RESEARCH ARTICLE

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# Differential effects of product and service innovations on the financial performance of industrial firms

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**Abstract:** Industrial companies face the particular challenge of developing new products and services in traditionally goods-centered environments. Using panel data from 558 German industrial companies, this article analyzes the financial performance consequences of product and service innovations. The analysis confirms a positive impact of product innovations on both revenue and profitability growth, whereas the profitability of an average industrial company remains unaffected by its service innovation activities, pointing to the challenge of managing the costs of service innovation in goods-centered environments. A moderation analysis provides a finer grained view: Isolating mechanisms, such as the complexity of market offerings and financial innovation barriers, disrupt the link between innovation and profitability growth for both innovation types. Specifically, they make service innovations more profitable but have detrimental effects on product innovation profitability. Factors that traditionally hinder financial success with product innovations actually provide effective safeguards for service innovations.

**Keywords:** Service innovation · Product innovation · Company performance · Industrial markets · Seemingly unrelated regression (SUR)

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## Introduction

Employee engagement Innovation is a fundamental driver of organic growth (De Faria and Mendonça 2011; Kindstroem 2010; Melton and Hartline 2013) and key in establishing and sustaining competitive advantage (Cainelli et al. 2004; Hunt and Morgan 1996). Despite a lively debate about how exactly innovative firms outperform non-innovators, researchers and practitioners generally agree on the beneficial performance effects of innovations. Yet most research focuses on goods-related innovation (e.g. Bowen et al. 2010; McNally et al. 2010) such that the effects of innovation in services has attracted substantial attention only recently (Aas and Pedersen 2011; De Brentani 2001; Ordanini and Parasuraman 2011; Dotzel et al. 2013).

However, service innovation is no longer the exclusive domain of service companies (Bettencourt and Brown 2013; Kindstroem 2010). Product-driven (or goods-based) firms, referring to those companies typically classified within the industrial sector whose core market offering is a physical good, systematically add innovative services to their traditional product-based business (Fang et al. 2008; Gebauer et al. 2011; Jacob and Ulaga 2008). Their goal is to strengthen the company's competitive position, stabilize cash flows, protect the core product business, and generate additional revenues from existing and new customers (e.g. Neu and Brown 2005; Wise and Baumgartner 1999). In fact, nowadays over 30% of large manufacturing firms venture into the service business, with the proportion increasing to almost 60% in Western economies (Neely 2008). Along with Caterpillar, IBM, GE, Siemens, and Philips, Claas evolved from a pure product manufacturer of agriculture machines (e.g. harvester, mowers, rakes) into a provider of maintenance, repair and technical training services, where the development of new services is an integral part of the overall business strategy.

The specific characteristics of industrial markets raise the question whether findings derived from goods-based innovation research (Bowen et al. 2010; Hult et al. 2004) or the analysis of innovation activities by pure service firms (Cainelli et al. 2004; McDermott and Prajogo 2012) apply to industrial companies. Most notably, industrial firms are in the unique position to innovate in products and services and thus need to allocate scarce resources to both innovation types (Kindstroem et al. 2012). They need to choose wisely as to where and to what extent to innovate. In addition, the traditionally goods-centered business model of industrial firms can be a boon or bane for the development of new services. Utilizing the installed base of products allows industrial firms to develop new services that complement their own goods thus leveraging their existing customer base to market new services (Ulaga and Reinartz 2011). However, given the product-centric history of industrial firms, venturing into service innovations requires a strategic change process demanding new capabilities and skills that not all industrial firms are likely to master (Bettencourt and Brown 2013; Kindstroem 2010).

Due to the lack of empirical evidence open questions remain concerning the impact of product and service innovation on the performance of industrial firms. Particularly,

practitioners need to understand the consequences of both innovation types to take informed management decisions (Barczak 2012). To shed more light on this important area of innovation research, we investigate the following research questions: Do both innovation types contribute to industrial companies' bottom line? Can we identify contingency conditions that promote the effect of product and service innovations on industrial companies' financial performance? Do the same conditions that favor product innovations enhance the financial impact of service innovations?

Using panel data from 558 German industrial companies covering a three-year period, this study investigates the financial outcomes of two innovation types. Our analysis confirms a positive impact of product innovations on both revenue and profit growth, whereas the profitability of the average industrial company remains unaffected by its service innovation activities. The development of service innovations only pays off in the presence of isolating mechanisms, such as the complexity of market offerings and financial innovation barriers. They make service innovation more profitable but have detrimental effects on product innovation profitability. By delineating these effects, this study makes the following contributions: To the best of our knowledge, this is the first empirical study comparing the effectiveness of both innovation types and thus offers a broader understanding of the underlying performance effects. Specifically, our findings extend prior research focusing either on the financial outcomes of product or service innovation (Gebauer et al. 2011; Kastalli and Van Looy 2013). Further, as our research disentangles the revenue and profit implications of both innovation types it also captures their underlying cost effects; thus highlighting the critical role of cost monitoring when it comes to service innovations. Finally, this study improves our knowledge about the most salient moderator variables that determine industrial companies' success with innovation activities.

The remainder of this article is structured as follows: We first review existing literature on product and service innovation. After we develop our hypotheses, drawing on resource-advantage theory, we present the methodology, specify our model, and detail findings from our hypotheses tests. On the basis of these insights, we derive implications for practitioners. Finally, this article concludes with some limitations and further research directions.

## Literature review

In general, innovation refers to the generation and implementation of new market offerings that previously were unavailable to the firm's customers (Ordanini and Parasuraman 2011). With respect to product innovation, empirical studies typically find positive effects on financial performance outcomes (Hult et al. 2004; Zhou 2006), ranging from moderate (Danneels and Kleinschmidt 2001) to strong (Firth and Narayanan 1996). For example, product innovation relates positively to revenue growth (De Faria and Mendonça 2011) and profitability (Cozza et al. 2012). In support of this, several meta-analyses confirm the positive impact of product innovation on firm performance (Bowen et al. 2010; Calantone et al. 2010; Szymanski et al. 2007).

When it comes to service innovations empirical controversy remains whether they can directly impact the bottom line and thus truly differentiate a firm in the marketplace (Bettencourt and Brown 2013). Researchers and practitioners have expected positive performance effects (Aas and Pedersen 2011; Kindstroem 2010), following the assumption that they exert indirect effects on company performance through improved customer satisfaction and loyalty (Baines et al. 2009). Chen et al. (2009), for example, argue that service innovation can lock-in customer loyalty due to the enhanced ability to meet and exceed customers' needs. The authors report a strong effect of service innovation on the non-financial performance construct (e.g. image, reputation). Further, amongst others, Thakur and Hale (2012) confirm a positive effect on loyalty of existing customers as well as the attraction of new customers to the firm. However, other studies document that the development of new services can also directly impact the financial outcomes such as revenue growth (e.g., Cainelli et al. 2004), profitability (e.g. Cheng and Krumwiede 2012; Ordanini and Parasuraman 2011) and ultimately firm value (Dotzel et al. 2013). Yet the overall results remain mixed, as shown in our summary of empirical research in Table 1. Aas and Pedersen (2011) find no effect of service innovation on company profitability and profitability growth, and Mansury and Love (2008) observe an insignificant relationship between service innovation and economic value added per employee. Compared with goods-based counterpart, research on service innovation remains new and offers ambiguous empirical evidence.

**Tab. 1:** Empirical research on financial performance outcomes of service innovation

| Authors (Year) | Sample | Financial performance measures | | | Company type | | Innovation types | | Method | Moderating effects |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Revenue | Profit | Performance construct | Service firms | Industrial firms | Product innovation | Service innovation | | |
| Aas and Pedersen (2011) | 4707 firms located in Norway | n.s. / + (revenue/employee) | n.s. / n.s. (BEP ratio) | | x | x | | x | Mann-Whitney W. Test | |
| Cainelli et al. (2004) | 735 Italian firms across eight sectors | + (revenue growth, revenue/employee) | | | x | | | x | RA | |
| Chen et al. (2009) | 123 Taiwanese service firms | | | + revenue, profit, market share (5 items) | x | | | x | SEM (PLS) | |
| Cheng and Krumwiede (2012) | 235 Taiwanese service firms | | | + / + non-financial (3 items) / financial (3 items) outcome | x | | | x | SEM (AMOS) | |
| Eisingerich et al. (2009) | 114 firms of three service sectors | | + (net income) | | x | | | x | SEM (PLS) | Relationship diversity and commitment |
| Gebauer et al. (2011) | 332 European manufacturers | | | + financial results, market share (2 items) | | x | x (single innov. construct) | x | SEM (AMOS) | Service differentiation |
| Grawe et al. (2009) | 304 Chinese service firms | | | + revenue, profit, market share (4 items) | x | | | x | SEM | |
| Lin and Chen (2007) | 877 Taiwanese firms | n.s. (revenue) | | | x | x | x (single innov. construct) | x | RA | |
| Mansury and Love (2008) | 206 U.S. service firms | + (revenue growth) | n.s. (value added employee) | | x | | | x | RA (2SLS) | Six knowledge sources |
| McDermott and Prajogo (2012) | 180 AUS service firms of 14 sectors | | | + revenue, profit, market share (3 items) | x | | | x | RA | Firm size |
| Ordanini and Parasuraman (2011) | 91 Italian hotels | + (revenue) | + (EBIT) | | x | | | x | RA (3SLS) | Volume and radicalness of innovation |
| Thakur and Hale (2012) | 169 U.S. and 146 Indian service firms | | | + / + non-financial (4 items) / financial (5 items) outcome | x | | | x | SEM (PLS) | |
| **This research** | 558 German firms across 16 sectors | + / + (revenue growth) | + / n.s. (profitability growth) | | | x | x | x | SUR | Innovation barriers Complexity Innovation intensity |

Notes: + positive effect, n.s. non-significant effect, RA = OLS-based regression analysis, SEM = structural equation modeling, SUR = seemingly unrelated regression.

To date, most of the empirical studies available focus on companies operating exclusively in the service sector, such as when Ordanini and Parasuraman (2011) analyze the financial outcomes of service innovation in the hotel industry, or when Cainelli and colleagues (2004) consider various service sectors, ranging from software development to hotels to financial services. While empirical studies pay particular attention to the financial service sector (e.g. Papastathopoulou and Hultink 2012), little research has addressed the performance consequences of service innovation in industrial firms – a surprising gap, considering that these firms face the particular challenge of developing both new products and new services in a traditionally goods-based environment (Kindstroem et al. 2012). Service innovations require different development processes than physical goods (e.g. De Brentani 1991) and established routines in industrial firms might become obsolete or even hinder the success of service innovations. De Brentani (1991) discusses how each of the four service characteristics (intangibility, inseparability, heterogeneity, and perishability) affects firms' service innovation activities. Most notably, she refers to the high degree of uncertainty as the majority of service innovations remain conceptual throughout the development process. Against this background, service innovation in industrial companies offers a promising, yet under-researched field (Droege et al. 2009).

The summary in Table 1 also shows that empirical studies rarely consider both innovation types but instead focus on exploring the performance consequences of either product innovation (Cozza et al. 2012) or service innovation (Aas and Pedersen 2011). Yet, research still neglects to address whether or not performance effects of product innovation apply readily to service innovations as well (Barczak 2012). Evidence of performance differences between these types suggests the need for a systematic comparison though (Ettlie and Rosenthal 2011). In addition, several studies subsume product and service innovation into a single innovation construct to capture the total effect of any innovation type. For example, Lin and Chen (2007) treat product and service innovations as two sub dimensions of technological innovation. Examining both innovation types separately within a single analytical framework provides an even finer-grained perspective on the differential performance implications.

Scholars have also called for an in-depth understanding of the financial performance outcomes of service innovations, highlighting that previous research typically focused on single outcome measures, such as revenue or profit streams (Eisingerich et al. 2009). Beyond this, some studies aggregate multiple indices into a latent performance construct, which ignores the potential for differential effects (Gebauer et al. 2011; Grawe et al. 2009). For example, Chen et al. (2009) subsume revenues, profits and market share under the single construct business performance.

When empirical studies examine multiple indices separately (e.g. revenues, profits), they primarily rely on ordinary least squares regressions (Lin and Chen 2007; McDertmott and Prajogo 2012), such as when Cainelli and colleagues (2004) conduct separate OLS regressions for each dependent variable. However, scholars call for a more elaborated selection of analytical techniques (e.g. Papastathopoulou and Hultink 2012). From a methodological point of view, a simultaneous assessment of regression

equations control for potential correlations (Dotzel et al. 2013; Grimpe 2007; Zellner 1962). Therefore, investigating financial performance outcomes within a single analytical framework should produce more reliable results.

Finally, rather than expecting similar effects across the board, it is assumed that certain contextual factors exhibit differential effects on the innovation-performance relationship (e.g. McDermott and Prajogo 2012). As Table 1 documents, two types of moderating variables appear in prior studies: external characteristics referring to environmental or market conditions as well as internal characteristics of the firm. For example, Eisingerich et al. (2009) demonstrate that relationship commitment positively and relationship diversity negatively moderates the financial performance of service innovation. With regard to the internal factors extant literature reported that firm size positively impacts the performance of service innovation (McDermott and Prajogo 2012). Yet because this previous research has focused on moderating effects for either product (Calantone et al. 2010) or service innovation (Eisingerich et al. 2009), it fails to shed light on the potentially differential effects of contextual variables on both innovation types.

In summary, the growing literature on service innovation still suffers from several gaps in understanding. First, whereas previous research on service innovation most likely focuses on the service sector, we conduct our empirical investigation on a representative sample of German industrial firms. Second, to overcome the limitations of studying either product or service innovations, we pursue a more fine-grained view of the performance differences as both innovation types are considered. Third, we contribute to literature by disentangling the growth of firms' revenue and profit trajectories within a single analytical approach. Fourth, we offer new insights for the conditions under which service innovations promote performance growth, especially the internal characteristics that support or hinder service innovations success.

## Theoretical background

To analyze the financial performance outcomes of product and service innovations, we draw on the resource-advantage (RA) theory of competition, which represents an extension of the resource-based view (RBV) of the firm. RA theory describes firms as combiners of tangible and intangible entities (resources) the organization owns, controls, or to which it has access (Hunt and Madhavaram 2006). Whereas the RBV posits that these persisting resource endowments explain performance differences (Barney 1991), whereby the sheer possession of particular resources drives value creation, RA theory also takes the market position of a firm into account (Hunt 2013; Hunt and Morgan 1997). In other words, resources do not lead per se to competitive advantage, but instead provide the raw materials with rent earning potential (Morgan 2012). RA theory holds that companies achieve financial success by competing for superior resources that yield competitive advantages in one or more market segments, due to either lower resource costs and/or greater value in the market offering (Hunt and Morgan 1996). As innovations allow firms to lower their resource costs or create superior value for their target market segments, RA theory underscores the importance of innovation (Hunt and Davis 2012). However, once companies achieve

superior performance, competitors try to neutralize and/or leapfrog advantaged firms by acquisition, substitution, imitation or major innovation (Chen et al. 2009).

Thus, RA theory provides a useful framework for explaining how resource combinations, applied in the right market segment, generate competitive advantages and superior financial performance. This competitive process is influenced by a wide range of environmental factors such as the societal resources of a firm (e.g. innovation intensity, market offering complexity, and financial innovation barriers), societal institutions, actions of competitors, supplier and customer characteristics or policy decisions (Hunt and Morgan 1996).

**Direct effects of innovation on company performance**

Industrial markets are characterized by increasing competition and a growing need for differentiation (Neu and Brown 2005), which according to RA theory makes innovation activities a logical response (e.g. Hunt 2013). Companies innovate to neutralize a competitor's superior market position or to obtain a competitive edge. In either case, innovation leads "to the discovery, creation, or assembling of resources assortments that enable the innovating firm to efficiently and/or effectively produce value added market offerings" (Hunt and Morgan 1997, p. 79). By occupying advantageous market positions and serving customers who value those market offerings, companies obtain competitive advantages and superior performance (Hunt 2013).

Industrial firms have for long been reliant on bringing innovative new products to the market. Thus, product innovation is an effective source of this competitive advantage. By differentiating themselves from competitors, companies can realize a price premium (Baines et al. 2009). Fulfilling customers' needs better enables the companies to demand higher prices for their market offerings. When developing new products, industrial companies innovate in familiar markets. With their goods-based business model, industrial firms typically possess the required market knowledge and understand how to communicate with customers (McNally et al. 2010), which ensures efficiency and effectiveness when rolling out new products to targeted market segments. On the basis of these arguments and in line with extant literature (e.g., Bowen et al. 2010; Calantone et al. 2010), we expect a positive impact of product innovation on revenue growth. Furthermore, consistent with earlier studies, we expect that product innovation is an important driver of firm profitability. Although the development of new products can be a cost intensive (e.g., significant investments in machinery) and risky undertaking (e.g., commercialization is not guaranteed), product innovations have been shown to generate above-average profits (Artz et al. 2010). Particularly, when new products are introduced, they face little direct competition which ultimately generates higher product margins. Against this background, we suggest product innovation as a driver of both, revenue and profitability growth.

*H1: Product innovation positively influences (a) revenue growth and (b) profitability growth of industrial companies.*

Like product innovations, service innovations also might add value to industrial firms' market offerings (Gebauer et al. 2011). Aimed primarily at fulfilling customers need more thoroughly service innovations create benefits for existing as well as new customers (Kindstroem, et al. 2012). Supporting this view, RA theory suggests that meeting customer needs and wants is central to competition (Hunt 2013). In industrial markets, in which many suppliers find it increasingly difficult to differentiate their products effectively from competitors' offerings, service innovations provide an important source of competitive advantage that ultimately might lead to improved financial performance (e.g. Aas and Pedersen 2011; Cainelli et al. 2004). Irrespective of the sector examined several studies indicate that service innovation can positively impact firm's performance (Cheng and Krumwiede 2012; Dotzel et al. 2013). Therefore, we expect a positive impact of service innovations on revenue growth:

*H2: Service innovation positively influences revenue growth of industrial companies.*

Service innovations in a goods-centered business environment require major organizational changes (e.g. service-oriented company culture, decentralized decision authority) and the development of new resources and capabilities, which incur substantial costs (Gebauer et al. 2010; Ulaga and Reinartz 2011). Competing against new market players and operating in unfamiliar market environments (Mathieu 2001) add to the challenge of capturing a superior market position. Supporting this view, Eggert et al. (2014) show that cost containment of service provision is a severe problem in industrial markets. That is, the cost of the new service business frequently outweigh revenue enhancement. We therefore expect that, on average, the profit growth of industrial companies remains unaffected by its service innovation activities.

**Moderator of the innovation-revenue growth relationship**

*Innovation intensity.* From an RA theory perspective, firms need continuous rather than occasional innovation activities to maintain their market position of competitive advantage (Hunt and Morgan 1996). The market success of product and service innovations is contingent on innovation intensity defined as the firms' yearly expenditures for innovation activities divided by their revenues (De Faria et al. 2010). With increasing innovation intensity, firms rely more on formal innovation processes, a critical success factor for both innovation types (Cooper and De Brentani 1991; Froehle et al. 2000). Firms place more emphasis on managing key innovation activities to enhance the effectiveness of their product and service innovations (Ettlie and Rosenthal 2011). For example, allocating more money to R&D activities allows companies to test their market offerings with target customers and use customer feedback to improve future products and services. Companies might invest more in market research and the product launch (De Jong and Vermeulen 2003), which should improve the odds of introducing a successful new market offering (e.g. marketing, training of employees). Innovation intensity should strengthen the positive impact of product and service innovation on revenue growth of industrial companies.

*H3: When the moderator innovation intensity is high (a) service innovation as well as (b) product innovation has a positive impact on revenue growth.*

**Moderators of the innovation–profitability growth relationship**

Establishing a sustainable competitive advantage is key to securing profitability growth. Industrial firms need to find ways to shield their innovations from competitors in order to capture the returns from their innovation activities. Isolating mechanisms can effectively deter competitors from imitating and thus protect the innovator's profit stream (Cho et al. 2012; Hunt and Morgan 1996). However, isolating mechanisms are double-edged swords and might exhibit differential effects on profitability growth depending on the type of innovation (e.g. Madrid-Guijarro et al. 2009). Specifically, whereas isolating mechanisms likely safeguard differentiation and strengthen the profit impact of innovations, they are costly and may weaken the effect of innovation on profitability growth. In this study, two informal isolation mechanisms are considered: market offering complexity and financial innovation barriers.

*Market offering complexity.* Product innovations are patentable and often are protected by various legal intellectual property rights (e.g. trademarks, copyrights), such that innovating companies have the exclusive right to capture the market value of their superior offerings. For example, a patent allows innovators to enjoy a (temporary) monopoly and thus safeguard innovation returns. Service innovations, in contrast, rarely are patentable and are thus more exposed to imitation (e.g. Artz et al. 2010). The use of alternative isolating mechanisms in turn might be more important for service innovations (Cho et al. 2012).

One way to prevent competitive imitation is to design complex market offerings. Market offering complexity captures the difficulty to understand and analyze an interconnected set of components. For service innovations in particular, that are characterized by intangibility and a high degree of customer interaction, competitors will find it difficult to decompose a complex market offering and duplicate its components. Service knowledge also is embedded in employees (Cantner et al. 2011), and without market transparency, competitors might not be able to identify which resources provide the foundation for a competitive advantage. In line with RA theory, we expect that causal ambiguity helps companies protect their knowledge and strengthens the profit impact of service innovations. In other words, as long as the knowledge in question is kept secret, returns will be exclusive to the innovator (e.g. Cho et al. 2012). However, complexity should be less effective as an isolating mechanism for product innovations, because reverse engineering techniques can more easily decompose the new product and copy its components (e.g. Ittner and Larcker 1997). Complexity also raises manufacturing costs, increases the odds of product failure, and adds to the challenge of communicating the benefits of the innovative product to targeted market segments. In summary, we expect complexity to strengthen the profit impact of service innovations but hinder this impact for product innovations:

*H4a: When the moderator market offering complexity is high (a) service innovation has a positive impact on profitability growth.*

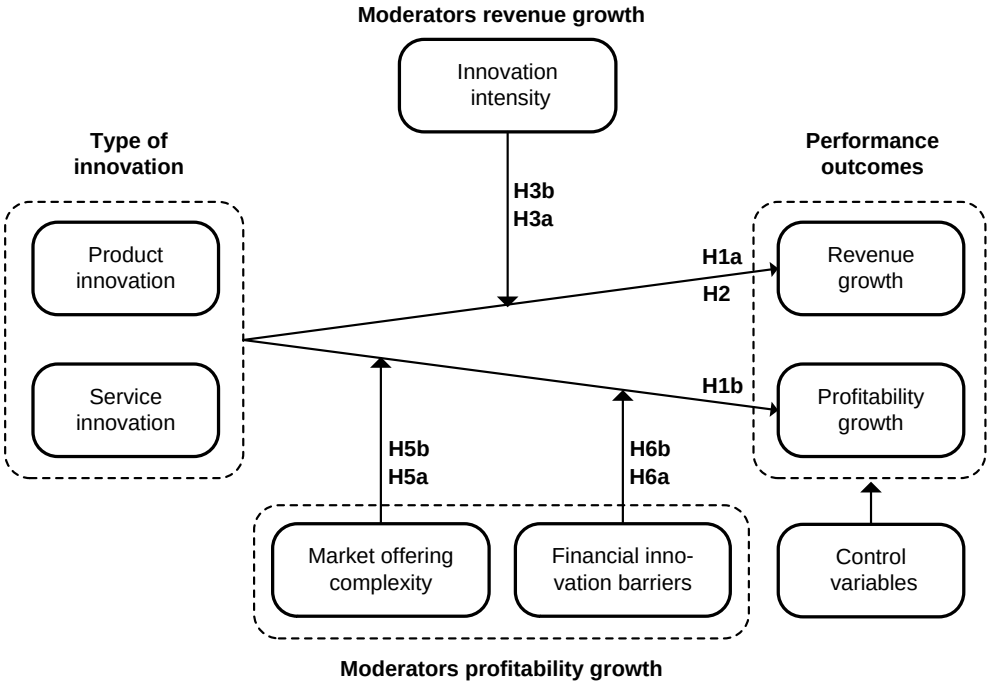
*H4b: When the moderator market offering complexity is high (a) product innovation has a negative impact on profitability growth.*

*Financial innovation barriers.* We expect a similar pattern of effects for financial innovation barriers referring to financial obstacles that prevent firms from innovation. That is, high investment costs and financial risks deter many companies from innovating in services (D'Este et al. 2012). Service innovations often require heavy investments in human resources, the acquisition of new capabilities and skills (Oliva and Kallenberg 2003), and major organizational changes for companies with a goods-centered tradition (Martinez et al. 2010). A service infusion thus incurs substantial and unforeseeable costs (Mathieu 2001; Renault et al. 2010). The high degree of uncertainty and financial risk associated with service innovation functions as an effective entry barrier, protecting the profits of incumbent firms. As product-oriented organizations, industrial firms instead are more familiar with product innovation, so their experience enables them to assess the costs and financial risks in this area. We expect financial innovation barriers to protect the profit stream of service innovations; however the cost of overcoming the barriers should weaken the link between product innovations and profitability growth:

*H5a: When the moderator financial innovation barriers is high (a) service innovation has a positive impact on profitability growth.*

*H5b: When the moderator financial innovation barriers is high (b) product innovation has a negative impact on profitability growth.*

**Fig. 1**: Overview of the theoretical model



## Empirical analysis

### Methodology

Seemingly unrelated regression (SUR) was applied to estimate the effect of the independent variables on the two dependent variables (Zellner 1962): revenue and profit growth. SUR simultaneously estimates the two regression models and allow the error terms of the independent variables to correlate (Grimpe 2007). The parameter estimation takes the correlated residuals into account and uses additional information for the estimation (Srivastava and Giles 1987), resulting in smaller standard errors and more precise regression coefficients. That is, SUR enables a simultaneous parameter estimation of n dependent variables, and the estimation efficiency further increases with different sets of independent variables and a larger sample size (Grimpe 2007; Srivastava and Giles 1987). In the case of uncorrelated residuals and identical sets of independent variables, SUR would produce results identical to two OLS regressions. Although SUR models are popular in econometrics, they have only recently been applied in innovation research and the field of marketing (e.g. Dotzel et al. 2013).

### Sample

We rely on the Mannheimer Innovation Survey (MIP) (Cantner et al. 2011; Thomae and Bizer 2013), which is administrated by the Centre for European Economic Research (ZEW Mannheim) on behalf of Eurostat, the statistical office of the European Union. The objective of this regular, bi-annual postal questionnaire is to systematically monitor the innovation behavior of German enterprises at the firm level. The concepts, constructs and questions are well tested (Laursen and Salter 2006) and follow the recommendations of the OECD on measuring innovation. Therefore, the six page questionnaires include questions on innovation activity, on company as well as firm characteristics, and general firm data. The survey is repeatedly sent out to senior managers of firms with ten or more employees and designed to be representative for all regions, industrial sectors covered, and enterprise sizes. A non-response analysis is conducted to ensure that the sample is representative of the population. As our research focuses on industrial firms, the sample is restricted to the NACE sectors 10–36, 50–52, 60–63 and excludes pure service companies. Further, as we are interested in analyzing the financial outcomes of innovation activities, our data comprises firms with (1) product innovations, (2) service innovations or (3) no innovations in the given period.

We analyze data from two consecutive survey waves (MIP 2005 and 2007). The analysis is limited to observations that supply data for both measurement waves and do not contain missing values, because SUR requires complete data sets. Our final sample consists of 558 complete observations across both measurement waves. To check for potential sample selection bias, we compared retained cases and the initial data set on their demographic data, including firm size and turnover. Dropped companies tend to be larger than the ones included in the final sample. With regard to

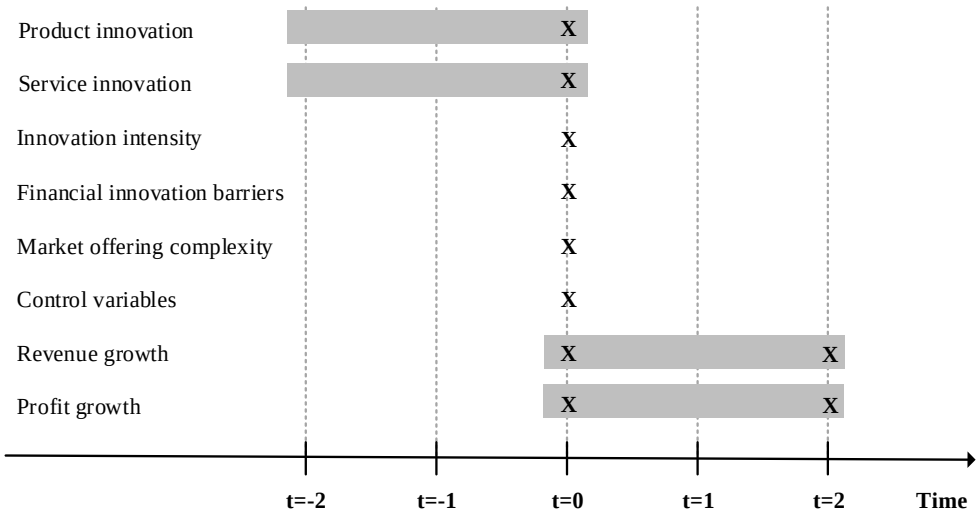
turnover, companies not incorporated in the final sample report higher revenues compared to the retained firms. However, the independent sample t-tests for equality of means revealed no significant differences between both groups (size: t=0.85, p=0.39; revenues: t=0.91, p=0.35), suggesting that sample selection bias is not a serious problem.

Sampled firms report, on average, annual revenues of 95.2 million Euros and 231 employees. We can differentiate 16 industry sectors; firms belonging to the metal (94 firms), machinery (59 firms), and medical equipment (59 firms) sectors account for the most prominent observations. A total of 292 companies are small firms (up to 50 employees), 169 are medium sized (between 51 and 250 employees) and 97 are classified as large (more than 250 employees).

## Measures

To measure the dependent variables, company performance, we relied on revenue and profitability growth (Cozza et al. 2012). To capture revenue growth, respondents indicated their companies' revenue in 2004 and 2006 (as reported in MIP survey wave 2005 & 2007) in monetary terms. To correct for nonnormality, as indicated by kurtosis and skewness indices, we apply a natural logarithmic transformation of the revenue data after calculating the difference between the two measurement waves. The operationalization of profitability used a categorical scale that measured the operating profit margin in 2004 (MIP 2005) and 2006 (MIP 2007); the difference is calculated likewise for measuring profit growth. Figure 2 provides a graphical representation of the measurement waves and data points used to measure the variables.

**Fig. 2**: Measurement waves and data points




With regard to the independent variables, we consider two innovation types: product and service innovation. The MIP questionnaires draws from a long tradition of research on innovation (for example, see Laursen and Salter 2006) and defines innovations as all new or significant improved goods and services (e.g. improvement in

quality or distinct user benefits) that are new to the firm/business unit but not necessarily new for the market. Rather than limiting respondents by offering a predefined list of certain innovations, it is thus left to the respondent to make a decision about the exact nature and type of innovation. In line with previous research (e.g., Therrien et al. 2011), we employed binary variables to capture the firms' innovation activities. Two dummy variables indicate whether a company introduced a new product in the in the three years prior to the questionnaire (2002-2004) that was (1) a physical good or (2) a service.

We also measure financial innovation barriers, market offering complexity, and innovation intensity as potential moderators of the innovation–performance link. The financial innovation barriers construct consists of four items that measure different financial innovation obstacles companies may face, more specifically we are measuring the economic risk, innovation costs, and the presence of insufficient internal as well as external funding sources (D'Este et al. 2012). To determine the importance of market offering complexity as a protection mechanism for innovations, respondents indicated whether designing and producing complex market offerings—goods and services – is a vital part of their company's overall strategy. Innovation intensity is measured as overall innovation expenditures divided by revenues (e.g. De Faria et al. 2010). Compared with frequently used proxies referring to R&D expenditures, this measure provides a broader view of the construct. We also use firm size, measured as the natural logarithm of the number of employees as a control variable. Because we capture profit on a Likert-type scale, we control for the natural limitation on profit changes close to the scale boundaries. We calculate the distance of the 2004 profit measure from the center of the scale and add it as a control variable to our profit growth model (Wang et al. 2008). All measurement scales and items are documented in the Appendix, while the correlation matrix is presented in Table 2.

**Tab. 2**: Descriptive statistics and correlations

| **Variable** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
|---|---|---|---|---|---|---|---|---|---|
| 1 Revenue growth | 1 | | | | | | | | |
| 2 Profitability growth | 0.20 | 1 | | | | | | | |
| 3 Product innovation | 0.09 | 0.04 | 1 | | | | | | |
| 4 Service innovation | 0.09 | 0.04 | 0.10 | 1 | | | | | |
| 5 Financial innovation barriers | 0.09 | 0.07 | 0.11 | 0.05 | 1 | | | | |
| 6 Market offering complexity | 0.05 | 0.01 | 0.25 | 0.11 | 0.07 | 1 | | | |
| 7 Innovation intensity | 0.13 | 0.06 | 0.30 | 0.18 | 0.18 | 0.21 | 1 | | |
| 8 SIZE (ln) | 0.18 | -0.02 | 0.28 | -0.01 | -0.04 | 0.07 | -0.05 | 1 | |
| 9 DISTANCE | -0.02 | -0.44 | 0.07 | 0.01 | -0.11 | -0.01 | 0.12 | 0.01 | 1 |
| **Mean** | 0.08 | 0.32 | 0.47 | 0.08 | 5.83 | 0.48 | 0.05 | 3.87 | -0.53 |
| **SD** | 0.43 | 1.53 | 0.50 | 0.27 | 3.71 | 1.02 | 0.08 | 1.61 | 1.70 |

## Models

We built two regression models: one with revenue growth as the dependent variable and one with profit growth as the dependent variable. The formal model specification is as follows:

(1) $\Delta Revenue_{2006\text{-}2004} = \beta_0 + \beta_1$ product innovation$_{2004} + \beta_2$ service innovation$_{2004} + \beta_3$ innovation intensity$_{2004} + \beta_4$ (innovation intensity$_{2004}$ x product innovation$_{2004}$) + $\beta_5$ (innovation intensity$_{2004}$ x service innovation$_{2004}$) + $\beta_6$ SIZE (ln) $_{2004} + \varepsilon_{revenue}$.

(2) $\Delta Profitability_{2006\text{-}2004} = \alpha_0 + \alpha_1$ product innovation$_{2004} + \alpha_2$ service innovation$_{2004} + \alpha_3$ financial innovation barriers$_{2004} + \alpha_4$ (financial innovation barriers$_{2004}$ x product innovation$_{2004}$) + $\alpha_5$ (financial innovation barriers$_{2004}$ x service innovation$_{2004}$) + $\alpha_6$ market offering complexity$_{2004} + \alpha_7$ (market offering complexity$_{2004}$ x product innovation$_{2004}$) + $\alpha_8$ (market offering complexity$_{2004}$ x service innovation$_{2004}$) + $\alpha_9$ $SIZE_{2004} + \alpha_{10}$ $DISTANCE_{2004} + \varepsilon_{profitability}$.

(3) $\rho = cov\ (\varepsilon_{revenue}, \varepsilon_{profitability})$.

where α and β represent the regression parameters to be estimated, and ρ refers to the correlation between the two error terms, $\varepsilon_{revenue}$ and $\varepsilon_{profitability}$. We mean-centered all metric independent variables as well as moderating variables to ensure unbiased parameter estimations and to further account for potential multicollinearity created by the interaction terms. The regression coefficients for the independent variables reflect the influence on the dependent variable at the average value of the moderator variables and the interpretation of the moderator remains unaffected (Hair et al. 2009).

## Results

We employed STATA 11 using generalized least squares estimation to determine both regression models simultaneously. The Breusch-Pagan test of independence reports a $\chi^2$ of 19.342 ($p$ = .000), which confirms that the residuals of the two regression models are not independent. In a similar vein, the significant cross-model correlation of .186 underscores the importance of simultaneously estimating both regression models. Table 3 reports two SUR estimations: Model 1 incorporates the main effects (i.e., product and service innovations), and model 2 adds the moderating effects leading to higher $R^2$ values in both revenue growth as well as profitability growth. For each model, the revenue growth model appears in the upper half, and the profitability growth model is documented in its lower half.

Model 2 shows both innovation types exhibit differential effects on revenue and profit growth. In support of H1a and H1b, for firms pursuing product innovations, we find a positive impact on revenue growth (β = .513, $p$ < .01) and profitability growth (β = .248, $p$ < .05). In H2, we predicted a positive impact of service innovations on revenue growth. We find just such a significantly positive relationship (β = .760, $p$ < .01). Further, in line with our expectations we cannot find a significant effect for profitability growth of service innovations (β = -.034, $p$ > .05).

**Tab. 3**: Results of the seemingly unrelated regression (SUR)

| | | Model 1 | | | Model 2 | | |
|---|---|---|---|---|---|---|---|
| | | **Coef.** | **SE** | **p** | **Coef.** | **SE** | **p** |
| **Dependent variable: Revenue growth ($R^2$: model 1 = 0.19; model 2 = 0.23)** | | | | | | | |
| H1a | Product innovation (PI) | 0.025 | 0.037 | 0.25 | 0.513 | 0.189 | 0.01** |
| H2 | Service innovation (SI) | 0.143 | 0.065 | 0.01** | 0.760 | 0.239 | 0.01** |
| | Innovation intensity | | | | -0.445 | 0.375 | 0.12 |
| H3b | Innovation intensity × PI | | | | 1.229 | 0.455 | 0.01** |
| H3a | Innovation intensity × SI | | | | 1.703 | 0.632 | 0.01** |
| | SIZE (ln) | 0.047 | 0.011 | 0.00** | 0.051 | 0.011 | 0.00** |
| **Dependent variable: Profitability growth ($R^2$: model 1 = 0.04; model 2 = 0.08)** | | | | | | | |
| H1b | Product innovation (PI) | 0.222 | 0.122 | 0.03* | 0.248 | 0.125 | 0.02* |
| | Service innovation (SI) | 0.168 | 0.215 | 0.22 | -0.034 | 0.224 | 0.44 |
| | Market offering complexity | | | | 0.150 | 0.109 | 0.09 |
| H4b | Market offering complexity × PI | | | | -0.296 | 0.127 | 0.01** |
| H4a | Market offering complexity × SI | | | | 0.313 | 0.173 | 0.04* |
| | Financial innovation barriers | | | | 0.011 | 0.197 | 0.29 |
| H5b | Financial innovation barriers × PI | | | | -0.054 | 0.032 | 0.04* |
| H5a | Financial innovation barriers × SI | | | | 0.162 | 0.068 | 0.01** |
| | SIZE (ln) | -0.031 | 0.038 | 0.21 | -0.051 | 0.038 | 0.09 |
| | DISTANCE | -0.398 | 0.033 | 0.00** | -0.391 | 0.033 | 0.00** |

*** Significance level: p<0.01 (one-tailed test); * Significance level: p<0.05 (one-tailed test)*

Regarding the moderation effects, we predicted that innovation intensity strengthens the revenue growth of both product and service innovations. In fact, we find a significantly positive moderating effect for both innovation types (H3a: β = 1.703, $p < .01$; H3b: β = 1.229, $p < .01$). Furthermore, we proposed that market offering complexity positively moderates the effect of service innovation on profitability growth while it negatively impacts the profit growth of product innovation. In fact, our results support both hypotheses (H4a: β = .313, $p < .05$; H4b: β = -.296, $p < .01$). Finally, in support of H5a an H5b, financial innovation barriers strengthens the profit growth of service innovation (β = .162, $p < .01$) and weaken that of product innovations (β = -.054, $p < .05$).

## Discussion and conclusion

As more goods-based companies seek service-led growth in industrial markets, our study provides important insights into the financial performance implications of product and service innovations. As a first major finding, our research indicates that product and service innovations have different financial performance implications in industrial markets. Whereas our analysis confirms a positive impact of product innovations on both financial outcome measures, the profitability of the average industrial firm remains unaffected by its service innovation activities.

However, service innovation helped our sampled companies to increase their overall revenue streams. This result is particularly interesting because prior literature repeatedly has underlined the difficulty of capturing the added value of services in

industrial markets. To fight commoditization and build differentiation for their market offerings, industrial companies often give services away for free (Rangan and Bowman 1992; Reinartz and Ulaga 2008), such that customers come to expect service innovations to be included in the price of the core product. Our analysis reveals that even when companies cannot attach an additional price tag to their service innovations, they effectively promote their traditional goods-based business and ultimately increase overall revenues. Supporting this view, Heskett et al. (2008) argue that customers who are satisfied with a new service are more likely to buy product replacements from the same supplier ultimately increasing firms' revenues.

This study further reveals that industrial firms face severe problems managing the costs incurred in service innovation. The non-significant impact of service innovation on profit growth reflects that average industrial firms could not transform additional revenue into additional profits. Our research thereby underscores anecdotal evidence that suggests industrial companies competing on innovative services cannot outperform their pure product counterparts (e.g. Cho et al. 2012). For example, Stanley and Wojcik (2005) find that half of all solution providers realize only modest benefits, and 25% actually lose money with their value-added services and solution offerings. Service innovations typically require intensive collaboration with customers (Melton and Hartline 2013; Santamaría et al. 2012) and industrial customers often demand highly customized services, making the process more challenging, less systematic, and less prone to standardization (Ettlie and Rosenthal 2011). Knowledge and learning rarely can be shared across different customers (Reinartz and Ulaga 2008), and companies cannot take advantage of economies of scale. Thus, balancing the need to adapt to specific customers and the need for industrialization of service innovations becomes key to achieving profit growth.

Designing and implementing service innovations is an organization-wide challenge for industrial companies (Kindstroem et al. 2012). The development of service-specific resources and capabilities implies substantial costs (Ulaga and Reinartz 2011); companies will fail if their revenues do not make up for the costs of their service innovations. Against this background, we suggest that industrial companies should closely monitor the costs of their service innovation activities. However, existing monitoring systems tend to be simplistic and one-dimensional, in contrast with their product innovation counterparts (e.g. Martinez et al. 2010). Because profit maximization is the ultimate goal of any industrial firm, our results call for more advanced cost control systems for industrial service innovations.

Despite these findings, the moderator analysis also offers a finer-grained view on the innovation-performance link, such that we can identify three factors that foster (and hamper) the impact of innovations on company performance. With regard to revenue growth, we uncover that innovation intensity promotes the success of product as well as service innovation. Though some service innovations 'simply happen' (e.g. Martin and Horne 1993) companies increase the odds of marketing a successful new offering if they allocate more money to their innovation activities. In order to keep the innovation momentum, industrial firms have to allocate substantial financial resources

to their innovation projects (Yen et al. 2012). Product innovation relies largely on hard innovation factors and demands the acquisition of new machinery and equipment (Kindstroem 2010; Tether 2005); service innovations instead depend primarily on investments in human resources (Melton and Hartline 2013). For example, the training and education of employees is critical for the effective development and implementation of new service innovations (Kindstroem et al. 2012). Regardless of these differences, both innovation types prove more successful when a greater share of firm revenues is reinvested into innovation activities.

Turning to profit growth as the dependent variable, our results confirm that both isolating mechanisms examined – financial innovation barriers and market offering complexity – represent double-edged swords, with antithetical effects on profit growth, depending on the type of innovation. Although financial innovation barriers are the most significant impediments to competitors immediately following the same innovation path (D'Este et al. 2012), once they have been overcome, they act as barriers to entry that effectively deter others from developing similar service offerings (Ulaga and Reinartz 2011). This safeguarding mechanism seems to prevail for service innovations, whereas the cost argument better explains the negative interaction effect with product innovations, which require high but more predictable development costs.

Our model estimation reveals a similar pattern of effects for market offering complexity as a moderator of the innovation–profitability growth relationship. Complex products make it more difficult for industrial companies to reap the fruits of their product innovations, but greater complexity helps translate service innovations into profit growth. The lack of patents as effective safeguarding mechanisms for service innovations increases the importance of complex market offerings as a means to protect companies' competitive advantage. The negative interaction effect for product innovations, in contrast, reflects losses in efficiency and the challenge of effectively communicating the value of complex innovations to targeted customer segments.

## Limitations and future research

Even though this study offers valuable insights for practitioners and researchers, it is subject to several limitations of large-scale databases (such as the MIP) which have to be borne in mind while interpreting the results. First, this study has explored the heterogeneous impact of product and service innovations on the financial performance of industrial firms. However, each type of innovation was captured as a homogeneous entity in the MIP dataset. That is, binary variables were employed to empirically assess the firms' innovation activities. Although previous research used similar measures (Cozza et al. 2012; Therrien et al. 2011) a more fine-grained view (e.g. incremental and radical) could extend our work on the financial performance implications. Depending on the specific nature and type of innovation the underlying performance effects might deviate (Dotzel et al. 2013). Second, due to the nature of the employed dataset, the present study is limited to three moderators revealing an interesting pattern of effects on the financial consequences of innovations. To date, little is known about the relationship of the environmental context, innovation type, and

company performance (McDermott and Prajogo 2012). Additional research should shed more light on such moderator variables. In particular, the consideration of market and industry characteristics might provide a more complete picture of the innovation–performance link. Finally, this study focuses on the short-term effects of innovation activities. However, innovating in industrial markets might pay off only in the long run, and adding further measurement waves would be a promising avenue for future research. Thus, a study based on longitudinal data may be useful in order to gain a deeper understanding of the consequences. Similarly, this study employed subjective performance measures. Although perceptual measures are highly correlated with objective ones, future research could include objective financial metrics such as ROI or ROA.

**Implications for business marketing practice**

Due to intense competition and constantly changing marketing conditions industrial firms are increasingly innovative to maintain their competitive edge. Product innovations have for long been viewed as the most promising path for industrial firms to strengthen their core business (Artz et al., 2010). However, in recent years many product-driven firms such as Siemens, Philips or Claas have shifted their innovation efforts from designing and developing physical goods to services. Attracted by the belief that services achieve higher returns in both revenues and profits service innovations have become a vital part of industrial firms' business strategy (Gebauer et al. 2010). Practitioners acknowledge that the development of new service offerings is important to a firm's competitive advantage – enabling future growth and survival on competitive markets. At the same time, service innovation in a traditional goods-centered business environment is a difficult undertaking: major organizational changes are required and the development of new resources and capabilities incurs substantial costs (Ulaga and Reinartz 2011). Thus, managers need to understand the financial consequences of both innovation types. It is currently not clear if both innovation types contribute to industrial firms' bottom line. Specifically, can industrial firms realize revenue and profit growth with product as well as service innovations? Our research provides actionable insights for managers to expand their understanding of how to achieve sustainable competitive advantage that ultimately leads to financial success with innovations.

Overall, our empirical analysis of 558 German industrial companies across 16 industry sectors support the view that innovations facilitate superior financial performance as both, product and service innovations are complementary tactics for realizing revenue growth in industrial markets. To further increase their revenues streams, industrial firms should move beyond their traditional goods-based business model and add innovative services to their market offerings. Despite apparent difficulties to find effective revenue mechanisms for service innovations, our research indicates that industrial companies can successfully grow their total revenues with innovative services, either directly or indirectly via increased product sales.

When it comes to profit growth, managers should be aware that service innovations are not a self-enforcing path to profitability growth. Whereas product innovations positively impact firms' profitability, the average industrial firms could not transform service innovation revenues into profits. Evidently, industrial firms pay insufficient attention to the challenges of the service business. In particular, managers need to implement structured development processes to develop service innovations in a cost-efficient way. In addition, they need to strike the right balance between commercialization (offering tailored services to specific customer needs) and industrialization (e.g. standardization) of service innovations (Storbacka 2011).

Our research also provides managers with a deeper understanding of moderating variables influencing the innovation-performance relationship, such as innovation intensity, market offering complexity, and financial innovation barriers. Innovation budgets are often among the first areas facing cost cuttings when firms have to tighten their belts financially. However, our results indicate that managers should rather consider increasing innovation budgets. Innovation intensity is found to strengthen revenue growth for both innovation types. With higher innovation intensity, firms are able to develop new market offerings more thoroughly, e.g. by intensive testing and prototyping with customers. This is of particular importance for industrial services given that more than 40% of them are found to fail in the market (Castellion and Markham 2012). Though some service innovations 'simply happen' our results thus make a compelling case that companies can increase the odds of introducing a new service successfully if they allocate more money to their service innovation activities.

Finally, our findings highlight the importance of carefully designing safeguarding mechanisms to achieve profit growth with service innovations. Both isolating mechanisms, market offering complexity and financial innovation barriers, strengthen the profit growth of industrial firms. For product innovation, in contrast, we find negative interaction terms. Consequently, managers should realize that factors that traditionally have hindered the market success of their product innovations can be effective promoters of profit growth through their service innovations. Hence, managing industrial service innovation requires a different managerial mindset and represents a fruitful area for scholarly innovation research.

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## Appendix: Measurement scales and items

| Variable/Construct | Item |
|---|---|
| Product innovation | During the last three years (2002-2004), did your company introduce a new market offering that is a physical good?<br>*Binary Yes/No Response Format* |
| Service innovation | During the last three years (2002-2004), did your company introduce a new market offering that is a service?<br>*Binary Yes/No Response Format* |
| Revenue growth | What was the overall revenue of the company in year X? |
| Profitability growth | What was your companies' estimated operating profit margin in year X?<br>*Seven-point scale (1 = below 0%; 2 = 0% to <2%; 3 = 2% to <4%; 4 = 4% to <7%; 5 = 7% to <10%; 6 = 10% to <15%; 7 = 15% and more)* |
| Financial innovation barriers | How strongly did the following factors impede your innovation activities?<br>1. Excessive economic risk<br>2. Substantial cost of innovation projects<br>3. Lack of internal sources of funding<br>4. Lack of suitable external sources of funding<br>*Four-point scale (1 = none; 2 = low; 3 = medium; 4 = high)* |
| Market offering complexity | Designing complex products (i.e., good or service) is important for our company to protect innovations.<br>*Four-point scale (1 = not relevant, 2= low importance to 4 = high importance)* |
| Innovation intensity | Estimate the total amount of expenditures for all innovation activities in year X<br>*Total innovation expenditures divided by revenues* |
| SIZE | How many employees did your company have in year X? |
| DISTANCE | Distance to the middle point of the profit scale in 2004 |