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Examining the influence of service diversification on manufacturing firms' bankruptcy likelihood

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Examining the influence of service diversification on manufacturing firms' bankruptcy likelihood

Research highlights

- We link type of service diversification with manufacturers' bankruptcy likelihood
- We highlight the contingency of this link on individual companies' characteristics
- We report evidence from 74 bankrupt manufacturers and 199 non-bankrupt competitors
- Product-related and product-unrelated service diversifications reveal different effects
- Companies need to align offerings of product-related and product-unrelated services to the level and nature of their resource base

Abstract

An expanding body of literature highlights the importance of service growth strategies for protecting the survival of product companies. There is a broad range of services that product companies may offer, yet it is not clear when should a company favour particular services or at least place grater emphasis on one type versus another. Using a unique dataset of secondary data from 74 bankrupt manufacturers and 199 matched non-bankrupt competitors, this study provides empirical evidence for the relationship between service offering strategy and bankruptcy likelihood, and the contingency of this relationship on the characteristics of individual firms. In particular, this research draws on portfolio theory to identify different types of service diversification that companies may realise along with potential effects. The results indicate that only companies operating in different unrelated product industries can benefit from an extended offering of product-related services. In turn, extended offerings of product-unrelated services are associated with lower likelihood of bankruptcy to the extent that a firm can rely on slack resources. Therefore, this research shows that simply offering more services does not automatically protect companies from failure. Firms must carefully align their service offering strategies to the level and nature of their resource base to enhance their chances of survival.

Keywords: service strategy, service offering, manufacturing companies, bankruptcy, diversification, portfolio theory

1. INTRODUCTION

Both marketing and operations management literatures are rich in highlighting the importance of service provision in improving the financial performance of manufacturing companies by generating a different kind of revenue stream, not as susceptible to commoditisation and pricing pressures as products are (see, e.g., Martin and Horne, 1992; Gebauer et al., 2009; Kindström, 2010; Salonen, 2011; Santamaria et al., 2012). The criticality of the role of services in supporting competitiveness and performance is heightened especially when companies operate in mature or maturing industries, and can no longer easily differentiate their products (Vandermerwe and Rada, 1988; Homburg et al., 2003; Kowalkowski et al., 2012; Suarez et al., 2013). Within this context, service provision entails expanding a firm's portfolio of commercial activities with the integration of value-added services previously performed by the customers and/or third parties (Spring and Araujo, 2013; Steiner et al., 2014). In many sectors, manufacturers today acknowledge the transformation of their business strategies towards increasing levels of service provision and, accordingly, the shifts to service-dominant logic, service-based value propositions, service-oriented business models, and service-driven manufacturing (Kindström and Kowalkowski, 2009; Steiner et al., 2014).

The service strategies of product companies can materialise in very different offerings, ranging from financial to professional services, including consultancy, R&D, technical support, or integration of multi-vendor products and services into customised solutions (Antioco et al., 2008; Kohtamäki et al., 2013b). Though the variety of services that manufacturers may offer has been extensively documented in a number of studies, additional research is needed to understand when should a firm offer particular services or at least place greater emphasis on one type versus another (Windahl and Lakemond, 2010; Cusumano et al., 2015; Eggert et al., 2014a). It is important for this research to provide empirical evidence of the impact of service provision on firm performance (Fang et al., 2008; Suarez et al., 2013; Parida et al., 2014), and recognise the diversity of manufacturing companies further to the variety of services they offer (Gebauer, 2010, Raddats and Burton, 2011; Gebauer et al., 2012; Kohtamäki et al., 2013a). The current study examines how different service categories relate to organisational performance, and the contingency of this relationship on the characteristics of individual firms.

Previous empirical studies on the performance effects of service strategies have focused on accounting- or market-based measures of firm performance and have almost exclusively relied on surveys to obtain data. Although the use of well-understood performance indicators and survey methods has provided valuable insights into this aspect of service provision, such approaches have certain limitations. Accounting- and market-based measures assume that organisational survival

will be evident in the long-term achievement of the economic goals of the firm, and do not address it as direct outcome variable. However, survival is argued to be the ultimate measure of organisational performance (e.g. Drucker, 1954), and many firms actually expand into services in order to survive the shakeout of their product industries (Kohtamäki et al., 2013a; Cusumano et al., 2015; Eggert et al., 2014b). Even if the survey method allows the collection of data on any potentially relevant variable (Gebauer et al., 2012), the inherent limitation is that reliance on self-reported perceptual measures may lead to biased estimates (e.g. Eggert et al., 2011; Oliva et al., 2012; He and Lai, 2012). Against this background, we examine a sample of 74 bankrupt and 199 non-bankrupt service-oriented companies and study the service offering-bankruptcy likelihood relationship using secondary data and logistic regression technique.

Prior research outlines that manufacturing firms vary widely in their ability to generate value from service provision. A main reason is that firm characteristics have a critical role in facilitating the implementation of various service offerings (Homburg et al., 2003; Antioco et al., 2008; Eggert et al., 2011; Kohtamäki et al., 2013a). We define firm characteristics as firm-level variables and resources (Hofer, 1975) and consider their potential interaction with the service offering. Thus, in summary the present study examines the interplay between service offering and firm characteristics and its impact on the bankruptcy likelihood of manufacturing companies.

2. BACKGROUND

2.1 Categories of service offerings

Traditionally, the service offering has been considered a central dimension to conceptualise a service orientation in business strategy (Homburg et al., 2003; Gebauer, 2008; Gebauer et al., 2010; Kohtamäki et al., 2013a; Kohtamäki and Helo, 2015). Researchers highlight that services can materialise in very heterogeneous offerings in the context of product industries (Mathieu, 2001; Ulaga and Reinartz, 2011; Kohtamäki et al., 2103b; Eggert et al., 2014a; Cusumano et al., 2015) and differ substantially with respect to the level of risk, the nature of value proposition, and the ability to create differentiation (e.g. Oliva and Kallenberg, 2003; Eggert et al., 2011). Accordingly, a considerable number of studies have been concerned with delineating categories of manufacturers' services (Gebauer et al., 2008; Jacob and Ulaga, 2008; Matthyssens and Vandenbempt, 2010; Raddats and Kowalkowski, 2014). For example, Mathieu (2001) provides a typology of service offerings based on the strategic objective of the services (supporting the installation and use of the product or helping the client optimise the different processes, actions and strategies that are associated with the product). Helander and Möller (2007) propose to differentiate between three systems supplier roles (equipment supplier, availability provider, performance

provider), which they relate to the strategic position of the firm and the customer strategy. Parida et al. (2014) suggest a split between four groups of services (add-on customer services, maintenance and product support services, R&D oriented services, functional and operational services) in relation to the added value for the customer and logic of the underlying business model. As these examples illustrate, existing classification schemes for manufacturers' services focus on the strategic goal of the offering; that is, category of service offering is often synonymous with service strategy (Raddats and Kowalkowski, 2014; Kohtamäki and Helo, 2015; Kowalkowski et al., 2015). Authors have been mainly concerned with delineating the organisational challenges that companies must face when pursuing each service offering strategy and, thereby, the transformation of internal structures, processes and resources necessary to integrate different services into the business logic. Contingency theory, particularly the notion that a specific congruence is needed between strategic orientation and organisational design, provides the conceptual foundation (Homburg et al., 2002; Gebauer, 2008; Kohtamäki and Helo, 2015). Most studies further assume the notion of the 'service transition', namely that companies undertake a gradual and sequential repositioning from basic, standardised services towards more advanced and comprehensive ones, along a product-service continuum (e.g. Oliva and Kallenberg, 2003; Penttinen and Palmer, 2007; Paiola et al., 2013). In line with this assumption, existing service classifications do not dwell on the question of whether and when companies should offer different services (Windahl and Lakemond, 2010; Eggert et al., 2011; Raddats, 2011). While prior research has extensively examined service-based differentiation, service strategies and service transition, we claim that additional insights are needed into this particular question. First, recent literature has challenged the service transition assumption; it seems that, in reality, many firms concurrently market different service categories, rather than transitioning from one to the other (Windahl and Lakemond, 2010; Kowalkowski et al., 2012; Raddats and Kowalkowski, 2014; Parida et al., 2014; Kowalkowski et al., 2015). Second, anecdotal evidence indicates that manufacturers often do not approach service decisions through rational planning (see, e.g., Homburg et al., 2003; Gebauer et al., 2008; Kowalkowski et al., 2013a); additions and changes to the service portfolio reactively follow customer demand and needs. Third, a more critical perspective on where to place the emphasis of service provision and why can help companies improve the strategic usefulness of the transformation from manufacturing- to service-oriented.

2.2 Services and firm performance

To understand whether different services pay off, it is important to examine their performance outcomes (Homburg et al., 2002; Cusumano et al., 2015). Relatively few studies have provided

empirical evidence regarding the impact of service provision on company performance (Jacob and Ulaga, 2008; Gebauer et al., 2012; Kohtamäki et al., 2013a; Kohtamäki and Helo, 2015), and the limited evidence is mostly focused on the degree of service orientation of the business strategy, i.e. the activeness with which services are offered to customers (e.g. Homburg et al., 2002; Homburg et al., 2003; Kohtamäki et al., 2013a) or the share of turnover generated by services (e.g. Gebauer and Fleisch, 2007; Fang et al., 2008; Suarez et al., 2013; Kohtamäki et al., 2013b), rather than on the scope of the service offering. Few noteworthy exceptions are the studies by Antioco et al. (2008), Eggert et al. (2011), He and Lai (2012) and Eggert et al. (2014), that build on the formerly mentioned Mathieu's (2001) service classification scheme, and Parida et al. (2014)'s examination of four empirically derived service categories as drivers of revenue growth. In order to complement these studies, we draw on established notions from the literature on corporate diversification to test the relevance of the composition of the service offering to company performance. The fundamental argument of diversification research is that the relative costs and benefits of a diversification strategy are likely to depend on how the different activities of the firm are related to one another (Gongming, 1997). To the extent that existing activities define the resource endowment and competitive position of the firm, there is a systematic relationship between type of diversification and firm performance. Linking this argument to our focus on services, we note that Suarez et al. (2013) hold that 'one should look not only at the separate contribution of services versus products, but also at the relationship and dynamics between the two'.

Further expanding the scope of previous research on the transition to service provision, we structure our investigation as a comparison between unsuccessful companies and successful competitors. Comparative studies of low- and high-performing service-oriented companies have been previously presented in Gebauer (2008) and Gebauer et al. (2010). While we build on these studies, our approach is more fine-grained because we match companies with their direct competitors. Moreover, in prior studies, firm performance has been measured based on financial indicators such as profits, revenue or market value (Gebauer et al., 2012; Eggert et al., 2014a) or through perceptual measures (e.g. He and Lai, 2012; Eggert et al., 2014b); we instead identify unsuccessful companies as companies that declared bankruptcy. Bankruptcy filing provides a clear and objective criterion to differentiate unsuccessful from more successful companies (Benedettini et al., 2015). It also captures poor financial performance in the most extreme sense (Singhal and Zhu, 2013).

2.3 Firm characteristics

As discussed, recommendations for the implementation of different service categories have often been rooted in the idea of contingency (i.e. success of service provision depends on the proper

alignment of organisational variables with the service strategy) and have focused on explaining specific strategy-organisational design configurations. The idea of contingency is also reflected by some of the empirical studies testing the relationship between service provision and company performance. For instance, with regard to organisational design factors, Oliva et al. (2012) have investigated how the separation of the product and service businesses mediates the effect of managerial commitment to the service strategy on service business financial performance. As further firm-level factors, situated managerial attention (Gebauer, 2009), customer centricity of market orientation (Gebauer et al., 2011), network capabilities (Kohtamäki et al., 2013a), availability of slack resources (Fang et al., 2008) and firm's market share (Fang et al., 2008) have been explored. All but market share positively interact with service orientation of the business strategy to improve firm's financial performance. Service orientation of corporate culture and human resource management (Homburg et al., 2003) also mediate the impact of service orientation of the business strategy on company profitability. Other studies of service performance go on to investigate the interplay between organisational variables and distinct service categories. Eggert et al. (2011) provide empirical evidence that a firm's product innovation activity has different effects on the service-performance link depending on the type of service. Similarly, Antioco et al. (2008) demonstrate that use of service technology and cross-functional communication positively moderate the performance outcomes of some service offerings but not of others.

We believe that this background outlines the need to recognise the heterogeneity of manufacturing companies in our investigation. Moreover, in taking such an approach, we are motivated by the calls from prior scholars for greater consideration of individual firms' characteristics that contribute to the performance effects from service initiatives (e.g. Tuli et al., 2007; Fang et al., 2008; Antioco et al., 2008; Eggert et al., 2011; Gebauer et al., 2012; Kohtamäki et al., 2013a). We adopt the view of Hofer (1975) and define the construct of firm characteristics as firm-level factors and and resources that impact the feasibility of a service strategy. As such, the construct is not specifically focused on aspects of organisational design and structure but it broadly addresses firm characteristics that may support or hinder success in offering specific service categories. However, since the nature of the study is to use secondary data, our scope is limited to externally visible firm characteristics and excludes internal processes and 'soft factors' (Homburg et al., 2003) like managerial attitude, corporate culture or employee behaviour.

3. HYPOTHESES DEVELOPMENT

We based our hypotheses on portfolio theory (PT) (Markowitz, 1959). A primary contention of PT is that portfolio diversification provides the opportunity to buffer the firm from sources of demand

volatility (e.g., seasonality, changes in customer preferences, launch of substitute products) (Jacobs and Swink, 2011). As various 'items' are combined in the firm's portfolio, associated demand uncertainties can be pooled so that the aggregate demand is both smoothed and increased (Amit and Livnat, 1988; Byers et al., 2013). At the essence of service infusion initiatives there is an increasing focus of manufacturers' business models on services. For the majority of firms, this involves the development of the total offering towards the provision of more extensive services (Gebauer et al., 2011; Spring and Araujo, 2013; Kowalkowski et al., 2013b), which in turn translates into increased portfolio diversification (Cusumano et al., 2015) as services are typically offered in addition to the core company products. However, diversification does not axiomatically generate firm-level benefits. As discussed by Jacobs and Swink (2011), PT suggests that the benefits of diversification are subordinate to the various items within the portfolio sharing the same productive assets and having imperfectly or negatively correlated demands. Accordingly, our hypotheses do not theorise direct effects from service offering strategies on bankruptcy likelihood but explore the relationship between service offering as bankruptcy likelihood as a function of firms' resource assets and cash flows.

Since Rumelt (1974), the strategic management literature has isolated two distinct modes of diversification (e.g. Teece, 1982; Palepu, 1985; Amit and Livnat, 1988; Robins and Wiersema, 2003). On the one hand, related diversification indicates the extent to which a firm's offering combines lines-of-business that share or draw on the same common core skill, strength, or resources; it results from the involvement of the firm in a set of industries that are closely linked to each other. On the other hand, unrelated diversification occurs when a company expands its operations beyond existing resources and capabilities in order to pursue market opportunities in industries that have little commonality with the businesses the company is already in. The effective deployment, allocation and management of the corresponding resources are the basis for a diversification strategy to create value. Rawley (2010) argues that the complexity of coordinating resources may act as an offset to the positive returns of diversification. Depending on the mode of diversification that is examined, firms exhibit resources that are mainly shared or specialised.

The logic of resource similarity can also be adopted to differentiate between service extensions. Indeed, certain types of services (e.g. maintenance, design, product upgrade) are operationally linked to manufacturing activities, and draw on similar critical competences and resources. To the extent that factors of production can be utilised jointly (Teece, 1980; Jacobs and Swink, 2011), i.e. shared, such product-related services can take advantage of the capabilities conferred by existing product-based assets and intangible input such as technological knowhow. As product and service

operations are pooled together (Amit and Livnat, 1988) and resources can be leveraged from the manufacturing to the service domain, spillover effects lead to reduced need for service-specific resources (Fang et al., 2008; Kowalkowski et al., 2011). For example, a supplier of packaging for food products can exploit its technical expertise in chemistry, microwave engineering and food science to offer technical advice to customer to develop their food products.

Our first hypothesis postulates that there is an interaction between the offering of product-related services and the unrelated diversification of the product business. Prior research indicates that bankruptcy becomes less likely when firms operate in multiple unrelated industries (Lewellen, 1971; Singhal and Zhu, 2013). Although there is no operational synergy to be gained, such diversification reduces the variance of returns, yielding an increase in the firm's debt capacity (Lewellen, 1971; Stapleton, 1982) and thus a lower risk of bankruptcy. We expect unrelated product portfolio diversification to have a stronger negative relationship with bankruptcy likelihood when the level of product-related services is high. Because unrelated businesses draw on different assets and resources, we assert that the unrelated diversification of the product business indicates the breadth of manufacturing-based capabilities possessed by the firm. The offering of a relatively broad set of product-related services reflects an environment where there is significant opportunity for scope economies in the exploitation of existing manufacturing capabilities. This effect should enable more efficient and profitable operations, and thus it should reduce the risk of financial distress. In contrast, if few or no product-related services are offered, then the level of manufacturing capabilities and unrelated diversification being equal, it is expected that a firm will be more exposed to failure because service activities will no longer act as a source of resource synergy. Thus, the following hypothesis:

H1. The level of product-related services moderates negatively (accentuates) the effect by unrelated diversification of the product business on a firm's bankruptcy likelihood.

Service extensions are not always product-related. That is, manufacturing companies may also offer services (e.g. financial services, logistic services) that have little overlap or commonality of knowledge and resources with the core product business. If such product-unrelated services are offered, the potential scope benefits with manufacturing operations are only those that can be realised from sharing some generic factors of production (Rumelt, 1982), like sale channels, customer relationships, or brand name. As a result, additional service-specific assets (tangible and intangible) must be deployed, regardless of the level of existing product-based capabilities.

Organisational slack indicates a pool of excess resources in an organisation that can be used in a discretionary manner (Burgeois, 1981). It provides the means for innovation and change (Mohr,

1969; Levinthal and March, 1981), and thus can enable flexibility in the development of strategy options and improvements in company performance (George, 2005). In particular, studies by Hambrick and D'Aveni (1988), Sheppard (1994) and Azadegan et al. (2013) found evidence of an inverse link between slack and bankruptcy, i.e. the availability of slack resources tends to lessen a firm's likelihood of bankruptcy. Organisational slack is key to product-unrelated services. Because it refers to spare resources, organisational slack enables firms to implement the service-specific resources required to offer product-unrelated services, without constraining or affecting other projects and goals. As a consequence, we envisage the beneficial effect of resource slack on bankruptcy likelihood to increase with the level of product-unrelated services. Companies with few or no product-unrelated services may not be necessarily in need of substantial slack resources to support their service initiatives. On the other hand, when companies offer many product-unrelated services, slack resources are crucial to develop and manage the service business effectively, thereby protecting the survival of the firm. Thus, the following hypothesis:

H2. The level of product-unrelated services moderates negatively (accentuates) the effect by resource slack on a firm's bankruptcy likelihood.

While our first two hypotheses elaborate on the premise of portfolio theory that asset capacity can be shared across items within the portfolio, our last hypothesis articulates the concept that demand volatilities associated with individual portfolio items should not be highly correlated. Manufacturing companies may diversify and thrive to compete by providing services whose prospective returns are imperfectly or negatively correlated with product ones. For instance, maintenance services provided for capital-intensive products (e.g. aircrafts, mining equipment) deliver a source of revenues that can be counter-cyclical to product sales (Wise and Baumgartner, 1999; Gebauer et al., 2011); in particular, higher service sales can balance the effects of declining product demand in times of economic downturn (Oliva and Kallenberg, 2003; Brax, 2005), when customers tend to keep their equipment in operation for longer. However, typical service extensions also include services (e.g. financing, distribution, installation and implementation) that are closely connected to the sale of new product units and therefore exhibit high interdependence of returns with product lines. Because there would be no service sales in the absence of product sales, we label such services as product-dependent. Product-dependent services can be a means to generate extra revenues, create entry barriers and support differentiation, but are unlikely to help companies counterbalance volatilities in product markets.

Traditional wisdom suggests that, relative to survivors, failed companies are typified by financial performance deficiencies in the years before failing. Theory and research on demise (bankruptcy

prediction models in particular) have further pointed out that previous financial performance is a significant attribute in categorising failed from non-failed companies (e.g. Altman, 1968; Deakin, 1072; Altman et al., 1977; Olson, 1980). We assert that poor financial performance becomes more likely to lead to bankruptcy when a firm focuses its service offering strategy on a set of product-dependent services. Although product-dependent services can have the effect of increasing returns from product sales (Cusumano et al., 2015), this effect will be dissipated in case of poor product demand. When companies incur decreasing market interest for the type of products they offer, then also service demand will be negatively affected and losses from the service business will add to losses from reduced product sales. Therefore, to the extent that a firm's past financial performance is affected by level of product demand, a service offering focus on product-dependent services will increase the burden of performance deficiencies and, in turn, further undermine the firm's chances of survival. In contrast, as noted above, a focus on product-dependent services may also amplify the benefits from successful performance from product sales. Thus, the following hypothesis:

H3. The orientation towards product-dependent services moderates negatively (accentuates) the effect by previous financial performance on a firm's bankruptcy likelihood.

Figure 1 summarises our theoretical model and hypotheses.

--- Insert Figure 1 here ---

4. METHODOLOGY

4.1 Sample selection

We first gathered a sample of failed service-oriented manufacturing firms from the 'Public and major company database' of bankruptcydata.com. This database includes bankruptcy filings by all firms with at least one public security and $50 millions in assets since 1986. We identified over 2800 firms that filed for Chapter 7 or 11 or otherwise declared bankruptcy until December 31, 2013. A preliminary screening was conducted by examining the company synopsis reports compiled by the bankruptcydata.com service, as these indicate the core industry of the firm and often include a brief description of its business. We dropped the firms that the synopsis information identified as service (i.e. non-manufacturing) firms. Consistent with the findings of previous research on organisational survival (Yang and Aldrich, 2012 - p.479), we also eliminated the firms that declared bankruptcy less than five years after foundation so as to avoid the well-known effects of liabilities of newness and smallness (Patel and Jayaram, 2014; Sheppard, 1994). For all other companies, we examined the relevant narratives in their 10-K form (or 10-K405 or 10-KSB or 20-F,

as appropriate) in order to determine if they had adopted a service strategy. 10-K narratives provide a comprehensive overview of a company business, and they reflect the focus of organisational strategy because they outline what upper management believes is important to stakeholders (Guthrie at al., 2004; Ditlevsen, 2012). Of relevance to the use of 10-Ks in this study is the work of Bowman (1984), who demonstrated the validity of annual report discussion as a source of information regarding firm activities[1]. Service proactive firms will typically provide evidence of service activities in their 10-K forms. Accordingly, it can be presumed that, if services are explicitly mentioned in 10-K forms, they are likely to be relevant to corporate strategy. Also relevant to this study, as will become apparent later, is that 10-K forms have the advantage of being produced in the time period of interest and avoid retrospective biases inherent, for example, in interviews that attempt to elicit information from the past (Harris, 2001; Golden, 1992; Barr and Huff, 1997). Lastly, 10-Ks are produced by many companies and are relatively easy to obtain (Barr and Huff, 1997).

To determine if the companies had ventured into services from 10-K reports, we used qualitative content analysis. Content analysis is a methodological technique that enables researchers to systematically and scientifically evaluate descriptive content in textual documents (Krippendorff, 2013; Tangpong, 2011). Although rarely used in marketing and operations management (Montabon et al., 2007), this is a firmly established method in various fields of research (Harwood and Garry, 2003; Neundorf, 2002) and is probably the most prevalent approach to the analysis of communication material (Bryman, 2004). Especially in social and environmental accounting research, it has also been extensively used on annual reports (see, for example, Bowman and Haire, 1976; Deegan and Gordon, 1996). *Tangpong* (2011) states that 'researchers interested in macro-level topics, such as operations strategy and strategy-operations alignment, can use content analysis to examine relevant data available in companies' 10-K reports'. The provision of services by a manufacturing firm would certainly fit that concept of macro-level topic.

In content analysis, text is coded according to a predefined set of themes or categories that illustrate the range of meanings of the topic of interest. For the purpose of this study, we developed a list of the services that manufacturing firms have integrated into their offerings. This was based on the academic literature, but also included anecdotal accounts from interactions of the research team with industry managers and previous projects on service strategies in which we participated. The list was then converted into 13 mutually exclusive service categories (see the Appendix) for use in content analysis. This was based on the preliminary examination of the latest 10-K form of 30

[1] Business descriptions in 10-Ks are at least as complete as those in annual reports to shareholders (Glueck and Willis, 1979).

leading service-oriented manufacturers from different industries, meaning that an 'emergent' approach to coding was implemented (Semler, 2001). The service categories were developed with the specific intent of ensuring that they were broad enough to consider that different firms might describe service activities with different levels of detail in 10-K reports. As can be seen in the Appendix, the definition of the coding categories also comprised the suggestion of specific services that fall in each category and that might be found in firms' reports. Notably, our coding categories confirm and extend the topology of manufacturers' services developed by Neely (2008) for use on database business descriptions. Qualitative content analysis pays attention to existence vs. not existence of information that relates to the selected content categories, rather than the frequency of occurrence of such information (Berg, 2001; Zhang and Wildenmuth, 2009). Accordingly, we identified a company to be active in services if it reported the offering of one or more of the 13 service categories in its business description or segment description (Item1 and 'Operating Segments' note to Item 8, respectively) in the relevant 10-K form. Clearly, to be included in the study sample, the bankruptcies must also report the offering of manufactured products.

The analysis was performed on the 10-K form (or 10-K405 or 10-KSB or 20-F) that the companies filed three years prior to the bankruptcy (i.e. in year t-3). The forms were gathered from 'Capital IQ' and 'Edgar' databases. Here, the three years time lag was introduced to mitigate the effect of the potential 'endogeneity' of the diversification decision, as outlined by Singhal and Zhu (2013 - p.1481). In essence, distressed companies may choose to diversify into services in the attempt of escaping from bankruptcy failure or, on the contrary, they may decide to shut down the service business so that to concentrate on their traditional manufacturing core. Considering firm activities before rather than at the time of the bankruptcy filing helps control for this possibility. The exclusion of the firms for which the relevant report was not available from 'Capital IQ' or 'Edgar' and of the firms that didn't meet the sampling criteria resulted in a sample of 164 bankruptcies of service-oriented manufacturers.

The next step of the research design was to find a set of matched survivors for each bankrupt firm. Potential matches were obtained by scanning the competitors that the firm mentioned in year t-3 report[2] and the list of competitors suggested by Capital IQ[3]. Matched survivors had to meet two criteria: (i) compete with the bankrupt on the product business; (ii) implement a service strategy. The first requirement was defined as having a product mix that overlapped with the one of the

[2] Although there is no legal requirement, point c.x of Item 101 of S-K regulation suggests that firms disclose the names of their main competitors in their narrative description of business.

[3] We examined various other databases offering competitor information, including Mergent Online, Hoovers, Factiva, Thomson One Banker and Bloomberg. However, these databases either do not include firms that are currently inactive (which is often the case of firms that declared bankruptcy) or identify competitors based on only industry membership and location (returning a very high number of hits). On the contrary, because it uses SEC filings, press releases and company contacts to identify competitors, Capital IQ indicates fewer and more likely relevant competitors.

bankrupt firm. Consistent with the bankrupts, the offering of one or more of the 13 types of services in the Appendix was assumed as a proxy for the adoption of a service strategy. The information was drawn from the year t-3 10-K form (or equivalent), and so again a potential matching firm was excluded if the year t-3 form could not be accessed from Capital IQ or Edgar. In addition, matching competitors must not have filed for bankruptcy either before or after year t-3 as we sought to ensure that survivors were not in danger of failure. Lastly, we limited the survivor sample to a maximum of five matched competitors for each bankrupt firm so that none of the bankrupts was overrepresented. This yielded a set of 223 matched survivors, covering a final sample of 80 bankruptcies.

The objective of this sampling approach was to reduce the effect of differences in firms' nature of business and environmental conditions that would generate from traditional random sampling approaches. Matched sample design is suggested as a practical and effective way to control for potential confounding factors in observational studies (Cram et al., 2009; Rubin, 2006). A long history of employing research designs that involve matched samples in failure research, accounting research, political science, medicine and even epidemiology research (e.g. Sheppard, 1994; Morgan and Harding, 2006; Stuart, 2010) also supports the use of such sampling technique. However, while we matched firms by product portfolio, we also employed statistical controls - i.e. we entered control variables directly into the model (Rubin, 2006; Sheppard, 1994) - to account for other potentially confounding factors (further discussion follows).

4.2 Measures

4.2.1 Unrelated diversification of the product business

We employed the unrelated component of the Entropy index as measure of unrelated diversification (Jacquemin and Berry, 1979; Palepu, 1985). This measure is comparable to the widely used Herfindahl index (Jacquemin and Berry, 1979), but it better reflects the degree of diversity among various firm's businesses (Martin and Sayrak, 2003). Unrelated entropy is given by the weighted average of the shares of the firm's sales in each industry group (industry groups defined by two-digits SIC codes), the weights being the natural logarithms of the inverse of the industry groups' sale shares. Because our measure was focused on the product business, we only included SIC codes in the range 10-39 (Neely, 2008). Weighted average formulas using SIC codes and sales/assets data have been very common in financial research (see, e.g., Baysinger and Hoskisson, 1989; Robins and Wiersema, 1995), being often preferred to 'strategic' measures of diversification (Wrigley/Rumelt's topology and similar schemes) (Martin and Sayrak, 2003; Sambharya, 2000; Varadarajan and Ramanujam, 1987).

4.2.2 Resource slack

Retained earnings were our measure for resource slack. Retained earnings reflect cash reserves that are maintained by the company to be invested into areas where they can create growth opportunities. Therefore, the higher the level of retained earnings, the more flexibility the firm has in developing strategy options to pursue business opportunities. This high-discretion form of slack (George, 2005; Sharma, 2000) captures the concept of 'available slack' (Burgeois and Singh, 1983; Bromiley, 1991; Cheng and Kesner, 1997), i.e. excess of uncommitted, immediately available resources. Since retained earnings can vary greatly relative to the size of the firm, we divided by total sales. Several previous empirical studies have measured lagged slack, under the view that if organisational outcomes are to be affected by slack, then the time of that effect is not immediate but lagged (e.g. Bromiley, 1991; Greenley and Oktemgil, 1998). Although other lag structures may be reasonable, we computed the average retained earnings/sales between years t-7 and t-3. Average measures for multiple years increase measurement stability (Kohtamäki et al., 2013a) and have been used for slack by Miller and Leiblein (1996), Cheng and Kesner (1997), and Palmer and Wiseman (1999).

4.2.3 Previous financial performance

Financial performance can be defined as anything from unit sales to investors' perception of the company's business prospects. Prominent financial indicators to evaluate how well a firm is performing against the objective of surviving in the long-term are indicators of the firm's profitability (Ramachandran and Kakani, 2005). Therefore, we measured previous financial performance via a firm's return on assets (ROA) at year t-3. ROA is also highly correlated with other profitability measures (Hambrick and D'Aveni, 1988) and is a common financial performance indicator in previous studies of bankruptcy (e.g. Hambrick and D'Aveni, 1988; D'Aveni, 1990; Daily, 1996).

4.2.4 Level of product-related and product-unrelated services

To measure the level of product-related and product-unrelated services, we considered whether the firms offered each of the 13 service categories in the Appendix. The level of services was calculated as the number of service categories offered. Counting the number of services captures the breadth of the service portfolio and is in line with the approach of several other studies (e.g. Homburg et al., 2003; Antioco et al., 2008; Gebauer et al., 2010; Eggert et al., 2011; Oliva et al., 2012; Eggert et al., 2014a). The information was gathered by re-coding the business descriptions in year t-3 10-K reports (the first coding used a dichotomous variable, whereby firms were judged to

either offer one or more service categories or not to offer at all). Product-related services encompassed seven service categories including 'maintenance and support', 'design and development', and 'system integration' services; product-unrelated services featured six service categories such as 'logistic', 'procurement' and 'financial' services (see the Appendix).

4.2.5 Orientation towards product-dependent services

The coding of service offerings at year t-3 was again employed to assess the importance of product-dependent services in the firms' portfolio strategies. We identified six categories of product-dependent services, encompassing 'financial' and 'installation and implementation' services (see the Appendix for the complete list), and examined whether a firm offered services within these categories. We calculated the share (number) of product-dependent services over total services and dichotomised the resulting continuous variable into a dummy variable. In particular, we considered a firm's service strategy to be oriented towards product-dependent services when the share (number) of product-dependent services over total services was 0.5 or greater. In contrast, we assumed that values of the share of product-dependent over total services below 0.5 were reflective of a firm's orientation towards product-independent services.

4.2.6 Control variables

We included control variables related to both the firm and the industry. Although the sampling procedure avoided potential effects of liabilities of newness and smallness, we controlled directly for firm size (captured as natural logarithm of sales) and age (captured as years since foundation). Based on Flagg et al. (1991) and Hambrick and D'Aveni (1988), we introduced further controls for firm liquidity (measured by the current ratio) and leverage (measured by the total assets to total liabilities ratio). All firm-level control variables were computed at year t-3. At industry level, we controlled for industry profitability, munificence, power and turbulence. We used the average ROA of the firms in the industry at year t-3 to assess industry profitability and followed the operationalisation of the remaining three constructs proposed by Boyd (1990). Munificence was the slope of the regression of industry sales for years from t-5 to t-1, divided by the mean value of industry sales for those years. For turbolence, we measured the standard error of the regression used to calculate munificence and divided it by the mean of industry sales. Finally, industry power was measured through the three-firm concentration ratio at year t-3. Categorisation of industry was based on the four-digit primary SIC code.

4.2.7 Data collection

We used multiple data sources. The data for the calculation of product business diversification were gathered from the Compustat Historical Segments and Capital IQ databases. The Compustat Fundamental Annuals and Capital IQ databases were used to estimate resource slack, past performance and the control variables for firm size, age, liquidity and leverage. We also examined 10-K reports (or equivalent) for firm-level data that was not captured by Compustat or Capital IQ. Finally, the data for industry-level controls were obtained from Compustat.

5. DATA ANALYSIS AND RESULTS

5.1 Model Development

To test our research hypotheses, we estimated a conditional multivariable logistic regression (LOGIT) model (Hosmer et al., 2013; Kleinbaum and Klein, 2010; Spicer, 2005), and employed the STATA 12 software programme to perform statistical computations. The regression modelled the probability that a firm will declare bankruptcy (coded "1") or not (coded "0"). LOGIT analysis fits well with the use of non-random samples (Balcaen and Ooghe, 2006) and does not require strict adherence to the assumptions (multivariate normality, homoscedasticity) of other statistical methods for modelling a dichotomous outcome in a regression context (e.g. discriminant analysis) (Spicer, 2005; Hair et al., 2007; Tinsey and Brown, 2000; Burns and Burns, 2008). In addition, in matched case-controls designs, conditional LOGIT allows specifying matched sets and avoids biased parameter estimates that would arise from choosing other (unconditional) candidate methods (Stuart et al., 2013; Cram et al., 2009; Kleinbaum and Klein, 2010). Recent research indicates logistic regression as a superior statistical method for predicting bankruptcy (Balcaen and Ooghe, 2006; Lennox, 1999). Although only a few applications exist in marketing and operations management, this method has been used extensively in epidemiology and other research disciplines.

The estimation of logistic regression models has proved to be extremely sensitive to outlier observations (Bianco and Martinez, 2009). We therefore excluded 12 cases of outliers (6 bankrupts and 6 non-bankrupts) from our sample. In addition, we removed 18 non-bankrupted firms for which the bankrupted match was an outlier. Because logistic models are also very sensitive to multicollinearity, we decided to mean-centre the variables used in interaction terms before the analysis. Moreover, best practices in the use of logistic regression analysis prescribe seeking the most parsimonious model that still accurately reflects the patterns existing in the data (e.g. Hosmer et al., 2013). The rationale for minimising the number of variables in the model is to avoid that the model produces numerically unstable estimates because it is "overfit" (Harrell et al., 1996). Hosmer et al. (1999) propose a method to purposefully select variables for a logistic model. The purposeful selection method starts with applying a univariable analysis of each independent variable to identify

variables that should be included in an initial multivariable model. Variables are then eliminated in a stepwise manner from the multivariable model based on significance or on the change-in-estimate criterion (Miettenen and Cook, 1981). Subsequently, variables that were excluded by the univariate analyses are one by one re-entered in the model and evaluated for significance. Once the direct effects model is obtained in this way, interaction terms are introduced separately to the direct effects model. Finally, the interactions that were not excluded at the previous step are added together to the direct effects model. Their statistical significance indicates moderation and defines the final model. Based on Bursac et al. (2008), the purposeful selection method provides more stable and generalizable estimates than traditional stepwise selection. Therefore, we followed this method to develop our own model.

The initial multivariable model should contain all independent variables (including controls) having a significant univariable test at the 0.20 or 0.25 level, along with any other variables judged to be of clinical importance. Table 1 shows the results of fitting a univariable conditional logistic regression model for each independent variable. Three variables, INDMUN, INDTURB, INDPOW, were not significant at the required level with p = 0.870, 0.836, 0.941 respectively. Given that they were not critical to test our hypotheses (they were introduced as potential controls), these variables were deselected from the initial multivariable conditional logistic regression model (Model 0). We next used p-values from the Wald test of the individual coefficients to identify variables that might be deleted from Model 0. Six variables did not contribute at traditional level of significance (0.05): AGE, LIQUIDITY, INDPROF, LEVRELSERV, LEVUNRELSERV, DEPSERVOR (Table 2). While the three service-related variables ought to be in the model because they were clinically important to test the research hypotheses, AGE, LIQUIDITY and INDPROF could be removed (Model 1). Following the fitting of the reduced model (Model 1), we assessed whether the removal of the variables produced an important change (>20%) in the coefficient of the variables remaining in the model. Table 2 shows that the coefficient of LEVUNRELSERV changed by 45% (from -0.10738 to -0.0582) from Model 0 to Model 1. Therefore we re-entered INDPROF (the excluded variable with smallest p-value) as suspected confounder (Model 2). Model 2 indeed satisfies the change-in-estimate criterion (Miettenen and Cook, 1981). To double check that no important variables were excluded during the initial univariable analyses, we added back each deselected variable (INDGR, INDTURB, INDPOW) in turn to Model 2. None of the coefficients became significant by Wald statistic p-value (results not shown). Model 2 is therefore the direct effects model, including the relevant first-order paths linking independent variables with the dependent variable. As such, Model 2 includes the influential controls and the variables that account for the direct effects in our hypotheses. In Models 3 to 5, we individually added to Model 2 the interactions

proposed in our hypotheses: between LEVRELSERV and BUSDIV (Model 3) (H1), between LEVUNRELSERV and SLACK (Model 4) (H2), and between DEPSERVOR and PASTPERF (Model 5) (H3). Two of the three interactions were significant at the recommended 0.1 level: LEVRELSERV x BUSDIV and LEVUNRELSERV x SLACK (see table 2). Both interactions remained significant ($p<0.05$) when added together to the direct effects (Model 6). The two degrees of freedom L-R test of Model 6 versus the direct effects model (Model 2) reaffirms that the two interactions add significant explanatory power over the direct effects ($G^4=11.682896$, $p=0.00724$) (Hosmer et al., 2013). Model 6 was therefore our final model.

--- Insert Table 1 here ---

--- Insert Table 2 here ---

With 273 observations (74 bankrupts and 199 non-bankrupts) and 11 covariates, Model 6 meets the sample size requirement of at least five observations for the rarer outcome per covariate included in the model (Stoke et al., 2000; p.213). As reported in table 2, all the models have statistically significant chi-square coefficient ($p=0.0000$). Table 2 also presents values for the Nagelkerke Pseudo R-square fit statistics, which reaffirm that lack of fit is not a concern with any of the models. The Pseudo R-square value improves with the inclusion of interaction terms (Model 6 vs. Model 2). Based on Dixon and Verma (2013) and Rao et al. (2014), we used an F-test (Cohen, 1968) to assess if this R-square increase was statistically significant. The F-Test results ($F=34.99$, $p=0.000$) (table 3) suggest that the addition of interactions terms in Model 6 significantly improves the fit of the model, providing additional support to the L-R Test performed above.

--- Insert Table 3 here ---

In addition to goodness-of-fit, we evaluated the predictive ability of the models (please refer to table 2). An examination of the observations correctly classified by Model 6 indicates an overall hit ratio of 90.47% under the typical cut-off value of 0.5. We followed Wooldridge (2009)'s recommendation and also computed this percentage for each outcome. 79.72% of the bankrupted and 94.47% of the non-bankrupted firms were correctly classified, indicating that the model is well capable of detecting both outcomes.

[4] G = (-2 Log-Likelihood of the model without the variable(s)) - (-2 Log-Likelihood of the model with the variable(s))

Finally, we tested the data for multicollinearity. The highest correlation between independent variables in Models 2 to 6 is -0.6121 (table 4), between DEPSERVOR and LEVRELSERV. Despite this relatively high correlation, the values of the Variance Inflation Factor (VIF), also shown in table 4, exclude multicollinearity problems. Indeed, the VIF value remains below 2.10 for all independent variables (threshold: 4). Table 4 also presents the mean and standard deviation of the independent variables in Models 2 to 6.

--- Insert Table 4 here ---

5.2 Hypotheses validation

The estimation of Model 6 (table 2) provides the empirical evidence to test our hypotheses. The significant, negative effect of product business diversification (b=-2.5081, p<0.01) indicates that increased levels of product business diversification reduce the risk of bankruptcy. The interaction between product business diversification and level of product related services is negative and significant (b=-1.6469, p<0.01); the level of product related services negatively moderates the relationship between product business diversification and bankruptcy likelihood, in support of H1. In figure 2, panel A, we illustrate exemplar relationships between product business diversification and bankruptcy likelihood for firms with low (mean – 1 SD) and high (mean + 1 SD) level of product related services.

The results in table 2 further reveal that the availability of slack resources (SLACK) is a significant discriminating factor between bankrupts and survivors (b=-3.1113, p<0.01). H2 is supported because the level of unrelated services (LEVUNRELSERV) negatively moderates the relationship between resource slack (SLACK) and bankruptcy likelihood. The relationship between resource slack and bankruptcy likelihood for firms with low and high (mean ± 1 SD) level of product unrelated services appears in figure 2, panel B.

However, we do not find support for H3. Our findings indicate a significant negative relationship between a firm's past performance (PASTPERF) and bankruptcy (b=-0.0531, p<0.05) but the moderation test (Model 5) reveals that firms with predominant and non-predominant product dependent services (DEPSERVOR) do not differ significantly with respect to the impact of past performance on bankruptcy likelihood.

Previous research indicates that, in order to fully analyse interactions, it is important to test the significance of their marginal effects (Stokes et al., 2000; Brambor et al., 2006). The preceding L-R Test and F-Test comparing Model 6 to Model 2 demonstrate that the added contribution of the

interaction terms proposed in H1 and H2 both provides an improvement in model fit and makes a significant contribution in explaining the dependent variable variance.

--- Insert figure 2 here ---

6. DISCUSSION

Both academia and practice emphasise the importance for manufacturing companies to add services to their market offerings as a way to secure a more stable and profitable revenue stream than product sales and, thus, survive price erosion and a decreasing competitive edge in their traditional industries (e.g. Oliva and Kallenberg, 2003; Baines et al., 2009; Gebauer et al., 2009; Visnjic and Van Loy, 2013). Companies must decide which services to offer, but existing research provides little managerial guidance regarding how to identify the right service offering policy. Against this backdrop, our research provides empirical insights into when companies should favour particular services so as to capture greater benefits from the transition from manufacturing- to service-oriented.

This study enhances the understanding of the diversity of services that manufacturers offer. As highlighted by various authors (e.g. Eggert et al., 2011; Gebauer et al., 2012; Parida et al., 2014) and documented in our review of literature, most empirical investigations of the performance effects from service infusion strategies focus on services in the aggregate, without further exploring differences among service types. Thus, we propose a view and a model for the analysis of the performance consequences of different service offering policies. More specifically, drawing on portfolio theory, this study disentangles various types of diversification that product companies may realise by adding services to existing product offerings and examines their link with the supplying firm's performance. Previous research on the service-performance link has focused on a small set of financial performance measures. This study responds to the call of Gebauer et al. (2011 p.1278) for use of more comprehensive perspectives of business performance. To our knowledge, this is the first study to explicitly identify the effects of service offerings on the chances of firm survival.

As predicted, our research indicates that the service offering policy does not have a significant impact on bankruptcy likelihood when we treat all companies as homogeneous entities. More extensive offerings of both product-related and product-unrelated services do not exhibit a significant direct effect on bankruptcy likelihood. Likewise, bankruptcy likelihood is not directly affected by whether companies mainly focus on product-dependent or product-independent services. As a consequence, our findings confirm that offering a given set of services is not per se good or bad for product companies (Homburg et al., 2003; Eggert et al., 2011; Oliva et al., 2012).

Our analysis of firm characteristics offers a more fine-grained view that allows us to identify indirect effects of the service offering on bankruptcy likelihood. We reveal that different benefits accrue from product business diversification and resource slack depending on the breadth of a firm's offerings of product-related and product-unrelated services. Therefore, our results contribute to the growing consensus among scholars that the relationship between services and performance is far from simple and add to the emerging academic findings suggesting that this relationship is contingent on the characteristics of individual firms (e.g. Fang et al., 2008; Gebauer et al., 2012; Kohtamäki et al., 2013a).

In practice, in line with previous research (Lewellen, 1971; Singhal and Zhu, 2013), we find that firms that simultaneously operate in multiple unrelated product industries increase their chances of survival. In addition, as the significant interaction between product-related services and unrelated entropy indicates, firms with a broader portfolio of product-related services display greater effectiveness of product business diversification on reducing bankruptcy likelihood. Thus, our results demonstrate that, by offering product-related services, firms can take advantage of existing product-based capabilities and consecutive scope economies that facilitate firm survival. In contrast, companies with undiversified product activities appear to struggle to gain benefits from extensive offerings of product-related services – a fact that we ascribe to limited product-based capabilities at these firms that can be leveraged to service extensions. General wisdom suggests that service strategies are more effective for firms that offer services related to their product business. For example, Fang et al. (2008) found that focusing on product-related services generates greater firm value. Our analysis underscores that, when looking at service provision from the perspective of protecting firm survival, the performance benefits of product-related services are less straightforward because they also depend on the breadth of a company's product-based capabilities.

According to the evidence from our study sample, companies with greater resource slack are less likely to fail. While we underscore this result from previous research, we also show that offering product-unrelated services can foster the benefits of slack resources. Specifically, firms offering more product-unrelated services experience a stronger impact of slack resources on bankruptcy likelihood. As slack is available, companies can effort to invest into new strategies (Burgeois, 1981). Our results clearly indicate that product-unrelated services can be an effective way to invest slack resources. In contrast, because product-unrelated services require resource investments into service-specific assets, it is difficult to achieve the efficiency and effectiveness of service provision in a company with little free resources, further implying that only limited performance benefits can accrue from a broader service portfolio. Firms lacking slack resources might consider expanding their service offerings at the expense of their product investments.

Importantly, recent research demonstrates that such strategies do not pay-off (e.g. Eggert et al., 2015).

The hypothesised interaction between orientation toward product-dependent services and past performance did not achieve significance in our model. A potential explanation for this concerns the measure used to categorise service offerings. In order to avoid multicollinearity with the two other service offering variables, we had to rely on a dichotomous measure for product-dependent services. By doing so, we introduced significant noise in the model. Another possible explanation involves the measurement of past performance. Our line of reasoning in using ROA was that company profitability relates to the level of product demand. This approach was commended by the unavailability of secondary data reporting the number of new product units sold by the companies, yet one could make the point that profitability might have a strong link with bankruptcy. Although profitability and bankruptcy likelihood have been kept separate in previous bankruptcy studies (e.g. Hambrick and D'Aveni, 1988), the argument is certainly plausible. Further research could investigate this issue and clarify whether the performance impacts of service types are affected by the correlation between product and service demands. Visnjic and Van Loy (2013) showed that, in the case of a compressor manufacturer, greater product sales generated greater service sales, yet the nature of the services offered was not explicitly considered in that study.

From a methodological perspective, we propose conditional LOGIT for studies contrasting low- and high-performing service-oriented companies. As noted, conditional LOGIT provides advantages over other (unmatched) regression methods for binary outcomes, including unbiased parameter estimates in case-controls designs. Finally, our study responds to calls for quantitative studies of services that are based on objective measures and secondary data (Eggert et al., 2011; Oliva et al., 2012; Gebauer et al., 2012).

7. MANAGERIAL IMPLICATIONS

Across industries, manufacturing companies strive to survive the pressure of difficult economic times by increasing their portfolio of ancillary services (Neely, 2008; Fang et al., 2008; Cusumano et al., 2014). Against this backdrop, our study provides empirical evidence that service expansion strategies can help the survival of product-based companies. However, our results indicate that offering more services does not automatically enhance a firm's chances of survival. Rather, firms must align service expansion strategies to the level and nature of their resource base. Specifically, our findings indicate that companies operating in different unrelated product industries, and therefore having a more diversified resource base, can benefit from an extended offering of product-related services because resource synergies between product and service operations are facilitated in

such settings. In contrast, product-unrelated services have limited opportunity to exploit product-based assets. Our findings show that extended offerings of these services are associated with lower likelihood of bankruptcy to the extent that a company can rely on slack resources. Therefore, firms should carefully consider their slack resources before extending the range of their product-unrelated services.

In this way, our study indicates that, for companies with low product diversification and little resource slack, expanding the service portfolio does not help protect organisational survival. While this corroborates research suggesting that small firms 'may need different tactics (than large ones) if they are to benefits from service infusion in manufacturing' (Kowalkowski et al., 2013b – p.18), it clearly does not imply that small firms should not transition into services. We submit that these firms should probably effectively focus on a few key services, for example the ones that are more relevant against competition and customer needs, rather than envisioning to capture more value by a broad range of service offerings. Nevertheless, it should be recalled that our study focused on bankruptcy likelihood as performance outcome. If a company is willing to take the risk of default, also service offerings that do not meet our recommendations could pay-off.

8. LIMITATIONS

We conducted our study among public companies for which we could find the 10-K, 10-K405, 10-KSB or 20-F form, and thus most of the companies were US-based. In this way, we could ensure that our dataset contained no missing values (LOGIT requires complete case analysis) and we could also reliably use the Compustat database for industry-level data (Ali et al., 2009). We assume that our findings would transfer to Western European manufacturers, yet further validation in other national contexts would be valuable. Also, further research might explore evidence from private equities, although recent statistics indicate that, at present, failure risk is significantly higher for large public companies than for small private ones (Danner, 2008).

We operationalized companies' levels of product-related, product-unrelated and product-dependent services by counting the number of services they offered within each category. Although using the number of services is in line with the strategic management literature and its focus on breadth of the offering as a key decision in the diversification strategy, diversification research holds that including the relative importance of different portfolio items provides a finer-grained measure diversification (Martin and Sayrak, 2003). Therefore, a natural extension of our work would be to investigate different dimensions of service offering, including the emphasis placed by the firms on specific services (Homburg et al., 2003). For, example, it could be interesting to investigate the number of customers to which specific services are offered or the activeness with

which they are offered as both these dimensions have shown a link to performance in previous empirical service-infusion research (Gebauer et al., 2010; Kohtamäki et al., 2013a). However, to the best of our knowledge, there is no public information or secondary source covering such data, and so this is an investigation that is likely to require primary data collection methods, such as surveys or expert interviews.

We linked the service offering to bankruptcy likelihood but we did not isolate the causal mechanisms (i.e. debt capacity, cash flows, sales, profits) through which this effect ensues. Therefore, additional research should try to capture the causal mechanisms embedded in the services-bankruptcy relationship and identify the relevant mediating variables.

The consistency of the results concerning our first two hypotheses with the theoretical underpinning of our model corroborates the asset relatedness argument of portfolio theory in the case of service extensions. Yet future studies should shed more light on the emergence of demand correlation effects. In particular, the methods used to measure the service offering orientation and past performance variables can be further developed. Finally, we encourage additional research adopting the portfolio diversification perspective. Diversification research can still contribute a great deal to understanding the characteristics of different service expansions, and how product companies can better articulate their service offerings to support organisational success and survival.

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Figure 1 – Overview of the theoretical model

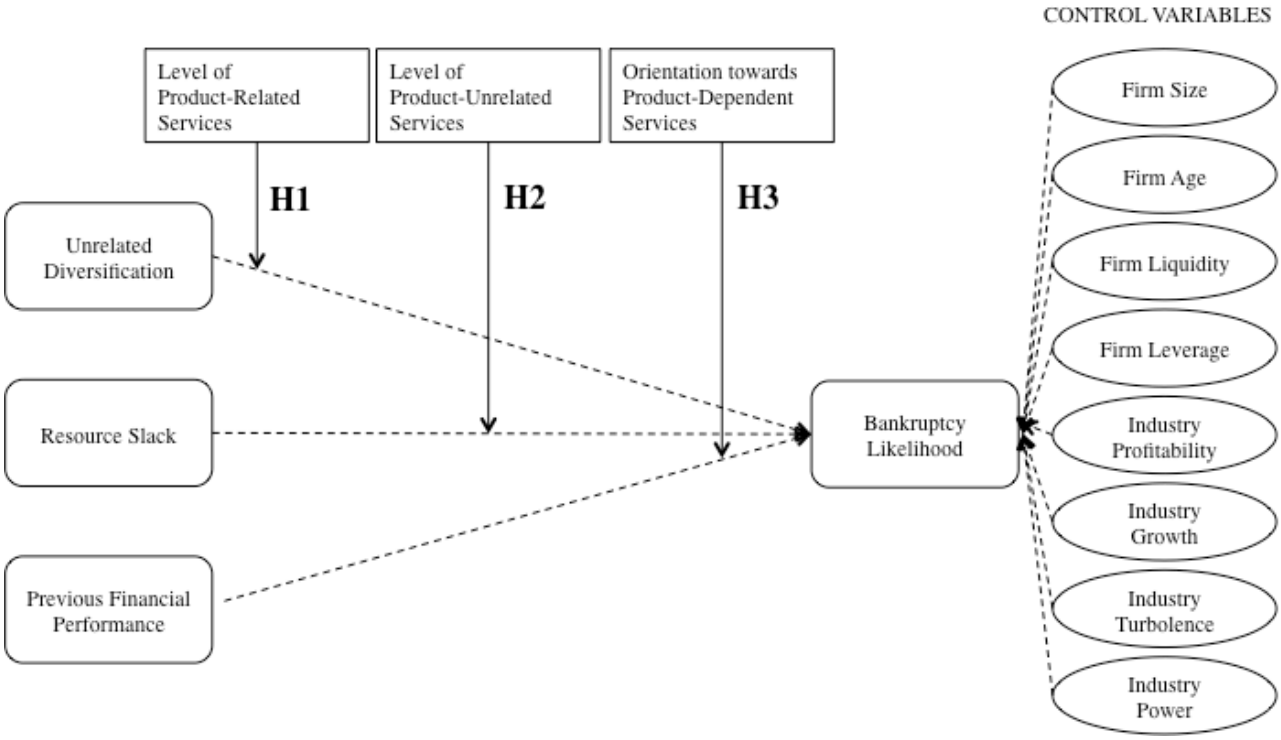


Table 1 – Results of fitting univariable conditional logistic regression models

	Coeff.	Std. Err.	z	p > |z|	95%CI	
SIZE	-0.4051	0.0853	-4.75	0.000	-0.5723	-0.2379
AGE	-0.0125	0.0039	-3.16	0.002	-0.0203	-0.0047
LIQ	-0.3041	0.1492	-2.04	0.042	-0.5965	-0.0116
LEV	-0.5699	0.1929	-2.95	0.003	-0.9481	-0.1917
INDPROF	-4.6542	2.5794	-1.80	0.071	-9.7098	0.4014
INDMUN	0.4339	2.6520	0.16	0.870	-4.7640	5.6318
INDTURB	0.4037	1.9523	0.21	0.836	-3.4228	4.2303
INDPOW	0.0007	0.0098	0.07	0.941	-0.0185	0.0199
BUSDIV [a]	-2.4643	0.6547	-3.76	0.000	-3.7476	-1.1811
SLACK [a]	-3.3708	0.6600	-5.11	0.000	-4.6645	-2.0772
PASTPERF [a]	-0.0860	0.0178	-4.81	0.000	-0.1211	-0.0510
LEVRELSERV [a]	-0.3163	0.1552	-2.04	0.042	-0.6207	-0.0120
LEVUNRELSERV [a]	-0.3577	0.1876	-1.91	0.057	-0.7255	0.0100
DEPSERVOR [a]	0.4860	0.3773	1.29	0.198	-0.2535	1.2255

SIZE = Firm size, AGE = Firm age; LIQ = Firm Liquidity; LEV = Firm Leverage; INDPROF = Industry Profitability; INDMUN = Industry Munificence; INDTURB = Industry Turbolence; INDPOW = Industry Power; BUSDIV = Business Diversification; SLACK = Resource Slack; PASTPERF = Past Performance; LEVRELSERV = Level of Product Related Services; LEVUNRELSERV = Level of Product Unrelated Services; DEPSERVOR = Orientation towards Product Dependent Services

[a] Value of variable is mean-centred

Table 2 - Results of conditional logistic regression analysis

	Parameter estimation						
	Model 0	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Controls							
SIZE	-0.2926***	-0.2771***	-0.2870***	-0.3781***	-0.3184***	-0.3066***	-0.4478***
AGE	0.0004						
LIQ	-0.0345						
LEV	-0.5072**	-0.5270**	-0.5297**	-0.6238***	-0.5503***	-0.5560***	-0.6708***
INDPROF	-2.7368		-2.5980	-1.9208	-3.1657	-2.8191	-2.1231
Main Variables							
BUSDIV [a]	-2.2411**	-2.1811**	-2.2370**	-2.1915**	-2.4183**	-2.5156**	-2.5081***
SLACK [a]	-2.1250***	-2.2213***	-2.1270***	-2.4738***	-2.5757***	-1.9769***	-3.1113***
PASTPERF [a]	-0.0409**	-0.0422**	-0.0411**	-0.0497**	-0.0412**	-0.0448**	-0.0531**
LEVRELSERV [a]	-0.1073	-0.0582	-0.0959	-0.1323	-0.0899	-0.1137	-0.1255
LEVUNRELSERV [a]	0.1994	0.1713	0.1924	0.3507	0.2583	0.2386	0.5152
DEPSERVOR [a]	0.2515	0.2957	0.2690	0.0805	0.3612	0.0806	0.1180
Interactions							
BUSDIV x LEVRELSERV				-1.4648**			-1.6469***
SLACK x LEVUNRELSERV					-1.5215*		-1.9309**
PASTPERF x DEPSERVOR						-0.0528	
Number of obs.	273	273	273	273	273	273	273
-2 Log-Likelihood	89.2185	89.7169	89.2587	81.5766	86.4004	87.1586	77.5758
Chi-square	90.42	89.92	90.38	98.06	93.24	92.48	102.06
d.f.(p-value)	11(.0000)	8(.0000)	9(.0000)	10(.0000)	10(.0000)	10(.0000)	11(.0000)
Nagelkerke R-squared	0.774		0.773	0.805	0.786	0.782	0.821
Correctly predicted (%) [b]							
1 (Bankrupt)	66.21	66.21	66.21	71.61	70.26	66.21	79.72
0 (Non-Bankrupt)	94.47	94.47	94.97	93.97	94.47	94.97	94.47
Overall	86.81	86.81	87.17	87.91	87.91	87.17	90.47

Coefficients are reported; * p<.1; **p<.05; *** p<.01

[a] Value of variable is mean-centred

[b] Cut-off value is 0.5

Table 3 – R-square change F-Test

$$F = \frac{(R^2_{model6} - R^2_{model2})/df1}{(1-R^2_{model6})/df2}$$

$df1 = d.f._{model6} - d.f._{model2}$

$df2 = n - d.f._{model6} - 1$, n: number of observations

	Model 2	Model 6
Nagelkerke R-squared	0.773	0.821
df1		2
df2		261
F		34.99
p		0.0000

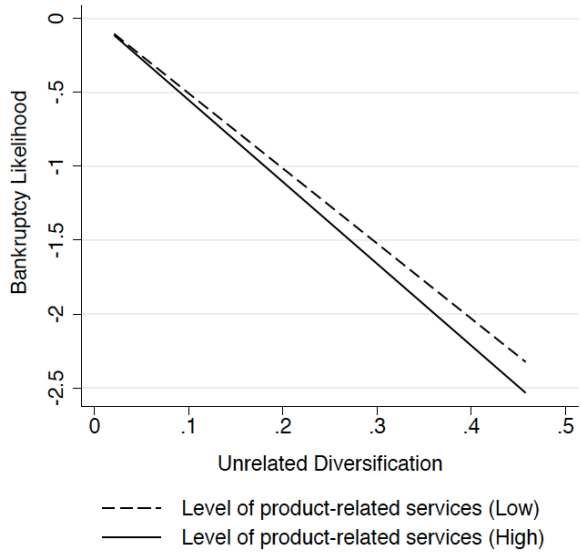
Table 4 – Correlations among independent variables in the final model

Variable	Mean	SD	VIF	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. SIZE	7.039	0.151	1.41	1								
2. LEV	2.028	0.078	1.14	-0.228	1							
3. INDPROF	0.055	0.005	1.04	-0.087	0.031	1						
4. BUSDIV	0.239	0.022	1.25	0.374	-0.113	-0.061	1					
5. SLACK	0.043	0.039	1.27	0.271	0.054	0.068	0.191	1				
6. PASTPERF	0.897	0.814	1.31	0.233	0.201	0.140	0.071	0.371	1			
7. LEVRELSERV	1.678	0.107	2.04	0.131	-0.097	-0.040	0.223	-0.081	-0.048	1		
8. LEVUNRELSERV	1.502	0.058	1.35	0.277	-0.067	-0.042	0.243	0.110	0.103	0.368	1	
9. DEPSERVOR	0.674	0.028	1.76	-0.041	0.093	0.016	-0.168	0.032	0.130	-0.612	-0.035	1

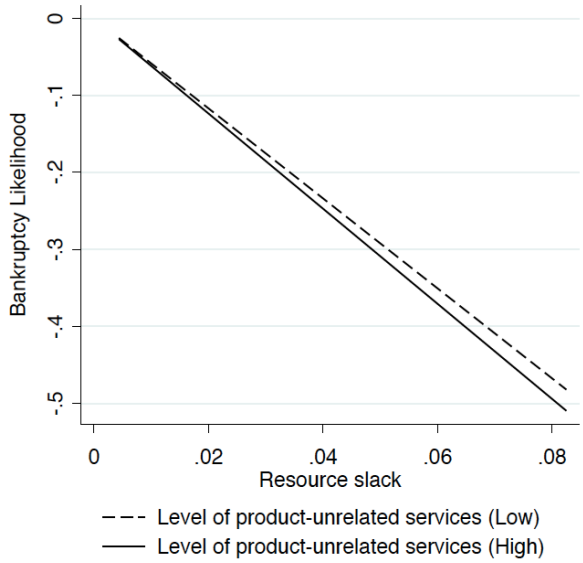
For variables used in interaction terms, Mean and SD refer to non-mean-centred values

Figure 2 – The moderating effects of level of product-related services and level of product-unrelated services

A: Effect of level of product-related services



B: Effect of level of product-unrelated services



Appendix – Definition of service categories

Service Category	Examples	Classification	Product-dependent
1. Trading and Distribution Services	Trading, import, brokerage, sale of used assets, distribution, retailing, direct selling	Unrelated	Yes
2. Logistic Services	Logistics, transportation, trucking, delivery, warehousing, inventory management, inventory planning, inventory control, packaging, shipping, order fulfilment, material handling	Unrelated	Yes
3. Procurement and Purchasing Services	Procurement, purchasing, vendor management services, sourcing services	Unrelated	Yes
4. Maintenance and support Services	Maintenance, repair, calibration, overhaul, spare parts, accessories, product related education/training, helpdesk, technical/operational support	Related	No
5. Certification and testing services	Certification, testing, inspection, auditing, quality assurance, commissioning	Related	No
6. Design and development services	Design, development, engineering, reengineering, prototyping, research services	Related	No
7. Consultancy Services	Consultancy, business advisory services, process optimization, professional education/training, problem analysis	Related	No
8. General outsourcing Services	Real estate management (operation/control/oversight), staffing services, surveillance, finance/HR/accounting/payroll services, IT outsourcing, fleet management, operating services, project management, planning, data collection, data processing	Unrelated	No
9. Financial Services	Financing, leasing, rental, insurance, extended warranty	Unrelated	Yes
10. Renewal and upgrade services	Product modification, conversion, enhancement, improvement, upgrade, renewal, refurbishing, reconditioning, retrofitting	Related	No
11. End-of-life services	Remanufacturing, recycling, collection, decommissioning, de-installation, dismantling, disposal	Unrelated	No
12. Installation and implementation services	Installation, implementation, configuration, integration of products into the customers' systems	Related	Yes
13. System integration	System integration, integrated solutions	Related	Yes