending on the country. To the best of my knowledge, there currently exists no empirical evidence that IP boxes have a significant effect on R&D investment.[40]

4.2. Empirical data and descriptive statistics

As described above, the purpose of this section is to investigate the effect of fiscal R&D incentives on R&D investment. Therefore, R&D expenditure is established as the dependent variable. The data stems from the Research and Development Statistics from the OECD Database. In this dataset, R&D expenditure is aggregated at the country-level and displayed in different segments. For the analysis, business enterprise R&D expenditure (BERD) by industry and by type of cost is used, denoted in 2010 dollars with constant prices and purchasing power parity (PPP)[41]. The total BERD is sub-divided into six industry sectors: firstly agriculture, hunting, forestry and fishing (from here on denoted as agriculture), secondly mining and quarrying (from here on denoted as mining), thirdly manufacturing, fourthly electricity, gas and water supply (from here on denoted as electricity), fifthly construction and lastly services sector.[42] This data is complemented by BERD by industry by main activity, applying the same denotation as the basis data set. Where missing values were added, I checked that the numbers that were available in both data sets for the respective countries matched. The data on BERD by industry is collected for 34 different countries over the period 1991-2014.

The first main variable of interest are input-oriented fiscal R&D incentives, represented by the B-Index. This methodology is also used in other empirical studies to measure input-oriented fiscal R&D incentives, e.g Falk (2006), Corchuelo and Martínez-Ros (2010), Ernst and Spengel (2011), Westmore (2013) and Bösenberg and Egger (2017). The particular values used in the analysis are those calculated based on the methodology presented in the preceding chapters.[43] A decrease in the B-Index represents more generous tax incentives, therefore I expect an increase in R&D investment.

The second main variable of interest are output-oriented fiscal R&D incentives, represented by a dummy variable that takes the value of 1 if an IP box regime exists and the value of 0 otherwise. Table 2 in chapter 3.1 is used as basis for the dummy variable. In line with the existing empirical literature already mentioned in the preceding chapter, I do not expect significant effects of IP boxes on R&D expenditure.

Several country-specific control variables are applied. Firstly, the corporate income tax rates (CIT) control for the location decision of MNEs, as applied by Ernst and Spengel (2011). The CIT stems from the OECD Tax Database, Table II.1. The tax rates used in the analysis are combined corporate income tax rates which include central and regional statutory tax rates. As especially for the period 1991 to 1999 not all tax rates are available, the data is complemented with tax rates provided by the IBFD in its annual European Tax Handbook. As higher tax burdens decrease the capital available for investment, a negative effect on R&D investment is expected.

GDP per capita is used as a control for living standard, following Lederman and Maloney (2003) who found that a higher level of development is associated with more R&D investment. The relevant data is taken from the National Accounts from the OECD database. The GDP per head is denoted in 2010 dollars with constant prices and PPP.[44]

The population controls for country size, as applied by Ernst et al. (2014). The numbers were taken from the estimates of the total population by major area, region and country in the 2015 Revision of World Population Prospects provided by the UN Population Division.[45]

The number of students enrolled in tertiary education divided by population covers effects from human capital, as suggested by Bebczuk (2002). The required data on students is provided by the OECD Education and Skills Database where students enrolled by type of institution are accounted for up to 2012. The data on population stems from the UN, as already explained above. A higher level of human capital is expected to be associated with more R&D investment.

To account for property protection,[46] the property index of the index of economic freedom, provided by the Heritage

[40] See also see De Rassenfosse (2015), p. 15, Alstadsæter et al. (2015), pp. 2-3.

[41] PPPs eliminate the effects of different price levels between countries, see OECD (2007).

[42] The classification of economic activities into industries follows ISIC Rev. 3.1.

[43] Please refer to Table A - 4 in the appendix.

[44] Availableunderhttps://stats.oecd.org/Index.aspx?DataSetCode=GERD_FUNDS.

[45] Availableunderhttps://esa.un.org/unpd/wpp/Download/Standard/Population/.

[46] See e.g. Karkinsky and Riedel (2012) that also use the index of economic freedom as a control variable.

Foundation, is included.[47] The index appoints a score from 0 (private property is outlawed) to 100 (private property is guaranteed and protected)[48] to each country and is available for the years 1995 to 2014 in the sample. As the index varies only marginally, the values appointed in the earliest year available are assumed for the preceding years for the purpose of the analysis. The protection of property rights, which also includes intellectual property, guarantees a company the possibility to exploit the results of its investment. Therefore, a positive effect of property protection on R&D investment is expected.

In addition, year- and country-fixed effects are included.

In Table 4, the variables are summarized. With a sample of 34 countries over a period of 24 years, a maximum of 816 observations can be reached for each variable. The regression is mainly limited by the data for R&D expenditure, with only 576 observations for total R&D expenditure and even less observations if sub-divided into the industries. The values differ considerably across countries and time, especially for the total, manufacturing and services sector. Due to the high numbers a logarithm is applied for purpose of the analysis. The total B-Indices range between 0.936 and 1.179, with the values for the B-Indices for machinery and equipment and buildings being considerably higher than for labor and other current costs. Since the availability of data on CITs limits the number of B-Index that can be calculated, the variables have an equal amount of observations.

4.3. Estimation strategy

To capture the effect fiscal R&D incentives on R&D investments, the ordinary least squares (OLS) method is applied. The estimating equation is given by

$$\begin{aligned} ln(R\&D_total)_{it} =& \beta_1 * B_Index_total_{it} + \beta_2 * IP_Box_{it} \\ &+ \beta_3 * CIT_{it} + \beta_4 * ln(GDPpCap)_{it} \\ &+ \beta_5 * ln(Population)_{it} \\ &+ \beta_6 * StudentsspCap_{it} \\ &+ \beta_7 * PropertyProtection_{it} \\ &+ \alpha_i + \lambda_t + \epsilon_{it} \end{aligned} \tag{13}$$

where subscript i denotes the ith country (i = 1, ..., 34) and subscript t denotes the tth period (t = 1, ..., 24). R&D_total$_{it}$ is the aggregated business sector R&D expenditure in country i in year t. If particular industries are considered, in formula 13 R&D_total$_{it}$ is replaced by R&D_agriculture$_{it}$, R&D_mining$_{it}$, R&D_manufacturing$_{it}$, R&D_electricity$_{it}$, R&D_construction$_{it}$ and R&D_servicesector$_{it}$. B_Index_total$_{it}$ represents the generosity of input-oriented fiscal R&D incentives. If particular expenditure types are considered, B_Index_total$_{it}$ is replaced by B_Index_ME$_{it}$, B_Index_B$_{it}$, B_Index_L$_{it}$ and B_Index_OC$_{it}$. IP_Box$_{it}$ denotes a dummy for the existence or absence of IP box regimes in a given country i and year t. CIT$_{it}$, GDPpCap$_{it}$, Population$_{it}$, StudentspCap$_{it}$ and PropertyProtection$_{it}$ account for the control variables listed in Table 4. The terms α_i and λ_t are country- and time-fixed effects respectively. ϵ_{it} denotes white noise.

4.4. Results

4.4.1. Baseline results

Table 5 presents the main regression results by industry sector. For each sector, the regression is run three times: In the first and second column, the total B-index and the IP box dummy are regressed separately, each time only with country- and year-fixed effects. In the third column, both main independent variable of interest are regressed, this time with the full set of control variables.

Consistent with past studies, the results suggest a negative effect of the B-Index on R&D investment. The effects are significant at the 5%-level for total BERD and in the services sector and at the 10%-level in the manufacturing sector. In the other four sectors the relationship is insignificant. This indicates that sectors matter with regards to the effects of input-oriented fiscal R&D incentives. Similarly, Castellacci and Lie (2015) find in their meta-study that, compared to other sectors, R&D investment in the services sector increases at a significantly higher rate in response to the introduction of tax credits. They argue that companies in the services sector have in general a lower R&D intensity, thus it is easier for them to increase their R&D investment compared to companies that already maintain a high R&D expenditure level.

Quantitatively, the β_1 of -0.87 in case of total R&D expenditure indicates that a reduction in the B-Index by 0.10 (i.e. a 1 dollar investment in R&D has to earn 10 cent lower pre-tax income to reach the break-even point) increases total BERD by 8.7%. On the industry level, the effects have similar magnitudes with an expected increase in industry-specific BERD of 8.8% and 7.9% in the manufacturing and the services sector, respectively. In comparison, Guellec and de la Potterie (2000) and Falk (2006) find substantially lower short-run elasticities of -0.16 and -0.22, respectively. Both use older time periods (1983-1996 and 1975-2002, respectively) and fewer countries (17 and 21, respectively). Therefore, the difference could be attributed to the more recent and extended sample. The insignificant effects for IP boxes are in line with the expectations. It suggests that the introduction of IP box regimes indeed has no influence on the level of business R&D expenditure in a country. Alstadsæter et al. (2015) list several possible reasons. For one, the award of successfully patented innovations discriminates commercially less exploitable but socially potentially more advantageous research. In addition, patent box regimes do not link the tax savings to R&D investment.[49]

[47] Available under http://www.heritage.org/index/explore?view=by-region-country-year. This index was used to account for property protection as the more widely used Ginarte-Park index of patent rights is only available up to 2005, see Park (2008).

[48] See Heritage Foundation (2017).

[49] See Alstadsæter et al. (2015), p. 3.

Table 4: Descriptive statistics; Notes: "log" indicates that the variable is put in natural logarithm in the regression.

Variable	Obs	Mean	Std. Dev.	Min	Max	Scale
R&D Exp (in 2010 dollars, constant prices and PPPs)						
- Total	567	18,290.350	44,222.330	17.726	296,465.700	log
- Agriculture	391	49.104	74.518	0.003	418.099	log
- Mining	373	140.238	371.693	0.013	3,005.693	log
- Manufacturing	506	15,030.340	34,253.330	11.617	208,018.900	log
- Electricity	414	134.320	200.827	0.031	1,025.707	log
- Construction	403	181.569	372.681	0.034	1,888.687	log
- Services	497	4,148.760	12,941.800	3.244	95,258.890	log
Variable	Obs	Mean	Std. Dev.	Min	Max	Scale
B-Index						
- Total	785	0.936	0.126	0.473	1.179	
- ME	785	1.011	0.143	0.437	1.267	
- B	785	1.243	0.186	0.714	1.827	
- L	785	0.912	0.138	0.335	1.199	
- OC	785	0.921	0.133	0.429	1.199	
IP box (Dummy Variable)	816	0.098	0.298	0.000	1.000	
CIT (0 - 1 scale)	785	0.310	0.081	0.125	0.582	
GDP per capita (in 2010 dollars, constant prices and PPPs)	805	31,718.690	13,637.680	1,601.623	90,628.360	log
Population (in thousands)	816	70,300.000	218,000.000	257.387	1,370,000.000	log
Students in tert. education per capita	648	0.238	0.038	0.001	0.349	
Property Protection Index (0 - 100 scale)	816	77.249	16.519	20.000	95.000	

There is mixed evidence on the relationship between the R&D expenditure and the CIT of a country. In the manufacturing sector, the results suggest a positive effect, while in the electricity sector a strong negative impact, which was originally expected, is found. Nevertheless, both effects are only significant at the 10%-level. For the log GDP per capita and the number of students in tertiary education per capita, significant positive effects are only found in the manufacturing sector. The direction of the effect is consistent with the expectations in both cases. However, the results in the other sectors show mixed algebraic signs for the two variables. The log population is significantly positively related to BERD as well for the total across sectors as for three out of the six sectors. In case of the total R&D expenditure the results is even significant on a 1%-level. As for the property protection index, the results show a rather small significant positive relationship on a 10%-level in the agriculture sector, the effect is insignificant and also small in all other sectors.

In every sector, the adjusted R-squared shows that the estimation improves when the control variables are added. In the specification with the total business-financed R&D investment as well as BERD in the manufacturing and the services sector, the values lie between 56% and 75%. However, in the other four of the industries (agriculture, mining, electricity, construction), the adjusted R-squared is low in comparison, amounting to values between 6% and 17% with controls added. This seems to indicate that in the four industries mentioned other influences exist that have not been included in the analysis. Significant effects of fiscal R&D incentives are only observed in the two sectors where the explained variance is comparably high. It might be possible that, by controlling for the missing influence factors in the four sectors mentioned above, significant results can be obtained in more sectors. Determining those control variables remains a question for future research.

Overall, the results suggest that input-oriented fiscal R&D incentives have a significant negative impact on R&D investment. The magnitude of those effects seems to depend on the respective industries. I did not find significant effects with regards to output-oriented fiscal R&D incentives, i.e. IP boxes.

4.4.2. Extended analysis

To consider the case that companies only react over time to newly introduced R&D incentives, I repeated the regression with a lagged BERD. The repetitions were conducted with a lag of one, two and five years (Table 6).

First, the magnitude and significance of the effects decreased with time. In case of the 1-year-lag, the significantly negative effect for BERD in total and in the services sector decreases, the significantly negative effect in the manufacturing sector vanishes. The results for total BERD contrast with Guellec and de la Potterie (2000), where the negative effect nearly doubles with a one-year-lag compared to the specification with no lag; both times having a significance level of

Table 5: Regression results by industry sector; Notes: *, **, and *** indicate significance at the 10, 5 and 1% level.

	Total			Agriculture			Mining			Manufacturing			Electricity			Construction			Services	
	no controls		controls	no controls		controls	no controls		controls	no controls		controls	no controls		controls	no controls		controls	no controls		controls
B-Index Total	-0.59		-0.87**	-0.98		-0.67	0.35		0.46	-0.70		-0.88*	0.01		-0.18	-0.07		0.29	-1.07**		-0.79**
IP box		-0.17	-0.10		0.14	0.10		-0.14	-0.04		-0.10	-0.12		-0.16	0.07		0.07	0.00		0.25	0.24
CIT			0.63			1.69			3.66			1.07*			-4.15*			3.94			-0.85
log GDP per capita			0.50			-1.03			-2.74			1.01***			0.64			-1.00			-0.08
log Population			2.87***			3.97			10.25**			2.07*			5.81**			6.99			0.91
Students in tert. education per capita			1.52			2.44			1.70			2.95**			1.52			-3.29			-0.63
Property Protection Index			0.00			0.02*			-0.01			-0.01			0.02			0.03			0.00
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	550	567	488	389	391	345	371	373	330	499	506	444	412	414	381	399	403	362	492	497	437
Adjusted R^2	0.59	0.56	0.72	0.03	0.03	0.06	0.03	0.03	0.13	0.45	0.42	0.56	0.03	0.03	0.10	0.08	0.07	0.17	0.69	0.65	0.75

1%. In their study they do not differentiate between industry sectors. In case of the two-year-lag, the results did not show any significant relationship, which now is in line with the findings of Guellec and de la Potterie (2000).

Guellec and de la Potterie (2000) do not find any significant effect of the B-Index on total private R&D expenditure with a four-year-lag. Again, this matches my results for total BERD in the regression with a lag of five years. In contrast, the results indicate negative effects in the mining and electricity sector, al-though only significant at a 10%-level. Interestingly, in those two sectors no significant impact was found in the original setting. With a β_1 of -2.13 (without controls) and -1.19, respectively, the effects are larger compared to the values found for the specification without a lagged variable. This is in line with Bloom et al. (2002), Falk (2006) and Westmore (2013) which all find larger long-run elasticities compared to the short-run elasticities. However, they only consider total BERD and do not differentiate between industry sectors.

All in all, the time horizon considered seems to be an important variable, too. Companies in the manufacturing and the services sector seem to react quickly to new incentives, while companies in the mining and the electricity sector need some time to adjust. However, especially when interpreting the results under consideration of a longer period in time it has to be kept in mind that fiscal R&D incentives are subject to change. Only some countries like Canada or the USA applied their incentive scheme constantly over more than ten years while for example Spain changed its system every few years.

In a third part of the analysis, I regressed the B-Indices that were calculated for the different cost types on total BERD (Table 7). In addition, the relationship of the B-Indices is investigated with respect to the R&D expenditure in the industry sectors that showed significant effects in the first part of the analysis, the manufacturing sector (Table 8) and the services sector (Table 9).

The results indicate that the generosity of R&D incentives targeted at other current costs has a significant positive effect in all three cases considered, with a magnitude between -0.86 and -1.26 depending on the specification of the regression. In case of the total BERD displayed in Table 7, the B-Indices for the other three cost types show no significant effects. Overall, the tax incentives targeted at other current costs like energy or administration costs seem to have the most impact.

This appears to be reasonable, as they account for around 30% of a company's total expenditure. Since the B-Indices are regressed on total BERD, changes in the tax system that affect other current costs will have a larger effect on the total investment than changes that affect expenditure on machinery and equipment or buildings. Therefore, it might be interesting to repeat the analysis with data on R&D expenditure differentiated by expenditure type. However, considering this explanation it is noticeable that tax incentives targeting labor expenditure, which accounts for around 60%, yield insignificant results. Another possible reason could be that, in the short run, it might be easier to increase other current costs compared to capital expenditure and employment.

Comparing the R&D expenditure in the manufacturing (Table 8) and the services sector (Table 9) yields mentionable results: In the manufacturing sector the B-Index for machinery and equipment has, in addition to the B-Index for other current costs, a significant negative effect on a 5%-level. On the other hand, in the services sector the B-Index for labor has a significant negative effect on a 10%-level. The B-Index for other current costs shows significant negative effects at a 1%-level when the control variables are omitted and at a 5%-level when the control variables are included.

Following the preceding argumentation, this occurrence could be based on the composition of the total BERD in the respective sectors. While the distribution of expenditure for machinery and equipment and buildings (5%, respectively), labor expenditure (60%) and other current costs (30%) is representative on an overall basis, there might be differences in-between sectors. For example, in the manufacturing sector expenditure on machinery and equipment could make up a larger proportion, whereas in the services sector salaries and wages could account for a greater share. As a result, the importance of R&D incentives targeted at the respective expenditure types would differ depending on the industry sector.

To summarize, the effect of output-oriented fiscal R&D incentives seems to depend on the type of cost the incentive applies to. The B-Index for other current costs is significant in the case of total BERD as well as R&D investment in the manufacturing and the services sector. The B-Indices for machinery and equipment and labor show a significant effect only for the manufacturing and the services sector, respectively.

The regressions in part one to three were also conducted with openness as an additional control variable. It is calculated as the sum of imports and exports in goods divided by GDP. The variable was dropped since it did not yield any significant impact in the regression. In the empirical literature, the importance and sign of openness is ambiguous. Bebczuk (2002) suggests a negative influence. On the other hand Falk (2006) finds positive but statistically insignificant effects while a study conducted by Ernst and Spengel (2011) results in significant positive effects for part of the specifications.

5. Conclusion

This thesis investigates the effect fiscal R&D incentives have on R&D investment. Input-oriented incentives have a long history and are widely spread. Output-oriented incentives are not as common but grew in popularity over the last decade. Both types of R&D incentives are characterized by a wide variety of possible designs. To compare the generosity of input-oriented fiscal R&D incentives, the B-Index methodology was introduced. Like the underlying incentives, the B-Indices vary greatly across countries and over time.

In the empirical analysis, the effects the B-Index and IP boxes have on R&D expenditure, differentiated by industries,

Table 6: Regression results for total B-Index by industry sector (lagged BERD); Notes: *, **, and *** indicate significance at the 10, 5 and 1% level.

Industry Sector	Controls	no lag	1 year lag	2 year lag	5 year lag
Total		-0.59	-0.46	-0.38	-0.46
	x	-0.87**	-0.78*	-0.69	-0.41
Agrar		-0.98	-1.17	-1.48	-0.64
	x	-0.67	-0.75	-1.15	-0.81
Mining		0.35	-0.12	-0.56	-2.13*
	x	0.46	0.24	-0.12	-1.24
Manufacturing		-0.70	-0.54	-0.48	-0.70
	x	-0.88*	-0.77	-0.68	-0.76
Electricity		0.01	-0.65	-0.80	-1.31*
	x	-0.18	-0.89	-0.73	-1.19*
Construction		-0.07	-0.61	-0.80	-1.57
	x	0.29	-0.48	-0.32	-1.25
Services		-1.07**	-0.89*	-0.71	-0.28
	x	-0.79**	-0.79**	-0.61	-0.01

are investigated for a sample of 34 countries from 1991 to 2014. Other factors included are living standard, market size, human capital and property protection.

The main results can be summarized as follows. While there are no indications that output-oriented fiscal R&D incentives influence R&D investment in a country, significant positive effects are found for the input-oriented fiscal R&D incentives. The magnitude of the influence seems to depend on the industry observed as well as the time horizon considered. A reduction in the B-Index by 0.10 increases total BERD by 8.7%, BERD in the manufacturing sector by 8.8% and BERD in the services sector by 7.9%. When introducing lagged BERD as the dependent variable, the results suggest that companies in the manufacturing and services sector react within one or two years to changes in the B-Index. Companies in the mining and the electricity sector seem to take a longer period of time to adjust their R&D investment. Another relevant factor is the type of cost the incentives apply to. While the B-Index for other current costs is significant in all specifications, the B-Indices for machinery and equipment and labor are only significant in the manufacturing and the services sector, respectively.

As this study is conducted on an aggregated county level, the estimated effects presented are averages. The effect of fiscal R&D incentives seems to differ depending on the industry. Future research using firm level data could further investigate this relationship with respect to firm size and other specifications. In this setting, it might also yield interesting results to introduce lagged variables or to differentiate between types of costs.

Table 7: Regression results by type of cost, total BERD; Notes: *, **, and *** indicate significance at the 10, 5 and 1% level.

	B-Index Total			B-Index ME			B-Index B			B-Index L			B-Index OC		
	no controls		controls	no controls		controls	no controls		controls	no controls		controls	no controls		controls
B-Index															
- Total	-0.59		-0.87**												
- ME				-0.44		-0.68									
- B							0.21		0.04						
- L										-0.40		-0.64			
- OC													-0.86*		-1.03***
IP box		-0.17	-0.10		-0.17	-0.01		-0.17	-0.06		-0.17	-0.12		-0.17	-0.04
CIT			0.63			0.99*			0.49			0.54			0.49
log GDP per capita			0.50			0.54			0.34			0.45			0.50
log Population			2.87***			2.86***			2.67**			2.85***			2.86***
Students in tert. education per capita			1.52			1.09			1.52			1.43			2.04
Property Protection Index			0.00			0.00			-0.01*			0.00			-0.01
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	550	567	488	550	567	488	550	567	488	550	567	488	550	567	488
Adjusted R^2	0.59	0.56	0.72	0.59	0.56	0.72	0.58	0.56	0.70	0.58	0.56	0.71	0.60	0.56	0.73

Table 8: Regression results by type of cost, BERD manufacturing sector; Notes: *, **, and *** indicate significance at the 10, 5 and 1% level

	B-Index Total			B-Index ME			B-Index B			B-Index L			B-Index OC		
	no controls		controls	no controls		controls	no controls		controls	no controls		controls	no controls		controls
B-Index															
- Total	-0.70		-0.88*												
- ME				-0.68		-0.94**									
- B							-0.01		-0.43						
- L										-0.46		-0.60			
- OC													-0.89		-1.02**
IP box		-0.10	-0.12		-0.10	0.01		-0.10	-0.05		-0.10	-0.14		-0.10	-0.05
CIT			1.07*			1.67**			1.71			0.99			0.90
log GDP per capita			1.01***			1.15***			1.05**			0.96**			0.98**
log Population			2.07*			2.15*			1.83			2.04			2.10*
Students in tert. education per capita			2.95**			2.42**			2.64**			2.88**			3.47**
Property Protection Index			-0.01			-0.01			-0.01			-0.01			-0.01
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	499	506	444	499	506	444	499	506	444	499	506	444	499	506	444
Adjusted R^2	0.45	0.42	0.56	0.45	0.42	0.58	0.43	0.42	0.53	0.44	0.42	0.54	0.46	0.42	0.57

Table 9: Regression results by type of cost, BERD services sector; Notes: *, **, and *** indicate significance at the 10, 5 and 1% level.

	B-Index Total			B-Index ME			B-Index B			B-Index L			B-Index OC		
	no controls		controls	no controls		controls	no controls		controls	no controls		controls	no controls		controls
B-Index															
- Total	-1.07**		-0.79**												
- ME				-0.33		-0.19									
- B							0.05		0.14						
- L										-0.81*		-0.56			
- OC													-1.26***		-1.09**
IP box		0.25	0.24		0.25	0.31		0.25	0.29		0.25	0.22		0.25	0.31
CIT			-0.85			-0.74			-1.09			-0.91			-1.03
log GDP per capita			-0.08			-0.15			-0.27			-0.12			-0.08
log Population			0.91			0.79			0.77			0.88			0.99
Students in tert. education per capita			-0.63			-0.68			-0.45			-0.70			-0.10
Property Protection Index			0.00			0.00			0.00			0.00			0.00
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	492	497	437	492	497	437	492	497	437	492	497	437	492	497	437
Adjusted R^2	0.69	0.65	0.75	0.68	0.65	0.74	0.68	0.65	0.74	0.69	0.65	0.74	0.69	0.65	0.75

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Similar Chords, Different Tune? The Effects of Different Solution Formulations on the Identification of Collaborative Opportunities in Selective Revealing: A web-based Experiment

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Abstract

As selective revealing is being recognized as a new means to find collaboration partners, little attention has been paid on how selectively revealed solutions are best formulated in order to be positively perceived. Prior research has highlighted that technological gatekeepers, i.e. individuals with who handle the R&D communication network and hence potential recipients of revealed knowledge, rely on cognitive and perceptual abilities during the recognition and evaluation of novel technologies. To enrich existing knowledge about opportunity recognition in selective revealing, this study took a cognitive perspective and intended to explore the effects of different formulated revealed solutions on the identification of collaborative opportunities. By priorly manipulating the superficial and structural commonalities of two revealed solutions conducted in collaboration with industry experts, I designed a 2*2 within-subject experiment to validate whether such an induction of analogies increases the percipience of a selectively revealed opportunity. The data, which was attained during an online-experiment with university students from different fields of studies also included individual factors such as prior knowledge about markets and technologies, creative ability (proxied by divergent thinking test and creative self-efficacy) and other demographic characteristics. The gathered data was analyzed through a linear-mixed effect model to capture the repeated design of the experiment. The computation illustrated that relational commonalities between a market and a revealed solution considerably improved the perception about a revealed solution and the willingness to engage a collaboration. In addition, the results demonstrated that superficial similarities facilitate the retrieval of analogies from structural commonalities. For the individual factors, the provided evidence could not support the initial hypotheses that individual creativity and prior knowledge positively moderate the effects of superficial and structural similarities. Contrarily, the results revealed negative moderating effects of creativity and the field of study. Despite further research is necessary, this study delivered implications for both ends of the information flow in selective revealing by conjointly examining the effects of selectively revealed opportunities and personal traits, and enriched this field of study through comprehending the drivers of early action in open innovation and strategic renewal.

Keywords: Selective Revealing, Opportunity Recognition, Open Innovation, Analogical Reasoning, Gatekeepers

1. Introduction and problem statement

1.1. Background

Collaboration is an important aspect in business and usually gives the participating companies the prospect of increasing their competitive advantage (Ahuja (2000); Rothärmel (2012)). So, it is no wonder that firms constantly try to elaborate novel ways in finding new collaboration partners. Among researchers, selective revealing is reckoned to be a new approach in finding new collaboration partners of every description (Alexy et al. (2013)) and is interpreted as a firm's decision to voluntarily unveil parts of its intellectual property to the public (Harhoff et al. (2003); Henkel (2006); Henkel et al. (2014)). Within the last years, selective revealing gained public attention as organizations like Tesla or NASA climbed on the bandwagon and made some of their patents and technologies freely accessible to the public (Vance (2014)).

The approach of selective revealing is based on the formulation of firm-specific knowledge and its distribution to the public. In most instances though, the revealed knowledge is subsequently assessed by other companies and its gatekeepers, i.e. individuals within firms who screen the external environment for relevant knowledge to improve an organi-

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zation's innovative activity (Afuah and Afuah (2003); Allen (1977); Cohen and Levinthal (1990); Morrison (2008)). Freely revealed knowledge can thus be an important source of external knowledge for gatekeepers.

Due to the digital century, in hich innovation and knowledge becomes increasingly complex, more and more firms strive to obtain collaboration partners in order to stay innovative and gain external knowledge. As some studies have even illustrated (e.g. Haas and Ham (2015); Kaplan and Vakili (2015)), the achievement of disruption in innovation is increasingly achieved through the recombination of knowledge from different domains. Due to its wide reach and low coordination cost (Alexy et al. (2013)), selective revealing gives the focal firm the opportunity to reach potential collaboration partners from close and distant knowledge domains. However, researcher consent that the success of knowledge transfer significantly depends on the recipients' prior knowledge and expertise (Cohen and Levinthal (1990); Scheiner et al. (2015); Walsh (1995)).

By drawing upon cognitive theories' claim that the form of knowledge representation affects its processing and following use (Boland Jr et al. (2001); McClelland and Rumelhart (1985)), the revealing firm needs to find appropriate ways to illustrate the revealed knowledge so that it appeals to many different gatekeepers. Indeed, Alexy et al. (2013) stated that the formulation and presentation of the revealed knowledge by the focal firm can play a decisive role during the gatekeeper's evaluation of the revealed knowledge. The focal question is thus, whether different forms of knowledge representation affect the perceived benefits of selective revealing and impact the self-selection of technological gatekeepers.

1.2. Research question

Optimal information flows play an essential role in R&D and the innovation process (Allen (1977); Macdonald and Williams (1993); Tushman and Katz (1980); Whelan et al. (2010)). In this context, such information flows may be affected by both the firm that conveys and the firm that absorbs the revealed solution. In the later section, both ends of the dichotomies of an information flow are under review, followed by the deduction of a research gap and a research question.

1.2.1. Research question from the revealing perspective

The effects of selective revealing have received considerable attention in the last years (e.g. Alexy et al. (2013); Harhoff et al. (2003); Henkel (2006)). Revealing stands for the voluntary spillover of internal resources to the external environment. Instead of monetary advantages, it offers the focal firm other benefits (Alexy et al. (2013); Dahlander and Gann (2010); Harhoff et al. (2003)) such as finding new collaboration partners. It is generally accepted that openness positively affects a firm's ability to profit from innovation (Alexy et al. (2013); Dahlander and Gann (2010); Harhoff et al. (2003); Henkel (2006); Von Hippel and Von Krogh (2006)).

To benefit from openness in innovation, different researchers tried to investigate the conditions under which it is more probable to pursue the practice of selective revealing. Alexy et al. (2013), von Hippel (1988) and Harhoff et al. (2003) have stressed that revealing enhances the generation of uniform industry standards – especially in early technology life-cycles (Teece (1986)) – which allows the focal firm to enlarge its markets. The revealing of intellectual property might even be beneficial if a standard already exists; but only if the revealed knowledge increases the compatibility to the existing standard (Alexy and Dahlander (2014)). Reputational-related benefits are also among the factors that explain higher activity in revealing (Harhoff et al. (2003)) and have been empirically confirmed by investigating in the behavior of software developers in open source environments (Henkel (2006)). Further explanations why firms freely reveal are expected support from incumbents (Harhoff et al. (2003)), the modularity of a firm's knowledge (Alexy et al. (2013)), firm policies (Henkel (2006)) and complementary assets (Henkel (2006)). Notwithstanding its benefits, revealing may also sometimes come along with disadvantages, especially when it gives the competitors an opportunity of free-riding on the revealed knowledge (Harhoff et al. (2003)). Firms often fear that revealing triggers imitation among incumbent firms, leading to a loss of its competitive advantage.

Nonetheless, selective revealing is recognized as a strategic tool that shapes strategic collaboration. Alexy et al. (2013) proposed a process model in which the authors determined the antecedents of a voluntary spillover. The authors argued, that amongst others, high partner uncertainty, high coordination cost and high unwillingness to collaborate facilitate the company's decision to reveal its intellectual property. Thus, selective revealing may be seen as an instrument which helps firms to find new partnerships; especially when external preconditions don't allow for traditional collaboration modes (Alexy et al. (2013)).

Apart from the different contingencies, a collaboration based on selective revealing can arise according to Alexy et al. (2013) from two different modes of revealing: solution revealing and problem revealing. As the term already suggests, problem revealing is about sharing a problem with externals and enables the firm to obtain a solution to this problem. In contrast, solution revealing implies that firms voluntarily (and sometimes also strategically) unveil their solution to a problem (e.g. specific solutions) to the public.

The last section showed that selective revealing offers many important implications for innovation and strategy. Yet, none of the studies on selective revealing questioned the role of the formulation and structure of the revealed solutions. Even researchers such as Alexy et al. (2013) or Baer et al. (2013) acknowledge, that the savoir-faire about the formulation and illustration of selectively revealed knowledge is important in order to maximize its benefits. Considering that the recipients of such revealed solutions, i.e. gatekeepers, usually conduct a mere 'rapid analysis' (Scheiner et al. (2015)), the first impression from a revealed solution is very

important. The revealing firm hence needs to mitigate a potential communication noise by properly illustrating a solution which increases the perceived quality of that solution.

Up to now, most of the studies which aimed at reducing communication barriers in technology transfer focused on the receiving instead of the revealing instances. Many researcher for example argued that social tactics (c.f. Foster et al. (2011); Storper and Venables (2004)), information and communication technology (c.f. Roberts (2000)) or multiple gatekeepers (c.f. Gassmann and Gaso (2004)) could enhance the information flows in R&D and the innovation process.

Instead, this research pursues the argument that the revealing firm could use formulation techniques in order reduce noise and complexity, and help the recipient of the revealed solution to better identify novel and valuable solutions. An important role in technology transfer processes is given to the structure of the transferred knowledge (Gentner et al. (1993b)). Thereby, scientists argue that structural alignment, i.e. the ability to perceive similarities between existing know-how and novel information, facilitates information processing (c.f. Gentner (1983); Gentner et al. (1993b); Reeves and Weisberg (1994)). While research in the sector of entrepreneurial opportunity recognition confirmed this finding (c.f. Grégoire and Shepherd (2012); Gregoire et al. (2010)), it remains unclear, if the same effect will occur in selective revealing. In this respect, the effect of different formulated revealed solutions on the identification and evaluation of collaborative opportunities deserves further investigation. Consequently, the first research question is posited in the following way:

> Research Question 1.a: Do different formulations of selectively revealed solutions influence the recognition of collaborative opportunities by technological gatekeepers?

1.2.2. Research question from the receiving perspective

By getting to the other end of the dichotomy, the upcoming section takes a closer look at the role of the receiving instance in optimal information flows. As previously mentioned, this study assumes that technological gatekeepers represent the most important recipients of selectively revealed solutions. In the scientific community, the role of a technological gatekeeper has obtained much attention in the last decades (Ettlie and Elsenbach (2007)). Researchers thus generally agree that outside information is best assimilated when it is processed by only a small number of uniquely skilled technological gatekeepers (Allen (1970); Allen (1977); Klobas and McGill (1995); Tushman and Katz (1980); Tushman and Scanlan (1981); Whelan et al. (2010)).

Allen, who coined the concept of technological gatekeepers in the late 60's, defined them as "individuals who occupy key positions in the communication network of the laboratory." (Allen and Cohen (1969): 13). Gatekeepers act as translators (Scheiner et al. (2015); Whelan et al. (2010)), trying to overcome communication barriers and preventing irrelevant information from being further transferred into the company (Hauschildt and Gemünden (1999)). As a result of the increasing importance of external information for a firm's innovative capacity (Chesbrough (2006)), it is commonly suggested, that gatekeeper play a key role in identifying, acquiring, integrating and exploiting new technologies in the R&D processes of a company in order to stay competitive (Allen and Cohen (1969); Ettlie and Elsenbach (2007); Scheiner et al. (2015); Whelan et al. (2010)). Thus, the presented evidence strengthens the assumption that gatekeepers can be regarded as important recipients of selectively revealed solutions.

Considering the importance of technological gatekeepers in companies, studies have suggested that not everybody can fill this post. Technological gatekeepers usually exhibit particular characteristics. Macdonald and Williams (1993) and Allen (1977) for example have shown, that gatekeepers tend to be extroverted, technologically proficient and socially capable. Furthermore, they usually hold high hierarchical positions in firms (Scheiner et al. (2015)). Because of the necessity to build and cultivate a social network, it takes however a considerable amount of time become a gatekeeper (Nochur and Allen (1992)).

During the acquisition of external information technological gatekeepers are confronted with a vast amount of information. Within this mass of stimuli, they should detect relevant technologies and disregard irrelevant ones. The consensus of researchers is that the identification of valuable external information depends on a gatekeepers' cognitive and perceptual abilities and intuition (Scheiner et al. (2015)). In particularly, schemata, i.e. generic relics in the long-term memory from past situations or experiences, guide the recognition and understanding of new information (Matlin (2008); Walsh (1995)). Schemata and their categorizations facilitate the decision-making process and enable gatekeepers to evaluate the consequences of new technologies in a very fast manner (Scheiner et al. (2015); Winkielman et al. (2006)).

Albeit the myriad of studies which investigated in the cognitive and perceptual abilities of gatekeepers, most of them have failed to recognize importance of individual creativity. Plucker et al. (2004) defined creativity as 'the interaction among aptitude, process, and environment by which an individual ... produces a perceptible product that is both novel and useful ...'. Creativity could be of ample significance for gatekeepers, because it enables an individual to see interconnections among different elements and to combine them to something new.

In addition, this research will take a stance on the role of prior knowledge. Even though many studies successfully investigated the effects of prior knowledge (e.g. Grégoire and Shepherd (2012)), only few have recognized, that successful problem solvers are not necessarily coming from the same knowledge field as the problem itself (Jeppesen and Lakhani (2010)). Indeed Kaplan and Vakili (2015) have found that breakthrough innovations require distant and diverse knowledge recombination. Alas, the role of prior knowledge is still

ambiguous in the study fields of selective revealing and technological gatekeeping, and deserves further examination. The second part of the research question can be accordingly stated in the following way:

> Research Question 1.b: Do creativity and prior knowledge of technological gatekeepers impact the identification of collaborative opportunities in selective revealing?"

1.3. Outline of the thesis

This master thesis is a response to Alexy et al. (2013) call for research on the formulation of selectively revealed solutions. It attempts to examine the effects of different formulations of selectively revealed solutions on the recognition of collaborative opportunities. Thereby, I hope to provide valuable insights for the research of open innovation and knowledge transfer processes in selective revealing. Similar to the work of Grégoire and Shepherd (2012) on entrepreneurial opportunity recognition, an empirical study was conducted to examine if high similarities between a revealed solution and its target market ceteris paribus creativity and prior knowledge could facilitate the recognition of opportunities which arise from selective revealing. In order to answer both research questions, the next section emphasizes the existing theories on cognition, analogical reasoning, prior knowledge and creativity in the context of opportunity recognition. From the presented theory, I will deduce a conceptual framework and a body of hypotheses for the later analysis. Subsequent to the presentation of the contemporary theories, the third section demonstrates how the online-experiment and the manipulation of the stimuli were executed to address the research question. Furthermore, this section provides an insight on the operationalization of the experiment and the data analysis. The results from the descriptive statistics and a generalized linear model (GLM), which capture the within-variance of the outcome, are examined in the fourth section of this thesis. Besides an examination of the effectiveness of the randomization, this section will focus on the effects of the superficial and structural similarities on the evaluation of a collaborative opportunity and the additive and interactive effects of prior knowledge and creativity. The results provide the basis for the acceptance or the rejection of the elaborated hypotheses from section two. In the last section, the implications for theory and praxis as well as the limitations will be discussed.

2. Current state of research and hypothesis

2.1. Drawing upon a theory of cognition

This proposal builds on the broad foundation of cognitive theories (Matlin (2008); Reed (2006); Walsh (1995)), and more specifically on theories about individual cognitive patterns in the technology evaluation and identification process (Grégoire and Shepherd (2012); Scheiner et al. (2015)). The past research has shown that cognitive science is a salient element when it comes to the understanding of human behavior. Cognition, which is often also referred to as 'information processing', describes how an individual acquires, stores, memorizes, remembers and utilizes information, and hence covers a wide range of mental processes (Matlin (2008); Pecher and Zwaan (2005a)).

As Figure 1 exemplifies , information processing in individual's mind is a multi-stage processes. According to Reed (2006), information processing commences with the sensory store, where outside stimuli are stored untapped for several seconds. A mental filter, which is triggered by attention and concentration and occurs unconsciously, subsequently recognizes only specific parts of the afore stored information. The filtered information then runs through a stage that is called pattern recognition. This mechanism helps individuals to identify the stimulus through matching the information with existing and similar patterns that are retrieved from existing memory and knowledge. As multiple patterns may occur for a piece of information, a final selection phase determines which information enters the short-term memory (STM) and are used for information processing.

The mechanism of pattern recognition is thus a crucial step for information processing. It helps to transform and organize the raw information provided through our senses by matching the outside information with existing patterns that are retrieved from the LTM (Matlin (2008); Reed (2006)). Among cognitive science researchers, there are three plausible theories how patterns are recognized from sensory stimuli: a) the template theory, i.e. the overlap of similarities between two patterns, b) the feature theory, i.e. the recognition of certain parts of a pattern, and c) the structure theory, i.e. the pooling of several parts of multiple patterns. Pattern recognition is understood as a top-down process. This means that information flows from the LTM to the sensory store and that past experiences affect current decisions (Walsh (1995)). Nevertheless, it may also be the case that information processing occurs in form of a bottom-up approach. In such a case, information is directed from the sensory store to the LTM. Bottom-up flows usually occur due to a lack of context or experience, which leads to the outcome that the information itself shapes response to a sensory stimulus (Walsh (1995)).

While the previous passage was concerned with how patterns are matched with external stimulus, the following paragraph goes one step further and attempts to clarify another crucial topic in cognitive science: how is knowledge organized and which impact does it have on the recognition on patterns. In this case, researchers mostly refer to semantic memory, which is of high importance for many brain functions such as interpretations, the retrieval of apprehended concepts or the acquisition of new information and concepts (Posner et al. (1988); Saumier and Chertkow (2002)). Only if the semantic memory is stored and organized effectively, it can be retrieved properly from the LTM (Reed (2006)). However, due to the brain's immense complexity, there are several models that try to explain how semantic memory is organized and recalled. Two of the most popular models are the network model and the feature model (Matlin (2008)). A

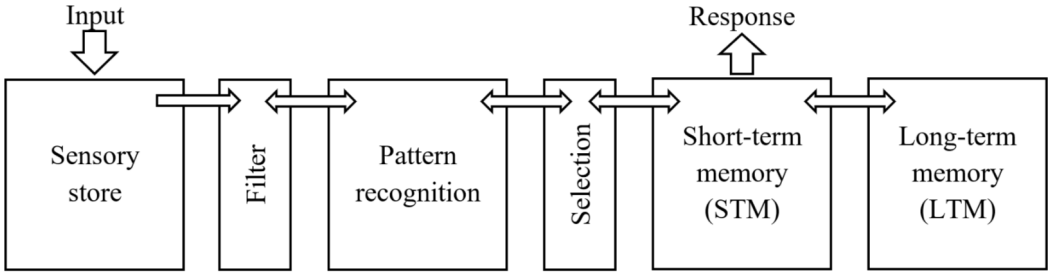

Figure 1: Stages of an Information-Processing Model, Source: Own rendering based on Reed (Reed (2006): 3)

network model consists of a set of elements (concepts, words, features) connected by means of links. Researchers like Barnden et al. (2002) argue that networks are composed in a hierarchical and a semantic way. In a semantic network, similar elements are linked with each other in the LTM and match patterns (Reed (2006)). Processing in this model usually occurs through spreading activation. This theory suggests that the activation of a word in the LTM propagates over the respective relationships with other stored words (Anderson (1983)). Contrary to the network model, the feature comparison model elaborated by Smith et al. (1974) postulates that every word or concept that is embedded in the LTM consists a one or several characteristic features, which in turn belongs to a superordinate category. Hence, with this model it is believed that pattern recognition and cognition happen through using features in order assert the resemblance of two concepts in order to create a response (McNamara and Miller (1989); Reed (2006)). However, the abovementioned models have the limitation of ignoring the importance of knowledge clusters (Reed (2006)). Scholars view the schema theory, which primarily assumes that the integration of knowledge takes place in larger clusters, as a remedy to this issue (Arbib (2002)). According to Rumelhart (1980) a schema contains information about a particular object or concept in an abstract, generalized form and may be understood as a representation of learned knowledge that facilitates information processing. This theory suggests that every schema consists of default knowledge, i.e. knowledge about the most important attribute of a schema, which allows people to make a decisions even though important information is missing (Anderson (1995); Naughton and Staub (2016)). Nonetheless, schemata are highly dynamic, and can be supplemented steadily by new knowledge that is derived from novel experiences (Reed (2006)).

In the managerial cognition research, scholars of strategic management and organization theory consent that managers who usually cope with very complex information worlds (Schwenk (1984)), unconsciously employ knowledge structures or schemata in order to support information processing and decision making (Walsh (1995)). Schemata are mental templates that rely on past experiences and memories (Matlin (2008); Walsh (1995)) and are reckoned as mental representations of an individual's perceived environment (Scheiner et al. (2015)). Yet, schemata are not only seen as mental concepts, but also as linkages between these components (Hayes-Roth (1977)). Accordingly, schemata must affect gatekeepers during identifying and evaluating new technologies by framing external information and giving guidance on how they are perceived.

As Section 1.2.2 has shown, gatekeepers are usually highly experienced. It can be assumed that their vast experience helped them to develop a myriad of schemata which facilitate the evaluation and identification of new technology. Indeed, researchers such as Matlin (2008) have shown that schemata are of v a very dynamic nature, are based on past events, and may change again within time (Walsh (1995)). In order that schemata can evolve, memories are selected, abstracted and integrated in the human mind (Matlin (2008)). However, due to its abstractedness and focus on past events, schemata can also mislead individuals in their decision making process (Matlin (2008)).

By recognizing the importance of schemata in human cognition and decision making, this study is extending cognitive research to open innovation and technological gatekeepers and is anchored on four main assumptions. First, this research assumes that cognitive processes are grounded. Grounded cognition is a theory of mental representation which assumes that there is an interaction between cognitive, perceptual and senso-motoric processes. Consequently, cognition coheres with the representation of thought processes and linguistic conceptualizations (Barsalou (2008); Borghi et al. (2013); Schilhab (2017); Wilson and Golonka (2013)). In contrast to the traditional cognitive theories, which assume that "cognition is computation on amodal symbols in a modular system" (Barsalou (2008): 617), grounded theories regard the brain as the central instance of cognition. This leads to the notion that independent thinking is not possible without multimodal embodiment (Pecher (2012); Pecher and Zwaan (2005b)). Recent work on embodied cognition suggests that even physical states (e.g. morality and dominance) affect human thinking and action (quote).

Secondly, this paper is built on the notion that, from a cognitive perspective, various forms of sensory stimuli may invoke different schemata, and hence affect an individual's cognition and decision making (Boland Jr et al. (2001); Thorndyke and Hayes-Roth (1979)). Cognitive research suggests that the assessment of an opportunity depends on how an external stimuli is linked with representations that exist

in the memory of an individual (Macpherson (2017)) and that schemata are invoked by verbal and non-verbal stimuli (Paivio (1990)). Consequently, verbal and non-verbal stimuli not only serve as means of communicating our thoughts but also play an active role in shaping them (Burgoon et al. (2013); Lupyan and Clark (2015)). By extending the argument of Scheiner et al. (2015), technological gatekeepers should also be influenced in their decision-making by external semantic stimuli. Henceforward, this assumption corresponds to the first research question that differently formulated revealed solutions affect the evaluation and identification of technology.

Thirdly, I follow the argument that the capability to process novel information is guided by schemata that were formed by past experiences (Rauss and Pourtois (2013); Walsh (1995)). This means that gatekeepers hold diverging perceptions of revealed opportunities which vary due to pre-existing mental representations, and their content and complexity (Gaglio and Katz (2001); Paivio (1990)). According to schemata theory an appropriate response and action to an external stimulus can only arise, if there's a match between the received information and a schema (Gaglio and Katz (2001)).

In turn, this master thesis is also based on the assumption that individual information processing is enhanced through personal creative ability. Plucker and Makel (2010) found that creativity is constituted by the interconnection of ideas (consequently schemata) and the environment. Creativity is hence understood as the individual ability to shift knowledge from one situation to another (Gick and Holyoak (1983); Hunter et al. (2008)). Thus, creative ability depends on the mental process and is a reached partly through the retrieval and shift of memory (Nijstad et al. (2010)). Creativity could turn out to be an important personal trait for technological gatekeepers and enhance the decision-making process in the evaluation and identification of novel opportunities.

With the four assumptions formulated, the following subsections will provide a deeper insight into the theories of analogical reasoning, prior knowledge and creativity with a specific reference to opportunity recognition.

2.2. Opportunity recognition from a cognitive perspective

This section builds on the aforementioned assumptions and the claim that technological opportunity recognition is supported by cognitive processes (Alvarez and Busenitz (2001); Baron (2006); Butler et al. (2010); Grégoire and Shepherd (2012); Gregoire et al. (2010)). Being considered of utmost importance in entrepreneurship (George et al. (2016)), opportunity recognition has received substantial attention among scholars. Before taking the matter into context of selective revealing, the major theories of opportunity recognition and its underlying cognitive mechanisms are reviewed. First, I will examine the term from an etymological and ontological perspective. Among the myriad of definitions for an opportunity, Baron (2004) concluded that an opportunity is characterized by three major criteria: its perceived desirability (i.e. legal and moral suitability), its newness and its potential to generate profits. However, opportunity recognition, i.e. the identification of a novel opportunity that features subjective and monetary advantages, is only the initial step in a continuing process (see Figure 2). In the context of this research, the study will solely focus on the discovery and recognition of an opportunity, which is distinct from the evaluation of an opportunity and further steps.

Research on the entrepreneurial opportunity is distinguished by the origins of an opportunity. In their extensive literature review on opportunity recognition, George et al. (2016) point to a dichotomy which becomes apparent through the usage of two similar terms: "opportunity discovery" and "opportunity recognition". Researchers deem opportunity discovery if a product or a demand in a market already exists and is merely identified. The term opportunity recognition, however, refers to the reorganization of such a product or market demands in order to explore new ways of that opportunity (George et al. (2016)). A third stream, opportunity creation, was identified by Sarasvathy et al. (2010). According to the authors, opportunity creation is the means of bringing an opportunity into existence through invention or the establishment of a new market.

Notwithstanding the importance of all three research streams, I advance the same view as Grégoire et al. (Gregoire et al. (2010): 415), who refused to focus on one nature of opportunity but rather proposed that opportunities are "courses of action that seek to derive benefits from these changes." Also in the context of this research, a determination of whether a technological gatekeeper discovers or recognizes an opportunity would miss the mark. Instead, I focus on the widely accepted assertion that cognition and personality traits affect opportunity recognition. As the further course of the theory section will show, cognition is only one of many influencing factors. The framework on opportunity recognition by Shane (Shane (2003): 11) confirms that the pursuit of an opportunity depends on a myriad of interrelated factors in which cognition is only a piece in the puzzle. According to the author, both individual attributes and external factors affect every single step of opportunity acquirement process (Shane and Eckhardt (2003)).

Despite that multidisciplinary framework, researchers consent that the recognition of an opportunity can be seen as a cognitive process in which people reason about finding interesting opportunities (Garcia-Cabrera and Garcia-Soto (2009)). Baron (2006) argued that pattern recognition provides the cognitive fundament for identifying opportunities. The researcher thereby argued that prior knowledge and experience helps an individual to find a pattern among unrelated events to recognize opportunities. Indeed, empirical findings have shown that schemata of experts are richer than those of novices and subsequently illustrated that the ability to recognize an opportunity rises with the sophistication of the held schemata (Baron (2006)).

From a cognitive perspective, the retrieval of knowledge from our memory is crucial for information processing. As illustrated in Figure 3, individuals' make sense of new informa-

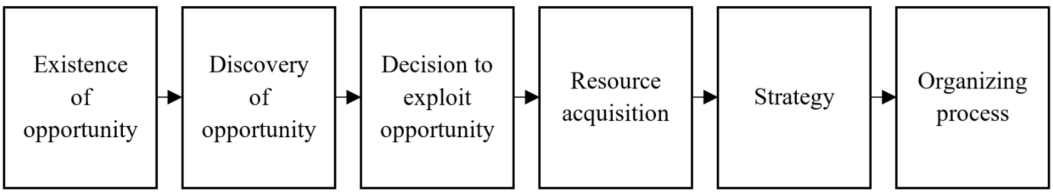

Figure 2: Directionality of the Opportunity Acquirement Process; Source: Own rendering based on Shane (Shane (2003): 12)

tion by comparing it with retrieved knowledge. Researchers mostly call this process analogical transfer or reasoning, i.e. the projection of knowledge from a domain to another (Gick and Holyoak (1983); Holyoak and Thagard (1995); Novick (1988); Ward and Kolomyts (2010)). Analogical reasoning is understood in multiple ways and can be the cognitive basis for learning, problem-solving, or as in this research, opportunity recognition. The vast amount of research on this topic bred many different theories such as Tversky (1977) contrast theory or Biederman (1987) Geon Model. This research draws on the 'structure-mapping theory of analogy' by Gentner (1983). The main notion of structure-mapping is that analogies are created through spanning knowledge from a domain (source) to another (target). Analogical thinking is a mental process which is domain-general and helps individuals to find relational commonalities between two objects or situations on a deeper level (Markman and Gentner (2001); Ward and Kolomyts (2010)). According to Gentner (1989), structure-mapping consists of several sub-processes that are: (a) retrieve knowledge, (b) finding an analogy between source and target, (c) evaluating the analogy and the fit between source and target, (d) making interferences about the target and (e) extracting the common principle .

The main assertion of the structure-mapping theory is that analogies are characterized by mapping the relational similarities or differences among objects (Gentner (1983)). In order to trigger analogies, knowledge needs to be mentally illustrated in such a specific way so that systematic comparisons can be conducted (Holyoak and Thagard (1995)). In this regard, the perception of semantic and sensory similarities between two objects or situations is the key determinant of analogical transfer (Gentner (1989)). Vallacher and Wegner (1987) and Whittlesea (1997) have shown that similarities in verbal stimuli induce and facilitate information processing and decision making.

But how are similarities assessed and what are the underlying cognitive processes so that analogies occur? Markman and Gentner (Markman and Gentner (1993b): 435) proposed that "similarity comparisons involve a process of structural alignment." Under structural alignment, scholars mean the cognitive process which facilitates the fabrication of comparisons and the comprehension of its implications (Gentner (1983); Gregoire et al. (2010); Holyoak and Thagard (1995); Markman and Gentner (1993a), Markman and Gentner (1993b), Markman and Gentner (2001)). Thus, when encountered with a new object or situations, people build on the observed similarities from old objects or situations in order to understand a new context. According to Gentner and Markman (1995) the cognitive process of structural alignment ensures that only the highest structurally consistent match between two objects will evolve as an analogy.

The structure-mapping theory of Gentner (1983) distinguishes between different kinds of similarities, depending on how many attributes (superficial elements) or relations (structural elements) two objects share. As Figure 4 illustrates , similarities can vary according to their shared attribute-relation combination.

A literal similarity for instance, comprises a large extent of both relational and attributional commonalities, while an anomaly comprises none. According to Gentner (1989), the different sub-processes of structure-mapping that have been mentioned previously are differently affected by different kinds of similarities.

According to Gentner and Markman (1995) a good analogical match is also characterized by its systematicity and structural consistency. Systematicity increases with the interconnectedness of an analogical map, i.e. the number of interdependent objects that are connected through mutual superordinate, or so called high-order, relations (Gentner (1983)). A structural consistent analogy prevails if there are parallel, mutual connections to at least another domain (Markman and Gentner (2000)). Given the latter requirements for a good analogy and its holistic perspective, thinking analogically is much more than just a mere finding and comparing of similarities.

With the insight that there are two categories of similarities and that these similarities have a different effect on the human mind, I advance this argument to the field of selective revealing and technological gatekeepers. Accordingly, this research assumes, similar to Grégoire and Shepherd (2012), that firstly collaborative opportunities which arise from selective revealing consist of unexploited matches between the supply of a new technology or process and a market demand, and that secondly technological gatekeepers utilize cognitive processes such as structural alignment in order to make sense of new opportunities. Based on these assumptions, both types of similarities between selectively revealed technologies and market demands should affect a gatekeeper's capability to recognize a collaborative opportunity.

During the next section, I will further examine both categories of similarities, itemize their peculiarities in the context of the recognition of collaborative opportunities and elabo-

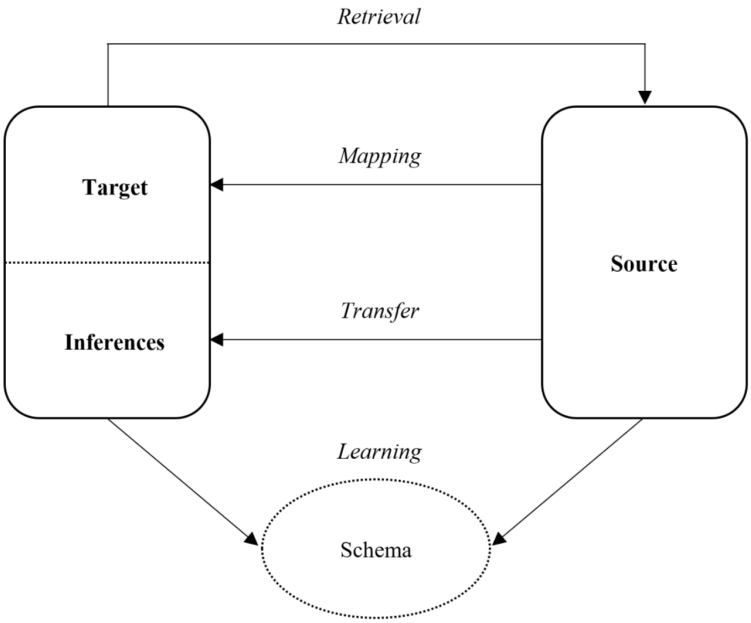

Figure 3: Major Components of Analogical Reasoning; Source: Own rendering based on Holyoak (Holyoak (2012): 236)

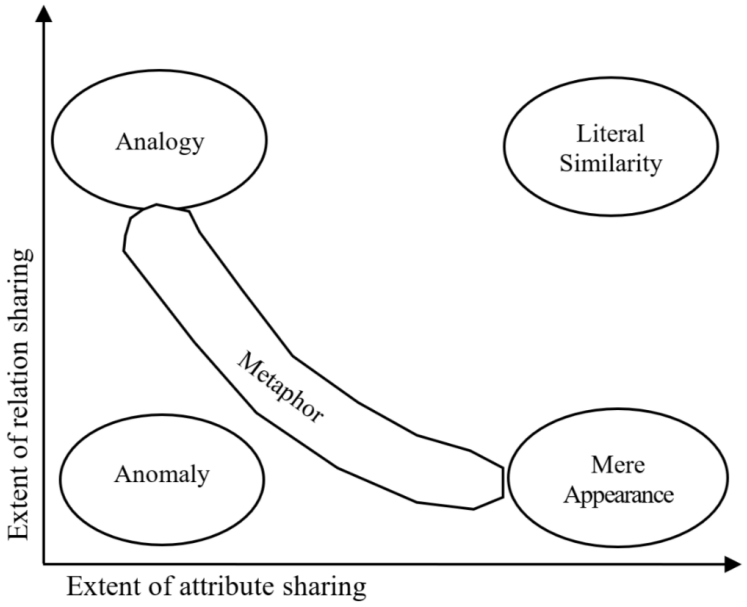

Figure 4: Kinds of Domain Comparisons; Source: Own rendering based on Gentner (Gentner (1989): 207)

rate hypothesis on the grounds of insights from cognitive science. Prior to this, Figure 5 gives an overview and an exemplification on the differences of both types of similarities. By comparing a planet system with an atom (which share both high superficial and structural similarities), this figure illustrates, how changes in the information about a revealed solution may impact the perception of structural and superficial similarities to a potential target market.

2.2.1. The effects of aligning superficial relationships

Two objects or situations are superficially similar if they have a resemblance in their external appearance, e.g. in their color, purpose or form (Gentner (1983)). An example for a superficial similarity can be exemplified in the comparison of a ball and a planet: both feature a circular form and can hence be seen superficially similar. In the context of this research and similarly to an entrepreneurial opportunity (Grégoire and Shepherd (2012)), a superficial similarity is at hand if the basic elements of a revealed solution (e.g. the material of the solution, the producer, the purpose and the context, as well as the used inputs and outputs) matches the basic elements of the market (the materials, inputs, outputs the people, etc.) in which the technological gatekeeper is active. As it is apparent from Figure 5, a planet and an elec-

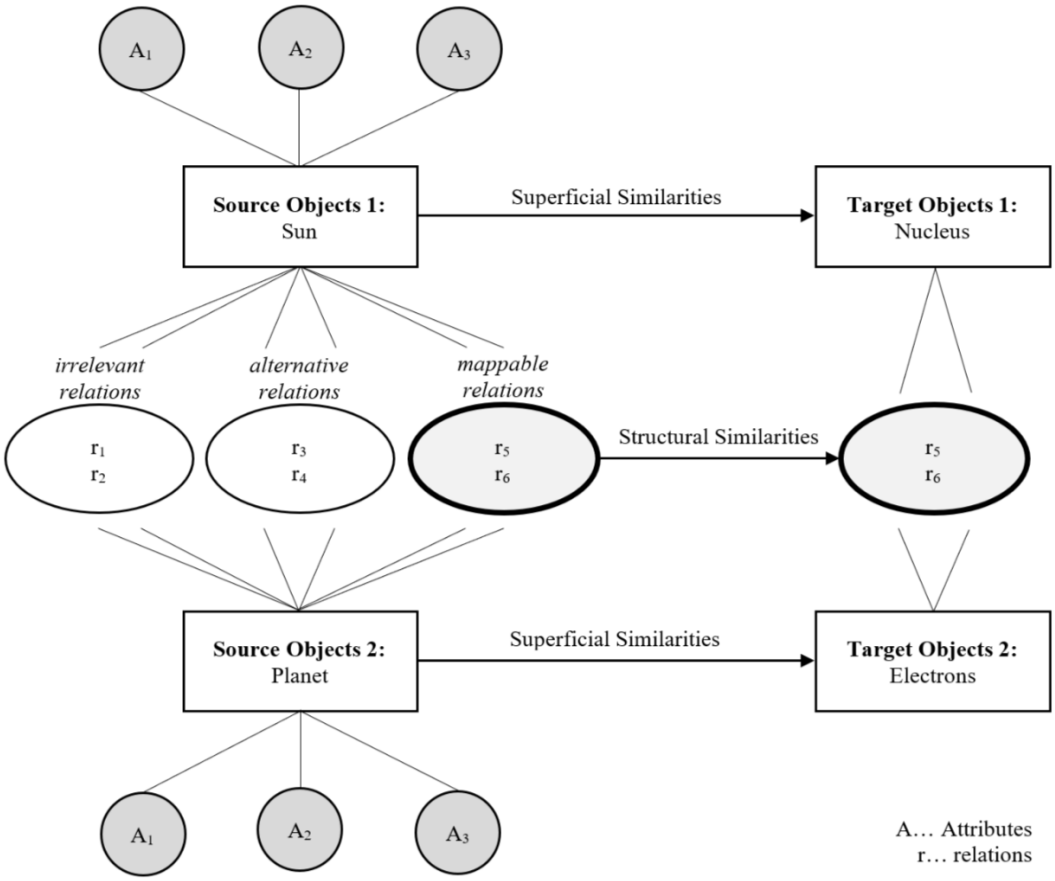

Figure 5: A Schematic Summary of Structure-Mapping Theory and the Difference between Superficial and Structural Similarities; Source: Own rendering based on Zook & Maier (Zook and Maier (1994): 590)

tron share superficial commonalities; both have, to name a superficial similarity, a circular form.

Superficial similarities are major elements in mental processes which facilitate the retrieval of analogies and the perception of its significance. For Grégoire and Shepherd (Grégoire and Shepherd (2012): 759), superficial similarities represent the "default mode" of reasoning. In the same vein, Gentner et al. (1993a) claimed that superficial similarities are the dominant source for analogies. From a cognitive perspective, superficial elements are easier to recognize because they are attached to the idea rather than the context (Gentner and Loewenstein (2003)) and provide plausible interferences (Koedinger and Roll (2012)). Indeed, researchers have shown that superficial similarities positively affect the retrieval and the access of analogies (Blanchette and Dunbar (2000); Gregoire et al. (2010); Keane et al. (1994)). This positive effect has been proven in many empirical studies. In an experimental investigation, Gick and Holyoak (1980) examined if problem-solving by analogy was enhanced by semantically similar task and solution descriptions. The authors thereby illustrated from a cognitive perspective that the retrieval of an analogy is easier contrivable if the stated problem resembles a suggested solution. In a similar study on problem-solving with analogies, Keane (1987) found that semantically distant analogies, i.e. objects with superficial dissimilarity, are tougher to retrieve than superficial similar objects. Also, in the field of educational science, scholars discovered that analogical reasoning and superficial similarities influence the learning outcome. In this regard, the scientific community consents that learners tend to rely on superficial similar elements during the acquisition of new concepts (Gentner and Loewenstein (2003); Namy and Gentner (2002)). In business research, the effects of superficial similarities were empirical confirmed in the adoption of new products (Moreau et al. (2001)), strategic change (Cornelissen et al. (2011)), new technologies (Grégoire and Shepherd (2012); Gregoire et al. (2010)) and new ventures (Cornelissen and Clarke (2010)).

From the abovementioned evidence, I conclude that superficial similarities between a revealed solution and a target market enhance the opinion of a technological gatekeeper the potentials of a collaborative opportunities for the incumbent firm. The higher the level of superficial similarities between a revealed solution and its market, the less uncertainty will a gatekeeper have about the opportunity. Thus, I propose the following hypothesis for this research:

> H1a: Individuals perceive a novel collaborative opportunity that arises through selective reveal-

ing more positively if there is a high superficial similarity between the revealed solution and the market compared to a low superficial similarity between the revealed solution and the market.

2.2.2. The effects of aligning structural relationships

Two objects or situations are structurally similar if they have a resemblance in their relational logic, i.e. if there is an underlying relation between the components or the surface elements between two objects or situations (Gentner (1983); Gentner and Markman (2006)). An example for structural similarities between two objects is again exemplified in Figure 5 with the comparison of the solar system and at atom: both possess a core (sun vs. nucleus) and both are, due to their gravitation, surrounded by bodies (planets vs. electrons). Structural similarities can be seen as a complementary to superficial similarities (Blanchette and Dunbar (2000)).

Whereas researchers often refer to "near analogies" when analogical transfer is induced by superficial similarities, analogies which are induced by structural similarities are called "far analogies" (Schwartz and Nasir (2003)). Notwithstanding its difficult retrieval (Keane et al. (1994)), far analogies can result in very creative outcomes (Smith and Ward (2012)). This is especially the case, if structural relationships span over many different objects (Gregoire et al. (2010)). In this regard, researchers speak of higher order relationships, i.e. a world in which individuals form a complex world of interdependent and mutual structural relationships (Gentner (1983)).

From a cognitive perspective, the significance of structural similarities lies in the deduction of interferences and the fostering of evaluation and understanding (Colhoun and Gentner (2009); Grégoire and Shepherd (2012)). The relevance of structural similarities is also evident in many empirical findings. Many of these studies confirm that analogical reasoning is facilitated by higher structural relations in semantic stimuli (Blanchette and Dunbar (1997); Blanchette and Dunbar (2000);Green et al. (2008)). When confronted with both superficial and structural relations between two objects, individuals even prefer, despite of reasons unknown, to draw upon more difficult structural relations in analogical reasoning (Gentner (1989)). However, relying upon structural features is not always self-evident: Novick (1988) for instance found that analogical interferences from structural relations are facilitated by prior knowledge.

In the context of this research, a structural relation between a revealed solution and the target market of a technological gatekeeper exists, if the revealed solution fits the latent demands of the market. Similar to the notion of Grégoire and Shepherd (Grégoire and Shepherd (2012): 760), the structural similarity between a target market and the revealed solution increases with its "intrinsic capabilities", i.e. the underlying mechanisms and functions which could satisfy the market's needs and overcome its pain points.

From the presented evidence, I imply for my second hypothesis of this research that structural similarities between the revealed solutions and the target market positively affect the evaluation of a collaborative opportunity for technological gatekeepers. Solutions, whose descriptive elements are structurally more similar to the target market may enhance the inducement of different schemata and aid in the processing of the information. The following hypothesis is thus posited in the following way:

> H1b: Individuals perceive a novel collaborative opportunity that arises through selective revealing more positively if there is a high structural similarity between the revealed solution and the market compared to a low structural similarity between the revealed solution and the market.

2.2.3. Effects in the nexus of structural and superficial similarities

While the last two sections regarded both types of similarities separately, this chapter examines the interplay of superficial and structural similarities and its effects. This perspective is necessary as two of the four treatment scenarios in the online experiment hold divergent levels of superficial and structural similarities (i.e. a scenario with high superficial and low structural similarities and vice versa).

Albeit both types of similarities are crucial in the development of analogical thinking, the scientific community consents that the human mind has a preference towards structural similarities as it induces the transfer and mapping of analogies (Gentner et al. (1993b); Holyoak and Koh (1987)). Evidence from a neuroscientific perspective amplifies this claim by showing that structural similarities cause more brain activity than superficial similarities (Blanchette and Dunbar (2000)). Holyoak and Thagard (1989) even argued superficial similarities are mere disruptive factors and that only structural properties serve as cues for analogies. This finding coincide with observations by Shane (2000), who alleged that an entrepreneurs ability to identify a new opportunity in a different target markets is not related to an opportunity's "obviousness". Because of their expertise, entrepreneurs were still able to recognize the value of such an nonobvious opportunity (i.e. opportunities which feature high structural but low superficial similarities) due the structural commonalities that were drawn between the market and the technology (Grégoire and Shepherd (2012)).

Similarly to Grégoire and Shepherd (2012), I will subsequently compare the scenario with low superficial and high structural similarity, i.e. the nonobvious opportunity, to the other scenarios. From the abovementioned evidence, I imply that scenarios with high structural similarities compared to scenarios with low structural similarities will receive more positive evaluations.

> H1c: Evaluations about a novel collaborative opportunity with low superficial and high structural similarity between the revealed solution and the market are more positive compared to a solution-market combination with low superficial and low structural similarity.

> H1d: Evaluations about a novel collaborative opportunity with low superficial and high structural similarity between the revealed solution and the market are more positive compared to a solution-market combination with high superficial and low structural similarity.

Despite of the importance of structural similarities, researchers have also agreed that superficial similarity facilitate the creation of analogical thinking (Blanchette and Dunbar (2000); Holyoak and Thagard (1995)). Superficial similarities help to retrieve a source for the analog, and are hence a precondition for an analogy (Holyoak and Thagard (1989)). The less prior knowledge one possesses about a situation, the more important superficial similarity consequently becomes in order to retrieve sources for an analogy. The lack of superficial similarities may thereby cause faulty reasoning and hence has an effect of the soundness of an analogy (Gentner et al. (1993b)). This evidence triggers the hypothesis that, compared to the default scenario (the nonobvious opportunity), the scenario with high superficial and high structural similarity between the solution and the market is superior in terms of the individual perception. Thus, the last hypothesis in this section is formulated as following:

> H1e: Evaluations about a novel collaborative opportunity with low superficial and high structural similarity between the revealed solution and the market are less positive compared to a solution-market combination with high superficial and high structural similarity.

2.3. The effects of creativity

Creativity is a very diverse phenomenon that necessitates a multiplicity of approaches to comprehend it. As neuroscientific research suggests, creative outcome depends on an interplay of individual, social and cultural criteria during a certain situation (Ward and Kolomyts (2010)) and involves cognition (Mumford and Antes (2007)). While creativity is usually seen as a process in which novel ideas are produced (Drazin et al. (1999)), scholars now argue that creativity is increasingly recognized as a crucial mindset when it comes to make sense of novel innovations or technologies (Maitlis and Christianson (2014)) and to identify new opportunities (Gielnik et al. (2012); Heinonen et al. (2011)).

Thus, by building on the fourth assumption in section 2.1., creativity may be seen in the context of this study as a facilitating element during the recognition of a collaborative opportunity in selective revealing. The aim of this chapter is to review the major contemporary theories on creativity and to close with a hypothesis that refers to the moderating effect of creativity on superficial and structural similarities and analogical reasoning. Due to the myriad of complex and diverse theories in the field of creativity research, this review commences with the conceptual and comparative elements of the different theories, followed by the introduction of the two most important theories for this research and the presentation of empirical evidence for the elaboration of the hypothesis.

In order to compare the different theories of creativity, researchers often distinguish different levels of creative magnitude (Kozbelt et al. (2010)). The different levels of creative magnitude are summarized in Table 1. Creative magnitude is according to Kaufman and Beghetto (Kaufman and Beghetto (2009): 10) “important to have a specific understanding and categorization of what it means to be creative.”. Thus, it helps researchers to gain a better comprehension of the nature, the extent and the restrictions of each theory in the field of creativity.

By looking at the four-c models of creativity, one could rightly assert that all four levels of magnitude are relevant for a technological gatekeeper. However, as this research is mostly concerned with the evaluation of technological opportunities, I will subsequently focus on theories which are related to the little-c and/or big-c level.

Apart from different levels of creative magnitude, creativity can also be categorized according to the research’s reference point (Kozbelt et al. (2010)). Runco (2014) created a framework in which he classified the different aspects of creativity research consisting of five elements: person, product, process, place and persuasion. Theories that emphasize the person for instance, try to apprehend how traits and characteristics of a person, e.g. motivation or openness, affect his or her creative ability. Theoretical approaches of creativity focusing on products usually scrutinize the creative outcome such as inventions, patents or publications. Regarding the cognitive aspect of this thesis, the most important category is process. Creativity research that focuses on this aspect aims to understand how thinking affects creative ability and which mental processes appear during that process (Runco (2014)). Analogously, I aim to understand how different formulated solutions affect the perception of such a solution given divergent levels of creative abilities.

The previous section hence clarified that theories of creativity should with regard to this research focus on the process and creative magnitudes from little-c to big-c. From Kozbelt et al. (2010), who provide an extensive review of ten different theories of creativity, several them match these specifications. In the next phase, I will focus on one category of theory that not only fits the process focus and the creative magnitude, but is also consistent with the cognitive aspect of this research: creative cognition.

The cognitive theory of creativity , which is mostly referred to creative cognition, attempts to clarify the impact of cognitive processes on knowledge and memories during the ideation and evaluation of novel situations (Kozbelt et al. (2010); Ward and Kolomyts (2010); Ward et al. (1998)). Creative cognition is thus strongly interrelated to cognitive science and asserts that individual creative ability depends on knowledge and its accession and combination (Feldhusen (1995); Ward (2007)). One of the most important models which illustrates the mental processes of creative cognition is the Geneplore framework of Finke et al. (1992). Exhib-

Table 1: Levels of Creative Magnitude

Model	Level of Magnitude	Scope
Systems model of creativity	Small c	Personal creativity, i.e. subjective qualities that count as creativity (Csikszentmihalyi (1998); Csikszentmihalyi (2013))
	Larger c	Cultural creativity, i.e. social qualities that count as creativity (Csikszentmihalyi (1998); Csikszentmihalyi (2013))
Four-C Model of Creativity	Little c	Creativity that takes place in everyday situations (Kaufman and Beghetto (2009); Stein (1953))
	Big c	Creativity which has the outcome of an eminent contribution, i.e. the work of a creative genius (Kaufman and Beghetto (2009); Stein (1953))
	Mini c	Creativity that occurs during a learning process (Kaufman and Beghetto (2009))
	Pro c	Creativity that arises due to expertise (Kaufman and Beghetto (2009))

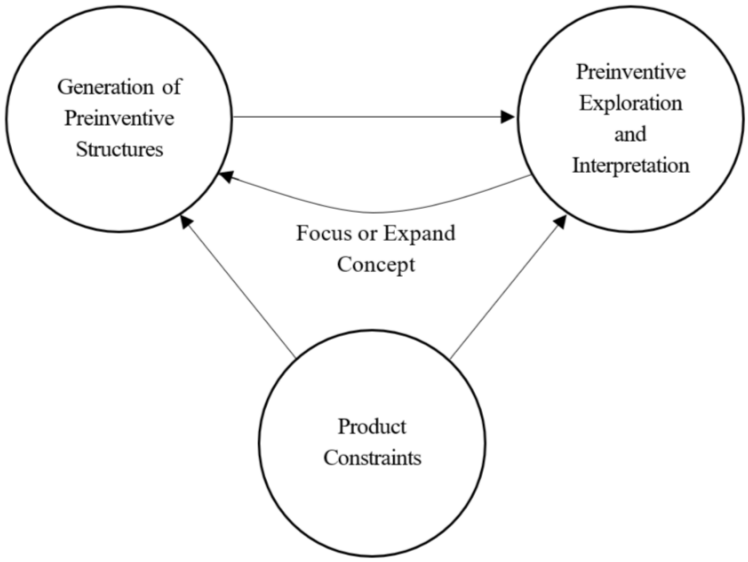

Figure 6: Geneplore Framework; Source: Own rendering based on Ward, Smith, and Finke (Ward et al. (1998): 193)

ited in Figure 6, the Geneplore Framework views creativity as a two-tier process, consisting of a generative and an explorative phase.

In the generative phase, several preinventive structures, i.e. the forerunner of an idea which is usually only an image or a sound, with a varying degree of creative potential are elaborated (Ward and Kolomyts (2010)). During this generative phase, several cognitive processes take place such as the retrieval of knowledge, images, schemata, features, concepts, analogies or a combination of those (Finke et al. (1992); Ward et al. (1998)). During the second stage of the Geneplore framework, selected preinventive structures are further elaborated with the aim to find a creative solution to an issue. Finke et al. (1992) thereby argued that preinventive structures may be chosen by certain aspects such as novelty or aesthetic factors. However, the last step is also seen as iterative, meaning that preinventive structures are permanently discarded or explored (Ward et al. (1998)).

To conclude, creative cognition views creative ability as a matter of employing or combining specific cognitive processes (Runco and Chand (1995); Ward and Kolomyts (2010)). The Geneplore framework stresses that an understanding of how creative outcomes are generated requires the appreciation of the underlying cognitive processes and their operation on existing knowledge and memories.

Despite its strong recognition in research, creative cognition has one major limitation which is worth a closer look in the context of this research: it conceptualizes creativity as a single entity and disregards the environment of an individual and its impact on individual creative ability (Kozbelt et al. (2010)). A remedy are the systems theories of creativity, which claim that "creativity results from a complex system of interacting and interrelated factors" (Kozbelt et al. (2010): 28). Gruber and Wallace (1998) and Csikszentmihalyi (1998), both pioneers in this field of research, claimed that multiple factors in one's environment such as network enterprise, belief systems or the professional milieu contribute to the creative ability. Creativity hence re-

sults from an interplay of socio-cultural factors (Kozbelt et al. (2010)). In this context, Csikszentmihalyi (1998) especially highlighted gatekeeper as the typical representative of system theories. Thus, systems theorist dramatically deemphasized the significance of individual contributions to creativity and is in stark contrast to the previous illustrated approach of creative cognition.

As the last section showed, creativity is a highly complex and divers theoretical model that requires to situate and to select existing theories according to the respective circumstances of the researched phenomenon. By acknowledging that collaborative opportunity recognition in gatekeeping falls into the categories of system theories and creative cognition, this review section will now exploit the empirical landscape of this domain. In entrepreneurial research, scholars already recognized the strong ties between creativity and opportunity recognition (Baron and Tang (2011); DeTienne and Chandler (2004)). Some researchers even tend to say that "opportunity recognition is a creative process itself" (Corbett (2005): 483; Hills et al. (1999): 217). Indeed, Ward (2004) proposed that opportunity recognition in entrepreneurial endeavors might be explicated by the Geneplore framework. Additionally, empirical examples have confirmed the positive relation between creativity and opportunity recognition among entrepreneurs. Ardichvili et al. (2003) have shown that entrepreneurs which successfully recognized opportunities tend to be more creative than other entrepreneurs. In another study, Heinonen et al. (2011) found evidence that creativity is positively associated with the perceived viability of the business idea. As a result, the implication of a positive association between opportunity recognition and creativity may be extrapolated to technological gatekeepers and the context of this research. Technological gatekeeper execute similar tasks as entrepreneurs (Bjerke and Hultman (2004); Boari and Riboldazzi (2014)).

The assertion that technological gatekeeping is a creative process like the Geneplore framework leads us to the assumption that the recognition of collaborative opportunities in selective revealing is also affected by different formulations of the revealed solutions. But to what extent does individual creativity moderate the effect of superficial and structural similarities in analogical reasoning?

As a matter of fact, creativity and analogical reasoning are strongly interrelated; for many researchers, analogical reasoning is a creative process itself (Finke et al. (1992); Ward and Kolomyts (2010)). Nevertheless, individual traits such as creative ability are also predictors of analogical transfer (Jones and Estes (2015)). Creativity enables individuals to find far analogies resulting in more creative interferences and outcomes (Holyoak and Thagard (1995); Smith and Ward (2012)). Studies from Corkill and Fager (1995) or Vendetti et al. (2014) have shown that semantic distance, i.e. superficial and structural similarities between a source and a target, influence the extent to which creativity is used during analogical reasoning. The authors discovered that higher semantic distances between the source and a target promoted the creation of more far analogies. These findings coincide with the claims of Gielnik et al. (2012) and Runco and Chand (1995), who proposed that the amount and the diversity of information triggers and enhances creative processes. Also from a neuroscience perspective, it has been confirmed that far semantic distance triggers creativity (Green (2016)).

From the presented evidence, I propose that the individual creativity of gatekeepers not only affects their ability to recognize collaborative opportunities, but also affects the generation of analogies. By acknowledging that low superficial and structural similarities trigger creativity, I infer that creativity positively affects opportunity recognition when there is a high semantic distance between the revealed solution and the target market of the gatekeeper. The hypothesis is thus posited in the following way:

> H.2.: Creativity moderates the relationship between superficial and structural similarities and the recognition of collaborative opportunities from selective revealing such that technological gatekeepers with high levels of creativity evaluate collaborative opportunities with dissimilar descriptive characteristics higher than gatekeepers with low levels creativity.

2.4. The effects of prior knowledge

2.4.1. Prior knowledge

The effects of prior knowledge in opportunity recognition have received much attention since the ground-breaking essay of Hayek (1945), who argued that as a result of unevenly dispersed information, decisions should be made by those who possess the most of it. Based on this argument, many scholars concluded that prior knowledge has, amongst others, a significant positive effect on the recognition of opportunities (Ardichvili et al. (2003); Arentz et al. (2013);Canavati et al. (2016); Hajizadeh and Zali (2016); Shane (2000)).

According to different studies, gatekeepers also need to be savvy in the domain they are acting in (Macdonald and Williams (1993); Scheiner et al. (2015)). Consequently, this section builds on the third cognitive assumption and aims to understand how prior knowledge from a specific domain affects technological gatekeepers in the evaluation and identification of novel opportunities. Thereby, a review on the underlying theories on domain-specific knowledge as well as a connection to cognitive abilities will be illustrated. At the end of this section, the latest empirical evidence paves the way for the elaboration of a hypothesis.

Prior to the introduction of the main theoretical approaches, this section commences with a disambiguation of domain-specific knowledge and expertise. Both terms are coherent, but it is easy to misspend them for the right context. An expert is a person "whose judgements are uncommonly accurate and reliable, whose performance shows certain types of rare or tough cases... and who acquired special skills or knowledge derived from extensive experience." (Chi (2006): 22). As this definition suggests, an expert possesses a great amount of domain-specific knowledge that is attained from past experiences. What distinguishes an expert

from a non-expert is the ability to detect solutions to problems, generate the best solutions and to retrieve knowledge with a minimum cognitive effort (Chi (2006)). However, while extensive prior knowledge and experience is a prerequisite to become an expert in a specific domain, it is not the only element that makes somebody an expert (Ericsson et al. (2007)). Becoming an expert is according to Feltovich, Prietula, and Ericsson (Feltovich et al. (2006): 57) not only a matter of prior knowledge and skills, but also of "mechanisms that monitor and control cognitive processes". Nevertheless, domain-specific knowledge and related experiences largely contribute to becoming an expert and have, correspondingly, a major impact.

From a psychological and cognitive perspective, it is generally accepted that domain-specific prior knowledge enhances problem solving in a particular domain (Newell and Simon (1972)). Also in the entrepreneurial research, prior knowledge is seen to be positively associated with opportunity recognition (Corbett (2005); Shane (2000)). According to Tricot and Sweller (2014), domain-specific knowledge even affects the most basic cognitive abilities such as learning. Comparisons between chess players and non-chess players have even shown that domain-specific knowledge affects the use of domain-general skills and memory strategies (Chi (1981)).

Cognitive research offers several explanations for the effects of domain-specific knowledge. First, the acquirement of domain-specific knowledge leads to the circumstance that more and larger integrated cognitive units or so called chunks are formed (Feltovich et al. (2006)). A chunk, which is situated in the LTM, is a memory structure with many elements (Gobet et al. (2015)). These chunks, whose existence was discovered by Chase and Simon (1973), facilitate individuals in the retrieval of information and in the recognition of patterns.

Inspired by research of Chase and Simon (1973), many scholars followed their lead and undertook further investigations in the specific cognitive processes that are affected by domain-specific knowledge. One major finding in the subsequent research was that domain-specific knowledge causes more abstracted and functional knowledge representations (Engle and Bukstel (1978); Hinds et al. (2001); Zeitz (1994)). Thus, compared to people with no knowledge in a specific domain, experts tend to represent domain-specific knowledge structures at a deeper level (Feltovich et al. (2006)). Thereby, the level of abstraction in mental representations increases with the amount of domain-specific knowledge and expertise (Hinds et al. (2001)). Abstract mental presentations facilitate experts to think in terms of relationships between elements of a specific knowledge structures. This in turn enhances the evaluation, reasoning and monitoring of a specific situation or problem (Ericsson et al. (2000)). In the contrast, individuals lacking domain-specific knowledge leads to a concreter, more isolated view on a special situation (Bingham and Eisenhardt (2011)).

When it comes to evaluate a novel situation, the evidence from the last sections illustrated that a person with domain-specific knowledge is supported by chunks and more abstract representations. However, a major issue lies in the question which of the acquired mental representations from domain-specific experience should be activated for a specific situation (Feltovich et al. (2006)). According to Hill and Schneider (2006) selectivity is the remedy which inhibits limited cognitive capacity (Feltovich et al. (2006)) and helps one to distinguish between general and domain-specific tasks. True expertise hence not only consists of domain-specific knowledge, but also the ability to apply the knowledge and cognitive processes for the right situations.

To conclude the theoretical review, I assert that the recognition of collaborative opportunities in selective revealing differs among individuals' due to their prior knowledge (Venkataraman (1997)). Consequently, gatekeepers with prior knowledge are better able to identify and evaluate novel collaborative opportunities that arise from selective revealing. Many studies have also confirmed that prior knowledge and schemata facilitate analogical transfer and reasoning (Gentner (1989); Holyoak (2012)). As demonstrated in Figure 3, a greater amount of prior knowledge provides more sources and hence increases the number of possible maps and transfers for better interferences. Even though superficial and structural similarities in analogical reasoning simplifies information proceeding (Kao and Archer (1997)), the magnitude of the impact is also steered by amount of the prior knowledge (Collins and Burstein (1989)). Schwanenflugel and Shoben (1983) have shown that similarities in representations are easier to understand if they respond to a suitable context. One very important feature that facilitates analogical transfer is the abstract and functional nature of knowledge representations, which is usually found in individuals with high levels of domain-specific knowledge. Novick (1988) argues that especially structural features of different objects are easier conceivable by people with prior domain-specific knowledge. This is attributed to the abstracted and functional knowledge representations, which allows individuals with prior knowledge to perceive relationships between elements of certain objects or situations. Empirical findings from Grégoire and Shepherd (2012) did confirm this suggestion.

From this evidence, I imply for the following hypothesis that gatekeeper who possess prior knowledge are better able to perceive the structural features between revealed solutions and the target market. the As this study differentiates between prior knowledge about the market and prior knowledge about the technology, I adopt the insight of Grégoire and Shepherd (2012) that only prior knowledge about the technology has a moderating effect on the recognition of technological opportunities for revealed solution. The hypothesis is hence formulated as following:

> H.3.a: Prior knowledge of technologies moderates the effect of structural similarities on the evaluation of collaborative opportunities in selective revealing such that technological gatekeepers with higher levels of prior knowledge

evaluate collaborative opportunities with similar structural descriptive characteristics higher than with dissimilar structural characteristics.

2.4.2. Peripherical knowledge

With the deduction of the last hypothesis, it was clearly demonstrated that domain-specific knowledge is a salient element in the identification and evaluation of opportunities of selectively revealed solutions. By talking of domain-specific knowledge, I simultaneously referred to core knowledge, i.e. knowledge that refers to a distinctive area of expertise (Simonton (2009)). However, researchers reckon that not only core knowledge, but also peripherical knowledge is increasingly important for the analogical reasoning process (Gavetti and Ocasio (2015); Haas and Ham (2015)). Some scholars even claim, that breakthrough innovation is more probable if peripherical knowledge is recombined and applied on a core domain (Fleming (2001); Kaplan and Vakili (2015); Savino et al. (2017)).

With peripherical knowledge, researchers often refer to knowledge from domains that is seemingly irrelevant to a given task at the beginning (Haas and Ham (2015)). However, according to Gavetti and Ocasio (2015), analogies can be also driven by peripherical knowledge. If the peripheral knowledge is in any sense related to the core problem, analogies will be formed that connect ideas from peripheral knowledge with the problem. In this case, the peripheral knowledge is the basis of the analogical transfer (Haas and Ham (2015)). Similar to the last findings about prior knowledge, peripheral knowledge enables individuals to find more potential sources and hence increases the number of possible maps and transfers for better interferences. By assuming that the distance between core-knowledge and peripherical knowledge domains is highly subjective and difficult to assess (Glaser et al. (2016)) and adopting the claims of Novick (1988), I assert that especially structural similarities between a revealed solution and the target market are easier conceivable by persons with deeper peripheral knowledge.

From these insights, I posit that peripheral knowledge of gatekeepers moderates the effect of structural similarities between the revealed solution and the target market. The second hypothesis in this second is thus stated as following:

> H.3.b: Peripheral knowledge moderates the effect of structural similarities on the evaluation of collaborative opportunities in selective revealing such that technological gatekeepers with higher levels of peripheral knowledge evaluate collaborative opportunities with similar structural descriptive characteristics higher than with dissimilar structural characteristics.

2.5. Conceptual framework and summary of the hypotheses

To conclude the current state of research, all hypotheses are again summarized in Table 2. The dimensions are consistent with the research questions and the dichotomy of optimal information flows: superficial and structural similarities investigate the bearings of the revealing instance, whereas creativity and prior knowledge address the potential issues of the receiving instance.

With the hypothesis being deducted, Figure 7 gives an overview on the dependent and independent variables and their interaction. I infer that the ability of analogical thinking presumably impacts how a collaborative opportunity is recognized. In keeping with the research questions, analogical thinking is affected by the structure of the information, i.e. superficial and structural similarities between the solution and the market, and individual traits, such as creativity and prior knowledge. Whether the interrelations between the dependent and independent variables are additive and/or interactive will emerge in the fourth section of this thesis.

3. Approach and method

To test the proposed hypothesis and to prove a causal relationship between the variables, I conducted a within-subject experiment (Bryman and Bell (2011); Mitchell and Jolley (2004)) with two revealed solutions, each formulated in four different scenarios. As illustrated in Table 3, the procedure to obtain the stimuli for the experiment, i.e. the different scenarios of the market-technology combination, was partly derived from Grégoire and Shepherd (2012) and conducted in a collaborative effort with industry experts.

The experimental approach allowed to test the causal and direct effect of superficial and structural similarities on the recognition of a novel collaborative opportunity. In addition, this set-up provided evidence through illustrating the relationship between creativity, prior knowledge, superficial and structural similarities, and the recognition of collaborative opportunities. The data collection was conducted through a web experiment (Reips (2002)) on Qualtrics (www.qualtrics.com). Table 4 exhibits a detailed design of the experiment.

3.1. Setting and participants

The experiment was conducted on the web-based platform Qualtrics in which the participants had to assess and evaluate different scenarios of selectively revealed solutions. The access to the platform was granted by the WU. In an attempt to make a case for external validity (Mitchell and Jolley (2004)), a real-world setting was achieved within the experiment by illustrating two revealed solutions from the "European Enterprise Network" (EEN). The EEN is a market platform in which firms have the opportunity to reveal their intellectual property and technologies in order to find new collaboration partners. For the study, the participants evaluated two selectively revealed solutions from the EEN that originated from the timber and wooden industry. The specific domain was chosen because more than half of Austria's area is covered with forest. This makes the local wood and timber industry a strong domestic economic force. Due to its specialization, the Austrian wood industry is seen as one of

Table 2: Summary of Hypothesis

Dimension	#	Hypothesis
Superficial and Structural Similarities	H_{1a}	Individuals evaluate a novel collaborative opportunity that arises through selective revealing higher if there is a high superficial similarity between the technology and market compared to a low superficial similarity of technology and market.
	H_{1b}	Individuals evaluate a novel collaborative opportunity that arises through selective revealing higher if there is a high superficial similarity between the technology and market compared to a low superficial similarity of technology and market.
	H_{1c}	Evaluations about a novel collaborative opportunity with low superficial and high structural similarity between the revealed solution and the market are more positive compared to a solution-market combination with low superficial and low structural similarity.
	H_{1d}	Evaluations about a novel collaborative opportunity with low superficial and high structural similarity between the revealed solution and the market are more positive compared to a solution-market combination with high superficial and low structural similarity.
	H_{1e}	Evaluations about a novel collaborative opportunity with low superficial and high structural similarity between the revealed solution and the market are less positive compared to a solution-market combination with high superficial and high structural similarity.
Creativity	H_2	Creativity moderates the effect of superficial and structural similarities on the evaluation of collaborative opportunities in selective revealing such that individuals with high levels of creativity evaluate collaborative opportunities with similar descriptive characteristics higher than with dissimilar characteristics.
Prior Knowledge	H_{3a}	Prior knowledge of technologies moderates the effect of structural similarities on the evaluation of collaborative opportunities in selective revealing such that individuals with higher levels of prior knowledge evaluate collaborative opportunities with similar structural descriptive characteristics higher than with dissimilar structural characteristics.
	H_{3b}	Peripheral knowledge moderates the effect of structural similarities on the evaluation of collaborative opportunities in selective revealing such that individuals with higher levels of peripheral knowledge evaluate collaborative opportunities with similar structural descriptive characteristics higher than with dissimilar structural characteristics.

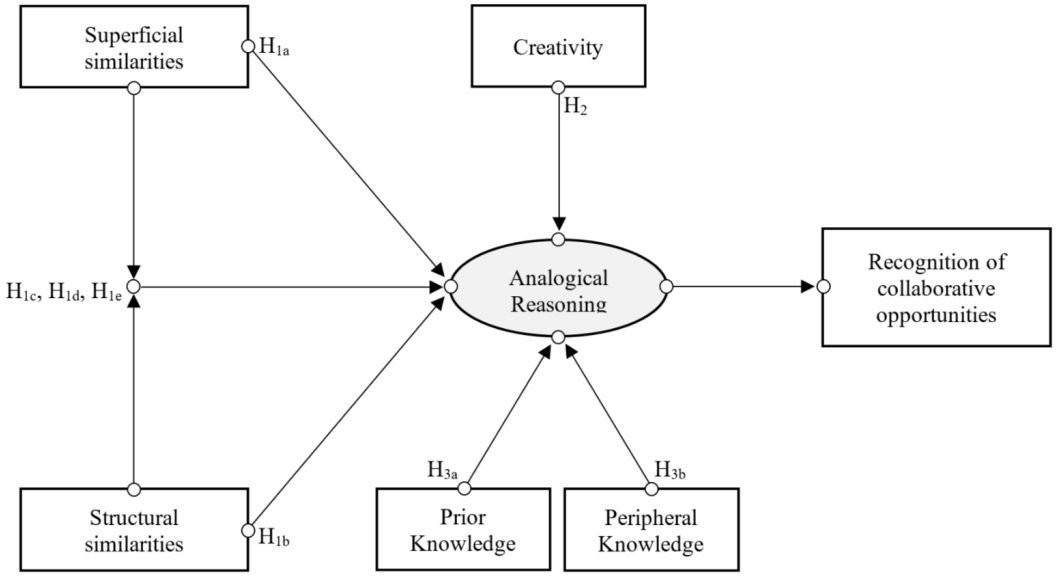

Figure 7: Conceptual framework and corresponding hypothesis

Table 3: Preparation of the Stimuli for the Experiment

	1. Selection	2. Manipulation	3. Manipulation-Check
Creation of two stimuli	Selecting two revealed solutions from the EEN according to their novelty and usefulness through a survey with industry experts.	In cooperation with three experts, four opportunity scenarios for each revealed solution were created. To come up with the scenarios, the superficial and structural similarities were manipulated.	Validating the manipulations of the technology-market pairs in a survey with university students.

the technological leaders in Europe (Hollersbacher (2010)). Many of Europe's leading wood processing companies and institutions are based in Austria. As a consequence of the of the timber industry's presence in Austria, both the stimuli creation and the access to potential participants was facilitated. Due to the specificity of the revealed solutions, I decided to execute the whole experiment in German. Consequently, the elaboration of the stimuli with industry experts was considerably simplified. Additionally, potential communication biases that would have arisen from the use of a non-native language were kept on a minimum level. This procedure was aligned with the sampling strategy, which destined to obtain participants solely from German-speaking countries.

Due to restrictions in time and resources, finding technological gatekeepers to participate in the experiment was constrained. However, students from technical and science degrees resemble gatekeepers very well, as both receive tertiary education (Allen (1970)). As a result, invitations to the experiment were sent to colleges and universities that have strong and weak ties with the wood industry in order to control for prior and peripheral knowledge in the sample. The sampling strategy, illustrated in Table 33 in the Appendix, reveals all contacted university departments and the communication channels used for the experiment. The maxim to attract as many participants as possible was supported by an incentive scheme. In total, vouchers with a total value of € 100 were raffled among all participants.

Eventually, data points from 653 participants were collected. With a completion rate of 40.5%, and the elimination of outliers according to Schlosser and Höhne (2016), the final number of participants for this analysis was 216. This number thereby did almost fulfill the requirements calculated from a power analysis (Cohen (2013)). The latter indicated that for the given research design and the desired effect the sample size should approximately count 62 participants in each treatment group. The sample characteristics are further illustrated in Table 5. In the quintessence, the participants originated from public universities and had a diverse background in natural science, engineering or business.

3.2. The manipulation of the stimuli

The creation of the stimuli for the experiment was an integral part of this study. As already mentioned, the stimuli consisted of four differently formulated scenarios from two revealed solutions from the EEN. The formulation of the stimulus was conducted in collaboration with industry experts from the Holztechnikum Kuchl. As summarized in Table 3, the creation of the stimuli for the experiment consisted of three phases.

Prior to the manipulation itself, the selectively revealed solutions were chosen in the first phase. To create a realistic setting, the revealed solutions which originated from wood- and timber-industry were selected from the EEN. The EEN is used by companies and institutions to unveil their intellectual property to find new partnerships. From a pool of 30 technologies available, ten distinctive solutions were chosen for a pre-selection. An overview of all technologies is provided in Table 20 in the appendix. The aim of the pre-selection was to identify technologies which were perceived novel and useful. For the assessment, alumnus from the Holztechnikum Kuchl evaluated the idea quality of the ten different solutions similar to O'Quin and Besemer (1989). The assessment of the idea quality consisted of the two dimensions novelty and usefulness (O'Quin and Besemer (1989)) and assess whether an idea represents an implementable solution to a problem (Dean et al. (2006)). An exact scheme of the questionnaire can be found in Table 21 in the appendix. With this pre-selection, I controlled for novelty and different levels of usefulness of the revealed solutions. By providing different solutions with diverging perceptions, I attempted to avoid potential framing biases during the experiment and to enhance the generalizability of this research.

Overall, 17 professionals from the wood industry evaluated the ten technologies in the survey. As a result, the following technologies were chosen for the further manipulation: "T15 - Bioethanolherstellung von Holzabfällen" and "T23 - Holztrocknung mit Infrarotstrathlung". The calculation of Cronbach's alpha confirmed the high internal validity of the survey ($\alpha_{Novelty} = 0{,}86$ and $\alpha_{Usefulness} = 0{,}83$). Both chosen technologies exhibited high levels of novelty. With respect to providing different solutions, the technologies varied significantly in their perceived usefulness ($t = 2{,}12 > 1{,}96$). While the solution for drying wood via infrared technologies was perceived less useful, the solution which described the process of producing bioethanol from wood was rated very useful. The two chosen solutions were subsequently further adjusted for the experiment by manipulating the superficial and structural similarity between the revealed solution and the target market. The aim of the second phase of the stim-

p

Table 4: Procedure of the Experiment

1. Technology Scenarios		2. Measurement dependent variables	3. Measurement prior knowledge	4. Measurement creativity	5. Measurement control variables
Randomization	High structural similarity High superficial similarity High structural similarity Low superficial similarity Low structural similarity High superficial similarity Low structural similarity Low superficial similarity	a) Opportunity-recognition belief b) Collaborative opportunity evaluation	a) Knowledge about technology b) Knowledge about market c) Peripheral Knowledge	a) Wallach & Kronach Divergent thinking test (1965) b) Creative self-efficacy	a) Recording demographic and socio-demographic data about participants

Table 5: Sample Characteristics

	Business science		Law		Timber & Forestry		Math & Sciences		Engineering		Σ
	N	%	N	%	N	%	N	%	N	%	
Number of Participants	96	45.5	34	16.1	27	12.7	25	11.8	29	13.7	211
Pursued Degree											
Bachelor	65	47.8	30	22.1	13	10.1	11	8.1	17	12.5	136
Master	29	41.4	4	5.7	14	20.0	13	18.6	10	14.3	70
PhD	2	40.0	-	-	-	-	1	20.0	2	40.0	5
Gender											
Female	39	49.4	17	21.5	6	7.6	11	13.9	6	7.6	79
Male	57	43.2	17	12.9	21	15.9	14	10.6	23	17.4	132

	Business science	Law	Timber & Forestry	Math & Sciences	Engineering	Σ
	μ	μ	μ	μ	μ	μ
Age	24.5	23.9	25.4	25.1	24.1	24.5
Job Tenure	4.0	3.6	3.6	3.3	3.3	3.7

uli creation was to develop revealed solution-market pairs with different similarity characteristics. All scenarios were conducted with the aid of three specialists in the wood and timber sector in order to prevent individual schemata from affecting the formulation of the different scenarios (Kao and Archer (1997)). Prior to the manipulation of the technology, each expert received a short introduction on superficial and structural similarities and further instructions about the format. Each stimulus consists of around 150-200 words. Hence, after the definition of a target market and the description of the technology, which were very similar to the original version on the EEN, the superficial and structural elements between the revealed solutions and the markets were identified. Superficiality is understood as shared basic features of two objects or concepts (Grégoire and Shepherd (2012); Holyoak and Thagard (1995)). Overall, two scenarios of the technology with high superficial similarity and low superficial similarity were generated. Subsequently, the same procedure was repeated for the structural similarities, i.e. a logical relationship between the components of two objects (Grégoire and Shepherd (2012); Holyoak and Thagard (1995)). Eventually, all traits of superficial and structural similarity were combined, resulting in four scenarios. A summary of the manipulations is presented in Table 23 in the appendix. Furthermore, a detailed illustration of all different scenarios for both technologies is depicted in Table 24 (for the technology "Holztrocknung mit Infrarotstrathlung") and Table 25 (for the technology "Bioethanolherstellung von Holzabfällen") in the appendix.

Even though the scenarios were constructed with experts – thereby confirming the face-validity of the stimulus – it was still necessary to conduct a manipulation check of both solution-market pairs. This manipulation check was conducted with 32 participants, mostly students, through an online survey on Qualtrics and yielded 64 evaluations of similarities and dissimilarities. A detailed description about the survey statistics is provided in the appendix in Table 26 and Table 27.

For the manipulation check, the participants were randomly assigned to one of the four scenarios of each solution. The sequence of the technologies was randomized to prevent order effects. After a short introduction to the problem, every participant was asked to list the similarities and dissimilarities of the illustrated scenarios between the revealed solution and the market. Once the listing was finished, the prior knowledge about the solution-market pair as well as sociodemographic details were collected. The rendered answers were later qualitatively categorized according to the prior defined manipulations standards (see Table 23). To verify the internal validity of the manipulations, a two-sample t-test for each scenario and technology was conducted. In this analysis, a p-value for the listed similarities of two opposing scenarios (e.g. high superficial similarity versus low superficial similarity) was computed. For both technologies, the participants listed more similarities in scenarios with high similarities and more dissimilarities in scenarios with low similarities (for detailed results, please consult Table 28 and Table 29 in the appendix). With a confidence interval of .95, all p-values confirm that the scenarios are significantly distinctive from each other. The results, which are summarized in Table 6, thus affirmed that the manipulations feature the desired effect and can be used in the online-experiment.

3.3. Experimental Design

For the experimental phase, I employed a 2*2 within-subject online-experiment on Qualtrics, consisting of six phases as illustrated in Table 4. The average participation time of the experiment was 14.67 min. In the first phase, every participant received a short introduction about the experiment. Particularly, they were informed about the role of technological gatekeepers in firms and of selective revealing. For this purpose, the participants were also asked to put themselves in the position of a gatekeeper in a firm, and

Table 6: Results of the Manipulation Check

Technology/Characteristic	Superficial Similarities [p-value]	Structural Similarities [p-value]
Holztrocknung mit Infrarotstrathlung		
Similarities	2.75E-07	1.85E-05
Dissimilarities	2.63E-03	8.08E-04
Bioethanolherstellung von Holzabfällen		
Similarities	9.37E-05	4.87E-07
Dissimilarities	7.42E-03	7.64E-04

in the following, to evaluate a novel opportunity that was recently revealed.

The second phase of the experiment emphasized the evaluation of collaborative opportunities. In this phase, the participants were randomly assigned to one scenario for each solution-market pair. In order to control for order effects, the sequence of technologies was randomized. After each solution-market pair was illustrated, the participants had to assess the solution-market pair according to the opportunity-recognition belief and the attractiveness of the collaborative opportunity (more details will be provided in section 3.4). Lastly, every solution-market block also consisted of the assessment of a participant's prior knowledge. Four questions were provided to assess a participant's prior knowledge about the previously presented solution-market pair.

After the fourth phase came the evaluation of individual creativity. The creativity assessment was conducted through a divergent thinking test. Every participant was asked to take part in a Wallach and Kogan (1965) divergent thinking test which was limited to two minutes (for further details, please see section 3.4.2). Similar to Grégoire and Shepherd (2012), another proxy for creativity in this research was creative self-efficacy. This variable was measured with a three-item scale developed by Tierney and Farmer (2002). Eventually, selected demographic and socio-demographic data about participants were collected. This data was necessary to control for differences in educational levels (i.e. degree, type of university and field of study), work experience, age and gender.

3.4. Operationalization of the experiment

With the operationalization, I intend to define the means of measuring the variables for this experiment. Summarized in Table 7, the theoretical constructs refer to corresponding elements in the conceptual framework. Each theoretical construct may consist of multiple variables to measure the desired effects. A detailed examination of all measurement scales is provided in the sub-sections below.

As illustrated in Table 7, most of the scales were derived from established academic literature. However, as this study was conducted in German, all items also had to be translated. In order to provide comparable questions and to avoid contortions of the questions, a re-translation was conducted (Smith (2003); Su and Parham (2002)). With a re-translation, an individual (in this case a student), who was unfamiliar to the original question, translated the German question back into English. The re-translated questions were compared with the original question to see if the German question had to be adapted. The process of re-translation is iterative and ensures that meaning of the original question is conveyed appropriately (Bernard (2012)).

3.4.1. Measurement of the dependent variable: collaborative opportunity evaluation and opportunity-recognition belief

In order to measure the dependent variable of this experiment, I used two distinct series of questions from Grégoire et al. (2010) as well as Tyler and Steensma (1995) to evaluate the recognition of collaborative opportunities. For each technology, the evaluation of the opportunity directly took place after the revealed solution was presented. A detailed extract about the operationalization of the dependent variables is illustrated in Table 30 in the appendix.

The first series of questions targeted the participants' opportunity-recognition beliefs, i.e. the belief whether the presented opportunity is of value and achievable (Shepherd et al. (2007)). The measurement of a participants opportunity-recognition belief on a seven-point Likert-scale is based on Grégoire et al. (2010), who established and validated a method which is appropriate to examine the recognition of several kinds of opportunities in different contexts. According to the researchers, there are two categories which contribute to an individual's opportunity-recognition belief: the fit between a novel opportunity and the market requirements, and the feasibility of the novel opportunity. In this context, the dimension of fit consisted of three items and mirrors the ability of a revealed solution to offer qualities that match a market's needs and requirements. On the other hand, the notion of feasibility captures one's belief about the achievability of the revealed solution and captures two items. By deploying the opportunity-recognition belief measure of Grégoire et al. (2010) I ensured that the target items are internally consistent. The Cronbach alpha of the two categories also confirmed internal consistency, with acceptable values of $\alpha_{Fit} = 0.786$ and $\alpha_{Feasibility} = 0.646$.

With the second series of questions, I attempted to find out how the participants assess the attractiveness of a col-

Table 7: Operationalization of the Analyzed Variables

Theoretical construct	Variables	Categories	Items	Source
Recognition of collaborative opportunities	Opportunity-recognition belief	Fit Feasibility	2 3	Grégoire and Shepherd (2012) Gregoire et al. (2010)
	Collaborative opportunity evaluation	Attractiveness	2	Tyler and Steensma (1995)
Prior Knowledge	Prior knowledge	Technology Market	2 2	Grégoire and Shepherd (2012); Shane (2000)
	Peripheral knowledge	Educational background	3	-
Creativity	Divergent thinking	Elaboration Flexibility Fluency Originality	1	Runco (2010); Runco and Acar (2012); Wallach and Kogan (1965)
	Creative self-efficacy	Self-efficacy	3	Beghetto (2006); Tierney and Farmer (2002); Tierney and Farmer (2011)

laborative opportunity which would arise through the revealed solution. This measurement was derived from Tyler and Steensma (1995), who evaluated the attractivity of a technological collaborative opportunity. The variable consisted of two items: (1) the direct assessment of the attractivity of a potential collaboration and (2) the probability that they would recommend the opportunity. This variable measured the answers – similar to the questions about opportunity-recognition belief – on a seven-point Likert-scale from 1 (strongly disagree) to 7 (strongly agree). The internal consistency was confirmed with a Cronbach alpha for this scale of $\alpha_{CE} = 0.883$.

3.4.2. Measurement of prior and peripheral knowledge

The third stage of the procedure of the experiment served as a mean to determine the individual level of prior knowledge about the presented solution-market combination. It controlled for a possible impact of prior knowledge during the evaluation of an opportunity and consisted of two sub-measurements.

In the first sub-measure - the assessment about the prior knowledge - each participant had to self-evaluate one's knowledge about the presented technology and about the concerned market. Similar to Grégoire and Shepherd (2012), the assessment about the prior knowledge consisted of two categories which in turn included two items as illustrated in Table 7. In the technology dimension, the participant was asked how familiar one is with the presented technology and the underlying scientific principles. In order to assess prior knowledge about the market, each participant was asked about the prior knowledge of the market and its latent needs and issues. All four items were captured on a 7-point Likert-Scale. A detailed listing of all items is depicted in Table 31 in the appendix.

In addition to this self-assessment, all participants were asked about their field of study in the last stage of the online experiment. This question does not only help to assess the relationship between prior knowledge and the study field, but also support the determination of the peripheral knowledge. In this regard, I will distinguish between close knowledge (i.e. participants with a background in timber science and forestry), analogous knowledge (i.e. participants whose study fields cover the technical principles of the revealed solutions, i.e. students with a background in engineering and natural science) and distant knowledge (participants with no relation to the revealed solutions, i.e. students with a background in business and law)

3.4.3. Measurement of creativity: divergent thinking and creative self-efficacy

In this experiment, individual creativity was assessed through a divergent thinking test and a questionnaire about creative self-efficacy. Both measurements have been adopted from the scientific literature.

Even though divergent thinking is only seen as a part of creativity (Runco (2010)), it is generally accepted that divergent thinking tests serve as an overall indicator for creative potential (Berg (2016); Runco (2010); Runco and Acar (2012); Zeng et al. (2011)). In the context of this study, a Wallach/Kogan test was carried out (Wallach and Kogan (1965)). Despite its maturity, this test is still very esteemed among researchers due to its reliability and validity (Runco and Acar (2012)).

In the Wallach & Kogan assessment of creativity, examinees are asked to come up with many possible ideas for a specific element (Wallach and Kogan (1965)). In this experiment, the item was a brick stone, similar to the suggestions of Wallach and Kogan (1965). The response time for the test was limited to two minutes to ensure that every participant had the same preconditions. Due to the time limit, a picture of a brick stone was illustrated so that every participant could

put oneself as quickly as possible into the exercise. The analysis of the results was carried out post experiment. Scores were allotted according to four criteria: originality, fluency, flexibility and elaboration. Eventually, individual creativity was determined through a proportional summative score in the Wallach & Kogan test (Runco and Acar (2012)). The objectivity of the divergent thinking assessment was guaranteed through a two-folded examination through the author and a student assistant. A deeper insight about the scoring mechanism and its criteria are specified in the appendix in Table 32.

Creative self-efficacy was another proxy for individual creative ability in this research. This variable was measured through a self-assessment of "one's imaginative ability and perceived competence in generating novel and adaptive ideas, solutions and behaviors" (Beghetto (2010): 457). According to researchers, the perceived creative competences are connected to the specific situational context (Jaussi et al. (2007)). In addition, creative self-efficacy also reflects one's personal value of creativity (Randel and Jaussi (2003)). Even though the interrelations between divergent thinking and creative self-efficacy have yet to be clarified (Plucker and Makel (2010)), this variable was integrated into this experiment. The measurement of creative self-efficacy is very brief and consists only of three items. The scales, derived from Tierney and Farmer (2002), Tierney and Farmer (2011) and Beghetto (2006), exposed evidence of reliability and validity due to the extent of scrutiny in scientific articles. In addition, the Cronbach alpha for this scale was $\alpha_{CreativeSelf-Efficacy} = 0.832$.

3.5. Data analysis

The analysis of the data gathered during the experiment was fragmented in seven phases as illustrated in Figure 8. After the raw data was obtained, a data cleaning was conducted. In this step, the aim was to convert the raw data into technical correct and consistent data (Dasu and Johnson (2003); De Jonge and van der Loo (2013)). During this step, necessary adaptions such as dummy creation, data alignment, replacement of missing values or dropping of obsolete columns were carried out. In addition to that, parts of the data were sorted out according to different pre-decided criteria. Thus, all participants with non-completed surveys as well as all non-students were rejected for the later analysis. In addition, response time outliers (i.e. the 5th and 95th percentile) were eliminated according to Schlosser and Höhne (2016). Once all outliers were eliminated, the divergent thinking scores, which were analyzed separately, were allocated to the participants. Lastly, it was manually controlled if each participant correctly assigned him-/herself to the right group in the field of study variable.

The third stage of the analysis comprised a check of the effectiveness of the randomization. By testing the difference between means of various sample-characteristics of each scenario (i.e. a two-sample t-test), it was determined if the randomization was successful. This step was necessary to ensure that all participants were equal with respect to all conditions except for the different solution-market pair scenarios. Once the success of the randomization was ensured, the analysis advanced to the sample characteristics and the internal reliability. While the sample characteristics were comprised of descriptive data, the internal reliability was computed through the calculation of the Cronbach Alpha, a coefficient that determines the interrelatedness of all items of a category in a measurement scale (Cortina (1993)).

The descriptive statistics of the data took up a major part of the analysis. In order to use these parametric methods, all variables which were of ordinal nature during the experiment (i.e. all Likert-Scales) were converted into numerical values by averaging the multiple Likert items (Allen and Seaman (2007)). The results from the correlation matrix or the calculation of the means within the different scenarios or different levels of prior knowledge/creativity represented a first indicator of the correctness of the hypothesis. In order to prove the hypothesis, however, a generalized linear model, or GLM, was conducted in the last stage of the analysis. Such a model is especially useful in repeated measurements. In the context of this research, this was necessary because every participant of the survey provided multiple data points by evaluating two out of four solution-market scenarios during the experiment. The GLM model was preferred over a repeated ANOVA (analysis of variance) due to missing values (i.e. participants only evaluated revealed solutions in two out of four scenarios) (McLean et al. (1991)).

The peculiarity of a GLM is that it analyzes both fixed and random effects of a dependent variables (Sachs and Hedderich (2006)). Fixed effects are effects that are only assignable to the treatment of the experiment and constant across all individuals. On the other hand, random effects are effects that are assignable beyond the treatment of the experiment. In this experiment, I used the common assumption that all random effects are independent (i.e. heterogenous variance structure), which allows parameters to vary (i.e. the slopes or intercepts of a model).

As two out of four treatments were carried out on the same participant, the GLM aimed at explaining the within-variance of the dependent variables. In particular, this analysis helped to differentiate whether the variance in the evaluation of a revealed solution was caused by individual differences (random effects) or the experimental manipulation that was carried out on the same persons (fixed effects), i.e. the effects of superficial and/or structural similarities (Field et al. (2012)). During the analysis, I applied the linear mixed-effect model of Pinheiro and Bates (2009) with a maximum likelihood estimation. This model belongs to the applications of multilevel modeling and assumes that the coefficients of a model are no longer fixed but random, meaning that both intercept and slope of a model can change (Hoffman and Rovine (2007)). The use of such a multi-level model allowed to relinquish the assumptions of sphericity (i.e. the requirement that the variance across the scenarios must be symmetrical) and homoscedasticity (i.e. the notion that variances are homogenous) compared to a conventional repeated ANOVA method (Quené and van den Bergh (2004)). Simi-

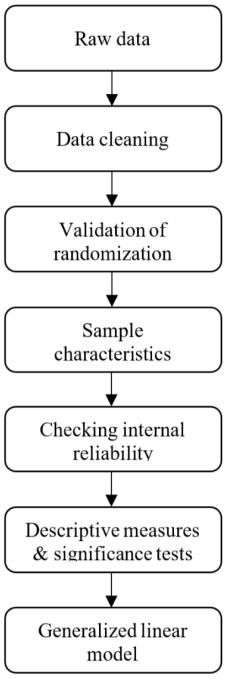

Figure 8: Process of the Data Analysis

lar to Judd et al. (2017), I used orthogonal contrasts to control for the treatment effects during the analysis. With the aid of these contrasts, I not only captured and isolated the main effects of superficial and structural similarities which were nested within each participant (Field et al. (2012)), but also assessed the different interactive effects. In addition, the other independent variables were added to the model in order to evaluate if their effect varied across the treatment variables. By deploying various models with different covariance structures, I ensured that the model with the highest fit compared to the base model (i.e. with superior Akaike's information criterion (AIK) and Schwarz's Bayesian criterion (BIC)) was chosen to test the previously elaborated hypotheses (Field et al. (2012)).

4. Results

4.1. Examining the effectiveness of the randomization

Even though randomization was operated through Qualtrics, the effectiveness of the randomization had to be revised due to the inability to monitor the allocation of participants to the scenarios during the experiment. In addition, there was a risk that the immense data cleaning that was carried out on the whole sample blurred the composition of the treatment groups. An initial check - summarized in Table 8 - illustrates that the number of participants in each scenario was approximately the same.

In Table 9, the most important participant characteristics are broken down for each scenario. It shows, that most participants in each scenario are currently undergraduates (with 1 = Bachelor, 2 = Master and 3 = Ph.D.). Furthermore, most participants originated from business studies (with 1 = Distant knowledge fields, i.e. Business and Law; 2 = Peripheral knowledge fields, i.e. Engineering and Natural Science; 3 = Close knowledge fields, i.e. Forestry and Wood Science). Regarding the gender, which was assigned in the data as a dummy for female, the proportion of female participants amounted from 33% to 44% between the solution-market scenarios.

To assess whether the treatment groups differed significantly from each other, I used a paired t-test to examine the differences in the characteristics across all scenarios. The p-values exhibited in Table 10, indicate for all but one (i.e. the studied field between the scenario High Superficial and Structural Similarities and High Superficial and Low Structural Similarities) comparison, that there is insufficient evidence to claim that the sample characteristics between the solution-market scenarios are different as they exceed the confidence interval of $\alpha = .05$. Due to the ordinal nature of the variables studied degree and studied field, I also computed a chi-squared test to assess if there is a significant difference in the distribution of the data among the scenarios. For both variables, the test-statistic was below the critical value ($\chi^2_{SD} = 5.26 < \chi^2_{(0.95;6)} = 12.59$ and $\chi^2_{SF} = 6.80 < \chi^2_{(0.95;12)} = 21.03$), which means that there is enough evidence to accept the null hypothesis (i.e. that the variables in the scenarios are independent from each other). Hence, both statistical tests allow the inference that the randomization was successful.

4.2. Descriptive data of the experimental outcome

In Table 11 and Table 12 the descriptive statistics for both dependent variables, ORB and CE are exhibited. Table 11 illustrates that the effects of superficial and structural similar-

Table 8: Number of Participants in Each Scenario

	High Structural Similarity	Low Structural Similarity
High superficial similarity	109	108
Low superficial similarity	104	101

Table 9: Characteristics of Sample within Treatment Groups

Solution-Market Scenario	Studied Degree		Studied Field		Age		Gender	
	μ	σ	μ	σ	μ	σ	μ	σ
High superficial similarity, High structural similarity	1.45	0.55	1.43	0.67	24.72	6.44	0.38	0.49
High superficial similarity, Low structural similarity	1.37	0.54	1.64	0.75	24.52	5.39	0.32	0.47
Low superficial similarity, High structural similarity	1.33	0.53	1.45	0.70	24.25	4.48	0.44	0.50
Low superficial similarity, Low structural similarity	1.37	0.50	1.52	0.72	24.63	4.58	0.36	0.48

Table 10: P-Values Comparing the Sample Characteristics of the Treatment Groups

	Studied Degree [p-value]	Studied Field [p-value]	Age [p-value]	Gender [p-value]
HSU/HST ↔ HSU/LST	0.287	0.033	0.807	0.423
HSU/HST ↔ LSU/HST	0.100	0.825	0.593	0.328
HSU/HST ↔ LSU/LST	0.255	0.331	0.915	0.768
HSU/LST ↔ LSU/HST	0.555	0.062	0.693	0.078
HSU/LST ↔ LSU/LST	0.956	0.263	0.868	0.624
LSU/HST ↔ LSU/LST	0.586	0.461	0.545	0.211

ities are positively reflected in the average ORB of the sample. In scenarios with high superficial and structural similarities, participants assessed the revealed solution on average by 0.07, and 0.12 respectively, higher. Table 12 shows similar, though smaller effects for CE. The correlation matrix further discerns the relationships between the variables. Except for some few exceptions, the correlations among the variables are low. However, the correlation matrix shows in both cases, that the superficial and structural similarities are slightly positively correlated with the dependent variables. A significance test was conducted to verify the monotonic relationship between the variables. This test showed that some correlation coefficients, such as the coefficient between structural similarity and the dependent variables, were statistically significant given a pre-defined confidence interval. A computation of the variance inflation factor by Fox and Monette (1992) further indicated that multicollinearity did not influence the results of both correlation matrices (values ranged from 1.02 to 2.14 and were under the critical value of 7).

Even though the information of both tables already provides interesting insights, the results must be treated very cautiously as correlation does not imply causality (cum hoc non est propter hoc). Whereas some findings deserve further examination (i.e. the positive correlation of structural and superficial similarities on opportunity-recognition belief and collaborative opportunity evaluation; or the negative significant correlations of divergent thinking and study fields on the dependent variables), other insights are either intuitive (such as the positive relationship between prior knowledge of markets and technologies and the studied field or the positive relation between divergent thinking and self-efficacy) or hard to interpret (such as the significant positive correlation between studied field and divergent thinking or creative self-efficacy). By means of a GLM, the next sub-sections will scrutinize selected relationships to detect causal and meaningful relationships between the variables and to prove or reject the elaborated hypotheses.

Table 11: Means, Standards Deviations, and Correlations of Opportunity-Belief Recognition and Independent Variables; * $p \leq .05$, ** $p \leq .01$

Variables	Mean	s.d.	1	2	3	4	5	6	7	8	9
1. Average opportunity belief	4.80	0.96									
2. Effect of superficial similarities	4.88	0.88	0.08*								
3. Effect of structural similarities	4.91	0.97	0.11**	-0.01							
4. Prior knowledge of markets	2.36	1.00	-0.03	0.04	-0.04						
5. Prior knowledge of technologies	2.46	1.01	-0.01	0.04	-0.03	0.56**					
6. Divergent thinking	1.52	0.45	-0.08*	0.00	-0.02	0.05	-0.03				
7. Creative self-efficacy	4.77	1.06	-0.01	0.02	-0.09*	0.25**	0.11*	0.19**			
8. Job tenure	3.73	2.75	-0.07	-0.05	-0.01	0.03	-0.01	-0.05	-0.01		
9. Studied degree	1.38	0.53	-0.08	0.06	0.02	-0.04	-0.19**	0.16	0.05	0.13**	
10. Studied field	1.51	0.71	-0.10*	0.03	-0.10*	0.40**	0.30**	0.25**	0.15**	-0.07	0.20**

Table 12: Means, Standards Deviations, and Correlations of Collaborative Opportunity Evaluation and Independent Variables; * $p \leq .05$, ** $p \leq .01$

Variables	Mean	s.d.	1	2	3	4	5	6	7	8	9
1. Av. Collaborative opportunity evaluation	4.78	1.33									
2. Effect of superficial similarities	4.81	1.28	0.02								
3. Effect of structural similarities	4.90	1.30	0.09**	-0.01							
4. Prior knowledge of markets	2.38	1.01	-0.04	0.04	-0.04						
5. Prior knowledge of technologies	2.47	1.01	0.03	0.04	-0.03	0.56**					
6. Divergent thinking	1.49	0.50	-0.10*	0.00	-0.02	0.05	-0.03				
7. Creative self-efficacy	4.79	1.05	-0.03	0.02	-0.09*	0.25**	0.11*	0.19**			
8. Job tenure	3.80	2.83	-0.03	-0.05	-0.01	0.03	-0.01	-0.05	-0.01		
9. Studied degree	1.74	1.01	-0.07	0.06	0.02	-0.04	-0.19**	0.16	0.05	0.13**	
10. Studied field	2.32	1.48	-0.04	0.03	-0.10*	0.40**	0.30**	0.25**	0.15**	-0.07	0.20**

4.3. The effects of different similiarity characteristics on the evaluation of a revealed solution

This section further examines how the induced superficial and structural similarities in the solution-market pairs influenced the perception of the revealed solutions. Figure 9 illustrates the average opportunity-recognition belief and collaborative opportunity evaluation across all scenarios. This illustration points out the distinctive differences in the evaluations across the four scenarios. As demonstrated, the evaluations for both evaluations were highest in the scenario with high superficial and high structural similarity ($\mu_{ORB-High/High} = 5.02$ and $\mu_{CE-High/High} = 5.03$). On the opposite side, the ratings for ORB were the lowest in the scenario with low superficial and low structural similarity ($\mu_{ORB-Low/Low} = 4.65$). However, this was not the case for the CE rating, which was the lowest in the scenario with high superficial and low structural similarity ($\mu_{CE-High/Low} = 4.60$). For both variables, ratings in the scenarios with high superficial and high structural similarity and low superficial and high structural similarity were above the average, whereas the ratings in the other two scenarios were below average.

Table 13 shows the p-value of a two-sample test and summarizes whether the differences of both dependent variables across the four scenarios are statistically significant. With varying confidence intervals, the differences in mean for both dependent variables between high superficial and high structural similarity, and low superficial and low structural similarity and high superficial and low structural similarity respectively are statistically significant.

The differences reported above were further examined through the linear mixed-effect model from Pinheiro and Bates (2009). The fixed effects on opportunity-recognition belief and collaborative opportunity evaluation are illustrated in Table 14. The latter shows, that for both dependent variables, the coefficient for structural similarity was positive and significant ($b_{ORB} = .10$, $p \leq .05$; $b_{CE} = .12$, $p \leq .10$). This result not only coincides with positive significant correlation coefficient, but also confirms the hypothesis that technological gatekeepers perceive a novel collaborative opportunity that arises through selective revealing more positively if there is a high structural similarity between the revealed solution and the market. On the other hand, the coefficient for superficial similarity is positive, however insignificant for both ORB and CE (bORB = .08, p = .12; bCE = .03, p = 0.58). This means that there's not enough evidence to support the first hypothesis H1a, which claimed that that technological gatekeepers perceive a novel collaborative opportunity that arises through selective revealing more positively if there is a high superficial similarity between the revealed solution and the market. The results for both coefficients were confirmed by a post-hoc test, a log-likelihood ratio statistic (see Table 34 and Table 35 in the appendix) and the F-Values (calculated through ANOVA in Table 14).

During the course of the analysis, different models including varying manipulations of explanatory factors were tested; however, all of them were not only inferior in terms of fit, but also showed no statistical significance in the added interaction terms. The random effects in the linear mixed-effect model are reported in Table 15. The first three columns exhibit the random effects between the treatment groups, i.e. variability between individuals and between superficial and structural similarity. The standard deviation in the residual states the variance within the treatment. Whereas variability between individuals and superficial similarities strongly varied across both outcomes, the between standard variance of structural similarity and the within-variance were equally high in both cases.

In addition to the computation of the random effects, the analysis also included several checks aiming at the identification of carry-over effects during the experiment. Neither a two-sample t-test nor the inclusion of a dummy in the GLM, which indicated the sequence of the illustrated technologies during the experiment, indicated a significant effect of carry-over effects.

The last part of this sub-section compares opportunity-recognition belief and collaborative opportunity evaluation across the scenarios with divergent levels of superficial and structural similarities. Table 16 reports the outcomes of the comparison of the "default-scenario" (i.e. the scenario with low superficial but high structural similarities) with the other scenarios. Again, it shows slightly divergent results across opportunity-recognition belief and collaborative opportunity evaluation. Only for the comparison between low/high and high/high the result is similar across both dependent variable. The results ($b_{ORB-L/Hvs.H/H} = .19, b_{CE-L/Hvs.H/H} = .22, p \leq .0.05$) confirm that the average evaluations for scenarios with high superficial and structural similarities ($\mu_{ORB} = 5.00$ and $\mu_{CE} = 5.01$) were higher than for scenarios with low superficial and high structural similarities ($\mu_{ORB} = 4.81$ and $\mu_{CE} = 4.79$). Consequently, these findings provide support for H1e. As Table 16 further exhibits, there is also partial support for hypothesis H1c. For this hypothesis, I assumed that scenarios with high structural similarities, but low superficial similarities will receive more positive evaluations than scenarios with low structural and superficial similarities. During the comparison of the default scenario ($\mu_{ORB} = 4.81$ and $\mu_{CE} = 4.79$) with the scenario with both low superficial and structural similarities ($\mu_{ORB} = 4.63$ and $\mu_{CE} = 4.71$), the results from the linear-mixed effect model yielded a negative significant value for ORB ($b_{ORB-L/Hvs.L/L} = -.17, p \leq .0.5$). It gives partial support to the hypothesis that non-obvious opportunities receive more positive evaluations than opportunities with low levels of superficial and structural similarities. However, the latter effect was non-significant in CE. For the hypothesis H1d, this analysis yielded a negative, but non-significant coefficient in both dependent variables ($b_{ORB-L/Hvs.H/L} = -.04, p = 0.61; b_{CE-L/Hvs.H/L} = -.16, p = .0.17$). Even though scenarios with low levels of superficial but high levels of structural similarity ($\mu_{ORB} = 4.81$ and $\mu_{CE} = 4.79$) received more positive evaluations than scenarios with high levels of superficial similarities and low levels of structural similarities ($\mu_{ORB} = 4.76$ and $\mu_{CE} = 4.61$), the data provided insufficient

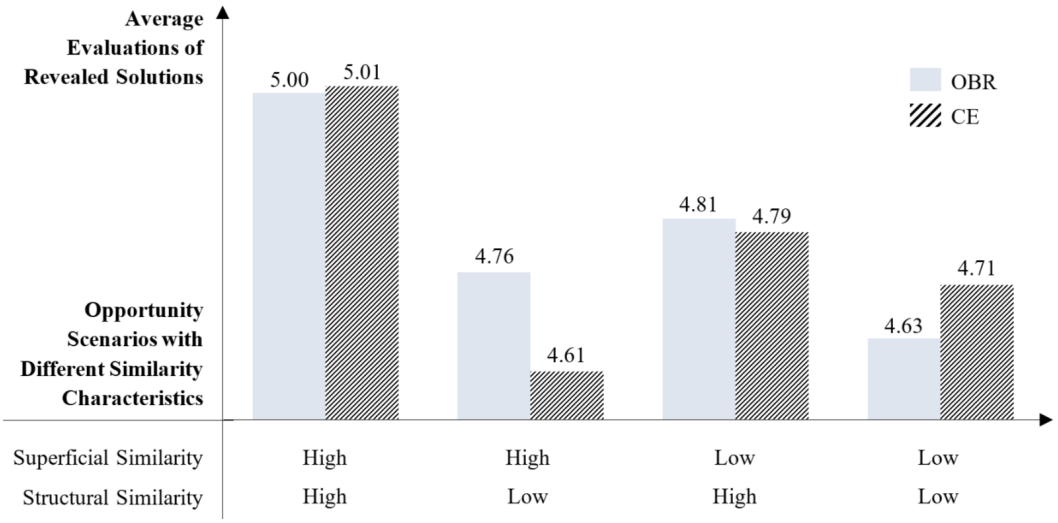

Figure 9: Evaluation of Scenarios across Different Similarity Characteristics

Table 13: P-Values Comparing the Sample Characteristics of the Treatment Groups; * p ≤ .1, ** p ≤ .05, *** p ≤ .01

	ORB			CE		
	High-High	High-low	Low-High	High-High	High-low	Low-High
High-low	0.24**			0.40**		
Low-High	0.19	0.05		0.22	0.18	
Low-Low	0.37***	0.13	0.18	0.30*	0.10	0.08

Table 14: Fixed Effects on Opportunity-Recognition Belief and Collaborative Opportunity Evaluation; * p ≤ .1, ** p ≤ .05

	ORB				CE			
	Value	Std. Error	denDF	F-Value	Value	Std. Error	DF	F-Value
Superficial similarities	0.08	0.05	102	2.30	0.04	0.07	102	0.24
Structural similarities	0.10**	0.05	55	4.91**	0.12*	0.07	55	3.29*
Prior knowledge (markets)	0.02	0.06	50	0.15	-0.09	0.08	50	0.64
Prior knowledge (technologies)	-0.02	0.06	50	0.01	0.08	0.08	50	2.12
Divergent thinking	-0.11	0.11	205	1.87	-0.24	0.16	205	2.87*
Creative self-efficacy	0.01	0.05	205	0.03	0.00	0.07	205	0.00
Job tenure	-0.02	0.02	205	2.02	-0.01	0.02	205	0.51
Studied field	-0.11	0.08	205	2.71*	0.01	0.11	205	0.02
Studied degree	-0.10	0.10	205	1.00	-0.13	0.14	205	0.87

Table 15: Random Effects on Opportunity-Recognition Belief and Collaborative Opportunity Evaluation

	ORB	CE
	Std. Dev.	Std. Dev.
Participant (Intercept)	2.33E-04	1.64E-01
Superficial (Intercept)	1.65E-01	2.18E-04
Structural (Intercept)	5.30E-01	7.07E-01
Residual	7.57E-01	1.09E+00

evidence to support the hypothesis.

4.4. The effects of prior knowledge

This section attempts to shed further light on hypotheses H3a and H3b. First, I address the claim that prior knowledge about the technology positively moderates the effects of structural similarities in the evaluation of collaborative opportunities. The results provided in Table 14 show direct effects of both types of prior knowledge on the dependent variables. Specifically, it shows that the direct coefficient for prior technological knowledge for variable of ORB is negative and non-significant ($B_{PKT} = -.02$; $p = .75$) and the coefficient for CE is positive and non-significant ($b_{PKT} = .08$; $p = .32$).

In order to get a better understanding of these results, the effects of structural similarities were partitioned in Figure 10 by the participants' prior knowledge of technologies. The partition was carried out through three groups, viz. low prior knowledge (all participants who were below the threshold mean minus standard deviation), moderate knowledge (all participants with levels of knowledge centered around the mean +/- the standard deviation) and high prior knowledge (participants with levels of knowledge above the threshold mean plus standard deviation). However, this illustration only gives an ambiguous picture on the effects of prior knowledge. For both evaluation types, the scores across high and low structural similarities were not coercively higher when prior knowledge was at hand.

Even though Figure 10 provides an interesting perspective on the effect of prior knowledge, it does not distinguish between within-subject and between-subject differences. A cue to this issue is offered in Table 17. The latter shows the interactive coefficients between structural similarity and prior knowledge of technologies. It does not only confirm the conjecture from the upper illustration that prior knowledge has no moderating effect for structural similarities, but also does render statistical evidence that prior knowledge of technologies has no significant moderating effect on structural similarities. Additionally, other ratios that recheck the significance of the model (i.e. the F-Value or the log-likelihood ratio) reaffirm that the effect is non-significant. This insight allows the conclusion that there is insufficient statistical evidence to support H3a, i.e. that prior knowledge about the technology positively moderates the effect of structural similarity.

Next, I address the claim that peripheral knowledge positively moderates the effects of structural similarities in the evaluation of collaborative opportunities. A look at the correlation matrix shows that the field of study is negative correlated with both dependent variables – however only significantly with the variable of ORB. With values from 1 (distant knowledge domains) to 3 (close knowledge domains), this correlation index indicates that the scores for ORB and CE decrease with the degree of studied expertise. Results from the GLM provided in Table 14 indicate similar, yet insignificant effects: the direct coefficient for ORB is negative and non-significant (b_{PKT} = -.11; p = .18) and the coefficient for CE is positive and non-significant ($b_{PKT} = .01$; p = .92).

As before, the effects of structural similarities were partitioned in Figure 11 by the field of study. The partition was carried out through three groups: distant knowledge (all participants who studied business or law), peripheral knowledge (all participants who studied engineering or natural science) and close knowledge (participants who studied timber science and forestry). With this illustration, no positive moderation of peripheral knowledge on the effects of structural similarity is visible. Contrariwise, it seems that participants from distant knowledge domains gave more positive evaluations for both levels of structural similarity. A look at the interactive effects of field of study and structural similarity confirmed this view for low structural similarities. As Table 18 clarifies, the interactive effect of low structural similarity and study field is negative and significant for the dependent variables of ORB ($b_{ORB:HST:PKT} = -.11$; $p \leq .05$) and negative and non-significant for the variable of CE ($b_{CE:HST:PKT} = -.10$; $p \leq .10$). Other ratios like the F-Value or the log-likelihood ratio confirm this result. The results hence contradict hypothesis H3b, which assumed that the field of study, or peripheral knowledge, positively moderates the effects of structural similarity on the evaluation of a collaborative opportunity.

4.5. The effects of creativity

This present section aims to examine the effects of creativity on the perception of a collaborative opportunity. The proxy for creativity in this analysis is the divergent thinking score from the Wallach & Kogan test. In contrast to the second proxy for creativity in this experiment, creative-self efficacy, the correlation coefficient and the GLM coefficient for divergent thinking are both significant. As divergent thinking and creative self-efficacy significantly correlate ($\rho_{DT/CSE} = .19$; $p \leq .01$), the variable for divergent thinking is solely used to assess the effects of creativity.

Consequently, both, the descriptive measures and fixed effects of the linear mixed-effect model, demonstrate a negative and significant effect of divergent thinking on ORB ($\rho_{DT/ORB} = -.10; b_{DT} = -.15; p = .12$) and CE ($\rho_{DT/ORB} = -.12; b_{DT} = -.27;\ p \leq .10$). This effect is further apparent in Figure 12, which depicts that the average evaluations of the revealed solutions decrease with creativity. In this figure, participants were, depending on their divergent thinking score, partitioned into three groups: low creativity (all participants who were below the threshold mean minus standard deviation), moderate creativity (all participants with levels of DT-scores centered around the mean +/- the standard deviation) and high creativity (participants with levels of DT above the threshold mean plus standard deviation).

In addition to the abovementioned effects, the interactive effects of divergent thinking on superficial and structural similarities were examined. The results, illustrated in Table 19, show that divergent thinking has across all levels of low superficial and structural similarities significant negative moderating effects. For high levels of superficial and structural similarities, the effects of divergent thinking are negative, yet

Table 16: Comparing the Effects of Different Scenarios on Opportunity-Recognition Belief and Collaborative Opportunity Evaluation; * $p \leq 0.10$, ** $p \leq 0.05$

Fixed Effects	ORB				CE			
	Value	Std. Error	denDF	F-Value	Value	Std. Error	DF	F-Value
Low/High vs. Low/Low	-0.17**	0.08	156	2.39*	-0.08	0.12	156	1.57
Low/High vs. High/Low	-0.04	0.08	156		-0.16	0.11	156	
Low/High vs. High/High	0.19**	0.08	156		0.22**	0.11	156	
Random Effects		Std. Dev.				Std. Dev.		
Participant (Intercept)		0.13				0.17		
Group (Intercept)		0.56				0.71		
Residual		0.76				1.10		

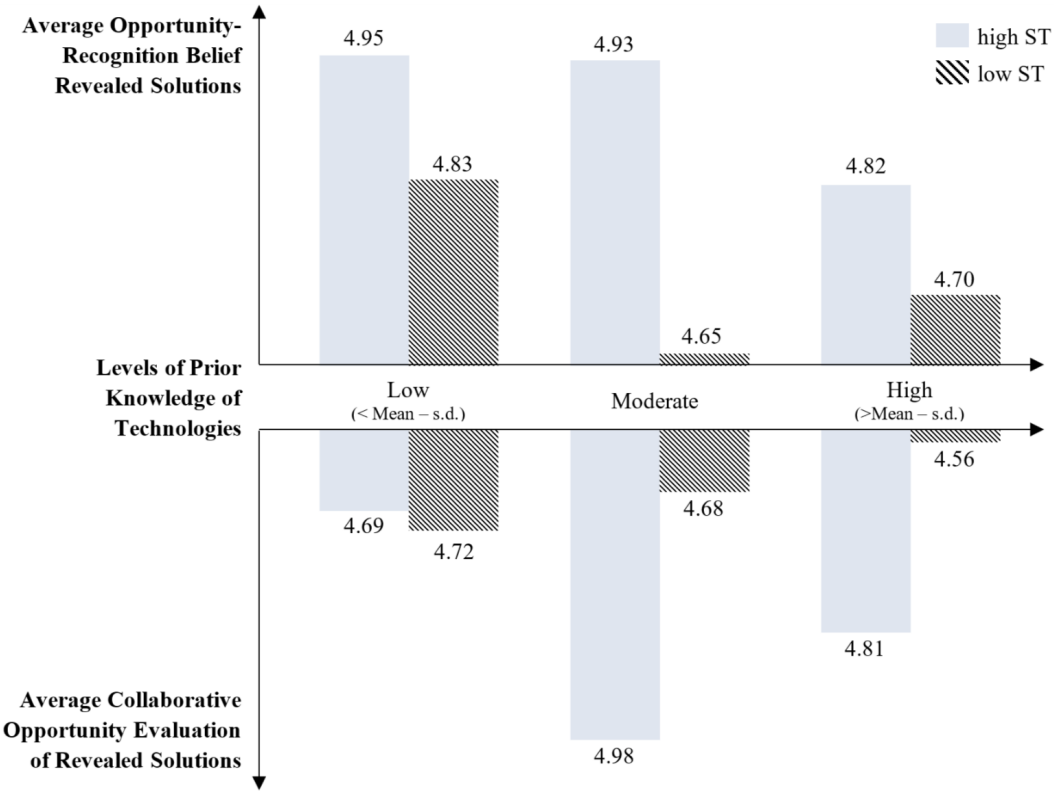

Figure 10: Effects of Structural Similarity by Levels of Prior Knowledge of Technologies

Table 17: Fixed Effects of Interaction of Structural Similarities and Prior Knowledge of Technologies; * $p \leq 0.10$

Fixed Effects	ORB				CE			
	Value	Std. Error	denDF	F-Value	Value	Std. Error	denDF	F-Value
HST : PKT	0.02	0.05	50	1.72	0.10	0.07	50	1.68
LST : PKT	-0.04	0.05	50		0.01	0.07	50	

mostly insignificant. Having these results confirmed by the F-ratio and the log-likelihood ratio, I imply that the statistical evidence supports the rejection of hypothesis 2. Instead of being a positive moderating factor, the results of this analysis suggest that creativity has rather a negative impact on the effects of superficial and structural similarities in the evalua-

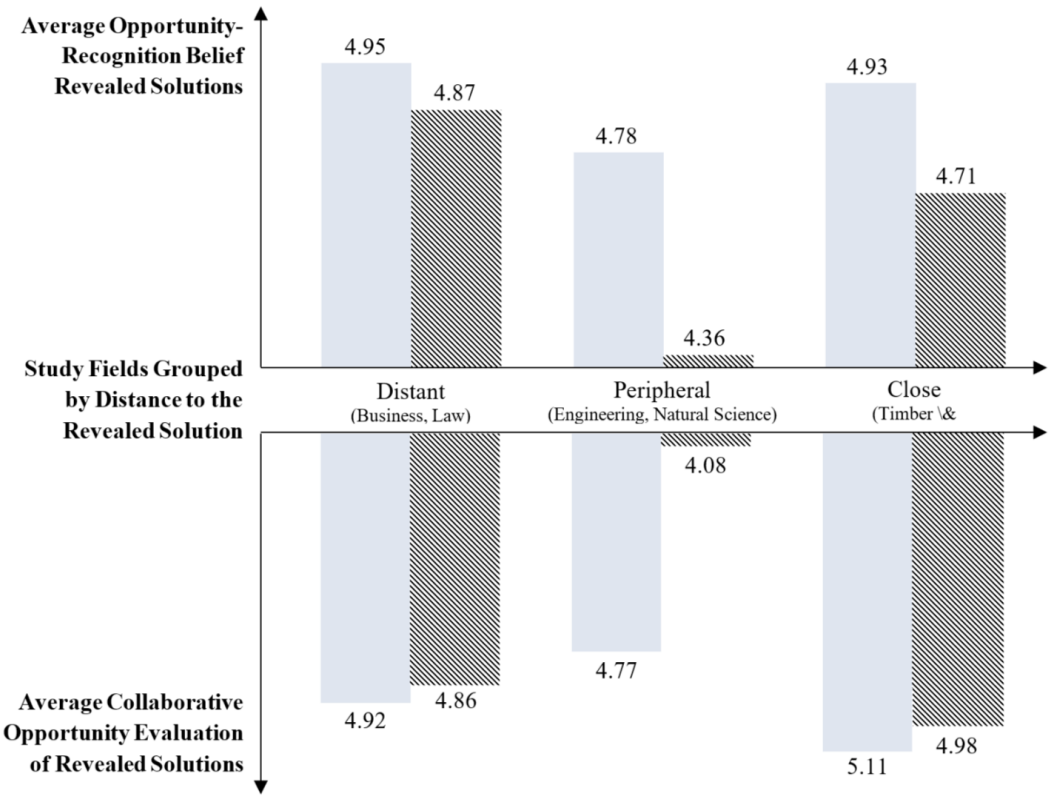

Figure 11: Effects of Structural Similarity by Field of Study

Table 18: Fixed Effects of Interaction of Structural Similarities and Field of Study; * $p \leq 0.10$, ** $p \leq 0.05$

Fixed Effects	ORB				CE			
	Value	Std. Error	denDF	F-Value	Value	Std. Error	denDF	F-Value
HST : SF	-0.05	0.08	54	4.38*	0.02	0.11	54	2.35
LST : SF	-0.18**	0.07	54		-0.13	0.10	54	

tion of a collaborative opportunity.

5. Discussion

Despite missing evidence for some hypotheses, the prior section gave important insights and serves as a fundament for the upcoming discussion, in which the results are going to be discussed from different perspectives. In the following, implications about the results will be drawn from a practical and a theoretical angle. Additionally, the last part of this chapter critically reflects on potential limitations and discusses options to mitigate them in future research.

5.1. Theoretical implications

To commence an impactful discussion on the theoretical aspects of this experiment, it is expedient to revisit and recall the original theoretical motivations of this research. With the first research question, I questioned whether different formulations of selectively revealed solutions influence the recognition of collaborative opportunities by technological gatekeeper. The second research question was closely related to the first research question and examined if creativity and prior knowledge of technological gatekeepers impact the identification of collaborative opportunities in selective revealing. Naturally, both research questions - which take interest in each end of the dichotomy of optimal information flows in selective revealing - involve different perspectives and theories. As a result, this chapter is divided in two subsections with a focus on each research question.

A general, but major implication that can be drawn from this research - before I deep dive into the implications for each research question - is that opportunity recognition is a cognitive process (Baron (2004); Baron (2006); Gregoire et al. (2010); Mitchell et al. (2002)). Many studies in entrepreneurial research both of theoretical and empirical nature confirm this view. By drawing on the commonalities between an entrepreneurial opportunity and a collaborative opportunity arising from selective revealing, this study was the

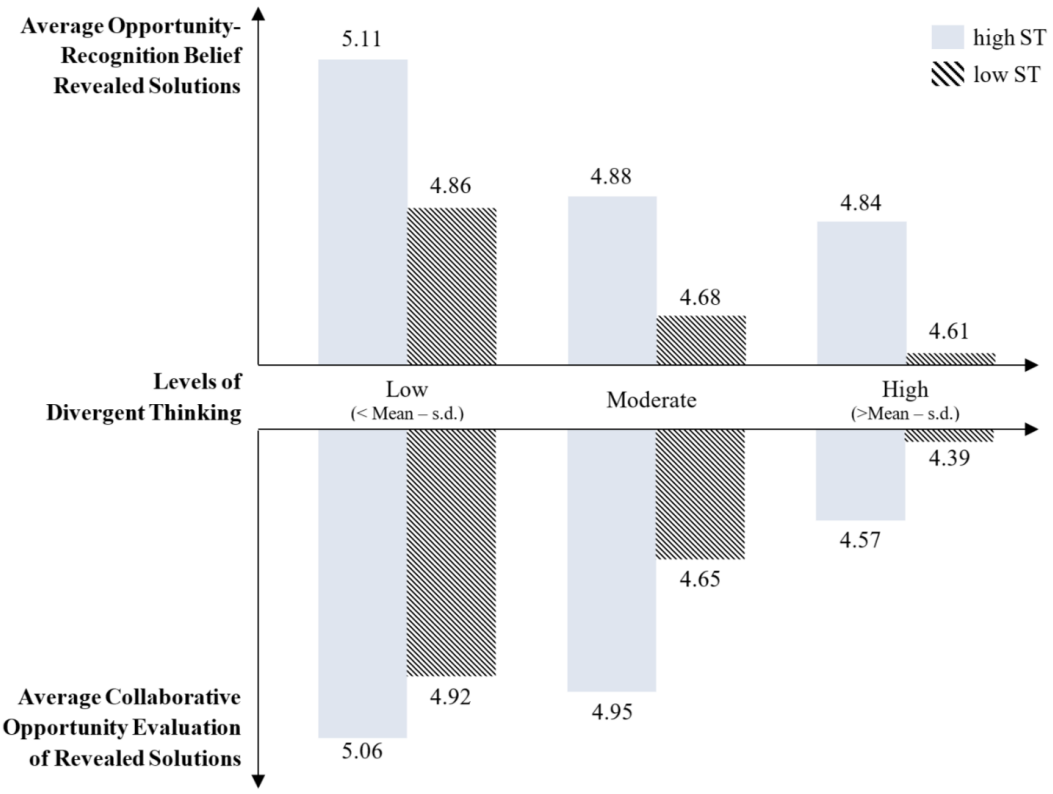

Figure 12: Effects of Structural Similarity by Divergent Thinking Score

Table 19: Fixed Effects of Interaction of Superficial and Structural Similarities and Divergent Thinking; * $p \leq 0.10$, ** $p \leq 0.05$, *** $p \leq 0.01$

Fixed Effects		ORB				CE			
		Value	Std. Error	DF	F-Value	Value	Std. Error	DF	F-Value
Superficial Similarity	HSU : DT	-0.11	0.11	101	1.86	-0.27*	0.15	101	1.97
	LSU : DT	-0.19*	0.11	101		-0.30**	0.15	101	
Structural Similarity	HST : DT	-0.08	0.11	54	3.48**	-0.21	0.15	54	3.46**
	LST : DT	-0.22*	0.11	54		-0.36**	0.15	54	

first to take a cognitive perspective in the considerations of selective revealing. At the same time, my inquiries provided a felicitous answer to the concerns of Alexy et al. (2013) on the formulation of selectively revealed solutions and a complement to the idiosyncratic focus on problem formulation in hitherto existing research (Baer et al. (2013); Simon (1973)).

5.1.1. Implications for the formulation of revealed solutions

Based on the theory of structure-mapping, this study reflected that analogical thinking is inherent in all mental processes and partly determines how we conceive our environment (Fauconnier (2001)). Consequently, analogical thinking is also a crucial explanatory factor in the perception of selectively revealed solutions. The major process that triggers analogical thinking lies in the alignment of structures and elements between a source and a target (Gentner (1983)). By performing an alignment of superficial and structural similarities between a revealed solution and its market, this thesis demonstrated that different formulations affect the perception of such a solution. In this case, perception refers to the belief that the opportunity is valuable (Grégoire et al. (2010)), as well as to the willingness to assume a collaboration with the revealing instance (Tyler and Steensma (1995)).

Analogies can hence be utilized by firms who reveal their intellectual property to frame a technological gatekeeper's perception about an opportunity. In keeping with previous research on analogical thinking and structural alignment, the carried-out study has affirmed that the alignment of espe-

cially structural relationships prevails sense-making about selectively revealed solution. With such an alignment, each individual's mental proximity between a market - with all its characteristics and needs - and the revealed solutions - with its underlying mechanisms and cause-effect principles - was reduced (Gregoire et al. (2010)). Most notably, the results have shown that high-order relationships are of ample significance when individuals encounter novel opportunities. Instead of relying on superficial similarities, the participants of this study rather made sense of an opportunity through structural similarities. Therefore, scenarios with high levels of structural similarities but low levels of superficial similarities were persistently rated better. Taken together, the results confirm that even though superficial similarities are an important part in the recognition of opportunities, their identification is mostly driven by structural relationships. These findings match the predominant view that analogies are particularly sensitive to structural commonalities and that, despite the involved high cognitive efforts in their retrieval, high-order relations can result in highly creative outcomes (Blanchette and Dunbar (2000); Keane et al. (1994)).

It is however also important not to misinterpret the effects of superficial similarities. Unlike to Grégoire and Shepherd (2012), who identified superficial similarities as a significant stand-alone impact factor in the recognition of entrepreneurial opportunities, my findings confirm the view of Blanchette and Dunbar (2000), which asserts that superficial similarities facilitate the retrieval of analogies from structural commonalities. This insight becomes obvious by comparing ratings between scenarios with both high superficial and structural similarities and scenarios with low levels of superficial and high levels of structural similarities. Dunbar (2001) ascribes such changing effects to more naturalistic environments. Such environments, in which information is illustrated more sophisticatedly, trigger the retrieval conditions in favor of structural relations and higher order relations.

While the results contribute to a better understanding of the formulation of selectively revealed solutions, the latest insights should also encourage future researchers to dig deeper in this field of study. In this respect, I suggest three levers for future research. First, an interesting element for prospective studies would be different scopes of solution formulations, ranging from varying levels of superficial and structural similarities to formulations with diverging levels of length and/or sophistication. Besides, subsequent research on this topic could, like in real-life settings, solely illustrate a revealed solution and relinquish a corresponding market in the formulation to increase generalizability. However, such a setting would complicate the manipulation of scenarios due to the ex-post identification of each individual corresponding market, which is shaped by prior knowledge and experience (Gruber et al. (2010)). Lastly, prospective studies should investigate the role of the environmental context on opportunity-beliefs and the willingness to collaborate ceteris paribus superficial und structural similarities between solutions and markets. Such investigations would shed light on concurrent view that the value of an opportunity is highly impacted by a myriad of factors such as its newness, its available alternatives or its underlying industry conditions (Hansen et al. (2016)).

5.1.2. Implications in regard of individual factors in selctive revealing

By regarding optimal information flows in selective revealing as a dichotomy, this thesis offers implications about the recipient instance, and in particular, how personal traits impact the perception of selectively revealed solutions. As the conceptual framework in Figure 7 exhibited, analogies are not only induced through the descriptive elements of a revealed solution formulation, but are also moderated through personal traits. In my argumentation, I followed the notion from cognitive science that the retrieval of analogies is facilitated through prior knowledge and expertise (Arentz et al. (2013); Hajizadeh and Zali (2016)). This rationale was additionally extended by the claim that creativity allows individuals to be more flexible in the retrieval of analogies, which leads in turn to more sound decision-making when one encounters a novel opportunity (Vendetti et al. (2014)).

Whereas previous scientific evidence has shown that the deepness and richness of prior knowledge and the capability to think divergently fosters the ability to notice opportunities (Shepherd et al. (2017); Walsh (1995)), the results in this study could not substantiate these arguments. Contrarily, the findings from my experiment illustrated that both, the field of study and the divergent thinking ability, had to some extent a negative significant impact on the opportunity-recognition belief and the evaluation of the collaborative opportunity.

The study design captured the variable of prior knowledge through two proxies: (a) a self-assessment of the knowledge about the illustrated technologies and markets and (b) a determination of prior knowledge through the participant's field of study. Regarding the self-assessment of prior knowledge, my findings do not confirm the results of previous empirical investigations (c.f. Grégoire and Shepherd (2012)) which proved that prior knowledge of technologies is positively affiliated with the development of analogies. It is even more surprising, that effects between the two proxies (prior knowledge of technologies and field of study) considerably deviate from each other. The effects from the field of study even illustrate a negative significant effect on the evaluation of a collaborative opportunity that arises from selective revealing. One cue for these results may lie in the newness of the presented technologies. Studies have shown that experienced entrepreneurs favour familiar technologies over unique and new solutions (Baron (2006)). The newness of the illustrated technologies might have increased the perceived uncertainty of students from "close fields of studies" (i.e. timber science and forestry) about the future success of the revealed technologies in the market (Butler et al. (2010)).

Similar to the previous section, the results might be also attributed to the naturalistic environment of the experiment. Dunbar (Dunbar (2001): 330) reflected that in such a testing

environment, "subjects must have a minimal amount of understanding of the source and target, but do not need the extensive knowledge of experts to use higher-order structural relations naturalistic environment". This might explain the reason, why neither prior knowledge of markets nor prior knowledge of technologies significantly affected the perception of a selectively revealed opportunity. Even though prior knowledge alters the cognitive processes (Ericsson and Charness (1994)), analogies do not require prior knowledge to develop. Additionally, Eggers and Kaplan (Eggers and Kaplan (2013): 308) found that the "encoding experience", i.e. the sense-making of opportunities, highly depends on routine which is acquired through repetition and resemblance. As students usually lack experience in the recognition of opportunities, this could be an explanatory factor for these results too.

In addition, past research on expert knowledge has shown that prior knowledge and expertise is not always associated with positive effects. A review on contemporary research on expert characteristics by Chi (2006) provided the insight that specialist knowledge also has its drawbacks. Among them are cognitive inflexibility, context dependency and functional fixedness. Individuals with high know-how accordingly have issues in recognizing opportunities if the information starkly deviates from standard applications in this domain (Chi (2006)). Apparently, it seems that students with training and education in the relevant domain of this experiment (i.e. timber and forestry) were more averse towards the revealed opportunities as they did not represent standard solutions in the domain. This aversion could also not be explained by a difference in the technology (i.e. infrared drying vs. bioethanol production) or higher job tenure.

Creativity, which was the second personal trait that was under scrutiny in this study, also significantly diverged from the initial assumptions. Being regarded as a key concept in creativity (Welling (2007)), analogies were in the set-up of this research considered to be positively moderated by individual creative ability. By drawing on the Geneplore framework (Finke et al. (1992)), I argued that creativity, which was assessed through a DTT, enhances the generation of preinventive structures and the transfer of existing knowledge to a new context. So why do the results of this study differ to such an extent from the theoretical opinion? One argument that could explain this deviation is that creativity is domain specific (Amabile (1983); Baer (2010); Runco and Sakamoto (1999)). Even though there is still disagreement among academics about the nature of creativity, evidence from Kaufman et al. (2009) has shown that creative ability in opportunity recognition is composed of general and domain specific skills. Considering that an analogy is constructed on prior knowledge (Welling (2007)), the effects of creativity, derived from a general DTT, could consequently loose its explanatory power to assess its effect on opportunity recognition in a specific domain. Evidence for this rationale may be found in the interaction term of structural similarity and divergent thinking: in scenarios with low structural similarities between the solution and the market, individual creativity seemed to be an impediment due to missing context. This view is substantiated through a significant interaction term combining structural similarity, divergent thinking and prior knowledge of technologies. Under these circumstances, it would have also been interesting to understand participants' intrinsic motivation and attention spans during the experiment (Baer (2010)). In theory, a lack in both traits is often seen as an impediment to creative ability (Runco and Sakamoto (1999)). Apart from the issue of domain specifity in creativity, the insights from my experiment are consistent with previous findings from Benedek et al. (2014). The researchers found that creativity, measured through a DTT, is unrelated to the cognitive process of shifting, i.e. "the process of switching between different tasks and mental sets" (Benedek et al. (2014): 74). As a result, creativity would not facilitate the creation of analogies, as it is unrelated to shifting knowledge from one domain to another.

Even though the results didn't deliver the desired results, this study yielded important insights on individual differences in the evaluation of selectively revealed solutions. Besides, my master thesis provides important recommendations for future studies in this field of research. Most importantly, prospective studies should take place in a different setting than an online-experiment to better control for individual differences. Additionally, prospective research should include other individual factors such as personal motivation (c.f. Molden and Higgins (2012)), alertness (c.f. Goh (2002); Shane and Eckhardt (2003)), risk adversity (c.f. LeBoeuf and Shafir (2012)), or cognitive adaptiveness (c.f. Haynie and Shepherd (2009)) in order to help explain potential differences in the results. At last, studies which involve tests about creative ability should consider the strong impact of domain specifity on creativity and should focus on assessments which establish a domain-specific context.

5.2. Practical Implications

By examining both ends of the information flows in selective revealing, this study addresses all operating firms in open innovation and notably all firms which reveal their intellectual property to appeal to potential new collaboration partners. The findings offer a blueprint on how revealed solutions should be formulated and which recipients should be addressed.

To fully tap into the potentials of reaching new collaboration partners with selective revealing, this thesis has demonstrated that a revealed solution should be formulated in a way so that it induces analogical thinking in the recipients' mind. Analogies evolve through observed similarities from old objects to understand a new context. As the results of the thesis confirmed, firms should emphasize structural commonalities between the revealed solution and target markets to trigger analogical thinking. The communication efficacy of a selectively revealed solution is further maximized through an interplay of superficial and structural similarities.

As in communication science or marketing, where a good deal of success depends on the message and on its recipients

(Vesanen (2007)), practioners in selective revealing should hence focus more on the content of their revealed solutions and on the individuals and firms they want to target. As some personal traits, such as individual creativity or prior knowledge, are significant impact factors in the recognition of a collaborative opportunity, the revealing instance should consider - prior to the release of its intellectual property - the characteristics of the potential recipient and the context of the transfer (Goh (2002)). This would render the possibility to tailor the descriptions of a revealed solution to the recipient's requisites, i.e. the target market. Despite its advantages, such a procedure would also involve more effort in revealing a firm's intellectual property.

This study holds important implications for potential recipients of revealed solutions and for firms, who employ technological gatekeepers in its R&D departments, too. I demonstrated that high creativity, and prior knowledge to a certain extent, are no compulsory prerequisites to recognize technological opportunities and hence challenges the common opinion that gatekeepers need to be technologically proficient and highly experienced (Macdonald and Williams (1993)).While highly experienced and knowledgeable gatekeepers will nonetheless be indispensable in the future, my findings make clear that multiple gatekeeping, in which a diverse team connects a firm's R&D department with the external environment, may be the key to enhance the innovative potential of a firm.

5.3. Limitations and future research

The methodology and the drawn implications also bring limitations. Albeit no empirical work is perfect, and one could objurgate the choice of the variables, I will emphasize the limitations which stemmed from the methodical strategy and most affected the quality of the insights and the capability to answer the research questions. Lastly, this section will also respond to analytical limitation that arose during this research.

The first limitation concerns the stimulus for the effect. Even though the stimuli highly resembled the original versions from the EEN in their dictions, it can be questioned whether such a collaborative opportunity would occur in a real-life setting. Visual elements, such as schemes or imagery, for example, are commonly used in many patents and revealed solutions because they facilitate the inducement of analogic thinking and foster understanding (Holyoak and Thagard (1995)). Yet, visual elements were deliberately omitted because they would have complicated matters for the manipulation of scenarios with high and low superficial/structural similarities. On these grounds, future research in opportunity recognition and/or open innovation should include visual objects and examine its effects on the perception of a novel opportunity.

Through focusing on the semantic elements in the illustrated opportunities, the manipulation of the different scenarios was facilitated. The manipulation of scenarios was carried out with the utmost effort in order to meet the theoretical requirements. Nevertheless, it entailed the consequence that the stimuli were framed in a subjective manner. As a remedy, three experts were involved during the creation of the manipulations. It helped to prevent that individual schemas affect the formulation of the scenarios (Kao and Archer (1997)). In addition, a pre-experimental manipulation check was carried out to verify whether the different scenarios featured the desired effect. Future research on this topic could nonetheless improve the creation of such a stimulus in two ways. First, the involvement of linguists could help to reconcile the effect of language on perception (Klemfuss et al. (2012)). Second, a greater extent of technologies and manipulations could enable researcher to benchmark the different scenarios and ensure to choose "substantively equivalent" manipulations (Grégoire and Shepherd (2012): 767).

Another alleged limitation represents the domain from which the solution-market combinations originated. The decision to choose manipulations from a similar domain partly stemmed from the design of the experiment. Due to the within-subject, the deployment of technologies from one domain, i.e. the timber industry, tended to minimize the error variance associated with individual difference. With the illustration of two technologies that are rooted in the same industry I also aimed to reduce the carry-over effect. This carry-over effect was additionally diminished through a randomization in the sequential arrangement of the technologies. A single domain also made it easier to control for prior knowledge and studied field. Nevertheless, future studies could employ more diverse stimuli, similarly to the article of Grégoire and Shepherd (2012). This would probably represent a more realistic experimental setting, as technological gatekeepers daily encounter technologies from different domains. Such a setting would also be especially interesting for the field of rapid cognition and first impressions, i.e. how attention spans change depending on what one sees (Gladwell (2005)).

The third limitation concerns the participants of the experiment. Despite the fact that students and technological gatekeepers have a tertiary education in common (Allen and Cohen (1969)), students lack other important characteristics such as gut feeling or professional experience (Scheiner et al. (2015)). Even though both types of prior knowledge were significantly correlated with the studied field of the participants, its extent is not comparable to that of a gatekeeper. This is probably also the reason, why the effects of prior knowledge were not statistically significant in the recognition of a collaborative opportunity. Though the facilitated mobilization of participants justifies the choice to use students as a proxy for gatekeeper, future empirical studies in this topic should target real gatekeepers.

The last limitation refers to an analytical issue, namely to the problem of fitting a model. In models of high-dimensional and complex data sets like the data in this research, overfitting may often incur. Overfitting refers to the dilemma that the training of the data happens at the expense of generalization to unseen data points, which results in high variance caused by random errors (Bühlmann and Van De Geer (2011)). By attempting to reduce the com-

plexity of a model (i.e. through neglecting variables) the tide can also quickly turn: too simple models, or underfitted models, might not be flexible enough to capture important features, thereby causing a high bias of the analysis. In order to find a model with a good fit (i.e. a balance between bias and variance), modern statistics increasingly rely on an optimization algorithm called "LASSO" (least absolute shrinkage and selection operator). The algorithm, which is based on regularization and selection, applies a penalization factor based on geometrical and Bayesian assumptions on each coefficient on the model (Zou and Hastie (2005)). Simply expressed, this optimization discards futile coefficients (i.e. coefficients whose contributions to the model fit are lower than the penalty factor) from the regression by setting it to a feature to zero (Bühlmann and Van De Geer (2011)). Even though the models in this analysis were selected upon comparisons of performance (i.e. through comparing the AIC and the BIC), future research could deploy LASSO algorithms, which can be also extended to the GLM functions (Schelldorfer et al. (2011)), in order to optimize the predictive power of models used in the analysis.

6. Conclusion

> Discovery is 10% inspiration and 90% perspiration. - Thomas Edison

Already Thomas Edison in 1929 reckoned that innovation is a multi-stage process that requires a myriad of methods and techniques (Acar et al. (2010)). By acknowledging the innovative potential of selective revealing and the recognition of an opportunity being a decisive step, this thesis has contributed to the emergence for more sophisticated solution formulations in this field of study. Indeed, I delivered implications for both ends of the information flow by conjointly examining the effects of selectively revealed opportunities and personal traits, and enriched this area of research through comprehending the drivers of early action in open innovation and strategic renewal. By centering this study around established academic literature from cognition (Gentner (1983); Holyoak and Thagard (1995)), selective revealing (Alexy et al. (2013)) and opportunity recognition (Grégoire and Shepherd (2012); Gregoire et al. (2010); Tyler and Steensma (1995)), I demonstrated that recipients of selectively revealed solutions rely on analogies that are moderated by personal traits in order to make sense of novel information.

This thesis hence affiliates to recent academic work that accentuates the significance of analogic reasoning in opportunity recognition (Gregoire et al. (2010)) and clearly illustrates that different formulations affect the perception of a revealed solution. The fact that opportunities are usually hastily encountered through websites or patents further highlights the need for more sophisticated solution descriptions in selective revealing. Most importantly, the results indicate that solution formulations which induce analogies through relational commonalities are more prone for positive evaluations. Yet, my findings also challenge the conventional presumption about the role of prior knowledge in technology evaluation and add another perspective through the inclusion of individual creative ability. All in all, further research on this topic will be necessary not only to affirm the results, but also to overcome some of the limitations of this work, such as the framing of the opportunity scenarios or the participants' origin. Especially the role of personal traits in the recognition of opportunities requires further examination. To get a better understanding and a more holistic picture of the present results, prospective studies should incorporate more variables that control for personal traits. In doing so, future efforts to understand the recognition of opportunities in selective revealing can hold benefits for individuals and firms alike. With my thesis, I have advanced the understanding of cognitive processes, namely similarity comparisons and structural alignment, in selective revealing and provided a basis for future research that should focus on the factors that facilitate and impede the means of this promising strategic tool in open innovation.

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Market reactions to the servitization of product offerings - An event study on the software as a service model

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Abstract

Servitization is transforming traditional manufacturing and product-oriented firms across industries in many ways. One of these transformations concerns the business models of firms that transform from selling products to provisioning products as a service with product-service systems (PSS). I analyze this form of servitization in the software industry, where the software as a service business model is becoming the standard for most start-ups as well as some big enterprises like Adobe and Autodesk. Event study methodology is applied to 359 software vendors' announcements of new software as a service offerings between 2001 and 2015, analyzing how installed base, parallel business models and partnerships with external service providers influence the reaction in the stock price of the software vendors. I find that "as-a- service" business models are not perceived as a substitute but rather as a complement for perpetual product sales and that collaboration with specialized service providers for the delivery of the new offering is rewarded by the stock market. I explain the findings with organizational inertia within the software vendors' organization as well as that of their customers. The findings are used to discuss how companies can manage the inertia by developing new product lines for the PSS model, offering perpetual product sales in parallel and cooperating with third party service providers for the service delivery.

Keywords: SaaS, Software-as-a-Service, Servitization, Business model transformation, Stock markets

1. Introduction

Since the beginning of industrialization, services have grown from a residual category for anything that is not agriculture or manufacturing to being the sector driving growth in most industrialized economies (Chesbrough and Spohrer (2006)). The growing importance of services is not just a phenomenon observed in macroeconomics, but it is drastically changing the way businesses work. It appears that Levitt (1972) controversial statement that everyone is in the business of services was indeed correct, as services have become something that every company has to master. Take IBM, a former leader in computer manufacturing, as an example. The company now receives one third of its revenues from its Global Business Services, division that did not even exist before the 1990s (Chesbrough and Spohrer (2006); International Business Machines Corp. (2015)). The phenomenon in question, which has transformed manufacturing companies like IBM into service businesses, is often referred to as servitization in the academic dialogue (Gebauer and Friedli (2005); Gebauer et al. (2012); Kastalli and Van Looy (2013); Mathieu (2001b); Oliva and Kallenberg (2003); Suarez et al. (2013)). It stands for the process of companies moving towards services along the product-service continuum (Oliva and Kallenberg (2003)), with the relative importance of services increasing for their business. Many academics explain the phenomenon with the financial, strategic and marketing opportunities that services offer (Baines et al. (2009)).

However prominent services are becoming to businesses of all types, some empirical studies have raised doubts about the profit effects of servitization to providers (Fang et al. (2008); Neely (2008); Visnjic et al. (2012)). These studies have shown that increasing degree of servitization of a company's business does not necessarily lead to an increase in profits, rather the opposite. Scholars often refer to this as the servitization paradox, which they explain with the difficulties organizations face in adapting to the different ways in which service business is conducted compared to product business. At the same time, scholars also note that even if servitization may reduce the profitability of companies, they often cannot afford not to move towards services and that servitization represents a prerequisite for growth (Fang et al.

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(2008); Visnjic et al. (2012)). This begs the question whether servitization should be approached proactively at all.

Servitization of product-oriented companies can take many forms beyond adding services that are offered complementarily to the main product, with some companies even discontinuing selling their product to customers and only offering it as a part of a service (Cusumano et al. (2015); Johnson et al. (2008); Rapaccini and Visintin (2014); Ulaga and Reinartz (2011)). Such business models have gathered a lot of hype around themselves[1] and have started transformations in industries like the pre-packaged software industry. These offerings have been labelled as product-service systems (PSS) in the academic dialogue (Beuren et al. (2013)). Nevertheless, many companies have remained cautious about disrupting their business model with such PSS offerings. To date, academic research has been unable to help these companies in their decision-making as existing empirical research has either generalized servitization to cover any form of movement towards service-based revenue (Fang et al. (2008); Kastalli and Van Looy (2013); Neely (2008)) or recognized PSS offerings as products rather than services (Suarez et al. (2013)). This is testament to the fact that existing empirical research has exclusively observed servitization as a company level phenomenon.

This is why I propose a product-level analysis that focuses on the transformation in product business models from product sales to offering product as a service, or PSS. In order to observe the product-level change, I employ an event study that measures how the investors of publicly traded companies react to announcements that imply a transformation from selling products to provisioning them as a PSS. I then correlate the market reaction to variables about how the company manages the transformation, while controlling for environmental influences. Consequently, I am looking to answer the following research question:

> "What determines, from the perspective of investors, whether the introduction of a product-service system offering will lead to value creation?"

The event study is conducted in the software industry, which has seen the rise of the software as a service (SaaS) business model that embodies the transformation from selling products to provisioning them as a PSS. The software industry fits the purposes of this study well, because the cloud computing framework (Armbrust et al. (2010)) has accelerated servitization in the industry, making sure that there are enough events to draw from.

[1] Perhaps the most prominent example is Rolls-Royce's „Power By The Hour", a model where their customers pay for the use of the jet engine by the hour, with its maintenance, reparations, and upgrades all included in the price (Davies et al. (2006)). Other well-known examples include telecom contracts, where network providers like AT&T combine the mobile phone, the usage of the network as well as phone upgrades to a single subscription service (AT&T Inc. (2016)), and car-sharing services like BMW DriveNow, where car manufacturers combine the car, insurance, taxes, parking, gasoline and maintenance to a single pay per use service (DriveNow UK Ltd. (2016)).

This thesis is divided into five chapters. The second chapter following this introduction discusses the existing literature about the SaaS business model and servitization. Based on the discussion, I derive three hypotheses to be tested in the study at the end of the chapter. The third chapter explains the event study methodology used to measure how the stock markets react to the introduction of a SaaS offering, while the fourth chapter discusses the results of the study in detail. Finally, the fifth chapter discusses the results as well as their implications to both academics and practitioners. Additionally, the limitations of the study and propositions for further research to be conducted in the field are discussed.

2. Literature review and hypotheses

In this chapter, I review existing literature on (1) the software as a service business model and (2) the phenomena of servitization and product-service systems (PSS). The main goal of the first two subsections of the chapter is to understand what the benefits and challenges of servitization are and how the SaaS model embodies the phenomenon. Based on this, I then move on to the third subsection, which introduces three decisions that firms need to take when introducing new PSS offerings and how these are likely to influence the value-creation potential of the firm. As a result, three hypotheses to be tested in this study are introduced as a result of this chapter.

2.1. Software as a service

Software as a service (SaaS) describes a concept of software delivery that differentiates itself from the traditional perpetual licensing model of software business in two ways. First, in the SaaS model, customers access the software applications over the internet and do not own the software or the hardware needed to run it (Armbrust et al. (2010)). Second, the customers only pay for the usage of the software (pay-per-use) or the value gained by using the software (pay-per-value) and do not purchase licenses upfront from the software vendor (Sääksjärvi et al. (2005)). These two distinct characteristics are also why, from a broader perspective, the software as a service model embodies servitization in the software industry (Sultan (2014)). No longer is the underlying software product the most important unit of exchange, but rather the value-in-use provided to the customers (Baines et al. (2009); Vargo and Lusch (2008a)).

Models of software delivery as an on-demand service have been developed since the late 1990s, with Application Service Provisioning (ASP) model being the most well-recognized of the old terminology (Benlian and Hess (2011); Sääksjärvi et al. (2005)). These models never really managed to reach the attention of mainstream audiences, and it took considerable technological advances through the Cloud Computing concept and Multi-tenant architectures to really kick off the delivery of software as an on-demand service (Benlian and Hess (2011); Sääksjärvi et al. (2005); Stuckenberg et al. (2014)).

Multi-tenant architectures allow multiple customers to use the same instance of an application on the same infrastructure (Aulbach et al. (2008)), making the applications truly scalable and thus optimizing resource utilization. Similarly optimizing the utilization of resources, the Cloud Computing concept separates software delivery into isolated layers as presented in Figure 1 (Youseff et al. (2008)). This makes the development, deployment and provisioning of software more efficient than in previous models like ASP (Armbrust et al. (2010); Benlian and Hess (2011)).

Even though these technological advances have certainly been important for the breakthrough of service-based software delivery models, from a business model perspective the new software as a service concept is not different to its predecessors. The underlying concept of the models is that services necessary for using software like installation, operation and maintenance are provided by the software vendor in one recurring fee model (Ma (2007); Sääksjärvi et al. (2005)). From a pragmatic perspective, this merely means that the software vendor takes over these additional services from the IT department of the customer, like illustrated in Figure 2. This makes sense from a resource optimization point-of-view, because this way the software vendor can benefit from economies of scale in operating the software and let the customer focus resources on its core business processes.

This study focuses on the servitization character of the SaaS model as well as the business model implications of the downstream integration of software firms. I thus only analyze the service-based business model of provisioning software as a service, where the underlying focus is on value-in-use of software products and where the software products are provisioned as part of a service instead of being sold to the customer. This is why this study treats all stages of provisioning software as a service, whether multi-tenant or single-tenant, ASP or modern SaaS, as equal.

2.2. Servitization, service-dominant logic and product-service systems

The word servitization is often traced back to Vandermerwe and Rada (1988) in scientific literature, but as Schmenner (2009) argues, the antecedents of the phenomenon stretch back all the way back to the second half of the 19th century, when manufacturers started to integrate vertically towards services. Initially, the most common step of servitization was to take control of services like distribution along the supply chain as companies were looking to gain control over the value chain and become less dependent on market actors (Schmenner (2009)). Initial definitions of servitization reflected this vertical integration nature, but more recent inquiry and integration of related research fields like the product-service systems (PSS) literature has led to a broader definition of servitization that also encompasses the integration of products and services in combinations that deliver value-in-use (Baines et al. (2009)).

Interest towards servitization as a phenomenon has been growing in the 21st century, not least in the field of manufacturing (Baines et al. (2009); Kastalli and Van Looy (2013); Neely (2008); Neely et al. (2011)). The growing importance of services for business and society has even lead to leading researchers calling for a new research discipline for service science (Chesbrough and Spohrer (2006)). The interest has also caught up on the software industry and information systems research in recent years (Benlian and Hess (2011); Komssi et al. (2009); Sääksjärvi et al. (2005); Stuckenberg et al. (2011); Xin and Levina (2008)).

Servitization can take many forms, depending on how the company wants to position its offering on the product-service continuum (Oliva and Kallenberg (2003)). Initial definitions of servitization defined the phenomenon as the addition of services to support the product in the core of the offering (Baines et al. (2009)). However, more recent research has identified another form of servitization where companies move from offering products and services to offering integrated solutions or product-service systems (PSS)[2] (Baines et al. (2007); Cusumano et al. (2015); Tukker (2004); Tukker and Tischner (2006)).

This is in line with the dominant logic distinction proposed by Vargo and Lusch (2004) in the marketing literature. They argue that there are two types of outputs produced by companies: (1) goods accompanied with services that support the goods as well as (2) services. The former represents what they call the goods-dominant logic (G-D), whereas the latter describes the service-dominant logic (S-D). Although some argue that this distinction is difficult to apply in practice (Sultan (2014)), it provides a method for distinguishing between the two stages of servitization. In the G-D logic, goods and services are units of output and the good is the focal point of exchange, whereas the S-D logic understands the service provision as the fundament of exchange with goods representing a mere part of the process of value co-creation (Lusch and Vargo (2006); Vargo and Lusch (2004), Vargo and Lusch (2008a), Vargo and Lusch (2008b)). Thus, servitization in the G-D logic would imply the addition of new services (see the initial definitions of servitization in e.g. Vandermerwe and Rada (1988)) to create extra value to the customers of a product. However, servitization could also be seen as a transformation from the G-D logic to the S-D logic, with the company switching the fundament of exchange from a product to a service.

Based on this distinction between the two stages of servitization, transforming to the software as a service (or more generally PSS) business model would represent the second stage. Software vendors have traditionally sold software licenses and provisioned maintenance and other services as additional offerings. The software as a service business model changes the fundament of exchange as the underlying software product becomes a mere part of a value creation process.

The underlying reason to become service-dominant and

[2] To be precise, there are three stages of product-service systems, product-oriented, use-oriented and result- oriented PSS, based on what the focus of the offering is (Tukker (2004)). For simplification, however, I focus on the more advanced use and result-oriented PSS types in this thesis.

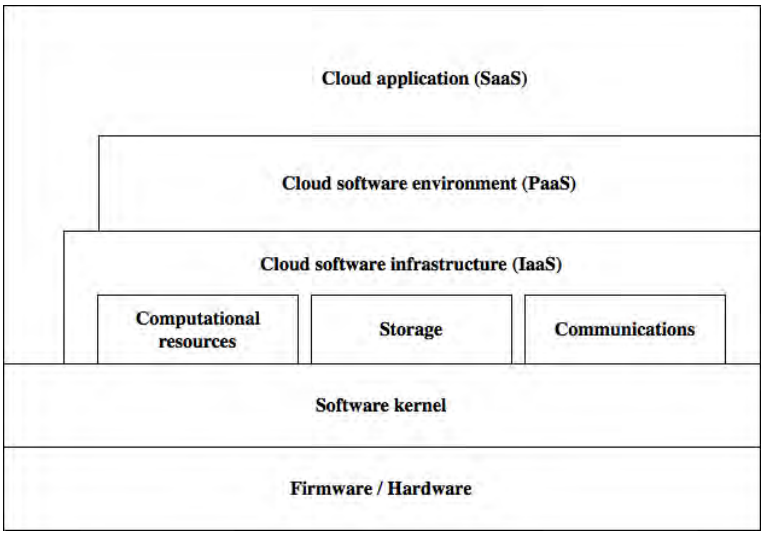

Figure 1: Ontology of five layers in Cloud computing (Youseff et al. (2008)).

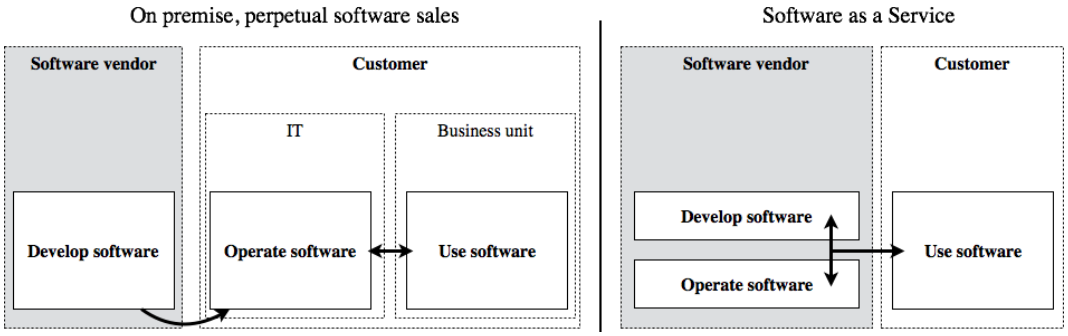

Figure 2: Difference in on premise and software as a service responsibilities (Stuckenberg et al. (2014)).

move towards PSS resides in the potential of such offerings to fulfill customer demands better. In a PSS, the customer pays for using or benefiting from the asset rather than purchasing it, leading to a reorganization of risks, responsibilities and costs associated with the ownership of the asset (Baines et al. (2007); Beuren et al. (2013)). This reorganization of resources also helps providers differentiate themselves from competition, foster customer relationships, and increase and balance revenues (Baines et al. (2007), Baines et al. (2009); Mathieu (2001b); Oliva and Kallenberg (2003)). This indicates that a move to a PSS offering can optimize resource utilization both for the provider and the customer.

However, the fact that many companies are slow or even reluctant to move toward PSS indicates that there are some barriers to their adoption. Indeed, researchers in both the PSS literature and the more general servitization literature talk about cultural as well as organizational challenges related to the adoption (Baines et al. (2007), 2009; Gebauer et al. (2005); Gebauer and Friedli (2005)). The indication is that an organization has to overcome inertia (Hannan and Freeman (1984)) on its way to successfully reaping the benefits of provisioning PSS.

2.2.1. Resource optimization benefits of PSS

Years of research on service management have led to a widely recognized concept of services that draws on their fundamental difference to products. Thus, services are often defined along the characteristics of intangibility, heterogeneity, simultaneity, perishability and the existence of an external factor (Stuckenberg et al. (2014)). These underlying characteristics are also the starting point for understanding the benefits of servitization that have been studied extensively in the past, both from the perspective of the customer and the provider (Baines et al. (2009)).

Competitive, financial and marketing benefits are generally seen as the drivers of servitization for providers (Baines et al. (2009); Mathieu (2001b); Oliva and Kallenberg (2003)). From a competitive perspective, services can lead to a strong competitive advantage as the service experience is more difficult to copy than physical products (Mathieu (2001b); Oliva and Kallenberg (2003)). Services can thus help companies differentiate themselves from their competition better (Neely (2008)). This is especially important in industries where products have become or are becoming commoditized. The case of Hilti in the construction tools industry that Johnson et al. (2008) present, provides a case

in point for this argument. The authors explain that the increasing commoditization of construction tools pushed Hilti to rethink customer value, leading them to offer access to tools as a service. This meant that the customers did not have to worry about storage or repairs anymore and could just enjoy being able to use the tools they needed, whenever they needed them.

From a financial perspective, services and PSS can help reduce the fluctuation of revenues as it is often more difficult for customers to give up on purchasing services than new products (Mathieu (2001b); Oliva and Kallenberg (2003)). Additionally, especially in industries with a high installed-base-to-new-units ratios, services can act as an essential new way of increasing revenues of a manufacturing company (Neely (2008); Wise and Baumgartner (1999)). Indeed, some empirical evidence indicates that servitization can help companies increase their total revenues (Visnjic et al. (2012)).

Finally from a marketing perspective, services increase the intensity and frequency of customer contact and thus transform the customer relationship from transactional to continuous (Mathieu (2001b); Oliva and Kallenberg (2003)). This in turn helps companies lock-in their customers and lock-out the competition (Neely (2008)). In other words, customers of PSS are in a tighter engagement with the provider and thus more loyal to them (Aurich et al. (2010)). Consequently, this leads to even more financial benefits as customer lock-in and loyalty reduce the fluctuation of revenues.

Additionally to these three benefits, a PSS facilitates speedier and more efficient innovation as the provider is able to monitor the products and services during their usage (Tukker and Tischner (2006)). Kastalli and Van Looy (2013) similarly propose that increased servitization can help develop an organization's innovation capabilities due to learning effects and increased customer proximity. All the discussed benefits to providers are summarized in Table 1.

For the customer, a PSS enables focused use of resources as it reduces the amount of resources tied to investments as well as administrative and monitoring tasks, meaning that the customer can ultimately avoid unnecessary costs and focus resources on core business activities (Baines et al. (2007)). Additionally, the reorganization of responsibilities is seen to improve quality (Aurich et al. (2010); Baines et al. (2007)), which makes sense as the provider can benefit from economies of scale and scope in delivering the use-value in a one-to-many model. Specifically, the PSS model allows the provider to collect data about the use of the service and focus quality and development efforts on the right functionalities (Sundin et al. (2009)). Finally, the added flexibility of the service model allows faster innovation and delivery of new functionality to customers (Cook et al. (2006); Manzini et al. (2001)).

2.2.2. Inertia associated with servitization and the servitization paradox

The abovementioned benefits of services combined with increasingly competitive environments in many industries have lead scholars to urge practitioners to integrate vertically in the value chain by provisioning services (Anderson and Narus (1995); Wise and Baumgartner (1999)). Indeed, some authors have since presented compelling evidence of the benefits (Kastalli and Van Looy (2013); Visnjic and Van Looy (2009)). However, the evidence has often been based on case-studies in individual firms.

Managing a service business also has its challenges and the provider transforming from selling products to provisioning PSS has to overcome inertia (Hannan and Freeman (1984)) caused by the transformation, both internally and externally. Indeed, empirical studies on the influence of servitization on firm performance have yielded mixed results. Neely (2008) found that initial servitization increases the profitability of a company, but that the profitability decreases with increasing extent of servitization. Furthermore, Visnjic et al. (2012) took a closer look at the effect of increasing servitization on profitability and market value of firms by dividing the scope of servitization into its breadth and depth. They measured the breadth of servitization in the number of services offered and found out that an increasing breadth has a negative effect on profits. Service depth, measured in completeness of service offering, on the other hand, was found to lead to higher margins and market values.

Meanwhile, studies by Fang et al. (2008) and Suarez et al. (2013) have indicated that the extent of servitization influences profitability and firm value negatively only initially. They show that after reaching a certain percentage of revenue from service sales (20-30% and 50-60% in the two studies respectively), the effects on profitability and firm value turn positive. However, the difference in the threshold values raises questions about the reliability of these results, although the difference might be explained by the fact that Fang et al. (2008) conducted their study among manufacturing firms, whereas Suarez et al. (2013) focused on software firms. Nevertheless, there seems to be an argument for the importance of a certain familiarity with services for firms looking to become service-oriented.

Most discussed reasons for the servitization paradox include the cultural and organizational shift required to turn from developing and selling products to a service provider (Gebauer et al. (2005); Gebauer and Friedli (2005)) as well as the challenges in creating and implementing a service-oriented business model (Gebauer (2009); Gebauer et al. (2005); Martinez et al. (2010)). Baines et al. (2009) categorize these challenges of servitization into service strategy, service design and organizational transformation.

First, organizations need to adopt a service-oriented strategy when transforming to a service provider. Becoming a service provider implies adopting a downstream position in the value chain, customer-centricity and service-orientation (Oliva and Kallenberg (2003); Windahl and Lakemond

(2006); Wise and Baumgartner (1999)). The challenges related to these include defining the firm's strategic positioning in the new competitive environment (Oliva and Kallenberg (2003)) as well as developing a strategy for generating the required trust and cooperativeness in their customers to manage long-term relationships (Wise and Baumgartner (1999)).

The differential nature of services to products is the reason for the second category of challenges related to servitization: service design. By definition, services are intangible, fuzzy and thus hard to define (Slack (2005)). This might not only discourage organizational actors from investing their efforts into developing and expanding the service offerings (Mathieu (2001b); Oliva and Kallenberg (2003); Vandermerwe and Rada (1988)), but it might also render existing capabilities of organizations useless, forcing providers to acquire and develop new capabilities related to customer value understanding as well as service design and delivery (Neely (2008)). All of this adds to the organizational inertia that providers need to overcome within the organization when transforming to offering PSS. Additionally, providers need to consider risks related to the design process of PSS, as taking over activities previously performed by customers might present additional challenges (Slack (2005)).

Finally, organizations need to adapt necessary organizational structures, processes and culture. The cultural shift from transactions, where assets change hands, to a continuous relationship, where customers pay for usage or value, can be a challenge to organizations (Baines et al. (2009); Gebauer and Friedli (2005); Rexfelt and Hiort af Ornäs (2009)). Like Mathieu (Mathieu (2001a); Mathieu (2001b)) notes, the service culture is very distinct to that of a traditional manufacturing culture, meaning that a shift in the corporate mind-set is required to prioritize and be successful in the service business (Oliva and Kallenberg (2003); Slack (2005)). To achieve a cultural change, organizations need to significantly alter existing practices and attitudes (Vandermerwe and Rada (1988)), leading to an organizational change process. For example, companies need to transform their marketing practices and organization from transaction-oriented to relationship-oriented (Vargo and Lusch (2004)). Likewise, they need to adapt use-value based sales practices in the place of traditional feature-based practices (Neely (2008)). Gebauer et al. (2005)highlighted this in their case study that showed that traditional sales personnel either gave away services for free as incentives to purchase the product or were not at all compelled by the sale of low-value service contracts in comparison to product sales worth millions of Euros.

To summarize, PSS have clear benefits to both providers and customers that stem from the optimization of resource utilization. However, the transition to provisioning PSS implies challenges to providers that have to do with service design, organizational transformation and strategy. Companies need to find strategies for moving towards PSS that maximize the benefits and minimize the inertia needed to overcome during the transition.

2.3. Three decisions to be taken when introducing PSS offering

Moving towards PSS has clear resource optimization benefits both to the providers and their customers that shareholders should also be able to recognize. However, the transition to provisioning services creates inertia that the provider has to overcome on its way to capturing the benefits. I assume that there are three key choices that companies need to make when introducing PSS and that these influence the gravity of the resource optimization benefits and the inertia faced. Based on the theorized effects of the choices, I build hypotheses about how the stock market is expected to react to introductions of new SaaS offerings.

2.3.1. Offerings for new product lines versus existing products

The first choice that companies need to make when moving towards PSS is whether to introduce a PSS for an existing product or for a new product line. A new product line does not have an installed base of customers, which can have both good and bad implications for the provider. An installed base of customers allows the company to make use of existing resources like customer relationships and product-related resources. However, it is not certain a new PSS offering can benefit from the resources as existing customers might not be willing to change to a service-based delivery model of the product, and the customers to be targeted with the new offering might be from a completely different segment than current customers. In fact, some argue that subscription-based offerings like software as a service are best targeted to an audience of smaller businesses that previously were not able to afford the up-front investment in software licenses (Teece (2010)). Practitioners often refer to this as the "long-tail" market, which the SaaS offering helps companies reach. Similarly, a PSS offering like BMW DriveNow is clearly targeted to customers who do not own a personal car and would not be customers of BMW if not for the DriveNow offering.

Besides an installed base of customers, existing product lines also benefit from the existing product-related resources like design and production processes. In software applications, a SaaS offering could theoretically benefit from the existing source code and the developers in place to develop the offering. This would reduce the risk associated with the new offering as not everything would have to be developed from scratch. However, software firms often have to rethink their development processes (Stuckenberg et al. (2014)) and develop a big part of the source code again to be able to create applications that fit the purpose of a software as a service offering. Thus, it is uncertain to what extent companies can actually benefit from existing resources when developing the PSS offering.

On the other hand, an installed base is likely to increase inertia, as the provider not only has to face resistance in its own organization but also in its existing customers. First, the existing product development organizations, processes and intellectual property can increase inertia, as the service-oriented offering has to adapt to completely new customer

expectations and thus the resources need to be revamped in order to be successful with the PSS offering. The existing resources could thus prohibit success in the new service-oriented model, which arguably happened in the case of SAP Business ByDesign, the story of which is described in one of the case studies in appendix D.

Second, the existing customers have to change their mind-set about how products are consumed and acquired, and in many cases, they also have to reorganize internal service organizations as the functions previously internal to the customers' organization are covered by the provider in the PSS offering. In the case of new product lines, companies have more freedom to experiment with new business models without running the risk of confusing or alienating existing customers. Consequently, a study by Sosna et al. (2010) suggests that such experimentation can be invaluable for companies that are looking to transform their business model.

To summarize, it is unclear to what extent software vendors can utilize their installed base of customers and product-related resources when creating and distributing new software as a service offerings based on existing products. At the same time, companies that introduce PSS offerings for existing products have to cope with additional inertia from within organizational resources as well as the installed base of customers. This is why I hypothesize that the reaction by the stock market will be more positive when SaaS offerings are introduced in the form of new product launches.

> Hypothesis 1: Announcements that introduce software as a service offerings for existing products will be perceived more negatively than announcements that introduce new software as a service product lines.

2.3.2. Parallel perpetual offerings

The second choice companies need to make when introducing PSS offerings is whether or not to continue selling the product with a traditional perpetual sales model. While focusing solely on the PSS model can optimize the usage of resources, a parallel offering can reduce the inertia the company has to overcome as customers are offered the choice to purchase the product via a traditional sales model.

The introduction of a PSS offering, just like any other business model innovation, often leads to two models being run in parallel, which can lead to challenges of cognitive and economic nature (Velu and Stiles (2013)). First, running two business models in parallel means that the organization and its employees need to hold two cognitive conceptions simultaneously. An example of problematic consequences resulting from this relates to incentivizing sales personnel, who in traditional product-oriented firms are used to making large license plus maintenance deals and are not likely to do well or be motivated to sell smaller monthly or yearly subscription packages (Gebauer et al. (2005)). If they are offered the choice, they will most likely just stick to selling what they know and understand.

Second, the two parallel offerings will compete against each other for customer adoption and cause duplication of resources. On one hand, a parallel business model approach could lead to the PSS offering cannibalizing[3] (see e.g. Chandy and Tellis (1998)) the perpetual software sales offering. On the other hand, the internal competition between the business models could cause the perpetual offering to inhibit the PSS model's success. Additionally, running the two business models in parallel leads to duplication of resources. For example, in the case of software, product development, operations and support have to be provided independently for both offerings. Thus, economies of scale cannot be reached in a way possible with just one business model.

At the same time, some scholars argue that it is sometimes preferable to offer multiple business models for one product in parallel (Casadesus-Masanell and Tarzijan (2012); Markides and Oyon (2010)). Birkinshaw (2001) points out that parallel business models can be beneficial if the market is heterogeneous enough to facilitate two business models for different customer types with different needs. In the context of software as a service, experts often speak of how the SaaS model fits the needs of small and medium-sized businesses well, because it makes complex and expensive applications accessible to firms with limited availability of capital to invest. This again refers to the "long-tail" market that can be reached through the SaaS model. However, from a resource optimization perspective the PSS model should make sense for all sizes of firms.

Still, decisively choosing the business model that optimizes resource utilization might not be the best choice. As I have discussed, the transition from a product-oriented business model to a PSS model is a big change in itself and forcing customers into a new mold without providing them a choice would increase the inertia the provider faces dramatically. Customers might either not be willing or able to change the way they acquire products, both of which are reasons why Sosna et al. (2010) argue that it is important to experiment when transitioning to a new business model. Thus, I hypothesize that parallel offerings are perceived more positively by the stock market than pure PSS approaches.

> Hypothesis 2: Announcements that imply an alternative perpetual software license offering to the SaaS offering will be perceived more positively than announcements that do not imply a parallel perpetual license offering.

Based on hypotheses 1 and 2, I formulate a 2-by-2 matrix of four strategies software vendors can choose from when introducing a SaaS offering, as illustrated in Figure 3. The

[3] Cannibalization stands for a phenomenon where the adoption of a new product, service or business model decreases the value of existing assets or routines. The value decrease in existing assets can concern both tangible assets like equipment and intangible assets like employees' knowledge and capabilities

2-by-2 is based on the two variables of existing vs. new products and parallel offering vs. no parallel offering. The four resulting fields are mutually exclusive and collectively exhaustive as there can be no strategies beyond these four and one introduction can only belong to one of them.

Because the two variables interact in the form of resulting strategies, I also have to look at possible interaction effects. It could be argued that a parallel perpetual offering makes less sense for new product launches than when transforming existing products to SaaS, because of the expectations of the installed base of customers. When introducing new product lines, there are no existing customers to lose. However, if all potential customers are observed, a pure SaaS offering might discourage many enterprises from becoming customers of the new software product. This is why I hypothesize that the inertia argument that speaks for a parallel perpetual offering also holds for new product launches. Thus, I predict no interaction between the two variables, leading to the hypothesized investor reactions that are presented in each of the four fields in Figure 3.

2.3.3. Partnering for PSS delivery

The third choice to be made by companies when introducing new PSS offerings is whether to develop the service capabilities of the product-service system alone or to partner with external service providers in the creation of the offering. This decision is very much of outsourcing nature, with companies having to balance between the opportunities and risks of externalizing the service activity to a third party (Rothaermel et al. (2006)). At the same time, however, such a partnership represents a deeper form of cooperation than traditional outsourcing, where trust and interaction are more important than mere cost economics (Lee et al. (2003)). From a resource optimization point-of-view, a partnership would allow the companies to benefit from the economies of scale an infrastructure service provider can generate by hosting software applications for multiple software vendors in a one-to-many model. Thus, the comparative costs of the infrastructure service provider should be lower than the same costs were the software vendor to host the applications itself. The comparative production costs indeed are the best predictor of outsourcing decisions (Walker and Weber (1984)). Additionally, the demand for SaaS application computing and storage usage can be difficult to predict, which means that volume uncertainty is high, which is also an important reason for outsourcing (Walker and Weber (1984)). Similarly, software application platform providers can benefit from economies of scale not accessible to individual software vendors, as they have developed source code that can be used by multiple software vendors in a one-to-many model. Additionally, infrastructure and platform partnerships can benefit the software vendor in more qualitative ways. As these firms specialize in the infrastructure and/or application platform development, the software vendor can also benefit from their innovation capabilities, leading to increased long-term competitiveness.

From an inertia perspective, it is not clear whether a partnership would increase or reduce inertia. On one hand, acquiring the competencies and resources needed for the additional services delivered as part of the PSS would reduce inertia as the provider does not need to go through a process of developing the resources and competencies. On the other hand, a partnership with an external provider could introduce new challenges in managing the relationships and interfaces between the companies, leading to additional inertia. Thus, studying how investors perceive this choice can create interesting insights into the literature on the openness of organizations to interact with their environments (Scott and Davis (2015), pp. 87– 106).

I hypothesize that a partnership is perceived well by the stock market as it enforces the resource optimization potential of PSS and reduces the need for the provider to transform its organization.

> Hypothesis 3: Announcements implying that the software as a service offering is deployed on a partner firm's infrastructure and/or application platform will be perceived more positively than announcements that do not imply such cooperation.

To summarize, I have identified three variables that companies can influence when introducing new PSS offerings. Furthermore, I have discussed the effect of all of the three variables on the resource optimization related benefits and inertia-related challenges. Based on this discussion, I have generated three hypotheses to be tested in this empirical study. The theoretical development is summarized in Table 1.

Even if the hypothesized influence of the three independent variables on resource optimization and inertia is at least partly straightforward, their relative importance is certainly not trivial. Consequently, I employ the event study method to measure the total effect of the independent variable on the expected value creation potential of the firm (as measured in abnormal returns of the stock price). In case other benefits or downsides of the independent variables influence the total movement caused in the dependent variable, they will merely be attributed to either resource optimization benefits or inertia drawbacks. In my opinion, however, resource optimization and inertia as high-level constructs should cover the benefits and drawbacks in an exhaustive way.

3. Methodology

Event study is a method widely used in academic studies to measure the impact on the stock price of changes in corporate policy (McWilliams and Siegel (1997)) and other corporate events like product and business model innovation (Alexy and George (2013); Fosfuri and Giarratana (2009)). The benefit of using stock market returns is that they are more objective and subject to less manipulation by managers than accounting measures (McWilliams and Siegel (1997)). Based on this widely established research design, I follow the steps needed to complete an event study in this chapter: defining what is considered an event, collecting data on

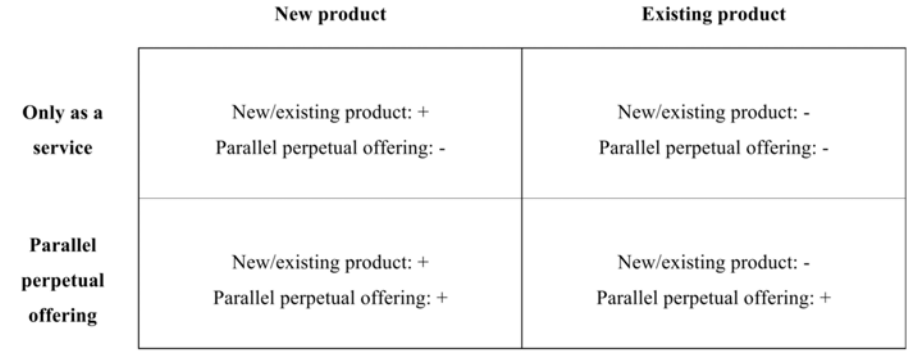

Figure 3: Four options for introducing new SaaS offering and hypothesized investor reactions (own illustration).

Table 1: Theoretical development of the effect of independent variables on resource optimization and inertia as well as the resulting hypotheses (own illustration).

Variable	Resource optimization	Inertia	Hypothesized effect
Existing product line	+	- -	- (H1)
Parallel perpetual offering	-	++	+ (H2)
Partnering	+	+	+ (H3)

Notes: The effects are comparison effect to the baseline value; for existing product line the baseline is new product introduction, for parallel perpetual offering the baseline is no parallel perpetual offering and for partnering the baseline is no partnering. A positive effect on inertia means that inertia decreases, i.e. the expected investor reaction improves. A positive effect on resource optimization means that resource optimization increases, improving the expected investor reaction. The values of one or two plusses or one or two minuses are not comparable between variables, they are merely used to compare the hypothesized effect of two conflicting effects (e.g. the positive effect on inertia of a parallel perpetual offering outweighs the negative effect on resource optimization).

events, controlling for confounding events, and selecting parameters to calculate abnormal returns (MacKinlay (1997); McWilliams and Siegel (1997)).

3.1. Event definition

As this study focuses on servitization as a product-level phenomenon, the interest is on events where a software vendor introduces a new software as a service offering.

> An event is the announcement by a software vendor of a software as a service offering for enterprise customers, either in the form of a new product launch or a new offering for an existing product.

I restrict the event definition only for software that is sold to enterprise customers in order to avoid the heterogeneity between consumer and enterprise applications. My assumption is that enterprise customers are slower to adapt to new models of purchasing than individuals and thus the inertia effects in B2B software are more important. Thus, consumer applications should lead to more positive reactions, but I do not analyze this further as the amount of consumer applications identified was too small ($n = 8$). Additionally, consumer software often is more content-oriented (e.g. games, media and entertainment and education), making it more difficult to compare to enterprise applications.

To specify the event definition further, I formulate definitions for (1) what firms are considered as software vendors and (2) what is considered a software as a service offering. The restrictions are based on the IDC's Software taxonomy (Morris (2015)), a widely accepted report in the software industry.

To be classified as a software vendor event in the definition, the focal company has to own intellectual property for the software and sell a replicated product in a one-to-many model. First, resellers, distributors and third-party service providers that do not own the software source code are not considered to be software vendors but channels for software vendors. For events where multiple companies announce SaaS offerings together, only the software vendor as per the definition above is included in the sample. Second, software companies assemble a package of code from components and sell multiple copies in a one-to-many business model. This means that non-replicable software products like completely individual software solutions are not sold by software vendors and thus not included in the sample.

As discussed in the literature review, the definition of software as a service is not trivial as the concept has many aspects to it. I define software as a service rather pragmatically and accept any type of technical implementation or stage of provisioning software as a service. For my definition the service character of provisioning software as a service is decisive and thus any offering is considered, where the software source

code is bundled into a subscription or other type of service as opposed to being sold as such, typically via a perpetual license (Morris (2015)).

3.2. Sample

The events were collected using a headline and lead paragraph search of press releases between 28.02.2001 and 31.12.2015 from three leading North-American newswires: PR Newswire, Business Wire and Market Wire. 28th of February 2001, the publishing date of the SIIA (Software & Information Industry Association) report on SaaS, was chosen as the starting point of the study timeframe because I do not want to include any potential exogenous effects of this report being published in the sample. This starting date also makes it possible to exclude potential exogenous effects of the dot-com bubble, which is widely seen to have climaxed on 10th of March 2000 (Agrawal et al. (2006)). The search was conducted using the Dow Jones Factiva interactive database with the following search string:

> (publish* or announc* or launch* or releas* or unveil* or reveal* or introduc*) and (saas or software as a service or on demand or pay per use or pay as you go or per month or monthly or per year or yearly or subscri* or (hosted and service) or (cloud and service) or application service provi* or ASP)

The search string includes a broad list of ways to express delivering software as a service, including cloud and hosted services, the ASP model, different subscription expressions as well as the actual words software as a service or the common abbreviation SaaS. The Factiva search engine automatically tests replacing spaces with dashes, meaning that this did not have to be explicitly coded into the search string. Finally, the asterisks imply any amount of any characters following the word, which allows controlling for all kinds of formulations of words like published, publishes or publishing.

The search was repeated for all companies listed in the NASDAQ National Market or the New York Stock Exchange (NYSE) and categorized in the 4510 - Software & Services Segment in the Global Industry Classification Standard (GICS), collected through the OSIRIS database. Additionally, in order to include large technology companies that operate both in hardware and software, companies included in the S&P 500 index under the broader GICS category 45 - Information Technology were added to the list of companies. I restricted the study to companies listed in these US stock exchanges because of problems related to event studies in multi-country settings (Park (2004)). This does not mean, however, that the companies would have to have their seat in the US. Similarly, companies that are listed in the NASDAQ or NYSE stock exchanges secondarily to another foreign stock exchange are equally viable to be included in the sample of firms.

Overall, this led to a list of 412 companies, from which some (e.g. Cornerstone OnDemand) have arguably been operating with the SaaS model from their inception, but because drawing a line between a pure SaaS company and a non-pure SaaS company cannot be done fully objectively, I included these companies in the sample. To make sure that this does not falsify the results of the study, I controlled for the firms' experience in the SaaS model.

To avoid any bias caused by only looking at events for companies that are still listed on the stock market at the time of the study and have not been acquired or bankrupted, I added 11 companies that have been delisted from one of the two stock exchanges and that have introduced SaaS offerings within the period of analysis to the list of companies. The events identified for these companies were coded with a dummy variable to be able to measure whether this has any effect on the final model. One potential bias could be that delisted companies have been more aggressive and have taken more risks in the transformation process to SaaS offerings, which in turn could influence the investor reactions. This addition led to a total of 423 companies considered in the study.

The fact that the search string only contains one global and-operator combined with a list of 14 different ways to describe a service-based delivery of software means that the search string was highly inefficient with a full text search of press releases, because words like subscrip* come across in numerous meanings and contexts. However, when used with a headline and lead paragraph search, the search worked efficiently as it controlled for any notion that implies the introduction of a SaaS offering, even if announced as a part of a bigger announcement or if the company did not explicitly express that the new offering was in fact a SaaS offering. The lead paragraph of press releases without exception summarizes shortly what is being announced. In order to make sure the headline and first paragraph search was not systematically excluding relevant events, two relatively major firms, Adobe Systems Inc. and Intuit Inc., were selected and the search was repeated for them with a full text search. With the full text search, Factiva found 873 and 723 press releases for the two firms respectively, whereas the headline and lead paragraph search resulted to 114 and 60 press releases. Despite the huge increase in results, no new events matching the event definition were found with the full text search compared to the headline and lead paragraph search.

Because the search was conducted individually for each of the 423 companies, it was not sensible to count the total amount of events the search string found for each company. However, I estimate that the average number of press releases per company was around 100 for the biggest companies in the S&P 500 index (64 companies) and around 20 for the rest of the companies. This leads to an estimated 13 000 press releases analyzed in total.

Out of these around 13 000 press releases, 523 were initially identified to fit the event definition based on my analysis of their content. When these events were analyzed more precisely during the coding of independent variables, 164 were dropped from the sample for various reasons. For example, some announcements turned out to announce a

non-SaaS product (e.g. Smith Micro Revue launch - Dec 17, 2007), whereas others turned out to announce a general SaaS strategy (e.g. Autodesk Business Strategy - Apr 4, 2001). Another common reason for excluding an event from the sample was that the announcement merely concerned a new version of a product that was previously already offered with the SaaS model (e.g. Callidus Software launches Monaco 2011 - Aug 1, 2011). Thus I finally ended up with a sample of 359 events as listed in appendix C. The distribution of these events over time is illustrated in Figure 4.

The event distribution over time shows how it took until 2007 for the SaaS model to really establish itself in the industry. Amazon Web Services started operating in 2006, which might either be a reason or a cause of the apparent increase in the amount of SaaS announcements. Interestingly as well, SaaS seemed to have reached a temporary peak in 2008, after which the density of announcements declined until 2013 before going up again. This seems to resemble the shape of Gartner's hype cycle with its peak of inflated expectations and the through of disillusionment (Gartner, Inc. (2016)).

3.3. Confounding events

Controlling for confounding events is a crucial part of the event study methodology, although it is often disregarded by researchers (McWilliams and Siegel (1997)). In order to be able to attribute the observed abnormal returns in the stock price to the studied event, one needs to ensure that no other apparent company-specific event is causing the abnormal returns. Thus, the presence of confounding events (e.g. announcement of important partnerships or new products, financial reports, or the change in a key executive) means that the corresponding event has to be excluded from the sample (MacKinlay (1997); McWilliams and Siegel (1997)).

Because it is likely that the confounding events (just like the studied events, see below) can also be anticipated and that the reaction to them continues on the day after the event, I controlled for confounding events during the event window as well as a trading day before and a trading day after it. This means that confounding events were controlled for a five-day window around the event date. Out of the 359 events, 121 were flagged as not confounded and 238 as confounded. Confounding events were also controlled for a three-day period in case the five-day window would lead to a too reduced sample. This way, 155 events were flagged as not confounded and 204 as confounded.

As noted in preceding event studies in the software industry, a reason for the big amount of confounded events is that software firms often make announcements in bundles during events like developer conferences (Alexy and George (2013)). To reduce potential bias on the results caused by some companies' events being more likely to end up in the final sample, I employ a two-stage Heckman model that in the first stage estimates the likelihood of an event entering the sample based on company characteristics and includes the resulting inverse Mills ratio into the second-stage regression model.

3.4. Parameters for calculating the abnormal returns

In event studies, the reaction to new information by the stock market is estimated based on abnormal returns in the stock price. To be able to define what returns are abnormal for the firm's stock, any global effects across all firms have to be excluded from analysis and a level of expected returns has to be estimated. To achieve this, daily returns are calculated using the closing price for both the firm and a comparable market. Then, over a period of time before the event called the estimation window, the two resulting time series are linked via a linear regression model. The resulting regression equation and the returns of the comparable market are then used to calculate the expected returns for the stock on every day of the event window. The expected returns are then deducted from the real returns to arrive at abnormal returns for each day. Finally, the abnormal returns are totaled over the event window to arrive at cumulative abnormal returns (CAR). Thus, one needs to define the event and estimation windows as well as a method to estimate the market returns in order to conduct the event study. An overview of relevant terminology of the various time windows discussed here is presented in Figure 6. For the event window, I select a period of three trading days: the day of the event as well as the trading days immediately before and after it. As information about announcements often leaks to the market before the announcement, the potential influences of leaked information should also be included in the analysis of market reactions. Similarly, observing the returns long enough after the event helps capture a more complete picture of the reaction to the new information. However, a problem with including anticipation effects and delayed reactions in the event window is that it reduces sample size as confounding events become more probable with longer event windows (McWilliams and Siegel (1997)). Some researchers have even shown that markets adjust to new information rapidly (Dann et al. (1977); Mitchell and Netter (1989)), which is why some event studies have not considered the returns of the day after the event at all (Alexy and George (2013)). Regardless, I believe it is important to include the day after the event in the event window as many of the announcements in the sample were made late in the afternoon, 2PM or later, leaving the market with only 2 hours to adjust on the day of the event. Additionally, with many of the events I analyzed individually to understand the data, I noticed that the stock market often counter-reacted to the high abnormal returns of the event date on the day after, which could hint that the market needed more time to really understand the qualitative data provided in the announcements.

For the estimation window, I select a window of 126 trading days. This follows the gold standard set by previous event studies in the IT industry that have often used a 125-day window (Agrawal et al. (2006); Alexy and George (2013); Oh et al. (2006)). The reason I add one more day to the 125 days is that by making the estimation window devisable with the event window, including each day of the estimation window in the calculation of the parametric Corrado z-statistic becomes possible. Thus, with the mere addition of one day

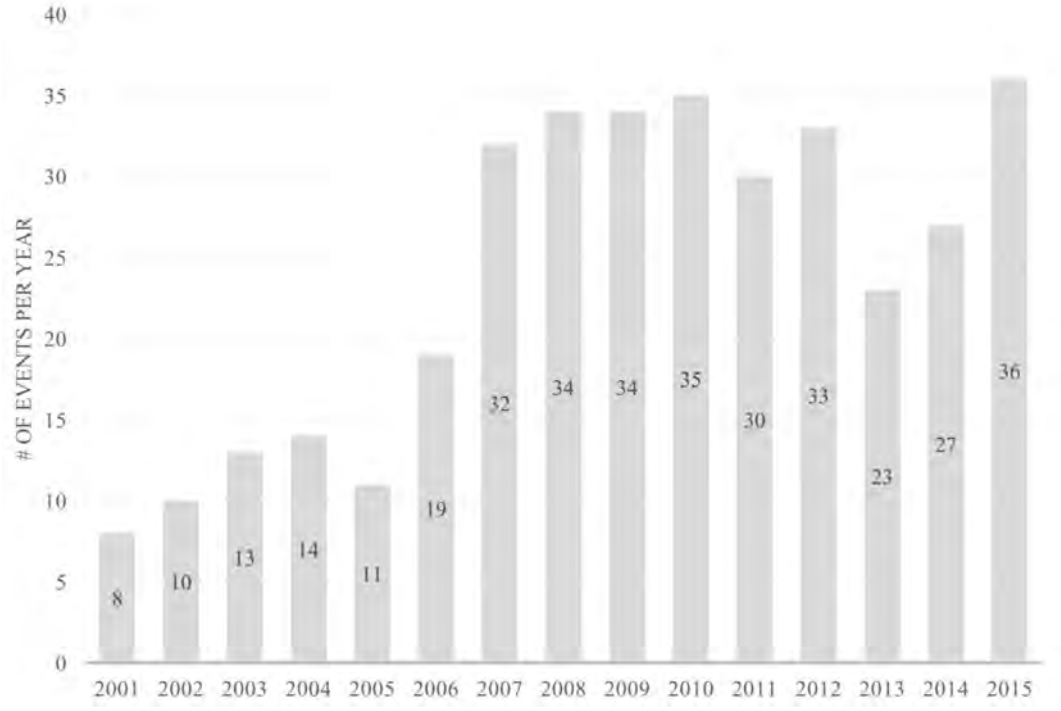

Figure 4: Distribution of studied events over time from 2001 to 2015 (own illustration).

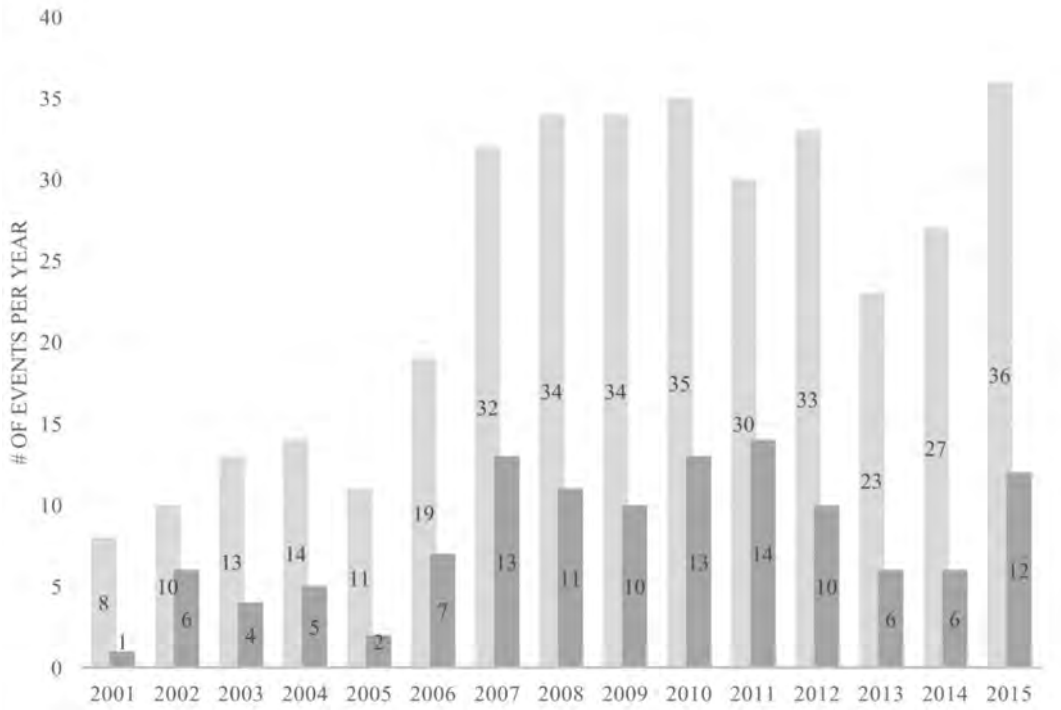

Figure 5: Distribution of all events and non-confounded events from 2001 to 2015 (own illustration).

to the estimation window length, the power of the Corrado z-statistic improves by 2.5 percent (1/41). I separate the estimation and event windows with a lag of 1 trading day. In the robustness checks, the lengths of the event and estimation windows are alternated to analyze the sensitivity of the results to the selected values.

Finally, I use the market model to calculate the abnormal returns caused by the events. There are many alternative ways to do that, such as the mean-adjusted returns, market-adjusted returns, and the Capital Asset Pricing Mod-

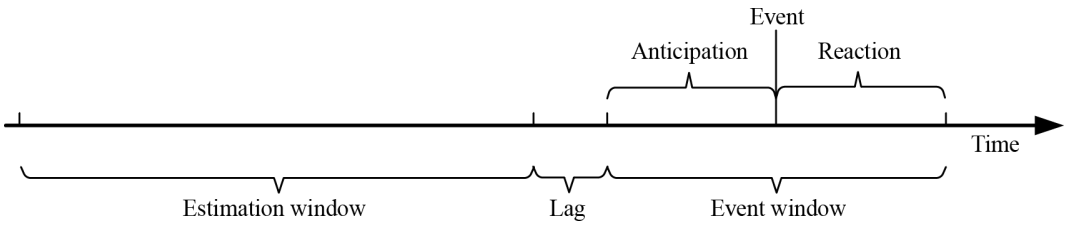

Figure 6: Relevant terminology of time windows in event studies (adapted from(MacKinlay (1997))).

els (CAPM), but according to Armitage (1995), Park (2004) and Agrawal et al. (2006), the market model is the most commonly used one in event studies, partly due to its ease of implementation. Binder (1998) also showed that despite its simplicity and some statistical challenges related to it, the market model in most cases is at least as good as the alternatives. To estimate the returns of the comparable market, I mainly use the S&P 500 index. Many previous event studies in the IT industry have employed the NASDAQ Composite (Agrawal et al. (2006); Alexy and George (2013); Oh et al. (2006)), which I also use in robustness checks. However, the reason for mainly using the S&P 500 index is that 73 out of the 123 companies (59%) with events in the sample are part of the NASDAQ Composite index, whereas only 19 (15%) are part of the S&P 500 index. This means that when using the NASDAQ Composite index, the comparable market returns include the returns of the stock being studied, potentially biasing the results. All of the time series data for the studied firms and indices were extracted from the Thomson Reuters Datastream and corrected for non-trading days like public holidays.

3.5. Measures used in multivariate regression model

The cumulative abnormal returns (CAR) that were calculated for each event as described above were used as the dependent variable of a multivariate regression model. In order to test the hypotheses derived in this thesis, additional independent variables were coded to measure the following characteristics of each announcement: new/existing product, parallel perpetual offering, delivery partnership as well as the firm's experience in the SaaS business model. The coding was conducted by the author for all events and repeated by another researcher for 20 events (18 % of the non-confounded sample) to make sure that coding was accurate and independent of subjective biases. Out of the 80 re-coded values, 77 (96.3%) received the same coding in the re-coding as initially. The corresponding Cohen's Kappa (Cohen (1960)), a coefficient that measures inter-coder reliability and includes the probability of matching coding by chance, was 92.5% for the initial re-coding. Discussion about the three disagreements with the secondary coder made me confident that no re-coding is necessary for all events. Examples of the coding can be found in appendix B and C.

With the variable "existing product", I differentiate between new product launches and introductions of SaaS offerings for existing products that have an installed base of customers. To determine the variable for each event, the semantics of the press release were analyzed. A new product launch often uses different formulations than an introduction of a new offering for an existing product, which de it convenient to code the variable in most cases. However, sometimes the differentiation was not straightforward, as press releases that seemed to represent new product launches were in fact introductions of new offerings for existing products. This sometimes became evident from the name of the offering, which often used the terms On- Demand or Cloud after the name of an existing product. In other cases, the researcher had to analyze the description given about the product and its customers to determine whether it is novel or not. For the purposes of this study, novelty did not refer to the novelty of the underlying technology or source code, but to the existence of an installed base of customers. For example in the case of an ERP software offering that is based on existing technology but targets a new customer group, the event would have been coded as to concern a new product.

Regarding parallel perpetual offerings, the variable differentiates between strategies that explicitly communicate the SaaS offering as a mere alternative to a perpetual product sales model and strategies that communicate the SaaS offering without mention of an alternative to customers. One example of explicitly communicating that the SaaS offering is a mere alternative to a perpetual offering is to mention other delivery models in the press release. Another way in which it becomes obvious that the SaaS offering is a mere alternative to a perpetual offering is when the company announces the offering with a byname like On-Demand or Cloud. It is obviously possible that poor communication might lead to a misinterpretation of the strategy used in the focal event, but a focused analysis beyond the press releases would be impossible to conduct in a consistent way over all events across the range of 15 years. Thus, I accept the limitations of basing the coding merely on the communication used in the press release and assume the impact of this to be minimal over a large amount of events studied.

With regard to partnering for delivery in the case of software as a service, a partnership to deliver the integrated product-service system refers to partnering with an infrastructure and/or platform (as a service) provider. Similarly to the variables above, this is coded based on what the focal firm communicates in the press release. Whenever another company was mentioned in the announcement, I analyzed whether the cooperation regarded the delivery of the

software as a service offering in the form of infrastructure and/or platform provided by the partner company. This was especially differentiated from cases where two companies together developed a product that was offered with the SaaS model. Again, it is possible that a partnership was left unmentioned in some press releases, but because companies so often mentioned it very explicitly, I believe the potential error caused by this to be negligible.

Additionally, a plethora of variables are used to control for non-spuriousness of the observed effects of independent variables. Some of these control variables are used in the selection equation of the Heckman two-stage regression model to control for the effects of some type of firms being more likely to introduce confounding events and thus not enter the sample.

First, I control for the effects of potential investor learning effects by controlling for the period in time (pre and post 2006). As the software as a service business model represents a completely new form of conducting business in the software industry, it is plausible that firms that entered the model in the earliest years in the sample were punished for their category divergence (Alexy and George (2013)) with an illegitimacy discount (Zuckerman (1999)). Several different discretization approaches for time were tested but no significant increases in model quality were achieved by going past a categorization with two levels.

Second, I control for firm size as measured in number of employees. It has been shown that firm size positively influences legitimacy and ability to introduce new categories (Greenwood and Suddaby (2006)). Additionally, larger firms are likely to be influenced less by the introduction of a new category, meaning that the scale of a potential increase or decrease in value would be smaller for large firms.

Third, I use two variables to approximate the firm's exposure to and experience with the SaaS business model. Firstly, I simply approximate whether the company has previously delivered software through the SaaS business model. This was coded as a binary variable based on the company having previous events in the collection of events and in a few cases based on the company description at the end of the press release. Because some companies in the sample might have been "Born in the Cloud" (companies that have operated with the SaaS model from their inception), I had to make sure that such companies would not get coded with no experience with SaaS for their first event in the sample. Secondly, I accumulate the amount of events per company to get an approximation of the amount of experience with the SaaS model, and divide this by firm size in employees to control for the fact that bigger firms are likely to have more announcements in the sample.

Finally, I control for absorptive capacity, which describes a firm's ability to create and utilize knowledge in a way that helps it gain and sustain competitive advantage (Zahra and George (2002)), as it is likely to influence a firm's capability to transform its business model and introduce new categories (Alexy and George (2013)). Additionally, highly innovative firms might lose some of the value of their innovativeness when they stop selling product versions based on innovation cycles and allow customers to subscribe to a service that gives them constant access to the newest version. A company that is able to introduce new and attractive features yearly, for example, would in the subscription model lose the ability to sell new products based on the new features and would have to give them to subscription customers for free. Based on the original definition by (Cohen and Levinthal (1990)), I approximate absorptive capacity using the R&D-to-sales ratio, which is calculated using the latest reported sales and R&D figures at the time of the event.

Additionally, I use the following firm attributes to predict the absence of confounding events: Sales (in thousands of dollars), sales-per-employee (in thousands of dollars), sales growth (over the past year) and PPE (property, plant and equipment)-to-sales ratio. The selection of these variables follows the example of previous event studies (Alexy and George (2013)).

4. Results

In this chapter, the results of the analyses are presented in detail. First, the influence of the selection of parameters for calculating the cumulative abnormal returns (CAR) is analyzed. Second, descriptive statistics and correlations between all variables are inspected. Third, the mean values of CARs based on various values of independent variables are investigated in univariate analyses. Furthermore, due to a significant increase in the mean values of the CAR after the year 2005, the univariate analyses are repeated with a subset of data that only includes events from 2006 onwards in chapter 4.4. Based on the knowledge gathered about the influence of individual independent variables on the dependent variable, multivariate analyses using various regression models are performed in the fifth subchapter. Finally, in the sixth and last part of this chapter robustness checks are performed to investigate how the parameters used for calculating the CARs influence the outcomes of the multivariate regression model.

4.1. Calculating cumulative abnormal returns

To understand whether an announcement of a SaaS offering leads to a positive or a negative reaction in the stock price, I deploy a student's t-test as well as the non-parametric rank test by Corrado (1989) on the mean values of CAR calculated with various input variables. I find that over the whole sample, the mean reaction to the announcement of a SaaS offering is very slightly negative, but not significantly different from zero. By varying the estimation window, the event window, and the comparison index, I confirm that an announcement of a new SaaS offering in itself is perceived neither positively nor negatively. The results of tests performed on the whole sample are summarized in Table 2.

What stands out from the analysis is that none of the variations of the input variables leads to a mean CAR that is significantly different from zero, even at the 10% level. Interestingly however, using an event window that does not include

the trading day after the event somewhat increases the mean value of the CAR. This could be an indication that investors initially react more positively to the announcements of new SaaS offerings and that the following day, on average, sees the share price of the firms' stocks backtrack somewhat.

To look into this further, I calculate the average abnormal returns (AAR) for the event date as well as the trading days immediately before and after the event. Furthermore, I divide the set of 121 non-confounded events into two subsets, one for events with a positive CAR and one for events with a negative CAR. The resulting AARs are summarized in Table 3. Comparing the AARs for each of the three days can help understand the data better, making the choice of an event window more informed.

The summary of the AARs in Table 3 highlights two patterns in the data. Firstly, whenever the cumulative abnormal returns are negative, all three dates receive negative abnormal returns on average. Meanwhile, whenever the CARs are positive, all three dates receive positive abnormal returns on average. Secondly, the AAR of the event date is without exception higher than the AARs of the days before and after the event. Most surprisingly, this also applies to negative events. Merely publishing information regarding a new SaaS offering seems to have a value in itself, almost as if the impact of the information provided would always get overvalued on the day of the announcement. Furthermore, negative events do not get overvalued in relative but absolute terms, meaning that they do not receive overly negative abnormal returns. Instead, their abnormal returns for the event date are overly high compared to that of the days before and after the event. Thus, the overvaluation gets balanced out on the trading days prior and after the event, especially for events with negative CAR. Interestingly, the variance in AARs for events with positive CAR is really small compared to the same variance for events with negative CAR. Because of these observations, it seems even more important to include the anticipation effects as well as a considerable post-event reaction in the calculation of CARs.

4.2. Descriptive statistics and correlation matrix

Next, I look into descriptive statistics of all variables as well as correlations between them, both of which are presented in Table 4. Regarding the descriptive statistics, one thing worth mentioning is that some of the control variables have less observations than the number of events, meaning that their inclusion in regression models reduces the sample size slightly. Because not all companies report R&D expenditures and number of employees in their annual reports, this simply has to be accepted. Fortunately, the sample size is big enough for this not to cause too much of a statistical limitation. Another interesting number is the maximum for R&D-per-sales (proxy for absorptive capacity), which shows a value of 1.009. This seems illogical at first, but looking into the event more precisely reveals that the company in question was growing at a great pace and thus was likely just aggressively investing in R&D. Furthermore, the descriptive statistics of the dependent variable show that the most negative and positive CARs are roughly as far away from zero.

The correlation table shows that the CAR correlates the strongest with the variables "partnering" and "PPE-to-sales". The variable "existing product" seems to be moderately correlated with the CAR, whereas "parallel offering" is only very slightly correlated with the CAR. When it comes to correlations between independent variables, "existing product" and "parallel offering" are highly correlated, with a correlation coefficient of 0.6762. This is not surprising as the combination of new product, no parallel offering, for example, occurs a lot more in the sample than the combination of new product and parallel offering. Because of this, dummies for each combination of these two variables, as represented in Figure 3, will be used to control for any spuriousness caused by the high correlation in robustness checks. Additionally, the number of employees (proxy for firm size) and sales are almost perfectly correlated. This poses no problems as the two variables are not used in the same regression models.

All in all, the correlation table cannot reveal much about the connections between the independent and dependent variables. Thus, I continue by performing univariate analyses that will reveal how different values of selected independent variables change the mean value of the CARs.

4.3. Univariate analysis of the dependent variable

Before diving into multivariate analyses about how the independent variables influence the market's reaction, I will have a look at how some of the independent variables influence the CARs. First, by splitting the sample based on the time of announcement, I find that the mean CAR of announcements in the early years of the studied timeframe is significantly lower than in the later years. Indeed, by splitting the sample in two subsets, I find that before 2006 the mean reaction to the announcements is significantly negative ($p < 0.01$) and after 2006 positive and significantly different from the mean value before 2006 ($p < 0.001$), as seen in Figure 7 and Table 5.

If the sample is split into more than 2 categories based on the time of announcement, it is evident that after a certain time, the influence of time disappears. This is visualized in Figure 8, where the data has been split to four equally long periods. In the first of these periods, the median and mean values of the CAR are significantly lower than in the latter three. Furthermore, after the first period no increase in the mean CAR can be observed. One should note that the sample is split into equally long intervals, not into equally large subsets. There are two important notes

that should be made related to that. First, the graphic seems to suggest that splitting the sample into early and late periods would make the most sense at the end of year 2004. However, statistically the most significant difference between the two subsets can be reached with a cutoff at the end of 2005, mostly due to the increased size of the early subset as compared to a cutoff at the end of 2004. Second, because the categorization of the sample into subsets was made based on time intervals instead of subset sizes, the differences in the

Table 2: Univariate analysis of mean CARs in different periods of time (own illustration).

Estimation window	Event window	N	Index	Mean	SD	Student's t-statistic	Corrado z-statistic
126	[-1,1]	121	S&P500	0.0002	0.0572	0.0412	1.3477
249	[-1,1]	121	S&P500	0.0004	0.0584	0.0729	0.1113
126	[-1,1]	121	NASDAQ	0.0004	0.0570	0.0811	0.3483
126	[-1,0]	121	S&P500	0.0013	0.0453	0.3320	0.4900
126	[0]	155	S&P500	0.0019	0.0286	0.8311	1.5478

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Estimation window has to be devisable with event window size to include every day of the estimation window in the calculation of the Corrado z-statistic. Event window implies the trading days included, relative to the event date. For event window with size 1, events that had confounding events in a 5-day window around the event but none in a 3-day window were added to the sample, thus increasing the sample size to 155. Corrado test statistic calculated for complete event window. One should note that the power of the Corrado test by definition increases as the event window gets smaller.

Table 3: AARs for different days based on various subsets of non-confounded events (own illustration).

Day	All events	Events with negative CAR	Events with positive CAR
N	121	66	55
-1	-0.0020	-0.0136	0.0120
0	0.0033	-0.0061	0.0147
+1	-0.0012	-0.0140	0.0143

Notes: CARs are calculated with a three-day event window, 126-day estimation window and using the S&P500 index. Day refers to the trading day relative to the event date.

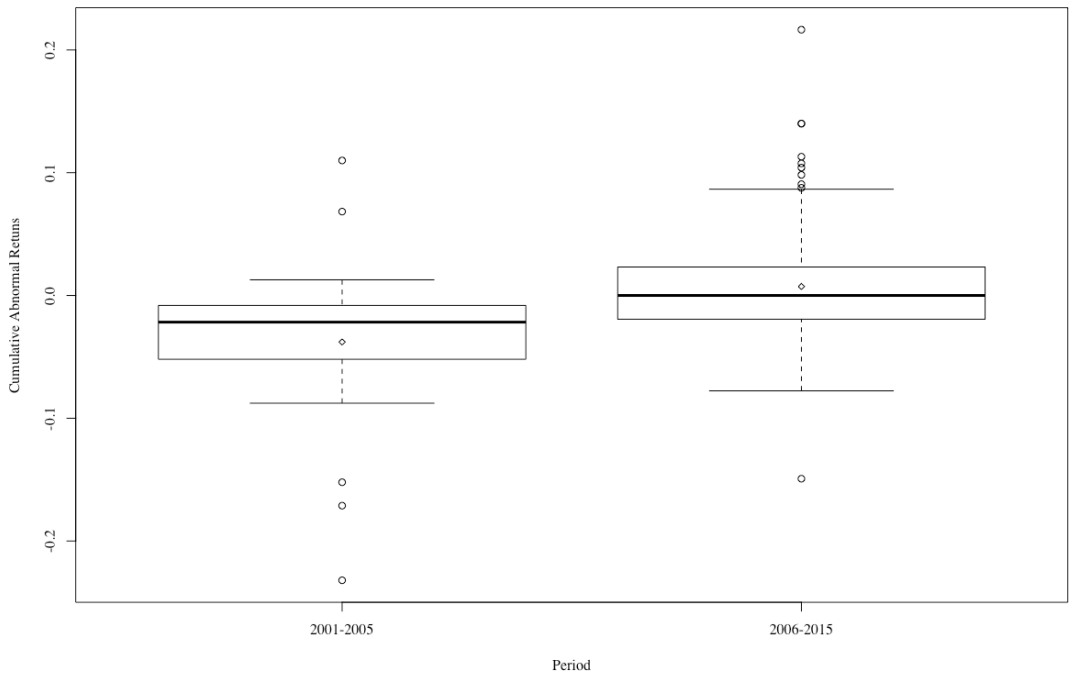

Figure 7: Cumulative abnormal returns before 2006 and from 2006 onwards (own illustration).

variances of the CAR between subsets seem greater than they actually are. Based on the graphic, it would seem that the variance of CARs in the first period is the greatest, but most of the difference between the 25 and 75 percentiles is explained

Table 4: Descriptive statistics and correlation table of variables used in the study (own illustration).

	1 CAR	2 Existing product	3 Parallel offering	4 Partner	5 Early time	6 Employees	7 R&D-to-sales	8 Sales-per-emp.	9 Sales growth	10 PPE-to-sales	11 Sales	12 SaaS before	13 SaaS exp.	14 Delisted
1	1.0000													
2	-0.0482	1.0000												
3	0.0041	0.6762	1.0000											
4	0.1017	0.0472	0.0329	1.0000										
5	-0.0970	0.0651	0.0618	-0.0331	1.0000									
6	0.0217	-0.0912	0.0018	-0.0635	-0.0749	1.0000								
7	-0.0368	0.0341	-0.0382	0.0071	0.1543	-0.3160	1.0000							
8	0.0535	-0.0332	-0.0713	0.0955	0.0187	-0.0493	-0.0169	1.0000						
9	-0.0052	-0.0642	-0.0917	-0.0511	0.0896	-0.1800	0.2310	-0.0286	1.0000					
10	-0.1033	-0.0804	-0.0274	-0.0461	0.1278	0.0547	0.1121	-0.0912	0.0315	1.0000				
11	0.0250	-0.0477	0.0217	-0.0903	-0.0432	0.8974	-0.2983	0.2013	-0.1568	0.0522	1.0000			
12	0.0490	-0.1356	-0.1364	-0.1635	-0.3347	0.1921	-0.1479	0.0098	-0.1518	0.0647	0.1911	1.0000		
13	-0.0055	0.0157	-0.0648	0.1359	-0.1305	-0.1503	-0.1777	0.0207	0.0071	-0.1606	-0.1565	0.1580	1.0000	
14	0.0293	0.1082	0.0951	0.0832	0.0632	-0.0857	0.0334	-0.0406	-0.0533	-0.0006	-0.0878	-0.0632	-0.0622	1.0000
Obs.	359	359	359	359	359	344	338	344	354	354	354	359	344	359
Mean	-0.0002	0.3389	0.2750	0.1333	0.1556	52086.6	0.1421	315.553	13.8467	0.1100	1.45e7	0.7611	0.0012	0.0556
SD	0.0517	0.4740	0.4471	0.3404	0.3629	114110	0.1025	278.234	31.2255	0.0937	3.08e7	0.4270	0.0035	0.2294
Min	-0.2320	0	0	0	0	30	0	24.0329	-55.7300	0.0051	5840	0	0	0
Max	0.2300	1	1	1	1	434246	1.0096	2336.47	340.530	0.8109	18.30e7	1	0.0303	1

by the smaller size of the subset (N = 17) compared to the other three (N = 27;44;33).

The negativity of initial reactions to new SaaS offerings could be explained by category legitimacy and emergence (Alexy and George (2013)). Investors seem to initially punish companies that introduce novel SaaS business models with an illegitimacy discount (Zuckerman (1999)), as it represents something they do not fully understand. Interestingly, Amazon Web Services were launched by Amazon in year 2006, which as an individual event might also have had an influence on the legitimacy of the SaaS business model. On the other hand, it might also be possible that the company was created as a consequence of the increased legitimacy of SaaS. The mean values of cumulative abnormal returns before and after 2006 as well as tests performed on them are summarized in Table 5.

Next, I split the sample in four using the two-by-two presented in Figure 3 to analyze the mean CARs and their differences based on the announcement type. The results of this analysis, as summarized in Table 6, show that there are considerable differences in the mean values for different event types. Although the differences are not statistically significant from each other, this gives initial indication of a correlation between the event type and the market's reaction. More specifically, the best mean reaction seems to be achieved by introducing a SaaS offering for a new product with a parallel perpetual offering and the worst result by not offering a parallel perpetual offering for a SaaS offering that concerns an existing product line. Also, it seems that the variable "existing product" seems to carry more weight than "parallel offering", as the difference in CAR when moving from new products to existing products has a higher volume than the difference when moving from no parallel offerings to parallel offerings. One should also note a limitation caused by the small sample sizes (3 and 13) in two of the four categories (new product, parallel offering and existing product, no parallel offering).

Due to the low number of observations in two of the four event types and the fact that the two underlying variables do not seem to interact[4], I also conduct a univariate analysis for the two variables independently of each other. These analyses are summarized in Tables 7 and 8.

Table 7 confirms that announcements of new SaaS offerings for existing products lead to more negative reactions than announcements where the SaaS offering is announced for a new product line. Here, the mean reaction to an announcement concerning an existing product leads to a 1.6 percent decrease in company value. This value is significantly different from zero on the 5 percent level, although only when measured with the student's t-test, not with the non- parametric Corrado test. This, seems to conflict with the prevalent opinion that the nonparametric Corrado test should perform better on abnormal returns data, because it does not assume a normal distribution of the data (Campbell and Wesley (1993); Corrado (1989)). This pattern will continue to show across the univariate analyses presented in this chapter, and provides a key insight for future event studies. It seems that sometimes the absolute values of abnormal returns are more similar with each other than their relative size as compared to abnormal returns during the estimation window. Additionally, Table 7 shows that an announcement for a new product line on average leads to a 2.2 percent higher increase in company value than that for existing product lines, and that the difference is also significant on the 5 percent level.

The univariate analysis on how the existence of a parallel perpetual offering influences the CARs, as presented in Table 8, indicates that the existence of a parallel perpetual offering leads to a decrease in CARs as compared to no parallel offering. This is surprising, because when looking at the reactions for all four event types, the conclusion was that a parallel offering improves the mean reaction both for new and existing products. The reason for this inconsistency is most probably that only 3 out of the 20 observations of a parallel offering are for new products, for which the mean reactions are significantly better than for existing products. This means that the low average of the 17 observations for existing products weighs down the total average for events where a parallel offering is given. Exactly the opposite happens for observations with no parallel offering. In other words, the correlation between the two independent variables leads to wrong conclusions when looking at them separately. Later on in the multivariate analyses one will indeed notice that the variable parallel offering has exactly the opposite effect on the CARs, meaning that an indication of a parallel offering will improve the investors' reaction to the announcement.

Finally, I perform similar tests for the independent variable that measures partnering with an infrastructure or platform service provider for the delivery of the SaaS offering. I again find a difference in mean values, indicating a connection between the dependent and independent variables. More specifically, the mean value of CARs with partnering is significantly different from 0 and from the mean value of CARs when no partnering exists on the 10 and 5 percent levels, respectively. Interestingly however, the parametric Corrado z-statistic is not significantly different from 0, similarly to the analysis of existing and new product lines. Regardless, indication exists that an announcement of a SaaS offering leads to an increase in the market value of the software vendor if the offering is announced to be delivered in cooperation with a cloud infrastructure or platform provider. The mean values of CAR when partnering and not partnering as well as the tests performed on them are summarized in Table 9.

Because a significant difference in the CARs was observed depending on whether the event took place before 2006 or not, it seems promising to take one further step in the univariate analysis and subset the data to only include events after 2005. Thus, the analyses presented in this chapter are now repeated for the independent variables to see whether

[4]New product vs. existing product seems to always have the same direction independent of the existence of a parallel offering. The same applies to the existence parallel offerings independent of whether the announcement concerns a new or an existing product.

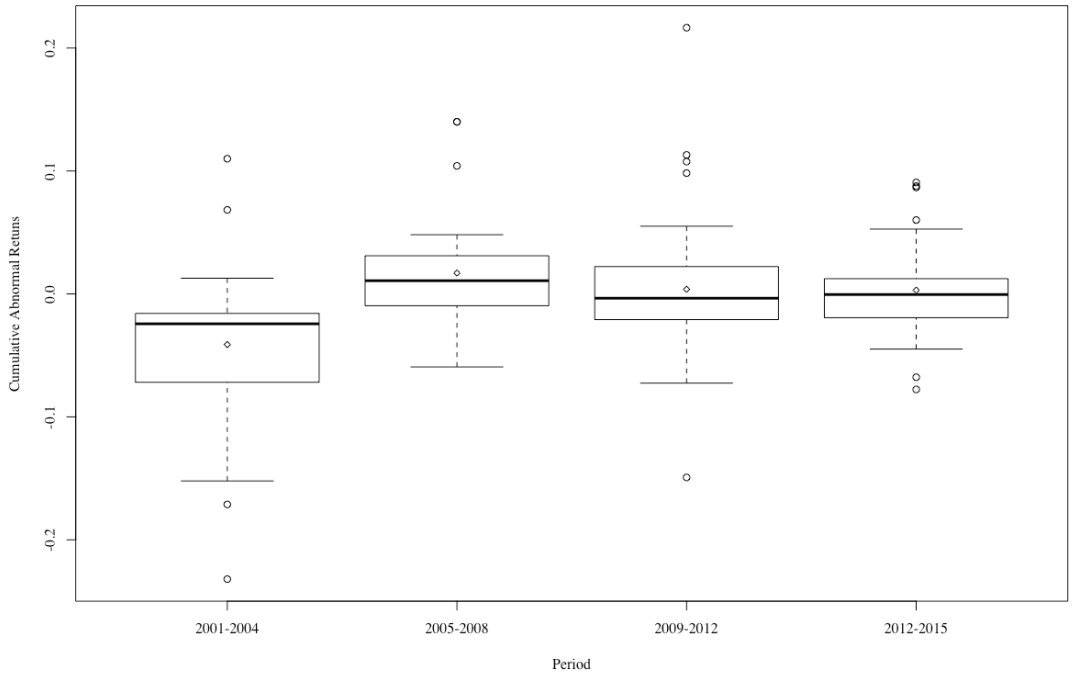

Figure 8: Cumulative abnormal returns over the studied time window split in four equally long periods (own illustration).

Table 5: Univariate analysis of mean CARs in different periods of time (own illustration).

Time period	N	Mean	SD	Difference	Corrado z-statistic
2001 - 2006	19	-0.038†	0.079		-1.808†
2006 - 2015	102	0.007	0.049	0.045**	1.230

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Difference shows the difference in mean value to the row above. Corrado test statistic is calculated using the complete event and estimation windows.

Table 6: Univariate analysis of mean CARs in different event types (own illustration).

Event type	N	Mean	SD	Difference	Corrado z-statistic
New product, no parallel offering	85	0.006	0.062		1.194
New product, parallel offering	3	0.013	0.034	0.006	1.414
Existing product, no parallel offering	13	-0.019	0.044	-0.025	-0.534
Existing product, parallel offering	20	-0.014	0.044	-0.020	-1.299

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Difference shows the difference in mean value to the row above. Corrado test statistic is calculated using the complete event and estimation windows.

Table 7: Univariate analysis of mean CARs for existing and new product lines (own illustration).

Event type	N	Mean	SD	Difference	Corrado z-statistic
Existing product	33	-0.016*	0.043		-1.240
New product	84	0.006	0.061	0.022*	1.393

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Difference shows the difference in mean value to the first row. Corrado test statistic is calculated using the complete event and estimation windows.

Table 8: Univariate analysis of mean CARs when a parallel perpetual offering is or is not implied (own illustration).

Event type	N	Mean	SD	Difference	Corrado z-statistic
No parallel offering	98	0.003	0.060		-0.990
Parallel offering	23	-0.011	0.043	-0.013	-0.804

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Difference shows the difference in mean value to the first row. Corrado test statistic is calculated using the complete event and estimation windows.

Table 9: Univariate analysis of mean CARs with and without a delivery partner (own illustration).

Partnering choice	N	Mean	SD	Difference	Corrado z-statistic
Without partnering	96	-0.005	0.057		-0.007
With partnering	25	0.021†	0.054	0.026*	1.348

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Difference shows the difference in mean to the row above. Corrado test statistic is calculated using the complete event and estimation windows.

it is possible to conclude anything about the mean values of the stock market reaction depending on their values.

4.4. Univariate analysis of the dependent variable after 2006

First, I look at the mean CARs for the different event types. The results of this analysis are presented in Table 10.

Compared to Table 6, which summarized the analysis for the whole sample of events, no radical differences can be found in Table 10. The directions of the differences in CARs between the event types have remained the same and the means across all event types have the same sign (positive or negative). From the tests of statistical significance, it can be noted that with 95% certainty introducing a SaaS offering for new products without a parallel perpetual offering leads to an increase in the market value of the software vendor. Interestingly again, the student's t-test produces a p-value lower than 5 percent, whereas the parametric Corrado test does not even produce a p-value smaller than 10 percent. For events where the product is new and a parallel offering is implied, the Corrado test produces significant results on the 10 percent level. However, the sample size of $N = 2$ does not allow any reliable interpretations.

Next, I look at the two variables that constitute the four event types for the subset of events after 2005, just like I did for all events. The results of the analyses are summarized in Tables 11 and 12.

Table 11 displays results very similar to the ones observed for the whole sample of events in Table 7. The exception is that the mean reaction for an announcement concerning an existing product line has become less negative than it was for the whole sample. Also, the mean value is no longer significantly different from zero on the 10 percent level. At the same time, however, in this analysis the mean value for announcements concerning new products has increased drastically to 0.013 from the previous 0.004. This value is significantly different from zero on the 5 percent level when measured with the student's t-test. Finally, the sample means are different from each other on the 5 percent significance level, just like in the analysis for the whole sample. Overall, it can be concluded that the increased legitimacy of the SaaS model is reflected in the results. Investors seem to punish companies less for introducing SaaS for existing product lines and reward introducing completely new SaaS product lines more. At the same time, though, their relative valuation of introducing SaaS for new products instead of existing products has not changed over time.

From Table 12 one can observe that the mean value of CAR for announcements that imply no parallel offering has increased slightly and reached the 10 percent significance level. Otherwise, there are no notable changes to report compared to the analysis for the full sample of events in Table 8.

Finally, I look at the same analysis for the partnering variable. The results of the analysis are summarized in Table 13. One can observe that, compared to the analysis over the whole sample, the mean values of the CARs for announcements both with and without partnering have increased. As a result, the student's t-statistic for the mean CAR for announcements that imply a partnership is now significant at the 5 percent level. At the same time, however, the significance of the difference between the mean CARs for the two sets of announcements has decreased, which would imply that the importance of partnering for the delivery of a SaaS offering reduces as markets become more familiar with the model.

For added robustness, the univariate analyses were repeated by using the NASDAQ Composite index as the comparison index for calculating the CARs. This led to no notable differences in the results of the univariate analyses. To avoid the limitations of a univariate analysis, multivariate analyses that allow analyzing the simultaneous effects of multiple independent variables on the dependent variable are performed. The results of these analyses represent the main findings of this study and they are presented in the next chapter. For the

Table 10: Univariate analysis of mean CARs in different event types after 2006 (own illustration).

Event type	N	Mean	SD	Difference	Corrado z-statistic
New product, no parallel offering	74	0.012*	0.052		1.433
New product, parallel offering	2	0.031	0.016	0.019	1.811†
Existing product, no parallel offering	12	-0.008	0.020	-0.021	-0.096
Existing product, parallel offering	14	-0.010	0.049	-0.023	-0.467

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Difference shows the difference in mean to the first row. Corrado test statistic is calculated using the complete event and estimation windows.

Table 11: Univariate analysis of mean CARs for existing and new product lines (own illustration).

Event type	N	Mean	SD	Difference	Corrado z-statistic
Existing product	26	-0.009	0.038		-0.388
New product	76	0.013*	0.052	0.022*	1.635

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Difference shows the difference in mean value to the first row. Corrado test statistic is calculated using the complete event and estimation windows.

Table 12: Univariate analysis of mean CARs when a parallel perpetual offering is or is not implied (own illustration).

Event type	N	Mean	SD	Difference	Corrado z-statistic
No parallel offering	86	0.010†	0.050		1.345
Parallel offering	14	-0.005	0.048	-0.015	0.130

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Difference shows the difference in mean value to the first row. Corrado test statistic is calculated using the complete event and estimation windows.

Table 13: Univariate analysis of mean CARs with and without a delivery partner after 2006 (own illustration).

Partnering choice	N	Mean	SD	Difference	Corrado z-statistic
Without partnering	79	0.002	0.047		0.703
With partnering	23	0.024*	0.055	0.022†	1.619

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Difference shows the difference in mean to the row above. Corrado test statistic is calculated using the complete event and estimation windows.

multivariate analyses, robustness checks are performed and reported in chapter 4.6.

4.5. Multivariate analyses

Because a multitude of potentially influential control variables have been identified, I begin with a model that includes all of them to find out which ones are necessary to be included in the final models. The results of this test are presented in Table 14.

The table shows that the combination of all control variables is relatively bad at explaining movements in the dependent variable. In fact, only the control for early time has a statistically significant effect on the CARs. By removing the variables controlling for whether the company has done SaaS before, the company's SaaS experience, and whether the company has been delisted since the announcement, the model fit is increased considerably. The resulting baseline model has explanatory value, meaning that a null hypothesis stating that all coefficients are zero can be rejected with 95 percent confidence. Even though firm size and absorptive capacity are not statistically significant in this model, I include them in the further stages for two reasons. First, I follow the example of previous event studies in the IT industry (Alexy and George (2013); Oh et al. (2006)) to maintain consistency and comparability in the methodology. Second, the theoretical effects of firm size on legitimacy as well as the effects of absorptive capacity on the ability to create new business models and benefit from the subscription model are

Table 14: Initial multivariate regression test to identify necessary control variables (own illustration).

Independent variable	All controls (OLS)	Baseline (OLS)
Early time	-0.054* (0.022)	-0.055** (0.020)
Firm size	-6.30e-8 (1.20e-7)	-7.39e-8 (1.08e-7)
Absorptive capacity (R&D-to-sales ratio)	-0.056 (0.064)	-0.043 (0.061)
SaaS before	-1.79e-4 (0.015)	
SaaS experience / size	0.681 (0.715)	
Delisted	0.008 (0.020)	
Constant	0.015 (0.016)	0.016 (0.010)
Model fit	1.69	3.21*

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). $N = 104$ (reduced due to some companies not reporting their R&D expenses in annual reports). Robust standard errors (clustered by firm) are reported in parentheses. Model fit is the f-statistic resulting from a Wald test with the hypothesis that all coefficients equal to zero.

important and should be controlled for. Furthermore, additional robustness checks show that leaving the two control variables out of the analyzed models has no significant effect on the results.

Next, two models that incorporate the studied independent variables to the baseline model are studied. The first model adds the 3 independent variables on top of the baseline model and performs an OLS regression. As the second model, a two-stage Heckman regression model is employed. In the first stage, the model predicts the existence of confounding events based on firm characteristics, and in the second stage it uses the Inverse Mills ratio extracted from the first stage to model potential bias caused by dropping confounded events from the sample. In both of the models, standard errors are clustered by firm. The coefficients generated by the two models along with those of the baseline model are summarized in Table 15.

The most immediate insight from the results of the two regression models is that the studied three independent variables have significant effects on the CARs. Based on the coefficients, introducing a SaaS offering for an existing product reduces company value as compared to introducing it for a new product. At the same time, providing a parallel perpetual offering and partnering with a cloud platform/infrastructure provider increase company value as opposed to not offering a parallel perpetual offering and not partnering. All of the corresponding regression coefficients are significant at least on the ten percent level in both models. In model 2, all coefficients are even significant on the five percent level. Additionally, the Heckman model also seems to have more explanatory power based on the higher F-statistic value. Furthermore, the test of independent equations for the Heckman model indicates that one can be confident that a two-stage model is justified. Thus, model 2 is selected to represent the main results of this study and the robustness checks will be performed mainly on this model.

Interpreting the coefficients of model 2, one can make three ceteris paribus statements about the influence of the independent variables on the investors' reaction to the introduction of a new SaaS offering. First, the introduction of a SaaS offering for an existing product leads to a drop in company value by 3.5 percent compared to an introduction of a SaaS offering in the form of a new product launch. Second, the notion of a parallel perpetual offering increases company value by 2.2 percent compared to an introduction with no mention of a parallel perpetual offering. Third, implying a partnership with an infrastructure or platform provider leads to an increase of 2.9 percent in company value compared to an announcement with no mention of partnering. Because all of these three coefficients are significant at least on the 5 percent level, the null hypotheses to the three hypotheses presented in chapter 2.3 can be confirmed to have been falsified. The hypotheses and findings of this study are summarized side-by-side in Table 16.

The variables that control for the effects of firm size and absorptive capacity have no statistically significant effect on the dependent variable, just like in the baseline model. However, the control variable for early time has a highly significant, highly negative effect on the CARs. Based on model 2, if the announcement was made before 2006, it led to a ceteris paribus decrease of 4.9 percent in company value compared to if it was made from 2006 onwards.

In addition to the three models presented in Table 15, various other models were ran to measure interaction effects and to ensure robustness of the results. First, the models 1 and 2 were extended with all possible interaction terms and with individual dummies for each of the four different fields of the 2-by-2 of possible strategies presented in Figure 3. However, the interaction terms were not statistically significant or did not have enough observations to allow any conclusions to be based on them. Using dummies for each of the four strategies similarly proved difficult with the low amount of observations. Because the direction of the coefficients was always the same on each side of the 2-by-2, it thus makes sense to

Table 15: Coefficients resulting from multivariate regression models (own illustration).

Independent variable	Baseline (OLS)	Model 1 (OLS)	Model 2 (Heckman)
Early time	-0.055** (0.020)	-0.054** (0.020)	-0.049** (0.018)
Firm size	-7.39e-8 (1.08e-7)	-7.64e-8 (1.23e-7)	3.05e-7 (2.46e-7)
Absorptive capacity (R&D-to-sales ratio)	-0.043 (0.061)	-0.047 (0.051)	-0.047 (0.048)
Existing product		-0.032** (0.010)	-0.035** (0.009)
Parallel offering		0.020† (0.012)	0.022* (0.011)
Partnering		0.029* (0.032)	0.029* (0.013)
Constant	0.016 (0.010)	0.015 (0.011)	0.058** (0.016)
Model fit	3.21*	3.42**	29.07**
F-statistic of independent equations			4.52*

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). $N = 104$ (reduced due to some companies not reporting their R&D expenses in annual reports). Robust standard errors (clustered by firm) are reported in parentheses. Model fit is the f-statistic resulting from a Wald test with the hypothesis that all coefficients equal to zero. F-statistic of independent equations results from a Wald test with the hypothesis that the first and second-stage model of the Heckman model are independent. The Heckman model uses the following variables to predict the absence of confounding events: sales in million USD (negative, significant), sales-per-employee (negative, insignificant), sales growth over past year (positive, insignificant), PPE (property, plants, and equipment)-to-sales ratio (negative, insignificant).

Table 16: Comparison of hypothesized effects and the results of this study (own illustration).

Variable (Hypothesis)	Hypothesized effect	Finding
Existing product line (H1)	-	- (3.5 %)
Parallel perpetual offering (H2)	+	+ (2.2 %)
Partnering (H3)	+	+ (2.9 %)

Notes: The effects are comparison effect to the baseline value; for existing product line the baseline is new product introduction, for parallel perpetual offering the baseline is no parallel perpetual offering and for partnering the baseline is no partnering.

report the results on the aggregate level.

4.6. Robustness checks

Because the event study methodology uses three different parameters for calculating the abnormal returns for each event, it is important to control for the robustness of the results by varying these parameters and repeating the multivariate regression with the resulting values of the dependent variable. Just like in Table 2, where the mean values of the dependent variable were analyzed over the whole sample, I vary the comparison stock index, the event window and the estimation window values and repeat the multivariate regression model 2 (Heckman) with the calculated CARs. Similarly to Table 2 as well, the sample size increases for the models with a smaller event window as the window size for confounding events can be reduced. The different models for robustness checks alongside model 2 are summarized in Table 17.

The robustness checks yield two major points for discussion. First, changing the event window length seems to drastically reduce the explanatory power of the model. Models IV and V barely hold explanatory power, and in neither of the models are any of the coefficients for the independent variables significantly different from zero. However, there is a logical reasoning as to why this is the case. Many of the announcements in the studied sample were made late in the afternoon. Thus, including the trading day after the announcement in the event window is crucial for a comprehensive representation of the market's reaction, as shown in chapter 4.1. The robustness checks display how the hypotheses do not hold if the reaction of the trading day after the announcement is not included. Even though studies have shown that the initial reaction to new information can follow within minutes, the focus of this study lies on the more well- informed reaction to the new information.

Second, changing the comparison index and the estimation window do not significantly change the coefficients. When using the NASDAQ Composite index as the comparison index, the coefficients for the variables "existing product" and "parallel offering" both slightly decrease, whereas the coefficient for the variable partnering increases fractionally. Regarding the significance levels, the significance of the variable parallel offering decreases from 0.047 (5 percent level) to 0.104 (just beyond the 10 percent level). Also, the

Table 17: Coefficients resulting from model 2 with various parameters for calculating CARs (own illustration).

Model	(I)	(II)	(III)	(IV)	(V)
Stock index	S&P500	S&P500	NASDAQ	S&P500	S&P500
Event window	[-1,1]	[-1,1]	[-1,1]	[-1,0]	[0]
Estimation window	126 days	249 days	126 days	126 days	126 days
Uncensored obs.	104	104	104	113	137
Early time	-0.049** (0.018)	-0.046* (0.019)	-0.049* (0.020)	-0.025† (0.014)	-0.009 (0.008)
Firm size	3.1e-7 (2.5e-7)	3.2e-07 (2.8e-7)	2.5e-07 (2.8e-7)	6.0e-08 (1.1e-7)	-4.6e-08 (5.0e-8)
Absorptive capacity	-0.047 (0.048)	-0.047 (0.052)	-0.042 (0.048)	-0.060 (0.043)	-0.013 (0.028)
Existing product	-0.035** (0.009)	-0.033** (0.009)	-0.031** (0.009)	-0.012 (0.010)	-0.008 (0.006)
Parallel offering	0.022* (0.011)	0.024* (0.011)	0.018 (0.011)	0.007 (0.010)	0.011 (0.007)
Partnering	0.029* (0.013)	0.031* (0.013)	0.030* (0.012)	0.016 (0.011)	-0.002 (0.005)
Constant	0.058** (0.016)	0.058** (0.018)	0.052* (0.021)	0.027† (0.015)	-0.011 (0.010)
Model fit	29.07**	28.45**	27.59**	18.48**	3.03
F-statistic of indep. equations	4.52*	3.49†	1.97	1.15	1.56

Notes: † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$ (all tests are two-tailed). Robust standard errors (clustered by firm) are reported in parentheses. Model fit is the f-statistic resulting from a Wald test with the hypothesis that all coefficients equal to zero. F-statistic of independent equations results from a Wald test with the hypothesis that the first and second-stage model of the Heckman model are independent. In models IV and V, the amount of uncensored observations is bigger than in the other models as a smaller window for confounding events can be used due to a shorter event window.

F-statistic value of the Wald test of independent equations (stage 1 and 2 of the Heckman model) drops to 1.97 in this model, meaning that the Heckman selection model is no longer necessarily justified. When using a 249-day estimation window instead of a 126-day window, the only notable change in the significance levels of the model is the reduced significance of the Wald test of independent equations, which drops to the 10 percent significance level.

Generally, the robustness checks increase confidence in the results but they also raise some valid concerns and limitations. On one hand, varying the estimation window does not seem to influence the results, which is a good sign of robustness. On the other hand, changing the comparison index from S&P500 to NASDAQ reduces the overall quality of the results and especially raises doubts on the finding concerning parallel perpetual offerings. The reason we have used S&P500 in this study is because a bigger portion of the studied events are from companies in the NASDAQ Composite index than from companies in the S&P500 index. Besides, and potentially because of that, using the S&P500 index seems to generally lead to more robust results with the data. Additionally, changing the event window length takes away any explanatory value from the model. There is a logical argument for including the trading day after the event in the measurement of the CAR, which I have discussed in chapter 4.1, but the fact that the model does not hold at all, if the day after the event is not included, raises concerns. Previous studies have looked into the stock market reactions on various days relative to an IT outsourcing event in detail (Oh et al. (2006)), and I would propose such an analysis as a form of future research for SaaS business models as well. Due to the increasing number of confounding events when increasing the event window length, this analysis was not possible with the data available to this study and could not fit the scope of the study due to the high workload of extending the sample.

To summarize, all three of the studied hypotheses have been confirmed in this chapter. The robustness of the results was studied, leading to some limitations and propositions for future research. In the next chapter, the results are discussed on a higher level, connecting them to existing research and discussing what the implications are to both theory and practice.

5. Discussion

In this chapter I discuss the implications of the results of this study for theory and practice along with the limitations of this study and my proposals for future research. By studying how stock markets react to software vendors' announcements of new software as a service offerings, this thesis contributes to the academic discourse around the phenomena of servitization. More specifically, it addresses the business model transformation aspect of moving from selling products to provisioning them as a service. The results can progress understanding about what constitutes the servitization paradox and how it can be managed when transforming towards service-oriented business models where a product-service system (PSS) replaces a product. Additionally, the results of this study can help decision makers at companies in and beyond the software industry understand how they should approach the goal of servitization through PSS offerings and how investors are likely to perceive their strategy of transforming the business model.

5.1. Implications for theory

A key part of the academic discourse around services are the challenges related to transforming from a production-oriented firm to a service provider. These arise both in the general conversation about servitization (Baines et al. (2009)) and in the more specific PSS field (Beuren et al. (2013)). So far, academics have generated a well-rounded understanding of what makes the transformation difficult and how servitization as a firm-level phenomenon (measured in percentage of revenues from services) is reflected in firm-level financial metrics (Gebauer et al. (2012)). Likewise, it is by far and large understood that provisioning services entails strategic, financial and marketing benefits to the provider (Baines et al. (2009); Mathieu (2001b); Oliva and Kallenberg (2003)). However, studies have found that the move from selling products to provisioning services decreases firm value and profitability - at least initially (Fang et al. (2008); Suarez et al. (2013)). Due to this, the notion of a servitization paradox (also referred to as service paradox) has been coined by scholars (Gebauer et al. (2005); Neely (2008)).

I argue in this thesis that the challenges of servitization that cause the problems firms face when transforming from selling products to provisioning service have to do with structural inertia (see Hannan and Freeman (1984)), both within and beyond the provider's organization. By looking at how investors, who valuate stocks based on value-creation potential in the long-term, react to software vendors' announcements of new SaaS offerings, I have found indication that inertia does get included in the valuations of investors when companies transform their business model from traditional product sales towards provisioning PSS. Additionally, I have found that companies can manage the inertia by introducing the PSS offering through new product lines and by offering a traditional product sales model to customers in parallel. Thus, the answer to the research question of this thesis is that the transformation strategy and its implications on inertia determine the value-creation potential of a new SaaS offering from the perspective of investors.

The first finding of this study is that, on average, an introduction of a PSS offering neither increases nor decreases company value as perceived by investors. This means that, per default, investors perceive the introduction of a PSS offering as neither value-creating nor as value- destroying. This indicates that, even if servitization has been shown to reduce company profitability and valuations in the short-term (Fang et al. (2008); Neely (2008); Suarez et al. (2013)), investors believe and understand this to be a temporary phenomenon that is caused by inertia related to the transformation process. In other words, investors seem to think that there is nothing inherently wrong with moving towards service provisioning by offering products as a service. Thus, I would go as far as to argue that the servitization paradox is not really a paradox, but that servitization as a form of organizational change simply has to overcome inertia.

This finding can support the argument for transforming towards provisioning products as a service but it does not yet provide guidance that companies could act on when executing the transformation. To that end, I argue in this study that there are differences between strategies for introducing a new PSS offering and that selection of a strategy influences the inertia caused by the new business model and the optimization of resource-utilization in the value chain. More specifically, companies can either provide the PSS model as the sole business model or they can choose to offer a parallel model of traditional product sales. The former option would mean that the company reduces the inertia associated with the transition, as customers are provided a choice and they would not have to change the way in which they acquire products, provided they are used to purchasing the product perpetually. At the same time, the company would be wasting resources as many processes would have to be duplicated to facilitate two inherently different business models for the same product. In the latter option, the company can optimize resource-utilization better, with the cost of additional inertia associated with forcing customers to subscribe to a PSS model. Additionally, companies can either introduce the new PSS offering for existing product lines or by launching completely new product lines. In the former case, the company would have to deal with additional inertia associated with the installed base of customers and them potentially not willing or being able to change the way they acquire the product. However, with the latter option the company would not be able to benefit from the installed base of customers and product-related resources within the existing product line.

By studying the influence of these strategic choices on the reaction of investors, I find that the challenges related to servitization are apprehended by investors and that investors seem to prefer minimizing inertia over optimizing the utilization of resources. The results of my regression analyses show that introductions of SaaS offerings for existing product lines that imply no parallel offering lead to the least firm value increase, whereas introductions of SaaS offerings for new product lines that also imply a parallel perpetual offering lead to the most firm value increase. More specifically, an introduction for a new product line increases firm value by 3.5 % as compared to an existing product line, and implication of a parallel perpetual offering increases company value by 2.2 % as compared to no implication of a parallel offering. This means that, despite the fact that existing product lines can make use of existing resources and an installed base of customers and that parallel business models lead to internal competition and duplication of resources, investors seem to believe that the inertia associated with pushing the organization and its customers to a service-based business model induces too big a challenge.

Two additional interpretations can be made out of these findings. Firstly, the finding on how parallel offerings are preferred by investors over a clear focus on the SaaS model sheds light on the role of PSS as product-replacing services (Cusumano et al. (2015)). The finding can be interpreted in a sense that investors do not believe that product sales should be completely replaced by a service provisioning. Rather, they seem to think that a PSS offering complements a tradi-

tional product sales model. Another, less radical interpretation of the same finding is that investors are unsure about the role of the SaaS model in the future and they believe companies should initially experiment on the model by offering it in parallel to traditional product sales. What speaks for the former interpretation is that I have studied introductions over a 15-year period and controlled for the effects of time and company experience in the SaaS model. Initially, before 2006, the average reaction to the introduction of SaaS offerings was significantly more negative than it was after that point. After controlling for this change in valuations, no indication of a trend of increasing valuation of the SaaS model (over time or by company experience) or an interaction between time and parallel perpetual offerings could be observed in the data. This indicates that the opinion of investors about the role of PSS offerings is not changing. On the other hand, if service-based business models were really not an alternative to traditional product sales at least in some cases, one would have to expect some pure SaaS software firms like Salesforce to introduce traditional license sales models, which has not been the case so far. Since this, at the time of writing this thesis, seems unlikely to happen in the future, investors are more likely uncertain about whether the PSS model can replace traditional product sales. There could also be variables inherent to the product in question that define whether or not a PSS model can create more value than a product sales model. The existence and type of such variables could form an interesting field for future research.

Secondly, the finding on how the firm value is influenced by whether the PSS offering is introduced for a new product line or an existing product line sheds new light on the importance of customer adoption challenges related to servitization. The discussion about the challenges of servitization has so far focused mostly on change within the provider's organization (Baines et al. (2009)), and challenges related to changing the organization of customers have not received the attention they perhaps deserve. For example, taking over processes like hosting and operating the software from customers also means that the customers' organizational structures become redundant. Besides organizational structures and processes, customers might also be cognitively dependent on acquiring the products via a perpetual purchase due to learning effects (Sydow et al. (2009)). The results of this study show a considerable negative effect on the investor reaction to the announcement of a SaaS offering if the offering concerns an existing product as opposed to new products, regardless of whether or not a parallel perpetual offering is provided. As companies do not need to worry about inertia or other inhibitors of change on existing customers' side in the case of new products, this supports the argument that customer side inertia is of high importance in the transformation process and possesses a great threat to value-creation through a PSS offering. On the other hand, as customers become more accustomed to acquiring products as a service, PSS offerings become more important and attractive to providers. Based on this finding, qualitative analysis into how customer path- dependence (Sydow et al. (2009)) can inhibit the introduction of PSS and other new business models represents another interesting direction for future research.

Furthermore, I discuss in this thesis that companies can either work together with external service providers (e.g. platform and infrastructure service providers like AWS, IBM and Google in the software industry) to deliver the PSS offering or they can choose to work alone, and that this choice influences the value-creation potential of the firm. By externalizing certain aspects of the service delivery, the provider can benefit from the economies of scale and innovation capabilities the third party can provide, meaning that resource-utilization is optimized. Additionally, externalizing the delivery of new service capabilities would mean that the provider does not have to transform its organization as much as it would if it were to deliver all the new capabilities internally, leading to less inertia. However, externalizing parts of the service delivery also means that the provider has to take on risks related to being dependent on an external party for the delivery of their product and becoming dependent on the selected provider. The results of this study indicate that the benefits of outsourcing outweigh the potential risks. Investors significantly increase (+2.9 %) their valuation of the provider firm's stock when the firm indicates that the new SaaS offering is delivered in cooperation with a third-party cloud platform and/or infrastructure service provider.

Besides these immediate findings, this study can contribute to literature on category emergence and organizations as open systems. Firstly, theory on categories understands that firms are evaluated by investors based on the category they are perceived to belong to and what is seen as legitimate for firms of that category (Zuckerman (1999)). Alexy and George (2013) have shown that firms, when entering the novel OSS (open source software) model that diverges from what is considered legitimate for their category, can influence the perception of their actions by blurring the boundaries between categories. The results of my study show that software vendors were initially punished with an illegitimacy discount (Zuckerman (1999)) when they introduced SaaS offerings. Thus, I have provided further proof of the illegitimacy discount and shown that investors initially considered the SaaS business model illegitimate for software vendors. Additionally, the results of this study show that the importance of partnering slightly decreases as the SaaS model becomes more legitimate. This result could indicate that in partnering with third party service providers for the delivery of a novel business model, firms possess another strategy for influencing the perceived legitimacy of their actions. Because the evidence provided by this study cannot be considered conclusive on this, further studies into whether and how partnerships can increase the perceived legitimacy of divergent actions are called for.

Secondly, moving towards the PSS model and partnering in its delivery can be interpreted on a high level as an embodiment of organizations interacting more openly with their environments (Scott and Davis (2015), pp. 87–106). The PSS model is arguably different from outsourcing in that

it implies a more fundamentally open interaction between firms. In the SaaS model, which represents the implementation of PSS in the software industry, customer firms are not simply outsourcing their IT systems and operations to a third party, but they interact in a network of actors in close partnerships that combine capabilities for mutual benefit (Lee et al. (2003)). Furthermore, the close partnerships imply that the social perspective to cooperation becomes as important as the economic and strategic perspectives, which is why the PSS model should not be seen as a mere form of outsourcing (Lee et al. (2003)). Because this study has shown that investors believe the SaaS model to create long-term value (as long as the inertia related to the change process is minimized), and that investors value partnerships between the SaaS provider and infrastructure and platform providers, the indication is that a way of more open interaction of firms with their environment is seen to be value-creating.

5.2. Managerial implications

The results of this study can also support the decision making of practitioners in the software industry – potentially even in other industries that are experiencing or will experience a transformation towards PSS offerings in the future. Although it seems fairly clear by now that the SaaS model is here to stay, many traditional software vendors are still struggling with questions like when and how they should bring a SaaS offering to the market. Many are also concerned about how their investors might potentially react to the introduction.

This study finds that investors do not punish companies for introducing a SaaS offering per-se. In fact, the results show that an average announcement (after discounting for initial illegitimacy discount by looking at events after 2005) of a new SaaS offering increases company value provided it is done through the introduction of a new product line. Consequently, companies should seriously consider the SaaS model when developing new product lines. However, it appears difficult to benefit from an installed base of customers for a software product with the SaaS model, meaning that firms are better off developing their SaaS offerings independently of existing product lines, whenever possible. An example of a company that understands the challenges is Dynatrace, who set up a completely independent subsidiary (Dynatrace Ruxit) to develop a line of new products with the SaaS model with a view of re-integrating the subsidiary to the main business later. More information on Dynatrace and other examples of SaaS transformations are provided in Appendix D.

At the same time, investors seem to believe that not all customers of software vendors want to purchase the software in the SaaS model, as the results show that investors clearly favor approaches where the company explicitly offers the software in the perpetual license sales model in parallel to the SaaS model. Thus, companies should, at least temporarily, provide customers with a choice in acquiring the software either through the SaaS or perpetual licensing model.

Finally, the study indicates that investors perceive a benefit in developing software on top of infrastructure and application development platforms such as AWS, IBM or Google, indicating that they are not as worried about dependency on platforms as they are about not benefiting from the optimized use of resources and access to innovation resulting from the partnership. Consequently, companies should pursue cooperation in delivering their SaaS offering to customers.

5.3. Limitations and proposals for future research

As is inherent for event studies, the biggest limitation of this study is that it can only draw on investors' reactions to publicly listed firms' actions. In the software industry in particular, the model of provisioning software as a service was initiated and first mastered by new firms like Salesforce and Workday, who did not have to carry the burden of an established business model. Yet with regards to transforming a business from selling products to provisioning them as a service, publicly listed firms form a representative sample of firms that face the challenges related to the process. Furthermore, I cannot think of an obvious reason as to why the investors of non-listed firms should observe the inertia and benefits associated with transforming towards PSS offerings differently. Nevertheless, future studies into how investors of non-publicly listed firms have valued introductions of PSS models could provide important insights into the phenomenon from a different perspective.

Similarly, a limitation of all event studies is that they draw on subjective perceptions of investors of publicly listed firms. Even though the method draws on a large number of investors' perceptions and as such is statistically objective, Zuckerman (1999) points out that non- conformance to categories as perceived by investors can be seen as illegitimate and punished in valuations. In practice, this means that analysts who decide how a vendor of pre-packaged software should be valued might see SaaS offerings as illegitimate for a pre-packaged software vendor. This could be reflected especially in the investors' valuation of parallel perpetual offerings. Consequently, future empirical analyses that draw on longitudinal financial performance data of firms that have introduced SaaS models with and without parallel perpetual offerings could create important insights.

With regards to the results, it is interesting to observe the strong influence of the length of the event window on the regression models. The shorter the event window, the more random the values of the CARs seem to become. Oh et al. (2006), who previously reported the mean abnormal returns in a similar study did not find as strong variance between the reactions on days 0 and +1 as I did. One reason for the phenomenon could be an increase in algorithmic trading (Hendershott et al. (2009)). Because the variance between the 0 and +1 trading days was especially high for events with a negative overall CAR, it could be possible that investors were surprised by negative media reactions and pressured to reduce their valuations eventually. Regardless, future case studies should pay more attention to event window lengths. Furthermore, the influence of algorithmic trading on the whole method would represent an important field for future research.

This study has explored new ground and opens up many new questions worth exploring and answering through empirical studies. The results indicate that the PSS model would seldom completely replace selling products and that it would rather act as an alternative targeted to customer segments that would otherwise not be interested in purchasing the product altogether. However, it could be insightful to study whether this depends on product characteristics. For example, could the level of standardization or some other product characteristics play a role in whether the product will be provisioned as a service for all customers? So far, no software horizontal has completely moved to the SaaS model, but the level of transition certainly differs between horizontals. For example, CRM (Customer Resource Management) software is largely dominated by the SaaS model today, whereas the market for SCM (Supply Chain Management) SaaS applications is still tiny compared to its pre-packaged counterpart (McGrath and Mahowald (2015)).

Furthermore, I have observed in my data how some companies have temporarily used parallel business models to manage the inertia of the business model transformation. However, the length of the transition period has varied considerably. Adobe Inc. only spent one year between introducing their SaaS offering for the Creative Suite product line and announcing a halt in developing new versions of the perpetual product. In contrast, Autodesk spent 15 years between introducing their first SaaS model for desktop software and halting all perpetual sales of products that are available in the SaaS model. Studying how and why the transition periods differ and comparing transitioned firms to the ones who are still transitioning or not even looking to stop perpetual sales could provide more qualitative insights on the phenomenon, either supporting my empirical findings or questioning them.

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When Family Businesses Sell

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Abstract

Family businesses favor the transition of ownership taking place within the family. However, the internal succession often fails, leading families to sell their businesses. Thus, in this thesis I aim to investigate the reasons of families for selling their businesses. I compare the perspectives of family owners and their potential successors to reveal their motives for selling the business to an external buyer. I put forward the proposition that the feasibility of a sale option is dependent on the potential sale scenario and the possible survival of the business to increase the sale inclination. My research is based on eight individual interviews with family owners and the next generation. Provided that those family businesses do not have specific internal succession thoughts, I exposed six different scenarios that have a positive or negative inclination towards selling the family business. Once the family owner or the next generation has established a sale intention a sale process is triggered. In my thesis I explore the sale terms that influence the negotiations during the sale process. My findings indicate that the survival of the firm has certain significance in the sale process. Families carefully examine the buyer, the acquisition price, and the anticipated durability in order to decide whether they complete a deal or discontinue the sale process with the particular buyer. With the discontinuance of the sale process, the intention to sell is still present, and the businesses reenter the sale process.

Keywords: Family Business, Mergers and Acquisitions, Management Buy-out/in, Succession, Sales Process

1. Introduction

"In the past family owned businesses had nowhere to go except intergenerationally... today there is an opportunity for those family-run businesses to sell" (Gilbert, 1989 as cited in Steen and Welch (2006), p. 290) this statement underlines the relevance of this thesis.

The landscape of businesses in the European Union consists of 60% family businesses (Commission (2009)). Up to 690,000 businesses, which account for 2.8 million jobs, go through the ownership transition every year (European Commission, 2006 as seen in Nordqvist et al. (2013)).

Even though the internal succession is favored by family businesses, the option of selling the firm and exiting the entrepreneurial activities are more common than ever. In the coming ten years every second small and medium sized enterprise (SME) in Germany will face a succession process and will require a new owner. However, the tendency that the offspring will continue the family business is decreasing (Flicke (2014)).

Researchers have focused on the issue of succession in family businesses for a long time. Nevertheless, the reasons for why family businesses decide to sell their firms and the valuation approach of the businesses are scarcely researched and have only gotten minor attention by scholars. However, the urgency of addressing this topic is increasing since a generation of baby boomers will retire without having an internal family successor in place (Gleason et al. (2011)). The economy will face a wave of succession in family firms, causing the need for an understanding of what conditions induce families to sell their businesses (Flicke (2014)). For most family businesses, the question of exiting the firm will be an event that does not occur frequently in the tenure of the generation in charge. Therefore, this thesis gives an explanation from the family businesses' environment. Within the scope of this thesis, the situation of families in the sale process and their decision-making will be examined in order to close the existing gap in the literature and in order to support those families in understanding and evaluating the circumstances that continually lead to sales decisions. An understanding of the different motivation factors involved in the decision-making of family business shareholders to sell their business or allow a management buyout (MBO) or management buy-in (MBI) is inevitable for reaching full comprehension of why family business ownership transfers.

The thesis will address the following research questions:

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When do family businesses sell to an external party via a management buyout/ buy-in or a merger and acquisition? How do families value their businesses?

2. Literature Review

2.1. Family Business and External Succession

Scholars have paid a lot of attention to the topic of succession in family businesses (Yu et al. (2012)). In particular Chua et al. (2003) found that most of the articles in the academic family business literature, nearly 19.5%, are concerned with succession. The topic of succession is eligible since surveys revealed that "80% of all business owners expect to transfer their companies to a key employee or family member when they retire" (Knott and McGrath (2004) as cited in DeTienne and Cardon (2012), p. 354). However, it is widely proven in the family business literature that intergenerational transitions succeed only in approximately 30% of the cases when looking at the transition from the first to the second generation (Beckhard and Dyer Jr (1983); Birley (1986); DeTienne and Cardon (2012); de Vries (1993); Lee et al. (2003); Wiklund et al. (2013)). Even less intergenerational transitions succeed in the second and third generation of the family business (de Vries (1993); Morris and Williams (1997); Niedermeyer et al. (2010); Wennberg et al. (2011)). Therefore, the relevance of external succession in family businesses is high. The topic of external succession and the reasons for selling the family business are however only scarcely researched and have not gotten much attention in the family business literature.

In order to understand what induces family owners to sell their business, it is necessary to penetrate the current research on family businesses and the external succession undertaken by scholars in recent years. In a first step, family businesses and their idiosyncrasies will be defined to create a common ground of understanding for the further analysis. A second step of the literature review will deal with the definition of external succession, which will be followed by narrowing down the different routes available to sell the business.

2.1.1. Family Businesses and their Idiosyncrasies

There are a lot of varying definitions concerning family businesses in the appendant literature. For this thesis I have chosen to make use of the definition by Carney (2005, p. 199) who define the family business as "an enterprise in which the family is involved in the ownership and management of the firm and the owning family desires transgenerational control". This definition allows me to consider different kinds of family businesses, which are in different stages with regard to maturity and the potential selling process. Other definitions require a family member to be a chief executive officer (CEO) and narrow the family business down to at least two generations in which the family is in control and has a minimum of five percent of the voting rights (Colli et al. (2003) as cited in Carney (2005)). Since these definitions limit the potential interviewees for the qualitative research part and reduces the management and ownership compositions, I focus on the first definition by Chrisman et al. (2012). Nevertheless, it is important to mention other definitions of family businesses stated in the literature as most of them consider the aspects of family ownership and control as well as the involvement of the family in the business and "the expectation, or realization, of family succession" (Carney (2005), p. 251).

In order to understand the reasons of family businesses for selling their firm, it is important to explain what differentiates a family business from other businesses. In a family business "the business is embedded in the family and [...] family and business are intertwined" (Wiklund et al. (2013), p. 1320). Furthermore, a family business is seen as having a long-term orientation (Miller & Le Breton-Miller, 2005 as cited in Wennberg et al. (2011)) and tends to avoid risk taking more than other firms (Zellweger (2007)). The literature on family businesses has further revealed that family businesses have a willingness to forgo an optimal capital structure (Burkart et al. (2003) as seen in Wennberg et al. (2011)) when in return the ownership structure maximizes the probability of retaining the control rights in the long run (Mishra and McConaughy (1999) as seen in Wennberg et al. (2011)). Hence, the above-stated factors contrast family businesses in relation to other firms. These main differences can be traced to the pivotal role family members exert in every layer of the family business (Davis and Harveston, 1998; Chua, Chrisman and Sharma, 1999 as seen in Ucbasaran et al. (2001)).

2.1.2. External Succession in Family Businesses

For this thesis, I adopt the definition of internal and external transition options in a family business by Wennberg et al. (2011). An internal transfer, meaning an intra-family transfer of ownership, is "occurring when one or several members in the nuclear or immediate family leave the ownership of the family firm in the hands of a successor (spouse or children)", whereas an external transfer of ownership "occurs when non-family members take over the ownership" (Wennberg et al. (2011), p. 4). The scope of the external succession in this thesis relies on actual ownership transition to a nonfamily member and not just the changing management. Whether the family business changes its ownership internally or externally is under the influence of the owner-family's structure, the relationships within the family and the involvement of the family (Wiklund et al. (2013)). Lee et al. (2003) argue that the idiosyncrasies of a family business are highly related to the decision of internal succession. The researchers found that with high idiosyncrasies internal succession is much more likely unless the qualifications of the inheritor are insufficient so that it could threaten the family businesses' survival. Regardless of the internal or external process, the succession proposes a difficult challenge for the outlook of the family business (Lansberg (1999) as cited in Howorth et al. (2007)).

Researchers discovered that firms which transition externally tend to have an increased performance in terms of sales

growth when compared to businesses with intra-family transitions. These findings also have held true over a long period of observation (Wennberg et al. (2011)). However, firms that are transferred within the family have a higher survival rate than externally transitioned firms (Wennberg et al. (2011)). These findings call for more information on exit routes and the reasons families have for exiting their firms.

2.2. Exit Reasons and Options in Family Businesses

Family businesses favor the succession within the family (DeTienne and Chirico (2013); Kuratko (1993) as seen in Parker (2016); Wiklund et al. (2013)), however, exiting the business cannot be considered a failure and is rather a choice for the family in order to harvest what they have built (DeTienne (2010); Mickelson and Worley (2003); Steen and Welch (2006); Wennberg et al. (2011); Wiklund et al. (2013)). Thus, the exit of the family business can be seen as "a wise entrepreneurial decision or even a sign of success" (Akhter et al. (2016), p. 374). This section of the literature review will discuss the reasons why families exit their firms and will explain the different exit options in a second step.

2.2.1. Exit Reasons in Family Businesses

De Massis et al. (2008) have researched the factors that prevent families from handing over their business to the next generation. The scholars discovered that "factors that play a role in the succession process are not necessarily factors that prevent succession from taking place" (De Massis et al. (2008), p. 185). An advanced focus on the factors that prevent succession revealed that there are three scenarios in which succession will fail. The first scenario discusses the problem of all potential successors not being willing to take over the business (De Massis et al. (2008)). Parker (2016) calls this dilemma the "willing successor problem" (p. 1243). He argues that parents are able to invest further resources in form of tangible and intangible capital and effort in order to reduce the attractiveness for the successor to sell the firm and increase the choice of enduring the family business (Parker (2016)). The second cause that could hamper a succession from proceeding occurs when the incumbent family members reject the offsprings as potential successors. Lastly, De Massis et al. (2008) establish a situation in which the ones in charge of the family business decide against family succession. Along with these scenarios, the scholars identified five antecedent factors that prevent family succession: contextual, individual, relational, financial and process factors. Due to the limited scope of this paper, the latter factors cannot be explained here. Instead, a detailed overview of the model by De Massis et al. (2008) will be provided in figure 4 and Table 9 in the appendix.

Salvato et al. (2010) argue that exiting the family business is not solely caused by the internal family factors discussed above, but rather influenced by external factors like changing business environment or industry crises.

Additionally, there are typical exit reasons in firms which are not limited to family businesses. A need for liquidity, reaching the retirement stage or even boredom, burnout and age or health issues as well as the death of the founder are among these reasons (Akhter et al. (2016); DeTienne (2010); Meier and Schier (2014); Mickelson and Worley (2003)). Graebner and Eisenhardt (2004) discovered personal reasons of managers for selling the business, including factors like the fear of failing as a manager, the high stress and the risk of dilution, which means that they exchange their current financial position for a higher one in the future for possible financial gain. However, these findings are not limited to family businesses and it needs to be researched in more detail whether those reasons can be extended to family firms as well. Nevertheless, the findings are important as they reveal personal factors that influence the exit decisions in businesses (Graebner and Eisenhardt (2004)).

2.2.2. Exit Options for Family Businesses

When a family has decided to exit their business there are different exit routes that could be feasible options for the family. These options possess different degrees of reward, risk, complexity and different levels of engagement by the family after the exit (DeTienne and Cardon (2012)). Among the exit options are initial public offering (IPO), discontinuing the business by liquidation or variations of selling the business.

Selling the business can take place in form of a family buyout (FBO), in which another family member takes over the business, a management buyout (MBO), in which the current employees buy the company, or in the form of a management buy-in (MBI), in which external individuals purchase the business. A last potential option of selling the business is a merger or acquisition (M&A) by another business (e.g., Akhter et al. (2016); DeTienne and Cardon (2012); Kammerlander (2016); Scholes et al. (2007)).

The focus of this thesis is on the sale to an external party, therefore, MBO/I and M&A will be will be in the foreground of the following two chapters. The exit route of an IPO constitutes an external transition as well. Nonetheless, it is not seizable for most firms, especially in the landscape of small firms. The most common exit option for small and medium-sized enterprises is the sale in form of an MBO/I or an acquisition (DeTienne (2010); DeTienne and Chirico (2013)).

2.2.3. Management Buyout and Buy-ins in Family Businesses

Howorth et al. (2004) define MBOs as the "purchase of the firm by a group of normally four to six senior managers who are already employed in the business, typically using their own funds plus external private equity and bank loan" and MBIs as the "purchase of the firm by external entrepreneurs, with funding from the same sources as for MBOs" (p. 511).

The largest group of MBO/Is comprise family businesses with incumbent managers taking over the firm from the family (Howorth et al. (2016)). "MBOs of privately held family firms involve a switch from concentrated family ownership to concentrated non-family ownership" (Chrisman et al. (2012), p. 198), however, MBOs do not necessarily decrease

agency costs when the target is a family business (Chrisman et al. (2012)). Before the MBO/I is established the ownership and management of the firms are often combined so that agency cost issues in a traditional sense do not apply (Howorth et al. (2004)) . Selling the family business in form of an MBO/I is a common option, constitutes an evolutionary process (Chrisman et al. (2012)) and is seen as a step towards professionalization (Howorth et al. (2007); Gilligan and Wright (2010) as seen in Howorth et al. (2016)). Hence, the informal methods are reduced and formalization will increase in the family business after the MBO/I is completed, especially when a private equity (PE) investor is participating (Howorth et al. (2016)).

The exit route through MBO/Is is a possibility for family businesses to "maintain [their] independent ownership and sustain the notion of 'familiness' over time" and to sustain "ethos and identity" (Howorth et al. (2007), p. 1). It also ensures the "continuity of the firm"(Howorth et al. (2004), p. 510) . Simultaneously, the business can often advance the growth opportunities and its operational efficiency (Scholes et al. (2009)).

Howorth et al. (2004) mention missing successor, missing experience of the successor, missing intention of transgenerational transition of the firm by the incumbent managers and the breakdown of the relationship between the management and the family as potential reasons for choosing the MBO/I route to sell a business.

2.2.4. Mergers & Acquisitions in Family Businesses

The activity of M&A in family businesses can either be of defensive or offensive nature. A defensive M&A process can be an "effective exit strategy" (Mickelson and Worley (2003), p. 251), on the other hand, an offensive exit strategy can increase the firm's value and create a competitive advantage while also meeting the demands of stakeholder (Mickelson and Worley (2003)). The families' values and culture can have a significant influence, negatively as well as positively, on the transaction, but when the top managements of the businesses do not work well together the M&A process is likely to fail (Mickelson and Worley (2003)). Additionally, it is known in the literature that approximately 70% of all M&A transactions are categorized as a failure (Cartwright & Cooper, 1995; Fairfield (1992) as seen in Mickelson and Worley (2003)). However, some merger motives arise out of the desire to achieve financial, operational and managerial synergies as well as a desire to increase the market power (Trautwein (1990)).

According to Caprio et al. (2011) family ownership decreases the likelihood of being acquired from an outside party, nonetheless, the acceptance of the firm being acquired increases when the shares in the hands of the family are below 20%.

2.3. Valuation in Family Businesses

If a family decides to sell the family business, a valuation of the firm needs to be established by the buyer and the seller. The valuation is "a procedure to determine the price to be paid for the acquisition" (Granata and Chirico (2010), p. 341). From a general standpoint of firm valuation there are several options including discounted cash flow methods (DCF), income statement- based methods like multiple valuation, as well as seldomly used balance sheet and goodwill-based methods (Fernández and Fernández (2002) as seen in Granata and Chirico (2010)). These valuation methods often obtain different values in absolute terms (Kammerlander (2016)).

Acquirers presume family businesses as less professional and lacking efficiency by virtue of the decision-making procedures which are guided by emotions instead of economic- rationality (Gómez-Mejía et al. (2007), as seen in Granata and Chirico (2010)). Thus, acquirers ask for a discount on the acquisition price when the target is a family business in contrast to a non- family business. Even though some of the value in family businesses does not only originate from the business activities but rather from the family itself and relevant research findings proof that family businesses tend to perform better than non-family businesses, the acquirers tend to focus on family businesses' negative aspects and undervalue them (Granata and Chirico (2010)).

From the family businesses' perspective, "owner-managers are willing to provide substantial discounts to their successors" depending on different factors, including the "perceived firm performance, managerial tenure within the firm, and the relationship ('familiarity' or 'closeness') between the owner-manager and the successor" (Kammerlander (2016), p. 205). Furthermore, Kammerlander (2016) ascertains a negative effect of the business size on the transaction price in relation to its real value based on the scarce potential successor who can finance the takeover transaction. Therefore, giving a discount, averagely 30%, on the transaction price could enforce successors to take over the firm.

2.4. Implications on Selling the Family Business

Selling the family business is a decision that requires a lot of preparation and thought on the family side about whether or not to give away its legacy to an external party. However, the sale to an external party can be the right choice to preserve financial and socio-emotional wealth for the family (Wennberg et al. (2011)). Motivations to sell the business stem from business reasons like shrinking markets and constant downturns as well as from liquidity issues and family related reasons including conflicts among the members and asymmetric altruism. Additional motivations arise from personal reasons related to age, other potential personal difficulties as well as the need for leisure time and the lack of a willing successor (Graebner and Eisenhardt (2004); Niedermeyer et al. (2010)). The decision to sell and harvest the wealth for the family increases in probability when family members see themselves more distanced from the founder in terms of generations between them (Salvato et al. (2010)). Nevertheless, in situations where strategic problems are not in place, owners are much more reluctant to sell their busi-

ness and even neglect attractive bid offers (Graebner and Eisenhardt (2004)).

Families choose the above mentioned exit routes to reinvest in other possible activities (DeTienne and Chirico (2013)). Additionally, families do not necessarily exit the whole business but rather sell or liquidate some of their portfolio companies or certain business activities within the scope of the family business and use the generated gain to support other investment options which can also be outside the family (DeTienne and Chirico (2013)). Family businesses are scarcely confronted with the sales decision and once the path is chosen a lack in deal knowledge regularly leads to dissatisfaction and conflicts within the family and within the business (Niedermeyer et al. (2010)).

3. Methodology

I followed a qualitative research approach within the scope of this thesis. Qualitative research allows for first-hand accounts of the families and facilitates the questions of when, why, how and to whom family businesses sell. A further argument for why I followed a qualitative research approach is that interviews reveal important insights into the sensitive evidence concerning the issues of external succession and selling the family business which cannot be achieved to that extent by quantitative methods. The qualitative method makes it possible to reveal processes which have not been examined in detail before.

3.1. Interview Gathering

I carried out eight individual face to face interviews. Six of the interviews were conducted in person and two via Skype. Four of the interviews were given by family owners in charge of the business, the remaining four interviews were conducted with the next generation in line for succession. The two different groups of interviewees enable an approach of the sales question from different angles. The interviewees age of the next generation is between 20 and 28 and all four of them have a background in business or engineering. I chose to include the next generation as potential company owners, to collect a different stream of information as the offsprings need to decide whether they take over the family business or sell the business later on in the process.

The interviews lasted between 25 and 80 minutes with an average length of 55 minutes and were audio recorded. Seven of the eight interviews were held in German, the remaining one was held in English. I translated the useful parts of the seven interviews from German to English.

The family businesses were chosen based on different criteria. Firstly, the definition of a family business stated above had to be met in order to fit into the interview. Secondly, I approached firms on a broad scale to find firms in different industries, sizes and stages of maturity to include different perspectives. I addressed approximately 20 firms by first calling the responsible person or an assistant and afterwards sending an e-mail with a detailed description of my research project. From these 20 firms around 50% had interest in giving an interview. Nevertheless, scheduling an interview with one of the firms in the short list was not possible in the working time. Another firm did not meet the criteria of a family business and had to be excluded. Thus, I gathered a total of eight firms for interviews that I conducted in a timeframe of six weeks. One interview was conducted with the owner of the business, who has succeeded his father recently. Three of the families with whom interviews were held had a sale history. All companies have business operations and headquarters all over Germany and two of the companies are located in Italy (Trucks/Grass). Table 1 shows a description of the interviewed family businesses. The companies were promised an anonymous treatment of the interviews which is why the following table does not state company names, but only the companies' economic sectors and a pseudonym.

3.2. Questionnaire

I used a semi-structured type of interview, with 33 preformulated open questions that did not have to be adhered to. Semi-structured interviews enable new questions to emerge during the interview and are a feasible option for guiding the interviews without constraining the course of interaction. Since the family businesses were in different stadiums and had different histories concerning succession and the sale of the business or parts of it, the interviews were all unique and led to different argumentations and perspectives on the interview questions.

Hence, the questionnaire was not applied similarly in each interview and was fitted to the interviewee's situation and the progression of the answers. However, the questions followed a specific pattern. The beginning of the interview was accompanied by questions related to the family business, its history and development up to this point. The reason for integrating this part was to create an atmosphere of trust between the interviewee and me and to gather important information on the company like the generation the business is in, succession thoughts, plans and the nature of its operations as well as information about family values and industry specifics. Secondly, the middle part of the interview dealt with scenarios and questions concerning sales and sales processes. I focused on the questions: Would you consider selling your firm (whole or parts)? Why? And eight different scenarios that pictured the interviewee in a difficult stage where the question was: Under which circumstances would you be willing to sell your business/ hold on to the business? These questions were universally applicable to every family business owner and the next generation and were used in every interview except when the family owner had already stated possible options in which a sale could be feasible or in which a sale was already accomplished in the past. Thirdly, questions about the valuation of the company and trade-off questions were asked to shed light on the decisions by family business owners when a discount on the price would be granted. Furthermore, non-financial reasons for selling the firm and what criteria the buyer needs to fulfil in order to be considered to sell the firm were part of the questionnaire.

Table 1: Description of the Family Businesses Interviewed, Source: Own findings based on interviews

Industry	sports/ fitness	publisher/ media	botanic/ garden	shopping centers	truck parts supplier	facades	seasonings distributor	engineering
Age of firm (years)	23	90	33	150	27	66	97	45
Turnover (€ , million)	<1	>20	<1	n.a.	<20	>4	n.a.	>13
Employees	>20	>200	>30	260	>40	>60	>100	>130
Ownership	100% family-owner	100% across family members	100% family-owner	100% across family members	100% spouses	100% family-owner	100% split between father and son	20% family-owner, 80% inactive partner
Generation	second	third	second	fifth	first	second	fourth	second
Position of Interviewee	owner-manager	owner-manager	next generation	next generation	next generation	next generation	owner-manager	owner-manager

Lastly, optional questions were asked in case the family had sold its business or parts of it. The focus were on the reasons for selling the business or parts of it and what thoughts and considerations were made by the family during that particular sale. The interview ended with the possibility for interviewees to forward questions they believed might be interesting to ask other family businesses in order to profit from a different perspective. The reasons for including this particular ending was to enable the family members to open up and reveal further thoughts on selling their business that I had not focused on and abstract information from the concerns of the families regarding the topic of selling the business. Figure 1 illustrates some questions used in the eight interviews and their purpose.

3.3. Analysis of Interviews

After I had gathered the data in form of eight interviews, I started to organize the information. Table 2 shows the sales history as well as the succession and sales intention of the interviewees' firms.

I followed the coding approach for qualitative research as introduced in Myers (2013) and Flick (2014). In addition to this, I used NVivo, a qualitative data analysis software, in order to plot the different information received from the interviewed persons. I started to analyze the interviews by open coding and summarizing parts of the text by succinct codes. These codes were used to identify, name and categorize phenomena. I coded aspects that are unusual or striking in the context of the sales question or succession intention as well as buyer criteria and different sale terms. Table 3 lists the codes, their definition and total number of occurrences throughout all eight interviews.

Guided by my questionnaire, I chose these codes as they focus on issues and phenomena of the sale intention and what role the interviewees play in the process as well as how they interact under certain circumstances. The sales scenarios provide explanations and reasons for why sales may take place and the surrounding circumstantial codes add to the aspects of the phenomena addressed. The structure makes it possible to compare similarities and differences between the codes and the perspectives of the interviewees. I aim for analyzing the connection between the different codes and their influences on sale intentions and the sale process.

4. Results

After having analyzed the eight interviews with the family business owners and the next generation, the research question when family businesses sell? can be answered. In the following chapters I will establish different propositions and provide models that can explain in what situations families decide to sell their firms. Figure 2 illustrates the process of the sale of a family business, on which I will elaborate throughout this chapter.

4.1. Succession Decisions as Driver of Sale Intentions

The family business owners, who are in charge of the business, favor an internal succession to keep the business within the family.

> Proposition 1: When confronted with the question of succession, family businesses develop sales intentions only when internal succession is not secured. Otherwise, selling the business is not an option.

The business Media has already established concrete succession plans and, therefore, during the interview, the family business owner made it very clear that "this is one of the reasons why I do not think about selling the business". The family business Media is the only firm in the interviewed set of companies that has a clear succession plan, in form of the succession of the nephew, who is already involved in the business. All other seven firms do not have a particular route of succession and either lack a willing successor or the successor has not yet specifically decided on continuing the business. The family business Spices has just realized the succession and the owner is not yet in the situation of thinking about succession. Nevertheless, the current owner states that even when they received a takeover offer, the father actively turned it down. He points out that the prospective buyers "wanted to buy us because they noticed that we are a challenge. My father did not want to sell because he knew that I would join as a successor". In contrast, Fitness, a business without successor, that is currently thinking about selling, states that "[the business] will continue until I say it is empty. . . over". Further, he acknowledges: "If I were given the chance I would sell it; otherwise I need to close down". The same holds true for the opinion of the next generation. A paradigmatic statement by the next generation of Trucks shows the importance of internal succession on sales intentions: "If I would go back to Italy in maximum five years, then yes, we would continue [the business] otherwise we would need to sit together and say ok, maybe it is better to sell the business" (next generation, Trucks). Moreover, the potential successor explains: "my parents are relatively young. . . but they start to lose desire [to continue the business] and they say if we [my brothers and me] carry on together they will continue the business; otherwise, we would sell the firm" (next generation, Trucks). Tubes, a business that has a potential successor in place but without a fixed succession plan, describes the situation as follows: "if he [the successor], after finishing his studies, would say that he wants to do something else for five years or join the firm directly and we would continue five years that could be a feasible option. The name is obtained, and if I exit and an internal successor is available, like with my father and me, it is a potential option. He has to decide. I would not pressure him. He would need to live with the same situation I do. . . He would not be the majority shareholder" (family owner, Tubes). If his son would not like the stated option, the family owner mentions that he would advise him against taking over the family business. If his son

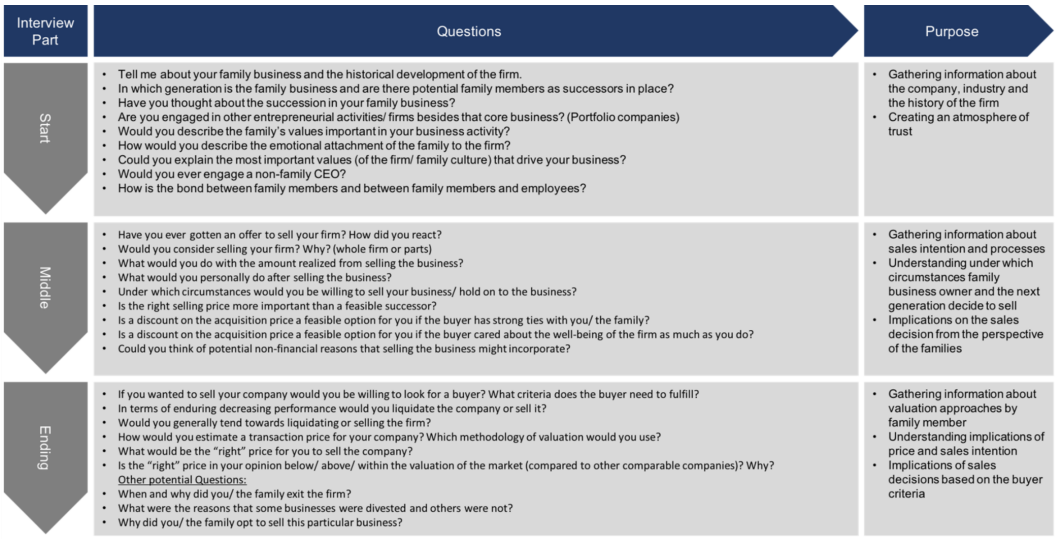

Figure 1: Questions, Purpose and Setup of the Interview; Source: Own illustration based on questionnaire used during the interviews

Table 2: Description of the Sale History, Succession and Sale Intention, Source: Own findings based on interviews

Family Business	Succession Intention	Sale History	Sale Intention
Fitness	No successor in place	Taken over the business from another family	Present
Media	Nephew as successor	Sold some parts of its business externally and bought other businesses	No intention
Grass	No willing successor	No sale history	Prospectively
Fashion	No willing successor	Taken over another family business	No intention
Trucks	No willing successor	No sale history	Prospectively
Windows	Unsure takeover thoughts by potential successor	No sale history	Prospectively
Spices	Succession has just taken place	No sale history	No intention
Tubes	Willing successor	No sale history	Prospectively

should decide against taking over the business, an MBO with current employees or the continuation of the business with an external CEO, without transferring ownership, are feasible options. The owner of Tubes further acknowledges that a "third option would be to sell the business".

Only the interviewed next generation of Fashion is reserved when it comes to the topic of selling the business even though he will not take over the firm as an actively involved manager and there are no succession or external takeover plans in place. Along these lines, he states: "I would probably not sell it. It is a family business and I am sure that it would not run that well when it is not a family owned business anymore... The alternative would be that [the family] maintains ownership and you have a really feasible external CEO" (next generation, Fashion). Thus, he would take over the ownership in form of an internal succession but without involvement in the operating business. Involving an outside CEO is also a potential option for Spices to cope with the question of succession when internal succession fails. The next generation of Grass and Windows could potentially continue the ownership and management of the firms. However, both do not have an actual intention to do so at the moment, and they both see selling the business as a potential option should they ultimately decide to turn down their commitment to the firm.

Hence, I come to the conclusion that family businesses facing a succession decision without an internal successor are likely to perceive selling the business as a feasible option. The conclusion supports proposition 1 and the finding also holds when comparing the decisions of the generation in charge of the business and the next generation. Both groups view selling the business as a considerable option when there are no internal succession plans. However, when an internal succession is a realistic option, the sales intention for family owners and the next generation decreases.

Table 3: Codes Used for Analyzing Interviews, Source: Own findings based on NVivo coding

Codes	Definitions	References
Attitude	Interviewees' attitude to certain topics	125
Buyer criteria	Different potentially accepted buyers	39
Family values	Values and attachments to the firm	17
Involvement after selling	Interviewees' opinion towards time after leaving the business	9
Liquidation	Under which circumstances a liquidation is possible or not	7
Memorable quotes	Striking and fascinating statements (cross sectional)	53
Non-family CEO	Thoughts about existing or potential external CEOs	12
Offer to sell the firm	Specific offer to sell the firm	12
Price	Price intentions and discounts	18
Sale history	Explanation of past sales	18
Sale intention	General thoughts about selling the business	28
Sales scenario	Under which circumstances interviewees' favors/ refuses selling	64
Succession decision	Plans and thoughts about succession	16
Valuation approach	Valuation techniques and specific company valuations	15

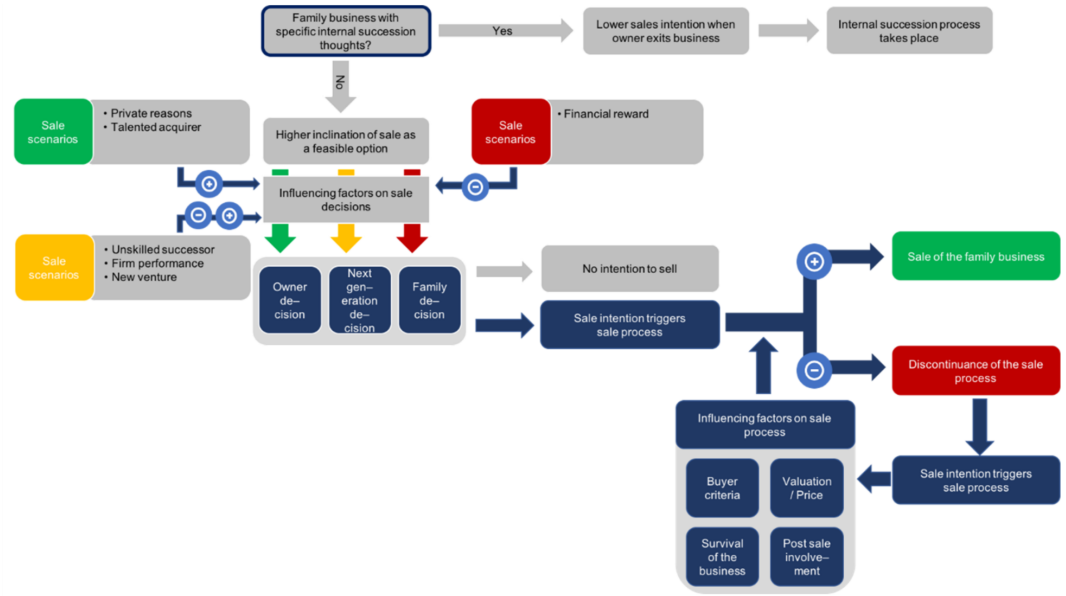

Figure 2: When Family Businesses Sell – A Process Model; Source: Own illustration based on key findings when family businesses sell

4.2. Sales Scenarios as Influencing Factors on Sales Decisions

Different types of sales scenarios lead to contrasting considerations of family owners and the next generation concerning the possibility of a deal. The types of scenarios I discussed with the interviewees and their consideration towards selling the business due to the scenarios are shown in Table 4.

The different sales scenarios and the considerations of family business owners and the next generation encourage the next proposition towards when family businesses sell.

> Proposition 2: The feasibility of a sales option is dependent on the potential sales scenario and the possibility of survival of the business. Family owner and the next generation consider sales scenarios individually and decide whether selling the firm is a potential option.

Table 4: Sales Scenarios and the Sales Possibility Stated by Interviewees, Source: Own illustration based on interviews

	Fashion	Fitness	Grass	Media	Spices	Trucks	Tubes	Windows
Private reasons	Yes	Yes	Yes	N.a.	Yes	Yes	Yes	Yes
Unskilled successor	Yes	Yes	Yes	N.a.	No	N.a.	No	Unsure
Firm performance	No	Yes (depends on age)	No	Yes	Yes	No	Yes (depends on age)	No (if external reasons)
Financial rewards	No	No	No	N.a.	No	Yes	No	No
New venture	No	No	Yes	N.a.	Unsure	No	Yes	Yes (in parts)
Talented Acquirer	Yes	Yes	Yes	N.a.	N.a.	Unsure (depends on price)	Yes	Yes

Figure 3 shows the potential scenarios discussed during the interviews and the attitudes towards selling the business.

The above visualized scenarios and the associated attitudes towards selling a family business are all based on thoughts concerning the survivability of the business. Whether a family business has continuance after selling the firm is seems to be the root of why the attitudes are either favorable or not. Hence, the following subchapters discuss the scenarios in more detail and give explanations for proposition 2.

4.2.1. Private Reasons

All eight interviewees, when asked the question whether private reasons influence their decision to sell, answered that a potential sale of the firm is a preferred option when private reasons like severe sickness of the owner, a divorce or other family internal reasons occur. The positive attitude of all interviewed persons seems to stem from the option of stepping down and profiting from a sale with the possibility that the firm survives. The next generation of Fashion states: "If I would not sell it [the company], it would probably fail by itself, but if I sell it, it would at least have a chance of surviving" (next generation, Fashion). Additionally, private reasons seem to be so unpredictable that there is not much time for making concrete plans of succession so that even the family owners would favor a sale to avoid pushing the potential family successor into the firm. The family owner of Tubes mentions that: "I would definitely say it needs a cut. I would also not wait for potential successors from the internal family. Then I would only pressure my offspring... I would rather say cut" (family owner, Tubes).

Securing the survival of the firm seems to be the internal drive of this decision-making process as these scenarios are uncalculatable for the families and their businesses and an uncontrolled succession could jeopardize the firm's future. Thus, family businesses favor selling the company when private reasons threaten the family business to secure its survival.

4.2.2. Talented Acquirer

In line with the thoughts of the family businesses' survival is the positive attitude towards a talented acquirer when faced with the question of selling the business to someone. A talented acquirer, defined as someone who has the managerial skills to take care of the business and the perspective that the acquirer will continue the business without threatening the survival of the firm, creates a positive attitude towards selling the business.

As admitted by the next generation of Grass: "I would like to sell to him [talented acquirer] because I am quite sure the company won't die, you know". Further the family owner of Tubes acknowledges that "the social responsibility that I see as an entrepreneur would have, in this case, the highest priority" meaning that the acquirer would not threaten the survival of the business and refrain from cutting jobs in the firm.

In consonance with the above-stated quotes are the statements by the offsprings of Windows and Trucks. However, they point out that the sales price is an important factor that influences the decision. Confronted with the question whether a talented acquirer is granted a discount on the price, therefore, being favored over another acquirer who would pay a higher price but might threaten the company, the two offsprings give important insights into the survivability of the firms. Following the direction of the previous answers, the next generation of Windows states that "I think it is ethically reprehensible... Of course, you have built the company but you had the success over the years because of your employees. If you say, you are taking your payout... I think it is wrong to overlook that the company will be shattered". However, he further mentions that "a real hygiene criterion needs to be that at least the value propositions are roughly the same... If the offer is substantially lower it could be rejected". The interplay between the sales price and survivability of the firm are also the focus of the next generation of Trucks who mentions that "on the one hand if the offer is really good we would probably say screw it! And sell it. Re-

Figure 3: Attitudes Towards Selling the Business of Interviewees; Source: Own illustration based on attitudes experienced during interviews

gardless of the managerial fit. But I know my parents, they would probably want a guaranty and so on for the employees and that the one who carries on the business cares".

Family businesses tend to sell their firms when they see a potential for the firm to continue in the future with an external successor. Thus, they favor a talented acquirer and would even grant a discount on the sales price if the firm transitions to a feasible successor. The next generation of Fashion indicates that "the important thing when you give away your family business is that there must be a personal fit. When I give away my lifework, I wish that the person taking it over carries on the work in a way that fits my imagination or even creates something better".

However, the price cannot be neglected as it has a subordinate influence on the decision to sell the business. An argument of the owner of Spices illustrates this as follows: "I could imagine if you get a really great offer that you take the really great offer. Maybe because I think about myself or the family...Maybe in combination with a guaranty for secured jobs. Preferred is an offer with a really good price and to know that you sell it to a company with a strategic fit. But maybe this option is not always available".

4.2.3. Financial Reward

Even if the financial reward a family could gain from selling the business is a major factor in the mind game that families go through when considering to sell their business, the interviewees are almost all of the opinion that that the financial reward, in its isolation, is not a sufficient reason for selling the business: "I think it is less crucial if it is a million more or less. Of course, you want to get the best possible out of it but the best possible is not only about the price" (next generation, Fashion). As this mindset is consistent among the interviewees, the financial reward in its isolation is not a significant reason for a family business to sell. A statement by the family owner of Fitness emphasizes this by claiming "of course the price has to be somewhat right, but money is not everything. When you built such company, and managed it for so many years, you want it to be continued right".

The financial reward for selling a family business is, in its isolation, not sufficient to trigger a sales process. Nevertheless, the financial reward does play an integral part in the sales process, and its importance can be best described by the statement "you know we can say everything about money but you know... Money is important. It depends on the difference [monetary difference of two offers], you know" (next generation, Grass).

4.2.4. Inferior Firm Performance

When family businesses face periods of inferior performance, a decision to sell the business depends on whether you look at the next generation or the current family business

owner. A mixed attitude towards selling the family business is evident. The family business owners would see an inferior firm performance as a reason for selling their business, especially when they are close to facing the retirement stage. In contrast to the current owners, the offsprings clearly favor to hold on to the business to get the company on track, especially if external, market driven reasons are the cause of the inferior performance.

The family owner of Media explains two past sales of business parts, which belonged, at the time of the sales, to the portfolio business activities. However, the market was experiencing structural changes and the family business decided to sell. He states that "It was hard for my father but he was entrepreneur enough to accept that it was economically beyond good and evil and that it does not make sense to continue the business... Today the firm does not exist anymore". Thus, the family decided to sell the businesses as part of a management buyout, because they did not see the chance of survival for these particular business activities in the future. He states that "the business was the lifeblood of my father but economically a clearance. Also [selling] the other business was at the end economically a clearance. But it was always a side business. It was always clear the big business runs elsewhere". The family business Media later on also sold its core business which accounted for more than 80% of the revenues, as they saw the market changing in a way that threatened the survivability of the company. He mentions: "My brother has worked his whole life in that business. Still, we came to the decision to sell the business. Why? Also here the market has changed in a way that made the old business models difficult... The businesses were not free in their decision making" and further "at some point, we saw that the business runs into a deadlock. It was not the case 10 years ago, but it was foreseeable that it would happen... We saw that".

Family owners who actively manage the business and know the market, tend to favor selling the business when they see the survivability of the firm fundamentally threatened. Therefore, when experiencing this kind of difficult situation, profiting from the sales is more important than holding on to a business without future perspective.

On the other hand, the position of the next generation is quite different. The offsprings seem to have a preference for holding on to the business. The statements by Trucks and Grass are similar in nature and show a reluctance to sell an inferior performing company: "I think we would rather sell now, and not wait until the firm is performing worse... to sell the firm, that would not make sense for us" (next generation, Trucks). The offspring of Grass mentions that "in that case, I would try to change again to something different. Because I don't like to sell a company that is going very, very bad". Both offsprings are open towards selling the family business. However, selling the family business when it does not operate well might lower the transaction price. Thus, they advocate to sell the firm when it operates profitably.

The next generation of Fashion, who wants to avoid selling the family firm, indicates "when the market goes down... you have to bring innovation and so on to force through. If you can't do it yourself, you can get a consultant. I would not say that I would sell the business. You are either too bad or do something wrong... Maybe the circumstances of the year are bad, that is sometimes the case, but then you have to go on". The lack of actual managerial involvement and the connection of the offsprings to the operational business might lead them into underestimating the challenges they would face in such circumstances. They either prefer so to sell during a time when the company performs well to increase the price or underestimate the threat a business might face when running into structural problems, hence neglecting the possibility that the survivability of the firm is threatened. Family business owners account for this threat and tend to sell the business when they see no possible future for the business.

4.2.5. Unskilled Successor

When family businesses face the decision of succession, a low skill level of the potential successor steers the decision in the direction of choosing a sales option over an internal succession. The decision to hand over the business to a successor without the sufficient skills to manage the business creates contrasting views among the interviewees across both groups of family owners and the next generation.

The interviewee of Fashion mentions: "I would definitely say that the one has to be qualified for this job. Even if it would be my son, I would tell him to do something else". This is in line with the perspective of the family owner of Fitness states, who states: "I would definitely sell externally. It cannot be that someone makes himself unhappy because he thinks he can handle it. When he is not able, then he is not able". Family businesses favor internal succession, however, when the successor is too unskilled so that the family business' existence is threatened, they prefer to sell externally. Spices could imagine holding the shares in the family and engage an external manager as a transition phase or also selling the business.

Nevertheless, the firms who have family owners from different backgrounds would want a transition or preparation phase for the offspring to be able to manage the firm in the future. The family owner of Media reports: "I have deliberately looked for someone in the family whom I can hand over this heritage... So it can be continued so that the promise of my father can be continued". His nephew is currently in a dual study program, studying at a University and simultaneously working in the family business, in order to be prepared for the company takeover. The next generation of Grass has a similar standpoint and would involve the offspring "to understand what he can do and what he cannot do but, anyway, if I decided to sell it I would involve him because I think a big part of the money would go to him". Intentions of Tubes, Spices and Windows incorporate a transition phase of the current owner and successor or the involvement of an outside manager to support the successor in management questions. Table 5 shows whether the interviewees are from non-specialist backgrounds and whether they favor selling the firm when faced with an unskilled successor.

Table 5: Background of Interviewees and Their Succession Intention with an Unskilled Successor, Source: Own findings based on interviews

	Fashion	Fitness	Grass	Media	Spices	Trucks	Tubes	Windows
Background	Specialist	Non–specialist	Specialist	Non-specialist	Non-specialist	Specialist	Non–specialist	Specialist
Succession Intention	Not Intended	Not Intended	Not Intended	Intended	Intended	Not intended	Intended	Intended

An internal succession is still the preferred option for the family businesses. Nevertheless, this option is not realized at all costs. Families still have the priority to see the businesses' future secured. If the family businesses see their future in danger due to a lack of skill of the successor, they either decide to sell the business or create a transition solution that equips the internal successor with the needed skills to secure the ongoing operations of the firm.

4.2.6. New Venture Creation by the Next Generation

Individual factors influence the decision to sell the business so that the offspring can start a new venture and concerning the decision-making process there is no specific difference between the current generation in charge of the business and the next generation. Emotional attachment of the current family business owner to the family business can be seen as a reason against this sales decision. A statement of the family owner of Fitness exemplifies this: "I think I am of two minds. First, I would like to help my daughter start her company. But I don't think that I would sacrifice my business for it. I would not do it". This shows the difficulty of this sales scenario. Additionally, the next generation is reserved to sell the business only to fund a startup. The possibility to start a new venture is a highly individual event that cannot be fathomed within the scope of this thesis. Industry, firm performance, attachment to the firm and a hypothetical new venture and the likelihood of its success are only a couple of influencing factors that need to be considered.

4.3. Terms of Sale as Influence Factors on Sales Decisions

Once the family owner, the next generation or the family as a collective decide that selling the family business is a feasible option, the terms comprising the sale influence the sale process. Important sales terms are constituted by the potential acquirer and the intentions of the acquirer to keep the firm intact. A potential involvement of the family owner or the next generation is seen as a possibility to consult the acquirer. However, this is not necessarily a term demanded by families. The valuation process of the business only plays a subordinate role, as most family businesses do not have a valuation process in mind. Nevertheless, most of them would give a discount to the acquirer if they perceive him as the right choice compared to another offer from an unfavorable competitor. The terms of sale can lead to a successful sale outcome or to the discontinuance of the sales process. Thus, the terms have a sufficient impact on when family businesses sell.

> Proposition 3: Terms of sale have a significant influence on the sales outcome. When the terms of sale threaten the survival of the firm or unsatisfy the families, the sales process will presumably be discontinued.

4.3.1. Anticipated Survival of the Firm After the Exit

The sales process is influenced by the same motivations that lead family businesses to the decision to sell in the first place. Hence, the expected survival of the firm affects the outcome of the sale and is pivotal to the success and the continuance of the sales process.

The family owner of Media was going through two different sales processes which were both influenced by the durability of the firm after the sale was accomplished. He explains that while they were in the negotiation process with two consortia in order to sell their core business, events influenced their decision to whom they would sell the business:

"Then the plans got revealed where the working counsel of the seller and acquirer have negotiated. That were 3-4 [companies] who already came together and have internally decided how to split our company, who gets which parts. That would have meant the elimination of the site. Hence, we marched to the lead manager of the second consortium... We told them that they have a fair chance if they reenter the bidding process with no drawbacks to fear. I have urged to do that because this consortium has explicitly told us in advance that they would keep the site as a whole and that there will be no divestitures. And I believe that is the reason, even if it is hard to explain with hard facts... But I believe that is the reason why this consortium is the one that got the offer... The basic framework of the company still exists today. That was also the strategy". Threats to the business have changed the outcome of the negotiations and the story by the family owner of Media suggests that it is the strategy of a family business to increase its endurance.

In the sales process of one of their portfolio firms, the business Media had also canceled the negotiation process of an acquisition with another company as it got public that the acquirer wanted to exploit parts of the business. The family owner makes clear: "There was once an offer by another firm who wanted to take over the one part of the business... The supervisory board was highly enthusiastic and said that it is

a possible option. In the course of own research, we afterwards found out that this business had already bought many similar companies, exploited and utilized them. The discussions were directly over. Over. And as earlier mentioned an MBO emerged on a later stage".

Even when the family had plans of exiting the business, the anticipated continuance of the firm, jobs and the site were taken into account. Hence, if families see those aspects in harm's way the probability increases to cancel or change negotiations in the sales process of the family business.

4.3.2. Buyer Types as an Influence Factor on the Sales Decision

As I already mentioned, family businesses are looking for talented acquirers who can manage the business and will keep the business running. Therefore, the potential buyers have an impact on whether family businesses decide to sell. The different buyer types vary in their management style and in the way they meet the expectations of the family owner and the next generation and influence the sales process. The potential buyer can increase or decrease the likelihood that a family business sells.

The next generation of Fashion captures the apprehension on private equity investors quite clearly: "If you think of selling a business, I think only a minority of persons would sell it to an investor because the family business is too important for them. It is their lifework". He further mentions that "as soon as you have investors on board you have that performance pressure. You do not have that in family businesses, and that creates the opportunity of thinking much, much more long-term oriented. I would say that this is one of the success factors of our family business". The performance pressure that is created by investors, as well as the lack of attachment between the firm, the employees and an investor can best be described by a statement of the family owner of Tubes, who is a minority shareholder with a financial investor as the majority shareholder: "It is a pure investment for him [silent partner] there is no lifeblood in any form. In my case, there is lifeblood in the company. For me, I act as if it is my company. For him, it is purely a financial investment". The family owner of Media indicates that selling to an investor is also not an option for him since "the danger that the company will be shattered and not survive as a company is quite high with a financial investor". The offspring of Windows acknowledges that "a high acquisition price is not so attractive if it were clear that the company will be shattered... I think it must be ensured that there are certain securities for the employees and that it does not look like you are making a big haul and then the devil-may-care". I believe that the attachment between the firm and the family is extremely valuable for the families. Thus, they are reluctant to place the firm in the hands of a performance-oriented investor who would also initiate job cuts and who might divest the company. An investor is often viewed negatively by the families and the probability that a sale would proceed seems to be quite low. Nevertheless, two of the family businesses' offsprings and the owner of Spices would consider a financial investor. Still, they mention the impact the company has on the environment of the city and that they care about the businesses which provide jobs.

I come to the conclusion that for most family businesses a financial investor is not a desirable option, especially when high emotional attachment between the company and the firm is in place, as the families care more about the survival of the firm and the jobs of the employees. It is apparent that this combination of attachment to the firm and thought on durability influence the preference of the buyer type. The offspring from the firm Grass believes that a financial investor is a feasible option, but he acknowledges: "I am not really attached to the company because I have never been so involved. But I know that it means a lot to my father. That is the only attachment I have to the company". Hence, a weak attachment to the company might decrease the importance of the buyer type. Table 6 shows the preferred buyer types by the interviewed family businesses.

A popular buyer type for most families is a competitor (acquirer) or an employee (MBO). The business Media has already chosen an MBO as a sales option for two of their portfolio firms. Furthermore, Fitness, Windows and Tubes have thought about a potential MBO as a sales option. An acquisition through a buyer with a clear strategic fit with the own company is also seen as a possible option for selling the business: "I would look a bit on what makes the most sense for the company. Where I say that is the perfect fit" (next generation, Windows). This statement by the offspring shows that a preferred option comprises a good fit between buyer and seller. The personal fit was also mentioned by the next generation of Fashion, as he believes that a good fit will help both companies to "carr[y] on the work in a way that fits my imagination or even creates something better". Hence, acquiring companies with a clear fit, including supplier and competitor as well as employees or an external management in the form of an MBO/I are popular options for family businesses. The strategic fit decreases the intention of the acquirer to cut jobs or discontinue the acquired business, therefore, influencing the sale process positively.

4.3.3. Involvement of the Family Members After Exiting the Business

The family business owners and the next generation state that they would prefer a clear cut from the operating business when they leave the firm, however, they opt for giving advice, if asked. Thus, the option of having a say in the business after leaving the firm is a less influential sales term. The interviewees would like to support the acquirer with advice to help the business but they do not urge to influence the business. Also, a potential transition time after the sale could be an option to help the acquirer to get on board. A statement of the owner of Spices shows the problem of staying operationally involved with the business: "I can imagine that it does not work [to stay on board]. One is used to make the decisions... Suddenly you are in the same company, in the same environment of employees and you have to comply to a different management style".

Table 6: Preferred Buyer Type by the Interviewees, Source: Own findings based on interviews

	Fashion	Fitness	Grass	Media	Spices	Trucks	Tubes	Windows
Buyer	Competitor or employees	Employees	No preference	Competitor or employees	No preference	No preference	Competitor or employees	Competitor or employees

A statement by the owner of Fitness summarizes the above stated: "I would not want to have a say. I would support with help and advice when I am asked to do so. I would backtrack". The owner of Tubes even mentions the importance of a cut for him, when an external party takes over the business. He states: "When there is no family successor I favor to make a clear cut and would not be involved anymore... The cut would be important for me if I say I am out and my son does not want to join the company".

Regardless of their intentions, most of the family business owners admit that it is hard to backdown from the business. Both firms, Tubes and Media, had worked together with their fathers in a transition phase and mention the problems arising from someone who cannot let go of the business. The owner of Media explains: "I have intended to leave the operating business because I know what can happen if you do not do it. My older brother and my father were quarreled at the end of the life of my father... My father still tampered with the operating business and my brother did not find that funny... I do not intend to make the same mistake. That is an emotional process that needs to be accomplished... I cannot tell you how I will withstand this at the end. You only know that when you are in that situation. As I saw what kind of damage this creates and I hope I am steeled to do that reasonably".

The interviews disconfirmed the expectation that having a say in the business after its external transfer is an important sales term. They rather proved the opposite. Even if most of the interviewed firms would give advice to the acquirer, their preferred choice is to withdraw from the business completely. A possible rationale behind that could be that selling the firm is a form of emotional farewell and involvement in the operating business would disturb this process. However, advising the acquirers or being a member of the supervisory board, as the family owner of Media in one of his former portfolio companies, is a chance to monitor the business and its course of interaction to advance the durability of the business. Table 7 shows the intended involvement after an external transition.

4.3.4. Valuation of the Family Business as an Influence Factor on the Sale Decision

Finding the right price for the business is a crucial part of any sales process and needs to be considered when looking at sales decisions of families. As I found out, the price is important for family businesses. However, it is not the most important factor and constitutes only an issue when it is insufficient. More important than the price itself is the valuation procedure and whether the family business owner or the next generation value their companies above, below or within the market valuation. Valuation as a sales term does not threaten the survival of a firm but an underestimated valuation will likely lead to the discontinuance of a sales process.

An example for the discontinuance of a sales process is the failed attempt of the minority shareholder of Tubes to buy out the majority shareholder in an MBO process. He explains: "We wanted to start a Management Buyout, including employees but that was not so successful because the offer we made to the majority shareholder was viewed as an endowment. Quite derogatory. Means nothing else as double the price and we can talk about it".

The interviewee of Tubes mentions the difficulty arising from the different valuation approaches as he acknowledges: "Sadly the investor values the company different than me. He looks at the true enterprise value on the basis of a net present value method. He certainly will choose the method which leads to the highest selling price and will say that it is the negotiation ground. I would do it differently and look at the market and risks... We would have a big delta. Therefore, there is no negotiation".

Having a different valuation approach with conflicting results can jeopardize the sale process and cancel the negotiations. The fronting parties in a negotiation process both have to be satisfied with the price to continue the deal process. As stated in the example by Tubes, family businesses seem to value the company differently than a buyer who wants to take over the business. Table 8 shows the valuation approaches by the family businesses. Some of the interviewees also indicated whether they value the company above the market value.

The valuation and the resulting price for the family business can influence the sales process and lead to discontinuance if one party in the negotiation is unsatisfied with the results of the valuation. Most of the companies state that they would value their family business above the market value. In my opinion, these statements are quite biased as the personal property is often valued higher than the actual market price. The so-called endowment effect might also be active when considering family business owners and their valuation of their companies. As the offspring of Grass already mentioned: "To be honest I have something in mind but I am not sure if it is real... I don't think it's really accurate". This statement show that he overvalues the firm. Furthermore, the owner of Spices also talks about this phenomenon: "It is your own feeling. It is always like that... It is subjective and I think so too... I also think my father would have sold the business if he had gotten a price that would be reasonable for

Table 7: Involvement after Exiting the Business, Source: Own findings based on interviews

	Fashion	Fitness	Grass	Media	Spices	Trucks	Tubes	Windows
Involvement	Active	Advisor	No involvement	Advisor	Unsure rather advisor than active	No involvement	No involvement	Advisor

Table 8: Valuation of the Family Businesses, Source: Own findings based on interviews

	Fashion	Fitness	Grass	Media	Spices	Trucks	Tubes	Windows
Valuation Approach	Different methods (externally)	Member valuation times mileages and fix costs adaption	Multiples	Net present value methods (externally)	Net present value methods (externally)	Discounted cashflow method	Net present value methods (externally)	Net present value methods (externally)

him. That price would have been way above the fair value of the company".

Valuation is often more of a hygiene criterion that is met externally by an auditor and most family businesses are not involved in the actual valuation. When it comes to choosing a buyer, most firms would to some degree tolerate a lower price when they can be sure that the company is with the preferred buyer. However, the gap in the valuation of the buyer and seller can decrease the satisfaction on both sides and influence the sales process. The findings therefore support Proposition 3.

4.4. Continuance of the Sales Process

When family businesses have come to the decision to sell their business, potential influence factors might lead the sale process to stop with the particular buyer or under the certain price and valuation terms. Nevertheless, the intention to sell still exists and the family business will reenter the loop of the sales process. Reentering implies that as a next step another business might come into play and buy the company or an MBO with current employees emerges. Thus, the sales process stops when the family business is successfully sold or after the discontinuance of the sales process when the business reenters the sales process until it is sold or the intention to sell changes.

An example for this process is the family business Media, and its' decision to sell a part of the business. The sales terms did not satisfy the family and they stopped the negotiations with the buyer, however, their sales intention continued to exist and at a later stage an MBO emerged, leading to a successful closing of the exit process.

5. Discussion

5.1. Summary and Comparison of Findings and Literature

5.1.1. Summary

An understanding of the reasons of family businesses for selling their firms has been scarcely researched but it is crucial for understanding why family business ownership transfers.

The analysis of the interviews and the interviewees' decisions in different sales scenarios substantiated propositions 1, 2 and 3. Family businesses consider selling when internal succession is not possible (Proposition 1). Additionally, the feasibility of a sales option depends on certain circumstances. Family businesses prefer to externally exit their firms when confronted with private reasons or when a talented acquirer who has the capabilities of running the business comes along, provided that no internal successor is available for a foreseeable period of time. A financial reward is not a sufficient sales reason and the scenarios of a new venture creation by an offspring, an unskilled successor, and an inferior firm performance are seen differently across firms and generations. Nevertheless, families tend to favor selling the business when they see the survivability of the firm in danger and can thus increase its durability (Proposition 2).

Once the family has decided to sell their business, the terms of the sale have a significant influence on the sales outcome. When the terms of sale threaten the survival of the firm or do not satisfy the families, the sales process will presumably be discontinued by the families. The most important influence factors are the anticipated survival of the firm after the exit and the buyer type. Hence, the intentions of the buyer need to be similar to the intention of the firm to secure a durability for the firm. Nevertheless, a sufficient price to let go of the business is seen as a hygiene criterion and needs to be met to satisfy the families and in order to sell the firm (Proposition 3). Valuation of the business and potential involvement after the exit can be considered as subordinate sales terms, as they do not heavily influence the continuance of the sales negotiation. Valuation can be a sales term that leads to difficulties along the way of the negotiation process, as specific gaps between buyer and seller can aggravate an agreement.

5.1.2. Comparing the Findings to the Literature

In line with the findings of DeTienne and Chirico (2013), I have shown that family businesses favor internal successions. However, in many cases, internal succession fails be-

cause either the potential successor decides against a career in the family business or the family owners do not see the offsprings as a feasible successor (De Massis et al. (2008)). The failed internal succession increases the likelihood of families selling their businesses. As Lee et al. (2003) discovered, potential successors are turned down when their low skill level could threaten the business' durability. My findings support this line of argument. However, they also reveal that family businesses think about engaging external managers in situations with an unqualified successor. They would support the transition and learning process of the successor and enable an ownership within the family without an active management function from the family when there is no skilled successor. Nevertheless, the tendency to sell increases for family businesses, if internal succession fails. The findings by Howorth et al. (2004) are congruent with the intention of family businesses to sell when the successor is not perceived as feasible to inherit the business and trigger an MBO/I process. Nonetheless, I do not find evidence in my sample of interviews that would turn down transgenerational succession completely even if the successor would be skilled enough which is a stated possibility by Howorth et al. (2004).

The interviews revealed that not only internal reasons can lead to a sales decision but also external factors as found by Salvato et al. (2010). An extension to Salvato's research is that there are often differences between the family owners and the next generation. Family owners tend to know the market and their management capabilities better and external factors that lead to inferior firm performance will increase the intentions to exit and sell the firm. Nonetheless, when looking at the next generation, the sale intention due to external factors tends to decrease as they would rather hold on to the business and try to achieve a turnaround. The lack of management experience and the underestimation of their capabilities can be an explanation for this tendency.

Akhter et al. (2016); DeTienne (2010); Meier and Schier (2014) named other reasons that induce families to exit their business. Expanding their stream of research, I can add that private reasons like sickness, divorce or internal disputes increase the possibility of an exit and the pursuance of a sales option.

I discovered contradicting results to the findings of Graebner and Eisenhardt (2004) because my results did not reveal any form of sales intention due to the fear of failing as a manager or the plan to sell in order to capitalize on the financial gains. The research of the two scholars is not based on family businesses and my finding that the real financial reward does not, in its isolation, trigger a sales process indicates that family businesses behave differently from non- family businesses in this regard. Furthermore, the pressure of being a good manager does not occur as much in family businesses, as the families are the owners and often also the managers. Their long-term orientation, as well as their survival and existence over the years, seem to decrease the performance pressure. There are often no external entities that demand accountability for the actions of the family owners. Thus, I believe that the findings of Graebner and Eisenhardt (2004) are not entirely transmittable to family businesses.

Results by Mickelson and Worley (2003) suggest that the interplay between the top management of buyer and seller have to work well in order to make the deal successful. Reactions by Spices, Media and Fashion strengthen their argumentation, as the personal fit of the buyer was one of the major concerns of the businesses. Media discontinued the sales process with a firm because the fit and the intentions of the acquirer were not in line with the ones of Media.

When it comes to the valuation methods, the conventional methodologies like net present value methods and multiple methods are applied by the interviewed companies, which is in line with the findings of Granata and Chirico (2010). The results of Kammerlander (2016) who showed that family businesses give a discount on the acquisition price when a preferred buyer is found, is also reflected in my findings. Most family businesses favor a right buyer over a better price from someone who they perceive as not being the right fit for the company. Nevertheless, an important influencing factor and the outcome of the sales negotiations depends on the gap between the two different variables. I did not find evidence that family business owners or the next generation are more likely to sell their businesses the more generations are between them and the founder (Salvato et al. (2010)). My findings rather showed the contrary. The firms with the most distance to the founder, in the third, fourth or fifth generation, were the ones least likely to sell their businesses. The emotional attachment to the firm and the history of the firm and the family is much more advanced in those firms and the interviewees quarreled more with letting go of the business than the ones in younger generations.

5.2. Contribution

5.2.1. Contribution for Research

The process of the sell of family businesses is influenced by multiple factors. Despite own intentions to sell or hold on to a business certain patterns of the scenarios and a general process can be emphasized. Reasons for sales decisions of family businesses can be analyzed by researchers using the process outlined in this thesis. Most sales intentions occur due to a lack of a feasible internal succession option. However, most of the scenarios discussed in the interviews were ones that trigger or prevent a sales process. An insight into the generations of the family businesses, considering the ones in charge and the potential next generation of family business owners, reveals certain differences between these two groups. The decision-making to sell a business is often different in the face of a successor who is not interested in managing the family business actively in the future or prefers to follow other entrepreneurial activities. Furthermore, the thesis has shown that once the inclination and intention to sell are available and the sales process is triggered, the terms have additional influence on the outcome of the sale. The differentiation between when family businesses decide to sell and when the process is restrained or continued until a sale takes place is a different approach to looking at the topic of selling

a family business. Researchers should incorporate the next generation and split their future research between the process that leads to the decisions to sell and the sales terms which lead to the sale.

5.2.2. Contribution for Family Businesses

The thesis also offered insights into how family businesses make decisions in sales processes. It shed light on how the offsprings see their family business. The different scenarios when family businesses consider a sale as a possible option are often guided by individual influences and the specifics of the situation and the setting of the family business, the industry, the family and future arrangements. Owners and offsprings need to take all the latter closely into account when deciding to sell their business. Once they are willing to sell, the different terms will influence their decision on whether the potential buyer and the offer are the right fit to sell the firm. Families need to make sure how they want to see the business in the future upfront and should plan along with the sales terms to satisfy their outcome. The involvement of the family after the exit and the involvement of the family owner should also be considered before selling the business. Even if the involvement after the exit is not a major term, it can increase the satisfaction of the owner with the sale when the terms of involvement are fitted to the circumstances. Some might favor staying in the business while others might want to have a clear cut.

Regarding valuation, the consultation of an external party or auditor seems to be a standard option. Family businesses should consider the fair value of their firm and when they are negotiating from an angle of strength, decide whether a slightly lower offer might be a more favorable option for the business. The right fit between the acquirer, regardless of whether it is a strategic buyer or financial investor, and the family business is important to include early in the negotiations as it can profoundly influence a sales outcome.

5.3. Limitations

While my sample of interviews considers firms of different size, age, industry and ownership structure, there are still certain limitations of this study. Although I often found differences between the generation in charge and the next generation, a more in-depth study needs to be undertaken to thoroughly understand the differences between the decision-making processes between the two groups. Furthermore, as selling the family business is often guided by many individual influence factors, many more selling scenarios could be discussed with family businesses.

Even though I discovered that a financial reward and the gain for selling a firm is not a trigger for selling a family business, I often experienced that the interviewees would, later on, consider getting the most out of the sale in terms of price and other guiding factors. Thus, I am limited in saying how important the price is compared to a range of other factors because I looked at the financial reward in isolation.

Utilizing a larger interview pool yields the possibility of encountering further propositions as every interview is unique, as the circumstances are always different from family business to family business.

Including families in the interviews who already exited the business, by selling, would broaden the horizon of this study since implications of the sales process and the family's involvement in the business after the exit could be explained more in-depth. Furthermore, I was not able to gather sufficient information regarding the liquidation of family businesses and the implications behind it. Therefore, understanding which of the sales scenarios and sales terms lead to a liquidation rather than a sale in the form of an acquisition or MBO/I need further research.

5.4. Future Avenues of Research

The thesis gives indications for future research as some relationships between sales intentions and circumstances can be discovered more intensively. For example, understanding what exactly leads to a breakup of the negotiations between buyer and seller and how that breakup affects the future search for potential acquirers by the family business can be discovered in more detail. Furthermore, a quantitative analysis that looks at paid acquisition prices and compares changes in the business, like the cutting of jobs or an increase in divestitures could be of interest for family businesses and scholars. Such an analysis could explain whether family businesses turn down or accept a higher price when knowing that the business will be changing, given the premise that it is part of the sales terms.

While my research focused on scenarios that lead to an inclination to sell, further research could focus on the situations of family businesses after a sale has been actually pursued. Further scenarios and understanding their impact on the sales decision by ranking them in their influence and looking at an accomplished sales process might reveal interesting insights into the actual frequency of those scenarios.

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