



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.

(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 themselves¹ 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.

¹Perhaps 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

²To 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.

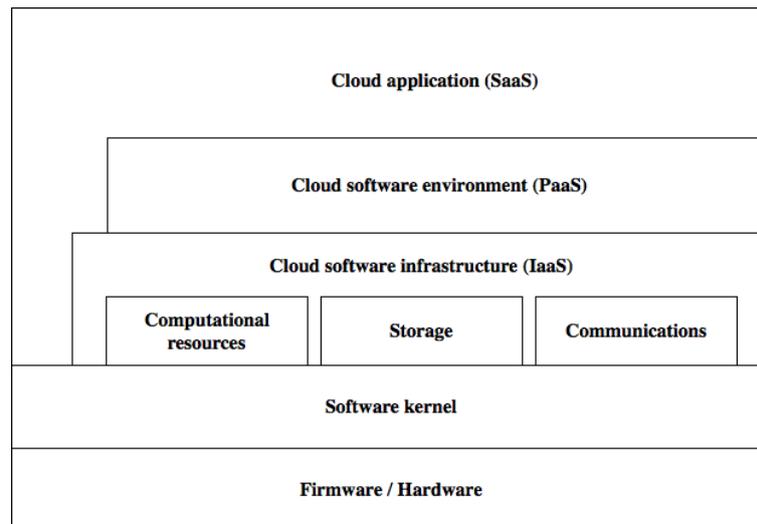


Figure 1: Ontology of five layers in Cloud computing (Youseff et al. (2008)).

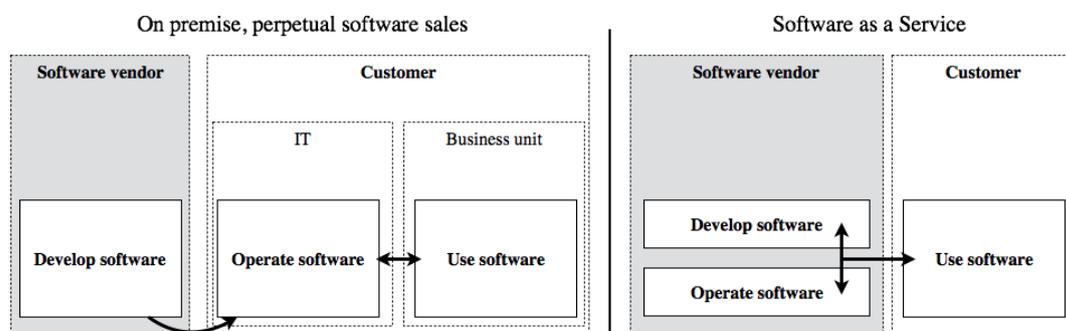


Figure 2: Difference in on premise and software as a service responsibilities (Stuckenberg et al. (2014)).

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 cannibalizing³ (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

³Cannibalization 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, ac-

quiring 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

	New product	Existing product
Only as a service	New/existing product: + Parallel perpetual offering: -	New/existing product: - Parallel perpetual offering: -
Parallel perpetual offering	New/existing product: + Parallel perpetual offering: +	New/existing product: - Parallel perpetual offering: +

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 op-

erating 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

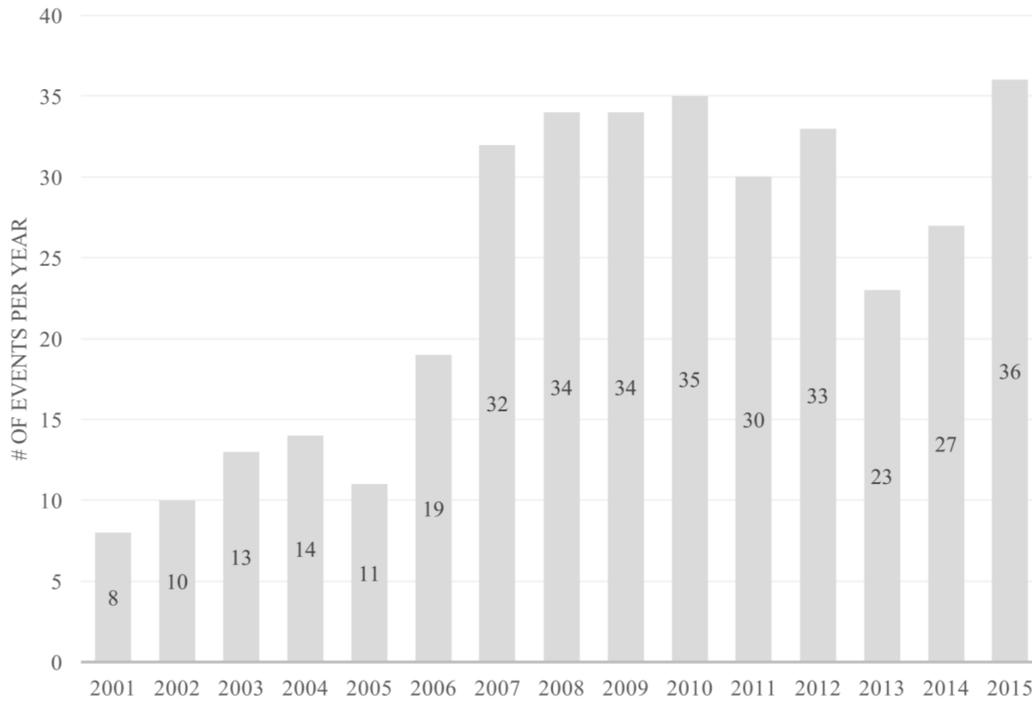


Figure 4: Distribution of studied events over time from 2001 to 2015 (own illustration).

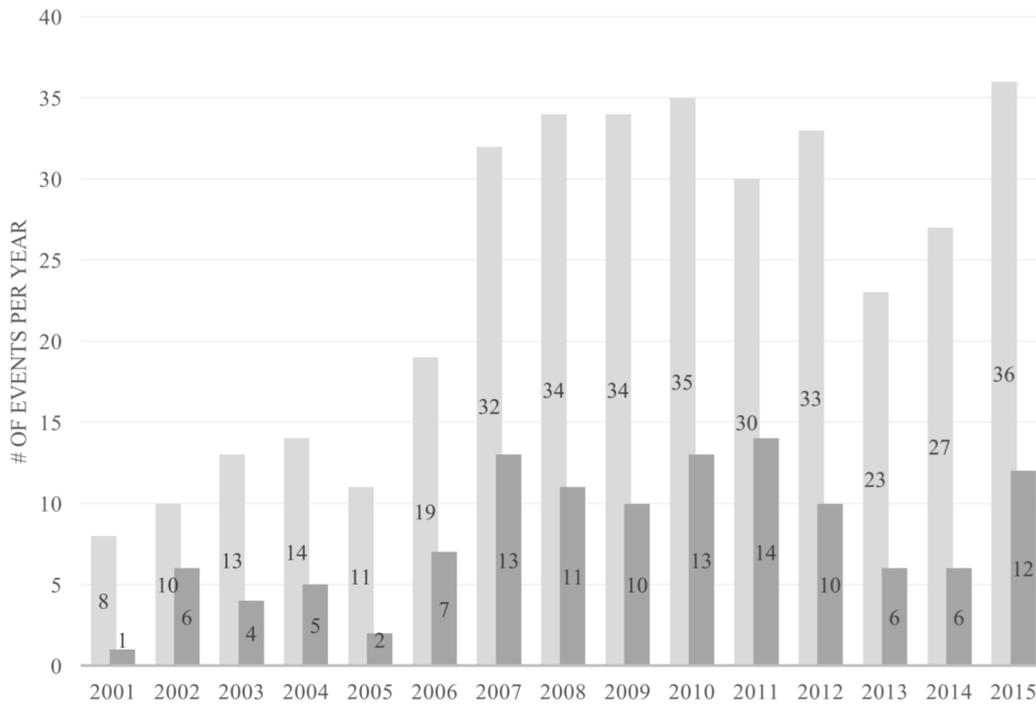


Figure 5: Distribution of all events and non-confounded events from 2001 to 2015 (own illustration).

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-

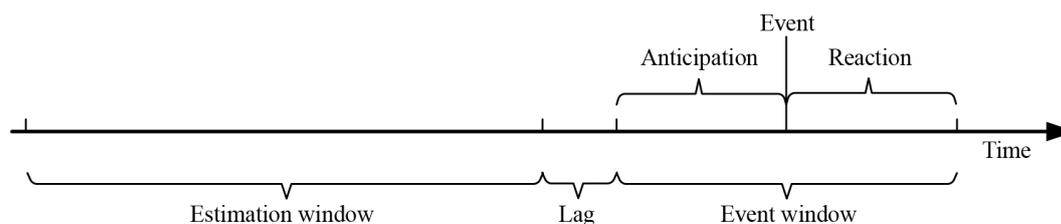


Figure 6: Relevant terminology of time windows in event studies (adapted from (MacKinlay (1997))).

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 divisible 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.

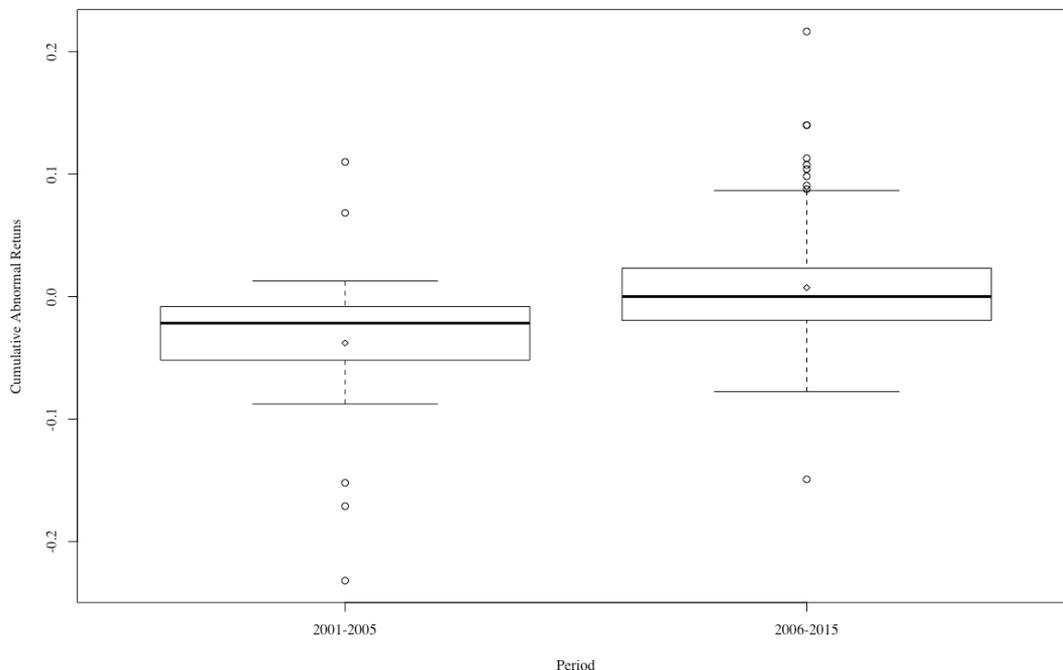


Figure 7: Cumulative abnormal returns before 2006 and from 2006 onwards (own illustration).

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	2	3	4	5	6	7	8	9	10	11	12	13	14
	CAR	Existing product	Parallel offering	Partner	Early time	Employees	R&D-to-sales	Sales-per-emp.	Sales growth	PPE-to-sales	Sales	SaaS before	SaaS exp.	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	0.2394
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 interact⁴, 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

⁴New 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.

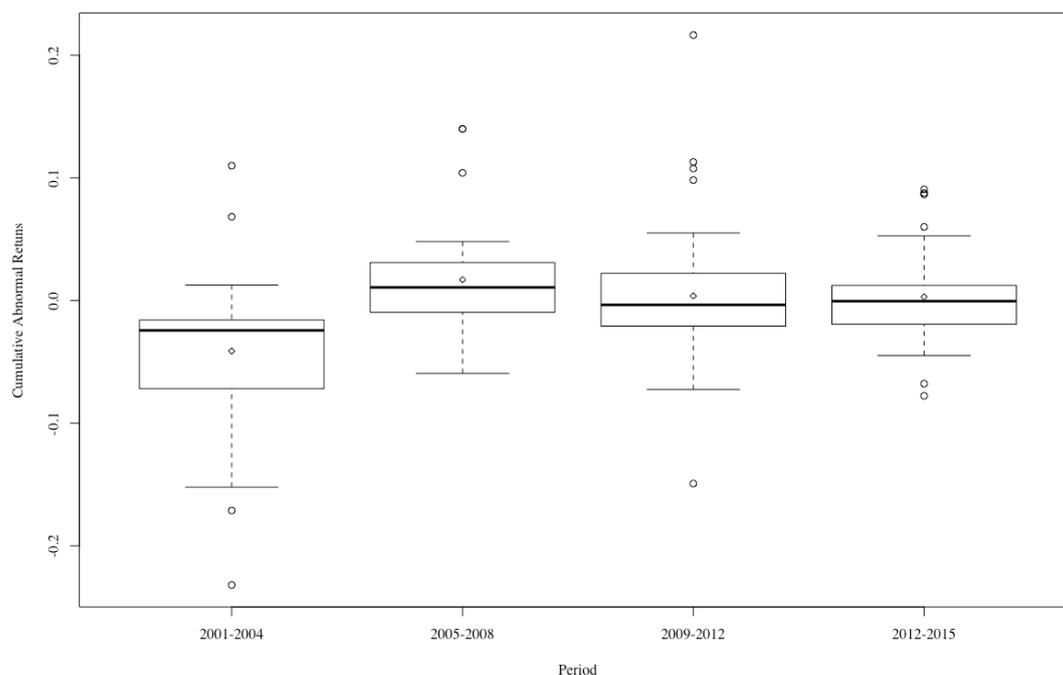


Figure 8: Cumulative abnormal returns over the studied time window split in four equally long periods (own illustration).

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 value 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 appli-

cation 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.

References

- Agrawal, M., Kishore, R., and Rao, H. R. Market reactions to e-business outsourcing announcements: An event study. *Information & Management*, 43(7):861–873, 2006.
- Alexy, O. and George, G. Category divergence, straddling, and currency: Open innovation and the legitimation of illegitimate categories. *Journal of Management Studies*, 50(2):173–203, 2013.
- Anderson, J. C. and Narus, J. A. Capturing the value of supplementary services. *Harvard Business Review*, 73:75–83, 1995.
- Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., Lee, G., Patterson, D., Rabkin, A., Stoica, I., et al. A view of cloud computing. *Communications of the ACM*, 53(4):50–58, 2010.
- Armitage, S. Event study methods and evidence on their performance. *Journal of economic surveys*, 9(1):25–52, 1995.
- AT&T Inc. AT&T Next - Get A New Smartphone Every Year from AT&T Wireless. Retrieved March 8, 2016, 2016. URL <https://www.att.com/shop/wireless/next.html>.
- Aulbach, S., Grust, T., Jacobs, D., Kemper, A., and Rittinger, J. Multi-tenant databases for software as a service: schema-mapping techniques. In *Proceedings of the 2008 ACM SIGMOD international conference on Management of data*, pages 1195–1206. ACM, 2008.
- Aurich, J. C., Mannweiler, C., and Schweitzer, E. How to design and offer services successfully. *CIRP Journal of Manufacturing Science and Technology*, 2(3):136–143, 2010.
- Baines, T. S., Lightfoot, H. W., Evans, S., Neely, A., Greenough, R., Peppard, J., Roy, R., Shehab, E., Braganza, A., Tiwari, A., et al. State-of-the-art in product-service systems. *Proceedings of the Institution of Mechanical Engineers, Part B: journal of engineering manufacture*, 221(10):1543–1552, 2007.
- Baines, T. S., Lightfoot, H. W., Benedettini, O., and Kay, J. M. The servitization of manufacturing: A review of literature and reflection on future challenges. *Journal of manufacturing technology management*, 20(5):547–567, 2009.
- Benlian, A. and Hess, T. Opportunities and risks of software-as-a-service: Findings from a survey of it executives. *Decision Support Systems*, 52(1):232–246, 2011.
- Beuren, F. H., Ferreira, M. G. G., and Miguel, P. A. C. Product-service systems: a literature review on integrated products and services. *Journal of Cleaner Production*, 47:222–231, 2013.
- Binder, J. The event study methodology since 1969. *Review of Quantitative Finance and Accounting*, 11(2):111–137, 1998.
- Birkinshaw, J. Strategies for managing internal competition. *California Management Review*, 44(1):21–38, 2001.
- Campbell, C. J. and Wesley, C. E. Measuring security price performance using daily nasdaq returns. *Journal of Financial Economics*, 33(1):73–92, 1993.
- Casadesus-Masanell, R. and Tarzjian, J. When one business model isn't enough. *Harvard Business Review*, pages 132–137, 2012.
- Chandy, R. K. and Tellis, G. J. Organizing for radical product innovation: The overlooked role of willingness to cannibalize. *Journal of marketing research*, pages 474–487, 1998.
- Chesbrough, H. and Spohrer, J. A research manifesto for services science. *Communications of the ACM*, 49(7):35–40, 2006.
- Cohen, J. A coefficient of agreement for nominal scales. *Educational and psychological measurement*, 20(1):37–46, 1960.
- Cohen, W. M. and Levinthal, D. A. Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, 35:128–152, 1990.
- Cook, M. B., Bhamra, T., and Lemon, M. The transfer and application of product service systems: from academia to uk manufacturing firms. *Journal of Cleaner Production*, 14(17):1455–1465, 2006.
- Corrado, C. J. A nonparametric test for abnormal security-price performance in event studies. *Journal of financial economics*, 23(2):385–395, 1989.
- Cusumano, M. A., Kahl, S. J., and Suarez, F. F. Services, industry evolution, and the competitive strategies of product firms. *Strategic management journal*, 36(4):559–575, 2015.
- Dann, L. Y., Mayers, D., and Raab Jr, R. J. Trading rules, large blocks and the speed of price adjustment. *Journal of Financial Economics*, 4(1):3–22, 1977.
- Davies, A., Brady, T., and Hobday, M. Charting a path toward integrated solutions. *MIT Sloan management review*, 47(3):39, 2006.
- DriveNow UK Ltd. Discover DriveNow. Register online, wait for your DriveNow Customer Card and drive off! Retrieved March 8, 2016, 2016. URL <https://uk.drive-now.com/#!/howto>.
- Fang, E., Palmatier, R. W., and Steenkamp, J.-B. E. Effect of service transition strategies on firm value. *Journal of marketing*, 72(5):1–14, 2008.
- Fosfuri, A. and Giarratana, M. S. Masters of war: Rivals' product innovation and new advertising in mature product markets. *Management Science*, 55(2):181–191, 2009.
- Gartner, Inc. Gartner Hype Cycle. Retrieved July 10, 2016, 2016. URL <http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp>.
- Gebauer, H. An attention-based view on service orientation in the business strategy of manufacturing companies. *Journal of Managerial Psychology*, 24(1):79–98, 2009.
- Gebauer, H. and Friedli, T. Behavioral implications of the transition process from products to services. *Journal of Business & Industrial Marketing*, 20(2):70–78, 2005.
- Gebauer, H., Fleisch, E., and Friedli, T. Overcoming the service paradox in manufacturing companies. *European management journal*, 23(1):14–26, 2005.
- Gebauer, H., Ren, G.-J., Valtakoski, A., and Reynoso, J. Service-driven manufacturing: provision, evolution and financial impact of services in industrial firms. *Journal of Service Management*, 23(1):120–136, 2012.
- Greenwood, R. and Suddaby, R. Institutional entrepreneurship in mature fields: The big five accounting firms. *Academy of Management journal*, 49(1):27–48, 2006.
- Hannan, M. T. and Freeman, J. Structural inertia and organizational change. *American sociological review*, pages 149–164, 1984.
- Hendershott, T., Riordan, R., et al. Algorithmic trading and information. *Manuscript, University of California, Berkeley*, 2009.
- International Business Machines Corp. Annual report 2015. New York, 2015. URL <http://www.ibm.com/annualreport/2015/assets/img/2016/02/IBM-Annual-Report-2015.pdf>.
- Johnson, M. W., Christensen, C. M., and Kagermann, H. Reinventing your business model. *Harvard business review*, 86(12):57–68, 2008.
- Kastalli, I. V. and Van Looy, B. Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance. *Journal of Operations Management*, 31(4):169–180, 2013.
- Komssi, M., Kauppinen, M., Heiskari, J., and Ropponen, M. Transforming a software product company into a service business: Case study at f-secure. In *Computer Software and Applications Conference, 2009. COMPSAC'09. 33rd Annual IEEE International*, volume 1, pages 61–66. IEEE, 2009.
- Lee, J.-N., Huynh, M. Q., Kwok, R. C.-W., and Pi, S.-M. It outsourcing evolution—: past, present, and future. *Communications of the ACM*, 46(5):84–89, 2003.
- Levitt, T. Production-line approach to service. *Harvard business review*, 50(5):41–52, 1972.
- Lusch, R. F. and Vargo, S. L. Service-dominant logic: reactions, reflections and refinements. *Marketing theory*, 6(3):281–288, 2006.
- Ma, D. The business model of "software-as-a-service". In *Services Computing, 2007. SCC 2007. IEEE International Conference on*, pages 701–702. IEEE, 2007.
- MacKinlay, A. C. Event studies in economics and finance. *Journal of economic literature*, 35(1):13–39, 1997.
- Manzini, E., Vezzoli, C., and Clark, G. Product-service systems: using an existing concept as a new approach to sustainability. *Journal of Design Research*, 1(2):27–40, 2001.
- Markides, C. and Oyon, D. What to do against disruptive business models (when and how to play two games at once). *MIT Sloan Management Review*, 51(4):25–32, 2010.
- Martinez, V., Bastl, M., Kingston, J., and Evans, S. Challenges in transforming manufacturing organisations into product-service providers. *Journal of manufacturing technology management*, 21(4):449–469, 2010.
- Mathieu, V. Product services: from a service supporting the product to a service supporting the client. *Journal of Business & Industrial Marketing*, 16(1):39–61, 2001a.
- Mathieu, V. Service strategies within the manufacturing sector: benefits, costs and partnership. *International Journal of Service Industry Management*, 12(5):451–475, 2001b.
- McGrath, B. and Mahowald, R. P. Worldwide SaaS and Cloud Software 2015–2019 Forecast and 2014 Vendor Shares (Market Analysis No. 257397). IDC Research, Inc., 2015. URL <https://www.idc.com/getd>

- oc.jsp?containerId=257397.
- McWilliams, A. and Siegel, D. Event studies in management research: Theoretical and empirical issues. *Academy of management journal*, 40(3): 626–657, 1997.
- Mitchell, M. L. and Netter, J. M. Triggering the 1987 stock market crash: Antitakeover provisions in the proposed house ways and means tax bill? *Journal of Financial Economics*, 24(1):37–68, 1989.
- Morris, H. D. IDC's Software Taxonomy, 2015 (Industry Development and Models No. 256767). IDC Research, Inc., 2015. URL <https://www.idc.com/getdoc.jsp?containerId=256767>.
- Neely, A. Exploring the financial consequences of the servitization of manufacturing. *Operations Management Research*, 1(2):103–118, 2008.
- Neely, A., Benedettini, O., and Visnjic, I. The servitization of manufacturing: Further evidence. In *18th European operations management association conference*, volume 1, pages 3–6, 2011.
- Oh, W., Gallivan, M. J., and Kim, J. W. The market's perception of the transactional risks of information technology outsourcing announcements. *Journal of Management Information Systems*, 22(4):271–303, 2006.
- Oliva, R. and Kallenberg, R. Managing the transition from products to services. *International journal of service industry management*, 14(2):160–172, 2003.
- Park, N. K. A guide to using event study methods in multi-country settings. *Strategic Management Journal*, 25(7):655–668, 2004.
- Rapaccini, M. and Visintin, F. Full service contracts in the printing industry: An empirical investigation of service definition. In *Engineering, Technology and Innovation (ICE), 2014 International ICE Conference on*, pages 1–6. IEEE, 2014.
- Rexfelt, O. and Hiort af Ornäs, V. Consumer acceptance of product-service systems: designing for relative advantages and uncertainty reductions. *Journal of Manufacturing Technology Management*, 20(5):674–699, 2009.
- Rothaermel, F. T., Hitt, M. A., and Jobe, L. A. Balancing vertical integration and strategic outsourcing: effects on product portfolio, product success, and firm performance. *Strategic management journal*, 27(11):1033–1056, 2006.
- Sääksjärvi, M., Lassila, A., and Nordström, H. Evaluating the software as a service business model: From cpu time-sharing to online innovation sharing. In *IADIS international conference e-society*, pages 177–186. Qawra, Malta, 2005.
- Schmenner, R. W. Manufacturing, service, and their integration: some history and theory. *International Journal of Operations & Production Management*, 29(5):431–443, 2009.
- Scott, W. R. and Davis, G. F. *Organizations and organizing: Rational, natural and open systems perspectives*. Routledge, 2015.
- Slack, N. Operations strategy: will it ever realize its potential? *Gestão & Produção*, 12(3):323–332, 2005.
- Sosna, M., Treviño-Rodríguez, R. N., and Velamuri, S. R. Business model innovation through trial-and-error learning: The naturhouse case. *Long range planning*, 43(2-3):383–407, 2010.
- Stuckenberg, S., Fieft, E., and Loser, T. The impact of software-as-a-service on business models of leading software vendors: experiences from three exploratory case studies. In *Proceedings of the 15th Pacific Asia Conference on Information Systems (PACIS 2011)*. Queensland University of Technology, 2011.
- Stuckenberg, S., Kude, T., and Heinzl, A. Understanding the role of organizational integration in developing and operating software-as-a-service. In *Information Systems Outsourcing*, pages 313–345. Springer, 2014.
- Suarez, F. F., Cusumano, M. A., and Kahl, S. J. Services and the business models of product firms: an empirical analysis of the software industry. *Management Science*, 59(2):420–435, 2013.
- Sultan, N. Servitization of the it industry: the cloud phenomenon. *Strategic change*, 23(5-6):375–388, 2014.
- Sundin, E., Sandström, G. Ö., Lindahl, M., and Rönnbäck, A. Ö. Using company-academia networks for improving product/service systems at large companies. In *Introduction to Product/Service-System Design*, pages 185–196. Springer, 2009.
- Sydow, J., Schreyögg, G., and Koch, J. Organizational path dependence: Opening the black box. *Academy of management review*, 34(4):689–709, 2009.
- Teece, D. J. Business models, business strategy and innovation. *Long range planning*, 43(2-3):172–194, 2010.
- Tukker, A. Eight types of product-service system: eight ways to sustainability? experiences from suspronet. *Business strategy and the environment*, 13(4):246–260, 2004.
- Tukker, A. and Tischner, U. Product-services as a research field: past, present and future. reflections from a decade of research. *Journal of cleaner production*, 14(17):1552–1556, 2006.
- Ulaga, W. and Reinartz, W. J. Hybrid offerings: how manufacturing firms combine goods and services successfully. *Journal of marketing*, 75(6): 5–23, 2011.
- Vandermerwe, S. and Rada, J. Servitization of business: adding value by adding services. *European management journal*, 6(4):314–324, 1988.
- Vargo, S. L. and Lusch, R. F. Evolving to a new dominant logic for marketing. *Journal of marketing*, 68(1):1–17, 2004.
- Vargo, S. L. and Lusch, R. F. From goods to service (s): Divergences and convergences of logics. *Industrial marketing management*, 37(3):254–259, 2008a.
- Vargo, S. L. and Lusch, R. F. Service-dominant logic: continuing the evolution. *Journal of the Academy of marketing Science*, 36(1):1–10, 2008b.
- Velu, C. and Stiles, P. Managing decision-making and cannibalization for parallel business models. *Long Range Planning*, 46(6):443–458, 2013.
- Visnjic, I. and Van Looy, B. Manufacturing firms diversifying into services: A conceptual and empirical assessment. In *proceedings of the 20th POMS conference, Orlando, Florida*, 2009.
- Visnjic, I., Neely, A., and Wiengarten, F. Another performance paradox?: A refined view on the performance impact of servitization. (*SSRN Scholarly Paper No. ID 2117043*). Rochester, NY: Social Science Research Network, 2012.
- Walker, G. and Weber, D. A transaction cost approach to make-or-buy decisions. *Administrative science quarterly*, pages 373–391, 1984.
- Windahl, C. and Lakemond, N. Developing integrated solutions: The importance of relationships within the network. *Industrial Marketing Management*, 35(7):806–818, 2006.
- Wise, R. and Baumgartner, P. Go downstream: The new profit imperative in manufacturing. *Harvard Business Review*, 77:133–141, 1999.
- Xin, M. and Levina, N. Software-as-a-service model: Elaborating client-side adoption factors. In *Proceedings of the 29th International Conference on Information Systems. Paris, France*, 2008.
- Youseff, L., Butrico, M., and Da Silva, D. Toward a unified ontology of cloud computing. In *Grid Computing Environments Workshop, 2008. GCE'08*, pages 1–10. IEEE, 2008.
- Zahra, S. A. and George, G. Absorptive capacity: A review, reconceptualization, and extension. *Academy of management review*, 27(2):185–203, 2002.
- Zuckerman, E. W. The categorical imperative: Securities analysts and the illegitimacy discount. *American journal of sociology*, 104(5):1398–1438, 1999.