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Servitization, Survival and Productivity

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Abstract

Servitization, i.e. the transition from manufacturing products to providing combinations of products and services, is expected to have many financial and strategic benefits for manufacturing firms. However, making this shift from product towards services can be very difficult; and manufacturing companies' investment in service business may not always result in corresponding higher performance. The purpose of this paper is to evaluate the impact of servitization on UK manufacturing firms' survival and success. We found that servitization increases the productivity level of manufacturing firms. However, its positive impact on firm survival only occurs at higher levels of servitization.

SERVITIZATION, SURVIVAL AND PRODUCTIVITY¹:
A LONGITUDINAL STUDY OF UK MANUFACTURING FIRMS

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Abstract

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Keywords: Servitization, Survival, Productivity

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INTRODUCTION

"Servitization", a strategy that consists on offering customer focused packages in order to add value to core corporate offerings, is seen as one of the main strategies to face the increasing competition from emerging markets. There are a number of case studies which illustrate 'servitization': Xerox has shifted from being a producer of photocopiers to being a documents company (White, Stoughton & Leng, 1999), whilst Spring and Araujo (2009) highlight the case of a paint supplier to automotive manufactures who, instead of selling paint and being paid per litre supplied, is now running the manufacturers' paint lines and is being paid per automobile painted. Probably the most celebrated case of 'servitization' is that of the aero-engine manufacturer Rolls Royce. Although Rolls Royce still sells aircraft engines, it earns an increasing share of its revenues from providing 'Total Care' solutions, and the functionality of its engines through 'Power by the Hour'. This shift has required both a cultural shift and organisational changes, as reflected in a quote from one of the manufacturer's executives: "we design these complex high value propulsion systems with turbine blades that see temperatures exceeding the melting point of the metal from which they are made [...] From a technological viewpoint they are splendid and wonderful [...] but our airline customers see them] as a tube they stick on to their aircraft to make it get to where they want it in a predictable and reliable way" (Johnstone, Dainty & Wilkinson, 2009: 523). Seeing the product from their customers' perspective has meant focusing first and foremost on customer needs, and their customers' point of view, rather than engineering excellence. For example, the engines now have numerous sensors which can predict when a fault is likely to occur and, where possible, potential faults are rectified before they occur, at times when the aircraft is not scheduled to be in service, thus minimizing the disruption to the airline (The Economist, 2009).

Another example, which illustrates how 'servitization' can revive the fortunes of a flagging business, is the case of the ICI-Nobel Explosives Company in the UK (Collins and Gibbs, 1995). Until the early 1990s, this company had focused on the production of explosives for coal mining, but its fortunes had declined with the contraction of that market, particularly in the UK. Production shifted to explosives for quarries, but as the company's production process had no inherent advantages over that of rivals, and as the product was viewed as a commodity, price competition was fierce with no brand loyalty. "Quarries could call at just about any time requesting a delivery the next day and the company was more or less obligated to react or risk losing the business" (Schmenner, 2009: 441). Being at the beck and call of customers led to further inefficiencies, such as an under-utilised fleet of delivery trucks, and to shrinking profits; the only resource that ICI-Nobel had was deep knowledge of blasting and a new software program that could optimize the location of drilled explosives' holes and the timing of the blasts. Using these assets, the company innovated, providing quarries with a complete service, involving planning the blast, drilling holes, inserting the explosive and firing the

blast. "The quarry did not pay for the explosive anymore. Rather, it paid for the 'rock on the ground' that the ICI-Nobel company provided as a service. No longer did the quarry have to keep blast planners, drillers, and shot firers on the payroll and no longer did it have to inventory any explosives or do anything other than dig up the blasted rock and process it further. ICI-Nobel, for its part, now had a way to extract some loyalty from its customers and build a barrier to entry versus the competition; the enterprise became very profitable" (Schmenner, 2009:442).

These perhaps extreme cases illustrate how companies can successfully re-orientate from a focus on the production of material products, to the provision of services and goods-service combinations in the form of 'integrated solutions'. However, studies have also illustrated that making this shift is not easy but fraught with difficulties (Mathieu, 2001; Gebauer, Fleisch & Friedli, 2005; Brax and Jonsson, 2009). Successful 'servitization' typically requires significant changes to both the culture and mindset of the business and its organization. Whilst there is very little large scale survey work in this area, a study by Neely (2008) finds that firms that engaged in 'servitization' strategies do not outperform those that retained a focus on manufacturing material products; they are instead more prone to fail and experience bankruptcy.

In this present study we contribute to this line of research by exploring the impact of servitization strategies on UK manufacturing firms. Building on the resource-based view of the firm as a theoretical lens, the aim of the paper is to analyze the impact of diversification into services on firms' survival and success. Throughout the paper, we consider servitization as a form of diversification strategy, and therefore also compare servitized firms with firms that diversified into manufacturing.

The paper uses the Business Structure Database (BSD), which contains information on firm demographics. By linking the information on local units to the enterprise level, we are able to explore the distribution of enterprises' sectoral activities, for a 13 year period from 1997 to 2009. The database allows us to distinguish between different types of servitization strategies, and to explore firms' engagement with different manufacturing and service activities.

The remainder of the paper is as follows. The next section briefly presents our theoretical framework and hypotheses. The section 3 describes the dataset, presents some descriptive statistics and discusses the characteristics of servitized firms in terms of sector and size distributions, in comparison with diversified manufacturing firms. We present the results in section 5. Section 6 concludes the paper.

THEORETICAL BACKGROUND AND HYPOTHESIS

A growing number of manufacturers have, since early 90s, been providing services to finance, operate, maintain and upgrade an installed base of products – their own, and increasingly those of other manufacturers, (Davies et al., 2006). Most companies have begun to primarily produce a chain of services and integrate these into a form most useful to certain customers; the vast majority of their systems costs, value added, profits and competitive advantage grows out of service activities (Quinn et al., 1990). By the late 90s, revenues obtained by servicing an installed base represented from 10 to 30 times the value of new product sales (Wise and Baumgartner, 1999). Across a range of manufacturing companies, it has been reported that service revenues now represent an average of over 25% of total revenues (Koudal et al., 2006).

Servitization has many expected financial and strategic benefits that have been discussed extensively in the literature. The sale of services should, for example, enable a company to increase both its turnover and the margins on that turnover; it should also increase customer loyalty and lock out the competitors. However this positive impact of servitization is neither immediate nor automatic. It has been reported that servitization is a risky decision, implying a radical change in the mindset of the companies, and different investments and skills (Oliva and Kallenberg, 2003; Brax, 2005; Gebrauer et al, 2005). This issue has been identified as the “service paradox”, in the sense that the manufacturing companies’ investment in service business does often not result in correspondingly stronger results (Gebauer et al., 2005). In one of the few large-scale empirical analysis, Neely (2009) has found that while servitized firms generate higher revenues they also tend to generate lower net profits as a percentage of revenues than pure manufacturing firms.

In this study, we use the resource-based view (RBV) of the firm as a theoretical approach to tackle the service paradox issue. In this framework, drawing on Penrose (1959), firms are conceptualized as a collection of sticky and imperfectly imitable resources and capabilities (Wernerfelt, 1984). These specific combinations of resources and capabilities constitute firms’ competitive advantage. However, this application-specific nature of these resources also limits firms’ opportunities to use them effectively in other contexts (Montgomery and Wernerfelt, 1989).

This issue is of a particular importance in the diversification decision of the firm, and the relationship between diversification and performance has been extensively discussed in previous literature. First, industrial organization economists highlighted market power advantages and internal market efficiencies of diversification strategies (Gort, 1962; Caves, 1981; Scherer, 1980; Lang and Stulz, 1994). Since Rumelt’s seminal work, strategic management scholars also have analyzed the impact of diversification, particularly by distinguishing between related and unrelated diversification

strategies (Rumelt, 1974; 1982). Diversification offers the firm the opportunity to generate economies of scope or synergy, by leveraging its resources and capabilities across divisions (Teece, 1980; 1982). However, there is still no consensus in the literature regarding the relationship between the type, degree and/or level of diversification and firm performance (Palich et al., 2000). Resource-based theory of the firm argues that diversification leads to superior performance, but the underlining relation is found to be non-linear. The greater the diversification, the harder it is to manage an increasingly diverse portfolio (Grant, Jammine and Thomas, 1988; Hill and Hoskisson, 1987). Therefore, the diversification strategy will be more successful if the different activities are related. Related diversification, by the means of economies of scope, allows firms to share critical resources between different business units that are mutually reinforcing (Barney, 1997). By entering new related markets, firms also benefit from learning by doing and extend their knowledge bases (Helfat and Raubitschek, 2000). However, the advantage of related over unrelated diversification is not unanimously acknowledged in the literature. It has been argued that unrelated diversification may be more beneficial in terms of reducing risk (Kim, Hwang, and Burgers, 1989; Amit and Livnat, 1988). And the benefits of economies of scope resulting from related diversification only arise if the firms manage to “create and accumulate new strategic assets” (Markides and Williamson, 1994: 150).

We use these insights from the resource-based view of the firm to tackle the diversification of manufacturing firms into services. We first argue that servitization is a particular form of diversification; hence servitized firms should be compared to diversified manufacturing firms, rather than specialized or single-business firms. Thus we propose the following hypothesis:

Hypothesis 1a. The performance effect of being servitized will be similar to the performance effect of being diversified in different areas of manufacturing, compared to single-activity firms.

Hypothesis 1b. Given the similarity of these two strategies, firms that have already diversified in manufacturing will perform better when diversifying into services.

Furthermore, considering the arguments outlined above, we argue that the performance effect of diversification strategies will also depend on the business scale and scope (Bercovitz and Mitchell, 2007). Although a special case of manufacturing firms diversifying into services has not been made, the arguments outlined above are mostly valid in the case of servitization. By adding complementary services to their products, manufacturers may also benefit from economies of scale and scope. Whereas the installed base arguments provides evidence for economies of scale (Wise and Baumgartner, 1999; Oliva and Kallenberg, 2003), economies of scope arise when firms leverage their capabilities in manufacturing to define and implement new services, as well as when they share their

resources between products and services (Visnjic & Van Looy, 2010, Gebauer et al., 2008). Therefore we propose following hypothesis to hold in the cases of both types of diversification:

Hypothesis 2a. Broader related scope will increase firm survival.

Hypothesis 2b. Greater business scale will increase firm survival.

Business scale and scope have indeed different benefits for the firms; however recent studies show that the positive impact of business scale increases with the broader scope (Bercovitz and Mitchell, 2007). Therefore, we will also test for the moderating effects between business scale and scope:

Hypothesis 3. Broader scope will increase the positive impact of business scale.

Finally, we also expect that servitization will not have the same impact on different measures of performance, namely on productivity and survival rates. Although recent evidence has shown that the relationship between productivity and survival is more complicated (Foster, Haltiwanger and Syverson, 2007), it's generally acknowledged that businesses with higher productivity grow faster and are more likely to survive. Therefore, if servitization is a successful strategy, it should increase both the productivity levels and the survival rates. There are various factors that affect the choice to servitize; increasing customer loyalty (Vandermerwe and Rada, 1988), product differentiation (Cohen and Wang, 1997), eco-efficiency and sustainability (Mont, 2004), new growth opportunities (Sawhney et al., 2004; Wise and Baumgartner, 1999), and stabilizing revenues through the product lifecycle (Cusumano, 2004). However, anecdotal evidence shows that one of the main reasons for servitization is pressures from customers and competitors. Especially in the case of small and medium enterprises, firms often have to provide services in order to keep up with their competitors, rather than differentiate their products. From this perspective, servitization can be seen more as a survival strategy than as a strategic choice. On the other hand, introducing and implementing services as a manufacturer requires new skills and investments (Bascavusoglu-Moreau & Tether, 2010). There is a level of maturity in service development above which services become profitable, this threshold effect has been confirmed empirically (Oliva and Kallenbert, 2003; Malleret, 2005). In this context, the development of organised and profitable services in companies is neither automatic nor immediate – it only happens when specific thresholds have been passed, both in terms of volume and organisation. Thus we test the following hypothesis:

Hypothesis 4. Servitization will have a greater positive impact on survival rates than on productivity rates.

DATA, DESCRIPTIVE STATISTICS AND EMPIRICAL MODEL

Data and Descriptive Statistics

We are using the Business Structure Database (BSD), a version of the Inter-Departmental Business Register (IDBR), containing information on firm demographics. BSD is constructed from the annual snapshots of IDBR, between 1997 and 2009, both at the level of the enterprise and at the level of local unit². By linking the information on local units to the enterprise level, we are able to explore the distribution of firms' activities.

Table 1 shows the size distribution of our sample. As expected, most of the firms are small or medium sized, 93% of the whole sample having less than 50 employees. Less expectedly, this trend seems to persist when we look at servitized and diversified manufacturing firms. This finding contradicts the previous literature that larger firms are more likely to servitize. Furthermore, this prominence of small firms is also persistent, 33% of the servitized and 35% of the diversified manufacturing firms have less than 10 employees during the whole period.

Insert Table 1 around here

Given the prominence of the small firms in our sample, we decided not to restrict our sample according to the firm size. However, in order to build a more homogenous dataset, and according to the theoretical arguments we presented in the previous section, we remove all the firms that operate in a single location, regardless to their size. The final database is therefore constructed from 48,805 observations, with 36.4% servitized and 60% diversified manufacturing firms.

Figure 1 shows the sectoral distribution of the manufacturing firms³. The most important sector seems to be the manufacturing of fabricated metal products (SIC 28) with 13% of the whole sample, followed by manufacturing of food and beverages (SIC 15) with 12%; publishing and printing (SIC 22) with 13 % and manufacturing of machinery and equipment (SIC 29) and other transport equipment (SIC 36) with 10%.

Insert Figure 1 around here

² More information (definition and illustrated examples) can be found in the Business Structure Database User Guide (BSD, 2007).

³ These numbers do not include services firms that have 50% manufacturing and 50% service employees.

When we look at the product diversification strategies of manufacturing firms, 16% of the diversified manufacturing firms belong to fabricated metal products sector. Publishing, Printing and Reproduction of Recorded Media (SIC 22), Manufacture of machinery and equipment (SIC 29) and manufacture of food Products, Beverages and Tobacco (SIC 15) appear as the most frequent sectors, with around 10%. However, servitization most frequently occurs in the Manufacturing of Food and Beverages sector, with around 19% of servitized firms belonging to that sector. Among the different servitization activities, the most common by far is retail, with 65% of servitizing firms offering trade, retail and/or wholesale services. Professional services is the second most widespread, at 14%. Some 7% of servitized manufacturing firms offer distribution services, followed by other services (2.5%). The share of servitized firms that offer combined services is rather small; only 1.5% of the sample offers a combination of retail and professional services, and another 0.5% combine retail with distribution. This distribution of service offerings is consistent in time and within different manufacturing sectors.

Empirical Specification

Dependent variables.

Survival and success are two distinct aspects of firm performance (Kalleberg and Leicht, 1991 AMJ); accordingly, we will have two different dependent variables in this study.

Survival analysis needs longitudinal data. As mentioned before, each establishment has a unique identification number in BSD, thus we identify entry and exit of the firms by linking successive years. An entry is defined as the first appearance of non-zero employment with a new identification number. If a pre-existing identification number has disappeared, we consider it as an exit. Exits can take various forms, such as merger, take-over, divestment, trade-sale or bankruptcy. For this analysis we have excluded all firms that have exited for reasons other than bankruptcy, i.e. mergers & acquisitions, etc. Exits by dissolution or acquisition may happen for other reason than low profitability; on the contrary, firms can be acquired precisely because they are profitable (Romanelli, 1989). We also excluded all the firms that have disappeared and reappeared during the period of analysis. A descriptive analysis of entry and exit rates thus constructed is presented in the following section.

Although firm success can be measured in different ways, here we define it by labor productivity, the only available measure in our database. The productivity is measured by the logarithm of total turnover on total employment.

Finally, we omit the first year of the data (1997), as we cannot compute the initial productivity levels for 1996. Given that our data is right-censored, i.e. all the firms exit in 2009, we also exclude 2009 from our analysis.

Independent variables.

In this study, we are interested in the impact of diversification into services on firms' survival and success. So the main variables of interest are the diversification dummies. We define a diversified manufacturing firm as an enterprise that has at least two local units active in different 5 digits SIC Codes within the manufacturing sector (MM). A servitized firm is defined as an enterprise that has at least one local unit in both manufacturing and in services (MS). We also constructed two dummies to distinguish between firms that are diversified only in services (MIS) and firms diversified into both manufacturing and in services (MMS)⁴.

Business scale is measured by the log of total sales, whereas business scope has been approximated by two different variables. The first measure takes into account the relatedness of the SIC Codes in which the firm is active, separately in manufacturing and in services. We expect that the closer the SIC Codes are related, the greater is the potential for the economies of scope. Therefore, we measure the economies of scope as follows:

$$Scope_1 = 1 + \sum_{i=1}^n \sum_{j=1}^n comb_{i,j} \quad \forall i \neq j$$

where $comb_{i,j}$ is measured by the sum of relatedness between any combination of two SIC codes i and j across the SIC codes that the firm is active in (n) (Rothaermel and Alexandre, 2009). For example, for each combination, $comb_{i,j}$ equals to 3 if the SIC codes are identical for the first three digits and different at the fourth digit; to 2 if the SIC codes are identical for the first two digits and different at the third digit. The second measure of business scope corresponds to the level of diversification (*Scope 2*). We measured this second scope variable by the number of active local units in the different SIC codes, at the five-digit level, in which the firm is active. Once again, this variable has been constructed separately for manufacturing and services sectors.

Control variables.

Previous literature has identified the importance of age and size to firms' survival rates and productivity (Audretsch, 1995; Ericson and Pakes, 1998; Jovanovic, 1982). In these studies, learning has been identified as a determinant of survival. The longer firms stay in the market, the more they learn and increase their chances of survival. Not only the current size of the firm, but also its initial

⁴ More details of the construction of the database and identification of single and multiple site establishments can be found in the appendix.

size affects its chances of survival, although its impact varies according to different studies and/or settings. We therefore include firms' age, size, initial size and, to accommodate possible non-linearities, their squared terms and interaction effects in our specification. The data on firm age and size are from BSD. Our measure of firm size is the natural log of the number of employees. Initial size is defined as the log number of employees per firm when it appeared in the data set for the first time.

We can also expect that it is the growth rate rather than the initial size of the firm that will determine its survival probability (Mata et al., 1995, Agarwal, 1997, Cefis and Marsili, 2005). On the other hand, some firms can deliberately choose also not to grow, in order to maintain their flexibility. Therefore, we also control for the firms' growth rate in our specification.

Ownership characteristics of the firms are also expected to affect their survival rates. From a learning perspective, firms that are part of a group are more likely to have access to market information, as they can learn from the other firms in the same group (Disney et al., 2003). We can also expect some difference between foreign and domestically owned firms, as reported by the previous literature. If the foreign owned subsidiaries have access to superior technologies, they should have higher survival rates and productivity levels (Caves, 1996). On the other hand, these firms may also face higher sunk costs when establishing themselves in foreign markets (Bernard and Sjöholm, 2003). Previous empirical studies have been inconclusive on the resulting effect. We therefore introduce a dummy variable to account for UK-owned firms. Finally, we also include a set of dummies at the two-digit level in order to take into account industrial differences.

Empirical Methodology:

For the survival analysis, we estimate a Cox Proportional Hazard Model that allows leaving the baseline hazard unparameterized. If we denote λ_i , the hazard rate of firm I , then:

$$\lambda_{it} = \lambda_0(t) \exp(Z(t)\beta)$$

Where $\lambda_0(t)$ is the baseline hazard, t is the time since entry and Z , a vector of explanatory variables, as presented in the previous section.

RESULTS

A first look at the entry and exit patterns

First we set out some details of the data as regards calculating entry and exit rates by firms' diversification strategy. Although we have data from 1997 to 2009, we use a sub-sample of 1998 to 2008 in this section to avoid potential truncation biases. Table 4 presents some raw data for the whole sample. We have around 39,000 firms in UK Manufacturing in our data. Reading across the row, just over the half of the firms (20,263) were stayers, less than 10% (3,265) were new entrants and 15% were exitors.

Insert Table 2 & 3 around here

Table 2 suggests that, on average, roughly 60% firms have been in the market for a year and will survive to the following year. 8% of the firms are new entrants, whereas 10% will exit every year, and another 10% after one year of activity. As a result we note a declining number of firms in years. Table 3 shows the number of entry and exits by firms' diversification strategies. We note that both entry and exit rates are higher for firms that servitize, compared to the whole sample as well as to firms that diversified into manufacturing. Particularly the number of entrants is significantly higher amongst servitized firms than amongst diversified manufacturing firms. On the other hand, Table 3 also suggests that diversified manufacturing firms are more likely to survive, with on average 53% of these firms surviving for the following year. This survival rate is quite similar to the manufacturing firms operating in a single site, although the average entry rate per year is around 26% for those firms.

This finding suggests that firms usually enter to the market focused on a particular industrial activity, with the diversification decision coming afterwards, if at all. This can also be seen by the increasing number of entrants by time, for both servitized and diversified manufacturing firms. Thus servitization seems to be strategic decision that comes later in the life cycle of the manufacturing firm.

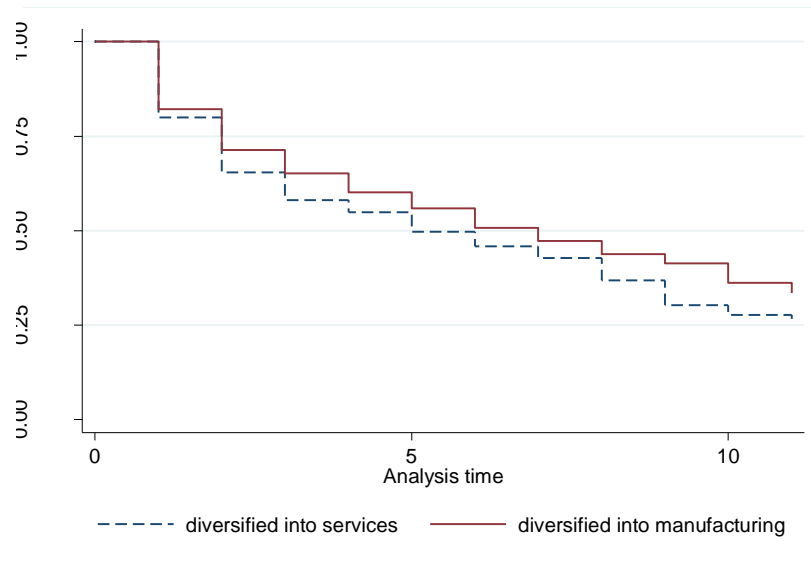
Impact on survival rates

We first look to the impact of servitization strategies on the survival rates of manufacturing firms. Previous studies have shown that servitized firms were more likely to go bankrupt than traditional manufacturing firms (Neely, 2008). In this section we try to evaluate how the hazard (time failure) rate of firms depends on their diversification strategies.

We start with some basic data. Figure 1 illustrates the Kaplan-Meier product limit estimator survival function for both servitized and diversified manufacturing firms, over the whole period. In both cases, firms that diversify into services and/or manufacturing are cumulatively less likely to

survive, with servitized firms being cumulatively less likely to survive. After 5 years, roughly half of the servitized firms have exited, compared with 40% of diversified manufacturing firms. We also note that the gap between the two types of firms is widening with time.

Figure 1. Kaplan-Meier Survival Estimates by Type of Diversification



This figure brings a first – but preliminary – evidence that although diversified firms have a higher risk of exit, there is not a very high difference between firms that diversity into manufacturing and into services. However, we have to consider other variables that might affect the survival rates of manufacturing firms. We therefore estimate a Cox proportional hazard model where we take into account the differences in age, size, and initial size between firms, as well as their non-linear impact.

 Insert Table 4 around here

Our starting point is the model (1) in Table 4, where we explore the impact of firms' initial size and their age on exit rates. At the second stage, squared terms of initial size and age, as well as their interaction term, the firm growth rate and ownership characteristics are added (Model (2)). The standard log likelihood test justifies the inclusion of additional variables and the squared and interaction terms. The results suggest a complex relationship between size and age, confirming previous results. We find a U-shaped relationship between size and exit rates. The results also show that while survival probability is increasing with age, older and larger firm are found more likely to exit. The growth rate has the expected positive effect on firm survival.

In models (3) and (4) we introduce different diversification dummies. Results show that diversification into manufacturing decreases the hazard failure, i.e. it increases the chances of survival

(model (4)). Although the impact of servitization is similar, it is not significant. This results confirm only partly our first Hypothesis (1a), regarding the similarity in terms of performance impact of diversification strategies. Next, we distinguish between firms that diversify only into services, and those who diversify both into manufacturing and into services, in order to test our Hypothesis 1b. Results indicate that there is no statistical difference between diversifying into both manufacturing and services, although the only significant effect is associated with firms that diversify into manufacturing only.

Insert Table 5 around here

Our next aim is to assess the impact of business scale and scope on survival probability. In the first 3 columns in Table 5, we introduce our two scope variables. Results show that broader scope decreases the exit hazard when firms diversify into manufacturing only (Column (2)). We hence confirm previous results and find evidence on Hypothesis 2a. However, the extent of diversification has a negative impact on servitized firms' survival, particularly for related diversification (Column (1)). In the third column, we investigate the interaction effect between the two scope variables, and find a positive impact for both types of diversification. Results suggest that the positive impact of related diversification only occurs for firms engaged in high number of different activities.

In columns (4) and (5), we explore the impact of economies of scale, and its interaction with business scope. We confirm the hypothesis 2b, given that the scale variable has the expected positive and significant impact on survival rates. However, no evidence has been found for hypothesis 3, on the moderating effects of scope and scale.

Impact on Labour Productivity

Table 6 shows the productivity estimations for the whole sample. The first columns show the basic specification where firms' diversification strategies are not taken into account. Results suggest a U-shaped relationship between the size and the productivity. Although non-linear, firm age seems to have a very small impact on the productivity level. Being a UK-owned firm, as opposed to foreign owned firms, has a positive effect on productivity. The introduction of diversification dummies does not have any impact on the basic specification.

Insert Table 6 around here

In the second specification (2) we introduce two dummy variables for firms that diversify into manufacturing (MM) and firms that diversify into services (MS), in order to test our hypothesis 1a. The results show that both strategies have a positive and significant impact on firm productivity, with a higher effect for servitization strategy. In the next specification (3), we attempt to look further into different types of servitization strategies. For that purpose, we distinguish between firms that diversify only into services (MIS) and firms that diversify both into services and into manufacturing (MMS). We find that firms that belong to the latter category achieve higher productivity growth. This finding confirms our hypothesis 1b.

Finally, results suggest that we cannot confirm our Hypothesis 4: we indeed find different impacts of diversification and servitization on survival and productivity, but contrary to our expectations, servitization seems to have a positive impact only on firm productivity. In future research, we are planning to expand our analysis by exploring the effects of different types of servitization strategies.

CONCLUSION

The purpose of this paper, which reports work very much in progress, was to investigate the impact of servitization strategy on manufacturing firms' performance, measured by their survival rates and their productivity levels. Servitization has been promoted as one of the main strategies through which firms can face increasing competition, stabilize revenues, and increase customer loyalty. However, previous work has also shown that moving into services is not straightforward, and the expected gains are not automatic or immediate. It has been even argued that servitized firms are more likely to experience bankruptcy.

We contribute to this line of research, by empirically investigating on the impact of servitization. By looking at around 30,000 UK firms, over a 10 year period (1998-2008), we studied the effects of servitization on manufacturing firms' survival rates and productivity levels. Based on the resource-based view of the firm, we argued that servitization is a form of diversification strategy, and indeed found somehow similar impact of diversification into manufacturing and into services.

Results show that, servitization does not increase, nor decrease the likelihood of failure; however, it increases the firm productivity. The positive impact of servitization on firm survival only occurs at higher levels of diversification.

The main contribution of this study is to provide empirical evidence on a much discussed subject – servitization. This paper presents a first evidence on the positive impact of servitization strategy on a large scale. However, much needs to be done to identify the successful servitization

strategies and the type of service activities that are most beneficial for manufacturing firms. We are planning to extend this work in the future, by exploring interactions and possible complementarities between manufacturing and service activities.

REFERENCES

- Anderson, J. and Narus, J. (1995). Capturing the Value of Complementary Services. **Harvard Business Review**, Jan-Feb, 75-83.
- Amit, R. and J. Livnat. 1988. Diversification and the risk-return trade-off. *The Academy of Management Journal* 31(1): 154-166.
- Baines, T.S., H.W. Lightfoot, O. Benedettini, & J.M. Kay. 2009. The servitization of manufacturing: A review of literature and reflection on future challenges. *Journal of Manufacturing Technology Management*, 20(5):547-567.
- Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. **Journal of Management**, 17, 99-120.
- Bercovitz, J. and W. Mitchell. 2007. When is more better? The impact of business scale and scope on long-term business survival, while controlling for profitability. *Strategic Management Journal*, 28, 61- 79
- Brax, S. A. and K. Jonsson. 2009. Developing integrated solution offerings for remote diagnostics: A comparative case study of two manufacturers. *International Journal of Operations and Production Management* 29(5):539–560.
- Collins, R. and M. Gibbs.1995. Ici-nobel explosives company. IMD case (POM 241).
- Cusumano, M. (2004). **The Business of Software: What Every Manager, Programmer, and Entrepreneur Must Know to Thrive and Survive in Good Times and Bad**. Simon & Schuster.
- Davies, A. 2003. Are firms moving ‘downstream’ into high-value services? In *Service Innovation* , Vol. 9:21–34. London: Imperial College Press.
- Disney, R., Haskel, J and Y. Heden. 2003 Entry, Exit and Establishment Survival in UK Manufacturing. **Journal of Industrial Economics**, Volume 51, Number 1, pp. 91-112(22)
- Gebauer, H., E. Fleisch, and T. Friedli. 2005. Overcoming the service paradox in manufacturing companies. *European Management Journal*, 23(1):14 – 26.
- Gottfredson, M. and K. Aspinall. 2005. Innovation versus complexity: Too much of a good thing? *Harvard Business Review* 83(10): 62 – 71.

- Grant, Robert M., Jammine A. and Thomse H. 1988 Diversity, Diversification, and Profitability among British Manufacturing Companies, 1972-84. *The Academy of Management Journal* Vol. 31, No. 4, pp. 771-801
- Johnstone, S., A. Dainty, & A. Wilkinson. 2009 Integrating products and services through life: an aerospace experience. *International Journal of Operations and Production Management*, 29(5):520-538.
- Katila, R. and G. Ahuja. 2002. Something old, something new: a longitudinal study of search behaviour and new product introduction. *Academy of Management Journal*, 45(6):1183–1195.
- Kim, Hwang, and Burgers.1989. Global diversification strategy and corporate profit performance, *Strategic Management Journal*, 10: 45-57.
- Kim, W. C. and R. Mauborgne. 2004a. Blue ocean strategy. *Harvard Business Review* 82(10):76 – 84.
- Kim,W. C. and R. Mauborgne. 1999. Strategy, value innovation, and the knowledge economy. *Sloan Management Review*, 40(3):41 – 54.
- Kim,W. C. and R. Mauborgne. 2004b. Value innovation. *Harvard Business Review*, 82(7/8):172 - 180.
- Lang, Larry H P & Stulz, Rene M, 1994. Tobin's q, Corporate Diversification, and Firm Performance. *Journal of Political Economy*, University of Chicago Press, vol. 102(6), pp. 1248-80.
- Malleret, V. 2006. Value creation through service offers. *European Management Journal* 24(1) :106 – 116.
- Mathieu, V. 2001. Service strategies within the manufacturing sector: benefits, costs and partnership. *International Journal of Service Industry Management*, 12:451–475.
- Miles, I. 2006. Innovation in Services. In *The Oxford Handbook of Innovation*, Oxford Handbooks in Business and Management. Oxford: Oxford University Press.
- Mont, O. (2004). *Product-Service Systems: Panacea or Myth?* The International Institute for Industrial Environmental Economics, Lund University.
- Neely, A. (2008). Exploring the financial consequences of the servitization of manufacturing. *Operations Management Research*, 1, 103-118.

Oliva, R. and R. Kallenberg. 2003. Managing the transition from products to services. *International Journal of Service Industry Management* 14(2):160–172. *Operations Management Review* 1(2).

Palich LE, Cardinal LB, Miller CC. 2000. Curvilinearity in the diversification-performance : an examination of over three decades of research. *Strategic Management Journal* 21(2): 155-174

Penrose, E. (1959). *The Theory of the Growth of the Firm*. Oxford Basil Blackwell.

Peteraf, M. A. (1993). The Cornerstones of Competitive Advantage - A Resource-Based View. *Strategic Management Journal*, 14, 179-191.

Pine, I., B. Joseph, B. Victor, and A. C. Boynton. 1993. Making mass customization work. *Harvard Business Review* 71(5):108 – 118.

Reiskin, E.D, A. L. White, J. K. Johnson. & T. J. Votta. 2000. Servicizing the chemical supply chain. *Journal of Industrial Ecology*, 3:19–31.

Romanelli, E. 1989. Environments and strategies of organization start-up: Effects on early survival. *Administrative Science Quarterly*, 34:369-387.

Rothaermel Frank T. and M. T. Alexandre. 2009. Ambidexterity in Technology Sourcing: The Moderating Role of Absorptive Capacity. *Organization Science* 20, 4 (July 2009), 759-780.

Rumelt, Richard P., 1974, **Strategy, Structure, and Economic Performance**, (Division of Research, Graduate School of Business Administration, Harvard University, Boston).

Schmenner, R.W. 2009. Manufacturing, service, and their integration: some history and theory. *International Journal of Operations and Production Management*, 5:431 - 44.

Silverman BS. 1999. Technological resources and the direction of corporate diversification : toward an integration of the resource-based view. *Management Science* 45(8): 1109-1124

Spring, M. and L. Araujo. 2009. Service, services and products: rethinking operations strategy. *International Journal of Operations and Production Management*, 29(5): 444 – 467.

Teece, D. J. (1982). Towards An Economic-Theory of the Multiproduct Firm 24. *Journal of Economic Behavior & Organization*, 3, 39-63.

Teece, D. J. (1980). Economies of Scope and the Scope of the Enterprise 22. *Journal of Economic Behavior & Organization*, 1, 223-247.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18, 509-533.

The Economist. 009. Briefing: Rolls-Royce: Britain's lonely high flier. January 10.

Tushman, M. L. and P. Anderson. 1992. Organizational determinants of technological change: toward a sociology of technological evaluations. *Research in Organizational Behavior* (14)311– 347.

Vandermerwe, S. and J. Rada. 1988. Servitization of business: Adding value by adding services. *European Management Journal* 6(4).

von Hippel, E. 1988. *The Sources of Innovation*. New York: Oxford University Press.

Wernerfelt, B. 1984. A resource-based view of the firm. *Strategic Management Journal*, 5(2), pp.171-180

White, A., M. Stoughton, and L. Feng. 1999. *Servicizing: the quiet transition to extended producer responsibility*. Technical Report, Tellus Institute, Boston, MA.

Wise, R. and P. Baumgartner. 1999. Go downstream: The new profit imperative in manufacturing. *Harvard Business Review* 77(5):133–141.

Wooldridge, J. M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, MA: MIT Press.

TABLES AND FIGURES

Table 1: Size distribution of the sample

Year	Whole		Servitized		Diversified	
	Number of firms	Percentage	Number of firms	Percentage	Number of firms	Percentage
1 to 10	172626	39.81	6763	38.85	12416	42.80
10 to 50	231241	53.33	6928	39.80	11488	39.60
50 to 100	19210	4.43	1526	8.77	2657	9.16
100 to 500	9402	2.17	1630	9.36	2135	7.36
50 to 1000	692	0.16	286	1.64	210	0.72
1000 to 10000	431	0.10	248	1.42	106	0.37
more than 10000	29	0.01	26	0.15	0	0.00
Total	433631	100.00	17407	100.00	29012	100.00

Source: Authors' calculation from BSD

Figure 1: Sectoral Distribution

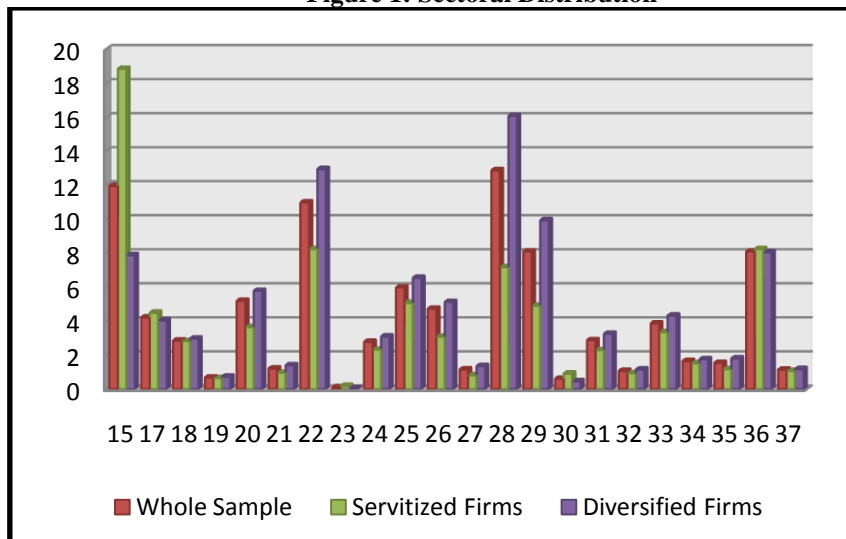


Table 2: Number of Entrants, Exitors and Stayers for the whole sample

Year	Numbers				Fraction of All (%)		
	All	Entrants	Exitors	Stayers	Entrants	Exitors	Stayers
1998	38,939	3,265	5,811	20,263	8.38	14.92	52.04
1999	35,722	2,594	3,529	20,264	7.26	9.88	56.73
2000	34,922	2,729	2,933	20,261	7.81	8.40	58.02
2001	34,267	2,278	3,140	20,253	6.65	9.16	59.10
2002	33,513	2,386	3,459	20,182	7.12	10.32	60.22
2003	32,469	2,415	3,189	19,793	7.44	9.82	60.96
2004	31,808	2,528	2,808	18,894	7.95	8.83	59.40
2005	31,462	2,462	2,323	18,026	7.83	7.38	57.29
2006	31,560	2,421	2,439	17,304	7.67	7.73	54.83
2007	30,950	1,829	2,874	16,566	5.91	9.29	53.53
2008	30,426	2,350	2,865	15,870	7.72	9.42	52.16
Total	366,038	27,257	35,370	207,676	7.45	9.66	56.74

Table 3: Number of Entrants, Exitors and Stayers for Servitized and Diversified Firms

Year	Number of Servitized Firms				Fraction of All		
	All	Entrants	Exitors	Stayers	Entrants	Exitors	Stayers
1998	1782	157	453	536	8.81	25.42	30.08
1999	1396	83	246	529	5.95	17.62	37.89
2000	1316	182	131	522	13.83	9.95	39.67
2001	1287	106	144	518	8.24	11.19	40.25
2002	1246	118	168	510	9.47	13.48	40.93
2003	1107	124	149	448	11.20	13.46	40.47
2004	1150	133	135	472	11.57	11.74	41.04
2005	1118	133	117	442	11.90	10.47	39.53
2006	1223	221	141	428	18.07	11.53	35.00
2007	1191	122	205	417	10.24	17.21	35.01
2008	1212	261	189	387	21.53	15.59	31.93
Total	14028	1640	2078	5209	11.69	14.81	37.13

Year	Number of Diversified Firms				Fraction of All		
	All	Entrants	Exitors	Stayers	Entrants	Exitors	Stayers
1998	3291	141	690	1294	4.28	20.97	39.32
1999	2705	87	393	1305	3.22	14.53	48.24
2000	2430	102	222	1317	4.20	9.14	54.20
2001	2285	67	186	1324	2.93	8.14	57.94
2002	2184	99	206	1298	4.53	9.43	59.43
2003	1925	113	206	1151	5.87	10.70	59.79
2004	1766	102	149	1068	5.78	8.44	60.48
2005	1636	122	127	947	7.46	7.76	57.89
2006	1674	164	108	883	9.80	6.45	52.75
2007	1750	114	215	887	6.51	12.29	50.69
2008	1745	180	183	863	10.32	10.49	49.46
Total	23391	1291	2685	12337	5.52	11.48	52.74

Table 4: Exit Hazards for the whole sample: type of diversification (1998-2008)

	(1)	(2)	(3)	(4)
Initial size	1.133*** (0.01)	0.752*** (0.04)	0.760*** (0.04)	0.760*** (0.04)
Age	0.320*** (0.01)	2.030*** (0.42)	2.119*** (0.44)	2.118*** (0.44)
Initial size squared		1.015*** (0.01)	1.014*** (0.01)	1.014*** (0.01)
Age squared		0.642*** (0.03)	0.636*** (0.03)	0.636*** (0.03)
Initial size* Age		1.132*** (0.02)	1.130*** (0.02)	1.130*** (0.02)
UK Firm		0.774* (0.10)	0.774* (0.10)	0.771* (0.10)
Growth		0.960*** (0.01)	0.960*** (0.01)	0.960*** (0.01)
MM			0.939*** (0.02)	0.939*** (0.02)
MS			0.976 (0.02)	
MMS				0.971 (0.04)
MIS				0.976 (0.02)
Industry dummies	yes	yes	yes	yes
N	34320	34320	34320	34320
Log-likelihood	-32193.54	-32074.58	-32057.23	-32057.22

Table 5: Exit Hazards for the whole sample: Scale and Scope (1998-2008)

	-1	-2	-3	-4	-5
Initial size	0.755*** (0.04)	0.773*** (0.05)	0.758*** (0.05)	0.793*** (0.05)	0.811*** (0.05)
Age	2.048*** (0.43)	2.105*** (0.44)	2.102*** (0.44)	1.316 (0.28)	1.339 (0.28)
Initial size squared	1.015*** (0.01)	1.013** (0.01)	1.015*** (0.01)	0.998 (0.01)	0.995 (0.01)
Age squared	0.641*** (0.03)	0.638*** (0.03)	0.638*** (0.03)	0.665*** (0.03)	0.661*** (0.03)
Initial size* Age	1.131*** (0.02)	1.127*** (0.02)	1.129*** (0.02)	1.226*** (0.02)	1.227*** (0.02)
UK Firm	0.772* (0.10)	0.773* (0.10)	0.773* (0.10)	0.773* (0.10)	0.774* (0.10)
Growth	0.960*** (0.01)	0.960*** (0.01)	0.960*** (0.01)	0.960*** (0.01)	0.961*** (0.01)
Scope 1_M: relatedness	1.002 (0.01)		1.445* (0.27)	1.016 (0.01)	
Scope 1_S: relatedness	1.026* (0.01)		1.026 (0.03)	1.005 (0.04)	
Scope 2_M: level of diversification		0.965*** (0.01)	0.968*** (0.01)		0.999 (0.02)
Scope 2_S: level of diversification		1.026*** (0.01)	1.026*** (0.01)		1.040*** (0.01)
Scope 1 * Scope 2 _M			0.694* (0.13)		
Scope 1* Scope 2 _S			0.996* (0.02)		
Scale				0.950*** (0.00)	0.961*** (0.01)
Scale*Scope 1 _M				0.995 (0.00)	
Scale*Scope 1 _S				1.007 (0.01)	
Scale*Scope 2 _M					0.988 (0.01)
Scale*Scope 2 _S					0.999 (0.00)
Industry Dummies	yes	yes	yes	yes	yes
N	34320	34320	34320	34320	34320
Log-likelihood	-32073.22	-32058.82	-32051.22	-32010.47	-31991.06

Table 6: Productivity Estimations – whole sample

	(1)	(2)	(3)
Size	-0.078*** (0.02)	-0.080*** (0.02)	-0.079*** (0.02)
Size squared	0.014*** (0.00)	0.014*** (0.00)	0.014*** (0.00)
Age	-0.008** (0.00)	-0.009** (0.00)	-0.009** (0.00)
Age squared	0.000** (0.00)	0.000** (0.00)	0.000** (0.00)
UK Firm	0.115*** (0.02)	0.113*** (0.02)	0.113*** (0.02)
Lagged productivity	0.551*** (0.00)	0.550*** (0.00)	0.550*** (0.00)
MM		0.061** (0.03)	0.061** (0.03)
MS		0.089*** (0.03)	
MMS			0.115** (0.05)
M1S			0.088*** (0.03)
Constant	1.710*** (0.05)	1.640*** (0.06)	1.640*** (0.06)
Industry dummies	yes	yes	yes
N	36797	36797	36797

APPENDIX:

A1.Data Cleaning

We first cleaned the database at the local unit level, by removing all the observations related to dead local units. We also removed the observations in non-manufacturing and non-services sectors (Sections A, B, E, F, and P of the UK Standard Industrial Classification (SIC) 2003). The data at the local unit level has been used to identify firms with multiple local units and the 5 digit SIC Codes to which they belong. We are hence able to distinguish between firms that are single site, from those who have multiple local units in different manufacturing sectors, and those who engage in both manufacturing and in services. We define “servitized firm” as an enterprise that has at least one local unit in both manufacturing and in services. A “diversified manufacturing firm” is defined as an enterprise that has at least two local units belonging to different 5 digit SIC Codes.

The service sectors thus identified have been aggregated in 12 main categories, namely retail, distribution, financial services, IT and telecommunication, R&D, real estate, courier, professional services, public services, refuse, recreational services and the others. We subsequently computed the number of local units in manufacturing and services, and the number of employees in each aggregated service category and in each 2-digit manufacturing sector. A new database at the local unit level has been thus constructed, by keeping only servitized firms. We then merged this new data at the local unit level, with the data at the enterprise level. Once again, all the enterprises classified as non-manufacturing and non-services sectors have been removed, as well as single-sited services firms. Among the multiple-sector service firms, we only kept the ones with an equal number of employees in manufacturing and services⁵.

A2.Classification of Main Service Categories:

SIC Codes	Main Service Category
50 51 52	Retail
60 61 62 63	Distribution
64.1	Courier
72 64.2	IT and Telecommunication
65 66 67	Financial Services
73	R&D
70 71	Real Estate
74	Professional Services
75 80 85	Public Services
92	Recreational Services
Other	Other

⁵ This is an objectively chosen threshold, and we are aware that there is no reason to not to include firms, that have for example 51% of their employees in services and 49% in manufacturing. We are planning to explore these firms in more detail in future work.