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Services and the Business Models of Product Firms: An Empirical Analysis of the Software Industry

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Some product firms increasingly rely on service revenues as part of their business models. One possible explanation is that they turn to services to generate additional profits when their product industries mature and product revenues and profits decline. We explore this assumption by examining the role of services in the financial performance of firms in the prepackaged software products industry (Standard Industrial Classification code 7372) from 1990 to 2006. We find a convex, nonlinear relationship between a product firm's fraction of total sales coming from services and its overall operating margins. As expected, firms with a very high level of product sales are most profitable, and rising services are associated with declining profitability. We find, however, that additional services start to have a positive marginal effect on the firm's overall profits when services reach a majority of a product firm's sales. We show that traditional industry maturity arguments cannot fully explain our data. It is likely that changes in both strategy and the business environment lead product firms to place more emphasis on services.

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1. Managerial Relevance Statement

In recent years, many leading technology companies that we usually think of as product firms, ranging from SAP and Oracle to IBM and Hewlett-Packard (HP), have seen increasing amounts of their sales coming from services. Is this shift toward services good or bad for product companies? Should product companies invest more in designing and delivering services or work harder to protect their products business? These are some of the questions we attempt to answer in this study by examining the role of services in the financial performance of firms in the prepackaged software products industry (Standard Industrial Classification (SIC) code 7372) from 1990 to 2006. We find a more complex relationship between services and firm performance than previous researchers have assumed. Product firms that end up focusing on services reach an "inflection point" where the contribution to performance of additional services changes from negative to positive. We estimate this to happen when services reach approximately 56% of a software product firm's total revenues. Overall, our findings should inform managers in product firms who want a better understanding of when and how services can aid the product business as well as contribute positively to financial performance.

2. Introduction

Many authors during the last several decades have noted the rising importance of services in the economy (e.g., Bell 1973, Stanback 1979). Indeed, services have become the largest and often the fastest-growing sector in developed countries (Triplett and Bosworth 2004), and service firms comprise a significant and growing fraction of the largest firms (Heskett 1986). More recently, several authors have stressed the increasing importance of services in the business models of manufacturing firms and product firms in general (Bowen et al. 1991, Quinn 1992, Wise and Baumgartner 1999, Neely 2009). Some product firms have focused on services because these provide them with a more stable source of revenue than products; service revenues such as maintenance and repair also often outlast the lives of the products themselves (Potts 1988, Quinn 1992). A few authors even have suggested that, in at least some industries, services can have higher margins than products, particularly during economic downturns (e.g., Anderson et al. 1997).

Much of the literature portrays the movement to more services in product industries as an almost inevitable life-cycle process resulting from the passing of time and changes in industry conditions. The well-known examples of firms such as IBM, Cisco, Hewlett-Packard, Sun Microsystems, Dell, and EMC that have successfully placed more emphasis on services in recent years have helped promote the idea that many product firms are moving toward services. IBM, for example, derives today approximately 60% of its total revenues from services, up from approximately 35% in 1996. More recently, in multibillion dollar transactions, Hewlett-Packard purchased EDS (Electronic Data Systems) in 2008 to form HP Enterprise Systems, and Dell Computers purchased Perot Systems in 2009 to create Dell Services.

This growing emphasis on services raises questions regarding both the reasons behind the increased relevance of services and whether or not such a shift is truly beneficial for product-oriented firms over the long term. From the theoretical and strategic perspectives, it highlights the importance of better understanding the relationship between services and the overall performance of product firms. For example, some researchers assume that services are "good" for product firms and so managers should welcome the increasing role of services in their businesses. Recent research has even explored "best practices" in the quest by product firms to integrate service activities into their product businesses (Oliva and Kallenberg 2003, Reinartz and Ulaga 2008). Wise and Baumgartner (1999, p. 134) summarized the argument: "Downstream [services] markets . . . tend to have higher margins and to require fewer assets than product manufacturing. And because they tend to provide steady service-revenue streams, they're often countercyclical. Clearly, in manufacturing today, the real money lies downstream, not in the production function."

In this paper, we analyze the role of services in overall firm performance within publicly traded software product firms from 1990 to 2006. Unlike other industries, most software product firms break out service revenues and costs, which allows us to analyze the impact of services across a panel data sample of firms over time. We study the relationship between services and firm performance, and take particular care in overcoming the technical challenges in the estimation. Specifically, we use system generalized method of moments (GMM) dynamic panel data methods (Arellano and Bover 1995, Blundell and Bond 1998) and discuss the advantages of this model vis-à-vis fixed effects (FE) models. We enhance the robustness of the instrumental variable (IV) estimation offered by system GMM by including additional exogenous instrumental variables in our model and running several sensitivity analyses.[1]

We find that the relationship between product and service margins in software product firms is more complex and less monotonic than what the Wise and Baumgartner (1999) quote and the literature suggest. Although we find that software vendors that remain largely "pure product" firms (e.g., Microsoft, Adobe) tend to have higher overall profitability than other firms, our results challenge the notion that additional services are always good or always bad for the performance of product firms, or that they are only important when a product industry reaches maturity. Our data suggest that when product firms focus on products as their main source of revenue (that is, when the relative contribution of services to total revenue is low), additional services tend to worsen operating margins. But, as the relative importance of services grows and product firms derive more revenue from services, there is a point where this relationship reverses and additional services tend to improve overall margins. This pattern cannot be fully explained by industry maturity effects, as the existing literature suggests. Instead, our data suggest that, as service revenues increase as a percentage of total revenues, product firms operationally improve the service part of their business. We find that, after including industry maturity and other controls in our models, this "service effect"—services having a positive marginal effect on the profitability of the product firm after a certain level—prevails. The notion of an "inflection point" in the impact of service focus on the overall operating margins of a product firm is new to the literature and represents an important consideration that can inform future research as well as management strategy. For the entire sample, we estimate this inflection point to happen when services (including maintenance, which we discuss later) reach approximately 56% of a software product firm's total revenues.

We believe that these findings have important implications for academic researchers as well as managers. Our study contributes to the broad issue of what determines firm performance as discussed in the technology management and innovation, economics, and strategy literatures. Most prior research has either ignored the impact of services on the business models of product firms or assumed a straightforward relationship with products. From a manager's perspective, we believe that most product firms do not pay sufficient attention to developing and offering new services or services that complement their products. However, the notion of an inflection point regarding

[1] We thank the associate editor for suggesting we include exogenous instrumental variables in addition to the GMM instruments.

service levels and profitability of the product firm suggests that managers in product firms should devote even more attention to balancing the potential short-term negative effects of emphasizing services with the longer-term benefits (such as by adopting measures to reach the inflection point more quickly).

3. The Dynamics of Products and Services

Prominent research in the past has suggested that services primarily play a significant role for product firms in mature industries. For example, in his widely cited paper, Teece (1986, p. 251) asserted that services "do not loom large" in the early stages of an industry. After the onset of maturity, firms may switch their innovation focus away from product to process innovation and compete based upon efficiency (Abernathy and Utterback 1978; Klepper 1996, 1997). Because firms may no longer focus on product differentiation, products can become commoditized and suffer from increased pricing pressure. Services, however, are a different kind of revenue stream and may not be as susceptible to product commoditization and pricing pressures. It has been noted that services can provide product firms with a more stable source of revenue, and recurring revenue streams from services such as maintenance and repair can outlast the life of the products themselves (Potts 1988, Quinn 1992). Consequently, much of the subsequent literature regarding services in product firms seems to have followed Teece's (1986) dictum, assuming that services become important mainly in mature or maturing product industries (e.g., Reinartz and Ulaga 2008).

Recent research, however, suggests that product firms may offer different types of services at different periods in the evolution of an industry or as part of different strategies and business models (Cusumano et al. 2008). Product firms can offer services before (e.g., consulting), during (e.g., financing), or after (e.g., maintenance, technical support, enhancements, and repair) the product purchase. In addition, some authors have highlighted the importance of services as a mechanism by which product firms can transfer product knowledge to new customers as well as new product developers, and increase customer interest for their products, particularly in situations of high uncertainty.

For instance, Attewell (1992, p. 9) documented the importance of services in the early mainframe computer industry. Specifically, he described a "two-stage process" by which computer manufacturers first sold services to customers to overcome their reluctance to buy the new technology and to be able to sell them the products in a second stage. In their detailed account of the computer industry, Fisher et al. (1983, p. 172) reached the same conclusion: "the provision of such support services by manufacturers greatly facilitated the marketing of their equipment to users by reducing the users' risks in installing that new, unfamiliar, and expensive object, the computer." This example suggests that product firms may sometimes provide services to help them sell products now or in the future rather than as an end in themselves (i.e., as a direct source of revenue and profits). Product firms in theory could potentially give away services for free or at a price below cost—and, in practice, we believe they do.

Therefore, much remains to be investigated regarding the role of services in product firms. Most needed are empirical studies of the effect of services on firm performance. The paucity of such studies to date, despite the fact that services are becoming an increasingly important component of the revenue mix of product firms, may be explained by the difficulties in obtaining reliable data. Most product firms do not break down revenues and costs in a way that allows researchers to collect separate data on services. For this reason, we constructed our own database, relying on public information.

4. Services in the Software Products Industry

This study focuses on the prepackaged software products industry during 1990–2006. The prepackaged software industry (SIC code 7372, North American Industry Classification System code 51121) includes firms that sell discrete programs consisting of software code that, when executed on a hardware platform, perform tasks such as automating a business process or displaying streaming video. Despite the fact that software is considered an intangible product, software products share many characteristics of physical products. Not only does prepackaged software often come in or with a physical medium (box, CD, instruction manual), but also, as with tangible goods, these kinds of software products embody a bundle of standardized features (Gallouj and Weinstein 1997) that are usually provided to all customers. The software products industry does have some unusual characteristics; for example, the cost of duplicating a digital product is nearly zero, whereas, as in other industries, the cost of providing manual services such as technical support, product repair, customization, or training is not zero.

Software firms typically break out product and service revenues in their 10-K annual reports to the U.S. Securities and Exchange Commission. This enabled us to use the Mergent database to capture revenue and financial information from the 10-K reports. To generate an initial list of firms, we used the SIC 7372 classification in Mergent as of 2002. Thus, our sample includes firms that were acquired or went out of business prior to 2002. In addition, we identified publicly listed prepackaged software firms included in the Software 500 list (www.softwaremag.com) during the years 2000–2003 but not captured by Compustat or Mergent. This resulted in a total of 464 firms. For each firm, we tried to collect data for the 1990–2006 period. Because Mergent goes back only 15 years, we conducted additional 10-K analyses to complete the data set as much as possible. This additional step was also necessary because of other limitations with Mergent; for instance, this database does not capture firms that existed in 1990 but ceased to be listed before 1997 (such is the case of Lotus, acquired by IBM in 1995). We identified 51 such firms. Because data for these firms are not captured electronically, we collected 10-K information for as many as possible using microfilm records. This increased the potential total sample to 485 firms. Despite our efforts, not every firm broke down their revenues into services and other categories. This problem, plus the occasional missing data in other variables, reduces our sample to 389, 399, or 394 firms, depending on the specific regression.

One important data issue is the definition of services within the software industry. Several kinds of activities are classified as services in our data set, including presales customer engagements, financing, and after-sales support. For instance, many software product firms provide consulting to their customers even before a product sale, such as analysis by makers of security products to assess a customer's existing level of exposure to malicious attacks. During a product sale, some software firms also provide loans to their customers. As an example, Oracle offers financing that "helps customers acquire IT products from Oracle and Oracle partners" (Oracle 2009). After the product has been purchased, software product firms often provide deployment services to help customers install and configure their products. In addition, they may provide technical support and training to help customers make the best use of the software products they are buying. Symantec, for instance, provides an "Incident Response and Management Program" (Symantec 2009) that includes extensive training for customers' employees to strengthen their command and control capabilities in the case of a security incident. Also included in our data set are services that extend the capabilities of the software product beyond its original design by developing customized add-on modules or integration code to connect to other products and systems, as is often required with business applications. Except for financing, product firms generally consider these various offerings (consulting, deployment, customization, training, technical support) as "professional services" (Lah et al. 2002, Lah 2005).

A few specific activities deserve more attention here. First, product support is perhaps the prototypical service activity in a products industry because it directly relates to the use of a product over time. We obviously classify product support as a service. Second, software product firms often sell "maintenance" services. Maintenance usually refers to routine technical support and the right to receive bug fixes (patches) and minor product enhancements as well as some product upgrades sold to customers under long-term contracts. In line with the treatment by most industry observers as well as accounting practices in software product firms, we have classified maintenance as a service in our study. Like professional services, revenues from maintenance services can only be recognized by the product firms over time, as they deliver the contracted support, bug fixes, or upgrades. By contrast, product firms can recognize the revenues of product sales in lump sums when they ship the products to customers. However, we acknowledge that the line that separates products and services is less sharp in this case in that some maintenance revenues could be considered as a form of product license renewal. As indicated, however, it is customary for software companies to consider maintenance revenues as service revenues and maintenance costs as part of service costs, and to recognize these revenues over time. Indeed, most companies lump maintenance and professional services into a single category.

A third activity that deserves special mention is that of software as a service (SaaS), also sometimes referred to as *cloud computing*. SaaS refers to a business model where software vendors host and run the software on their premises and rent the use of the software's capabilities to customers for a monthly or per-usage fee. Salesforce.com, for instance, offers on-demand customer relationship management software capability and is a prime example of this model. Compared to traditional software businesses, SaaS represents a change in product delivery from on-site deployments to hosted deployments, and in business models from licensing to pay as you go. As a result, SaaS defies easy classification, because it embodies features of both products and services. On the one hand, SaaS customers basically pay for the same features and code that they would obtain through a product license fee in the traditional model. On the other hand, SaaS customers do not own the product license, but have a contractual arrangement that resembles one of a service relationship. Moreover, the product company provides hosting and usually bundles the cost of technical support and maintenance into the monthly fee.

An elaborate discussion on the classification issues involving SaaS is beyond the scope of this paper. For our purposes here, we have classified SaaS revenues as product revenues. This decision is in part practical, because only a few publicly listed companies are exclusively dedicated to SaaS (such as Salesforce.com) and can therefore break the SaaS revenues into products (usually called *subscriptions*) and services (usually called *professional*). Most other firms do not break out their SaaS offerings from their regular product sales, and thus we have no way of separating them. However, it is important to note that for the time period covered by our data set, SaaS activities were not significant. A large survey by Macrovision and the Software and Information Industry Association found that only 4% of software vendors used "software service provider" arrangements in 2004, whereas the other vendors used more traditional licensing arrangements (Macrovision 2004). This relatively low figure for SaaS is consistent with figures provided by the few companies that do break out SaaS revenues. For instance, in its 2008 10-K report, Oracle (2008) lists SaaS as accounting for just under 3% of revenues for 2006, 2007, and 2008. Thus, because of SaaS's relatively low importance as a percentage of revenues through 2006, and the way we have classified SaaS in this study, we can safely argue that the trend we observe from products to services in our sample is not driven by a mere "reclassification" of activities such as in the SaaS model, but is a broader phenomenon that encompasses different kinds of services.

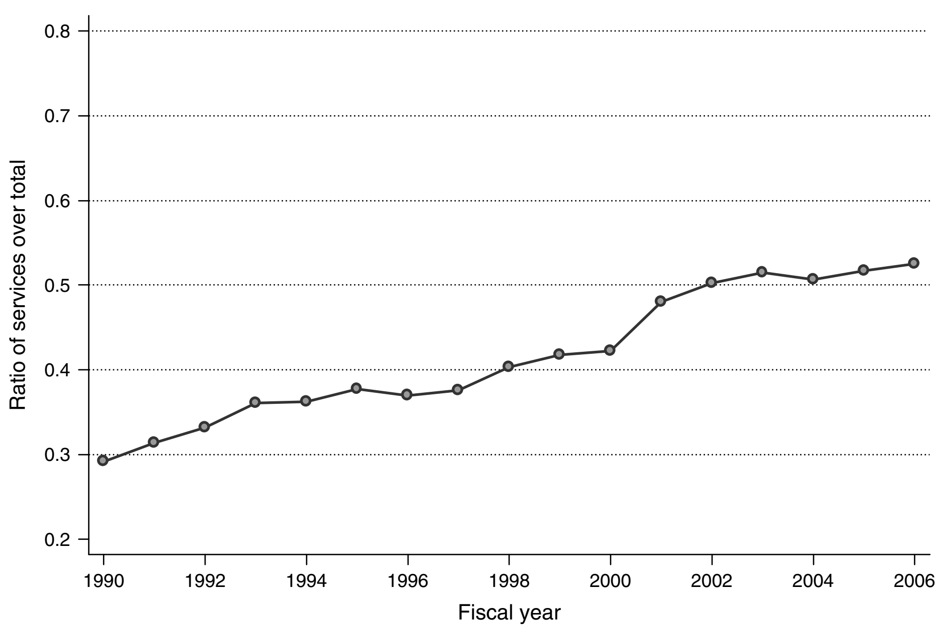
Figure 1 shows that services have indeed become increasingly important in the business models or revenue mix of software product firms. The importance of services, on average for the whole sample, has steadily increased from approximately 30% in 1990 to approximately 52% in 2006. In other words, the majority of today's revenues for companies in SIC code 7372 ("prepackaged software products") corresponds to service revenues, not products. (We also estimate that maintenance is approximately 55% to 60% of these service revenues for firms that break out maintenance from other services.)

5. Methods and Variables Used

A key challenge in estimating the effect of services on profitability in a dynamic panel data setting is the fact that, by the very nature of the phenomenon, the model specification is likely to suffer from several econometric problems. First, we cannot rule out that causality may run in both directions, from services to profitability and vice versa. Second, the customary presence of a lagged dependent variable in a dynamic panel data equation can give rise to autocorrelation. Third, time-invariant firm characteristics could be correlated with the explanatory variables.

Although FE models can tackle some of these issues, serious problems arise with FE models in panel data sets like ours that feature a "small T, large N" context with a lagged dependent variable (Mileva 2007). We therefore use an Arellano and Bover (1995) and Blundell and Bond (1998) dynamic panel estimation (system GMM) to determine the impact of services on firms' margins. System GMM is an extension of the model proposed by Arellano and Bond (1991), an IV methodology based on the realization that fixed and random effects models do not use all the information available in a given sample. After first-differencing the equation, the model is specified as a system of equations, i.e., stacked regressions in differences and levels, one per period. Different instruments for each equation are allowed; suitable lagged levels are used as instruments in difference

Figure 1 Revenue Contribution of Services in the Software Products Industry (Excluding Video Games)



regressions, and suitable lagged differences are used as instruments in the level regressions. In addition to lagged levels and differences, the list of instruments can include other strictly exogenous regressors (Baum 2006). For instance, in an effort to further improve our estimation, we include additional instrumental variables to complement the instruments generated by the GMM procedure.

GMM models present important advantages over fixed effects models and are particularly well suited to tackle the challenges listed above that are common in data sets like ours. For instance, the Arellano–Bover/Blundell–Bond estimation can deal with situations where the dependent variable partly depends on its own past realizations, situations where the predictors are not strictly exogenous (i.e., they could be correlated with past or current realizations of the error), and situations where heteroskedasticity or autocorrelation within individuals (but not across them) is suspected. We use the routine XTABOND2 in STATA version 10 to obtain the estimations below, and follow an estimation procedure similar to that described by Roodman (2006) and Mileva (2007).

A dynamic panel data approach is also better suited to exploring the effect of service activity on margins than the variance decomposition analysis used by other authors in literature on the determinants of profitability. For instance, Schmalensee (1985), Rumelt (1991), and McGahan and Porter (1997) used a variance component model to look at the relative importance of industry, time, corporate, and business-unit effects on the variation of profitability among firms. A dynamic panel estimation like the one we use here examines the residual variation in firm performance that remains unexplained in a variance decomposition analysis, and it can thus be considered complementary to the variance component estimation literature (Goddard et al. 2005).

Following below is a description of the variables used in our regressions; a summary can also be found in Table 1.

The dependent variable $opmargin_{i,t}$ is firm i's operating margin in year t. Operating margin is calculated as a firm's operating income divided by total sales, and thus cannot take values greater than 1, but can take large negative numbers. (For instance, startups may have large negative operating incomes in relation to their small or even nil sales during the first years.) This implies a potential abnormal situation with our dependent variable, because the operating margin measure is capped at 1 on the right. We therefore proceeded to eliminate outliers with operating income of −3 or lower—that is, firms with losses greater than 300% of sales. Eliminating outliers is a common procedure in determinants of profitability analysis (see, for instance, Goddard et al. 2005).

Table 1 List of Variables Used in the Model

Variable	Description
$opmargin_{i,t}$	Dependent variable, defined as the firm i's operating margin in year t
lag $opmargin_{i,t}$	Lagged expression of $opmargin_{i,t}$, i.e., $opmargin_{i,t-1}$
$servp_{i,t}$	Percentage of firm i's total revenues in year t that corresponds to services
$servp2_{i,t}$	Square term of $servp_{i,t}$
ln $sales_{i,t}$	Natural logarithm of firm i's sales in year t
$salesgrowth_{i,t}$	Rate of growth of firm i's sales with respect to the previous year
$maturitycat_{i,t}$	Captures maturity at year t in the category where the firm is listed; takes negative and decreasing values for points before the onset of maturity and positive and increasing values for points after the onset of maturity (full definition in §5)
$mktsharecat_{i,t}$	Firm i's market share in year t in the product category where firm i reported the majority of their business
yeardum	Set of year dummy variables
$employeeIV1_{i,t}$	Instrumental variable; defined as the total number of employees in all firms except firm i at time t
$employeeIV2_{i,t}$	Instrumental variable; defined as the mean number of employees per firm in year t, excluding firm i from the calculation
$salesIV1_{i,t}$	Instrumental variable; defined as the aggregate sales of the industry in year t, excluding firm i from the calculation
$salesIV2_{i,t}$	Instrumental variable; defined as the average sales per firm in year t, excluding firm i from the calculation
ROA	Firm's return on assets, alternative dependent variable
ROE	Firm's return on equity, alternative dependent variable

Moreover, the outliers we eliminate represent less than 0.1% of the total data points in our sample, and thus their elimination should not be a source of major concern.

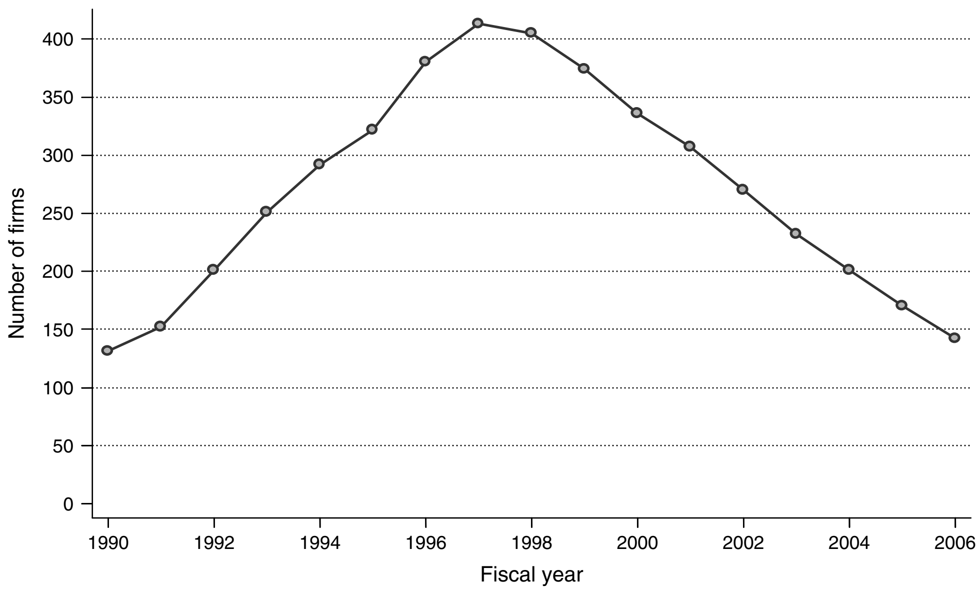
The variable lag $opmargin_{i,t}$ is defined as the lagged expression of $opmargin_{i,t}$, i.e., $opmargin_{i,t-1}$. It captures the speed at which external forces that cause firms to have above- or below-average profitability dissipate over time. This variable, therefore, captures the concern coming from the "persistence of profits" stream of literature (Bain 1956, Weiss 1974).

The variable $servp_{i,t}$ is the percentage of firm i's total revenues in year t that corresponds to services, in decimal form. This variable captures a firm's main orientation with respect to products or services.

The variable $servp2_{i,t}$ is the square term of $servp_{i,t}$.

The variable $\ln sales_{i,t}$ is the natural logarithm of firm i's sales in year t and is included here (as done in many studies) as a proxy for firm size and resources. Economies of scale are said to exist when a small proportional increase in the level of all inputs leads to a more than proportional increase in the level of output produced. Economies of scope can occur in a similar manner across activities ranging from manufacturing to research and development (R&D) such as when firms leverage their production and engineering resources or learning to reduce costs across more than

Figure 2 Total Number of Firms in the Software Products Industry (Excluding Video Games)



one product, project, or customer service engagement (Panzar and Willig 1977, Armour and Teece 1980, Cusumano 1991, Henderson and Cockburn 1996).

The variable *salesgrowth*$_{i,t}$ is the rate of growth of firm i's sales in year t with respect to the previous year, calculated as a firm's sales for the current period minus its sales from last year, divided by last year's sales.

The variable *maturitycat*$_{i,t}$ captures the maturity level of the industry in terms of the number of remaining competitors at any given year. To determine the onset of maturity in the software industry we looked at the evolution in the number of firms in the industry and by industry category. An abundant body of literature has shown that the point at which the total number of firms peaks often corresponds to the emergence of a major change in industry dynamics that leads to a "shakeout" that announces the onset of maturity (e.g., Agarwal et al. 2002, Utterback and Suarez 1993). Following industry practices, we divided our sample of software companies into seven product categories: business applications (36% of the sample), business intelligence (10%), multimedia (10%), databases (5%), operating systems (14%), networking (18%), and others (8%). We excluded the category "games" from our analysis due to the fact that almost all game-producing companies have no service revenue.

Figure 2 plots the number of active software product firms per year in our data set. The software industry follows the expected pattern, with the number of firms first increasing and then decreasing. Depending on the specific product category (individual category curves not shown in the graph), the onset of maturity can be considered as starting in 1997 or 1998—all individual curve "peaks" occur in one of these two years. Using the total number of active firms in each category per year (*densitycat*$_t$), we then calculated our maturity variable as $(1/\mathit{densitycat}_t) \times 100$ for $t >$ *peak year for the category*, and $(-1) \times (1/\mathit{densitycat}_t) \times 100$ for $t \leq$ *peak year for the category*. Thus, *maturitycat* takes positive and increasing values after the peak density year, but negative and decreasing values as we move further back in time from that peak year.[2]

The variable *mktsharecat*$_{i,t}$ is firm i's market share in year t in the product category where firm i reported the majority of its business. This variable follows from the "structure–conduct–performance" paradigm in economics (Bain 1956), which maintains that profitability is mainly due to a firm's market power and the resulting industry structure.

The variable *yeardum* is a set of year dummy variables to capture the effect of time. The inclusion of year dummies is a prudent step in fixed effects and GMM models, because the estimates of the coefficients' standard errors assume no correlation across firms in the idiosyncratic disturbances. Time dummies make this assumption more likely to hold.

Table 2 presents descriptive statistics for all variables (except exogenous IVs and year dummies) and the corresponding correlation matrix. The table suggests no major collinearity problems in our data.

[2] We tried other specifications of maturity such as using a dummy variable equal to 1 for observations starting in 1998 or simply using density. Our current specification seems to better reflect the implications of industry life-cycle theory. However, the sign and significance of the maturity coefficient in our estimations remains the same, independent of the specification used.

Table 2 Descriptive Statistics and Correlation Matrix

Variable	Mean	Std. dev.	Min	Max	1	2	3	4	5	6	7	8	9	10
1. *opmargin*	−0.30	0.80	−4.99	0.97	1									
2. *servp*	0.42	0.24	0.00	1.00	−0.06	1								
3. *servp2*	0.23	0.23	0.00	1.00	−0.05	0.95	1							
4. ln *sales*	10.55	1.93	1.16	17.61	0.41	0.03	0.01	1						
5. *maturitycat*	0.38	3.44	−12.5	12.5	−0.06	0.12	0.10	0.17	1					
6. *servp* × *maturitycat*	0.37	1.46	−7.59	10.00	−0.04	0.26	0.25	0.16	0.85	1				
7. *mktsharecat*	0.03	0.08	0.00	0.92	0.18	−0.10	−0.06	0.57	0.03	0.05	1			
8. *salesgrowth*	1.22	30.77	−1.00	1,623.54	−0.05	−0.08	−0.08	−0.09	−0.06	−0.01	−0.03	1		
9. *ROA*	−0.27	3.27	−170.0	34.18	0.10	0.02	0.01	0.09	0.02	0.01	0.03	0.00	1	
10. *ROE*	−0.68	14.98	−608.1	71.22	0.07	0.23	0.02	0.04	0.02	0.01	0.02	0.04	0.64	1

6. Services and Firm Performance

In this paper, we explore how a product firm's financial performance is affected by a greater or lesser emphasis on services. In particular, we measure a firm's profitability by calculating its operating margin, that is, operating income divided by sales. Our measure of profitability is a good proxy for overall firm performance given the context of our study. Other, more traditional measures, such as return on assets (ROA) or return on equity (ROE), are not typically used within this industry. Software firms rely primarily on intangible assets not included in these kinds of analyses, and they also tend to reinvest much of their profits in an effort to grow and survive given the industry's high growth, entry, and mortality rates. As a result, most other software industry studies have avoided these types of accounting measures (Lavie 2007). We use operating margin instead of net margins because net margins can be influenced by other financial factors such as tax benefits that do not correspond to service operations. In any case, the correlation between operating income and net income in our sample is 0.89.

Our estimation strategy is to use different econometric procedures to estimate a theory-driven model that includes, in addition to the classical predictors of firm performance, a component that allows us to investigate the role of services on firm performance. We start with an FE estimation, a system GMM regression, and finally a system GMM with additional instrumental variables. As we move along, each econometric procedure attempts to correct potential problems with the previous estimation. We then compare and check the consistency of the results.

Our model includes two classical predictors of profitability: a firm's market share (Bain 1956) in its main product category (*mktsharecat*) and the level of competition and commoditization in that product category, measured by a density-based maturity variable, *maturitycat*. We also include a lagged expression of the dependent variable capturing, as noted earlier, the "persistence of profits" argument (Bain 1956, Weiss 1974). In addition, the model includes two other variables often added as predictors or controls for firm profitability: firm size as measured by total sales (*totalsales*) and the rate of growth of firm sales with respect to the previous year (*salesgrowth*). We then include our measure of the firm's focus on services versus products, i.e., the percentage of total sales coming from services (*servp*). For many product firms, focusing on services at least initially may be an "unintended strategy" (Mintzberg and Quinn 1987). Product firms, especially in their initial phase, tend to see services as vehicles to help them sell products—a sort of "necessary evil"—and not as a source of revenue and profits in itself. The quote from former Sun chief executive officer Scott McNealy that "Services will be the graveyard for old tech companies that can't compete" (Morgenson 2004, p. C1) illustrates the point. As a result, product firms may give relatively little attention at first to improving the way they deliver services or how they contribute to profitability. Firms may even give away services or offer them below cost to increase the chances that customers will buy their products. However, once managers realize that services have become an important part of their business and revenue models, we expect the organization to start paying closer attention to managing service production and margins, such as by looking for "best practices" and more effective routines for service design and delivery (Nelson and Winter 1982). Given this reasoning, we include both a main effect and a quadratic effect of *servp*. Finally, we add an interaction term between *servp* and *maturitycat* to capture the specific effect of focusing on services during the mature phase of the industry life cycle.

Our model can be written as follows:

$$\begin{aligned} opmargin_{i,t} &= \beta_0 + \beta_1 servp_{i,t} + \beta_2 servp^2_{i,t} + \beta_3 \ln sales_{i,t} \\ &\quad + \beta_4 maturitycat_{i,t} + \beta_5 salesgrowth_{i,t} \\ &\quad + \beta_6 servp_{i,t} \times maturitycat_{i,t} + \beta_7 mktsharecat_{i,t} \\ &\quad + \sum_{j=\text{years}} \theta_j yeardumj_{i,t} + \alpha opmargin_{i,t-1} + \eta_i + \nu_{i,t}, \quad (1) \end{aligned}$$

Table 3 Results of FE Estimations for Operating Margin

	Model I FE
lag *opmargin*	0.259***
	(0.169)
mktsharecat	−0.519
	(0.341)
maturitycat	−0.006
	(0.007)
ln *sales*	0.137***
	(0.014)
salesgrowth	0.039***
	(0.004)
servp	−1.246***
	(0.201)
servp2	0.846***
	(0.203)
servp × *maturitycat*	0.008
	(0.014)
Year dummies	Yes
Number of observations	2,880
Number of groups	389
R^2	0.41 (overall)

Note. Standard errors are in parentheses, except where indicated.
***Significant at the 0.1% level.

where each variable is as defined in the previous section and summarized in Table 2, η_i is a set of individual firm effects (fixed effects) that capture all cross-sectional variation in the dependent variable, and $\nu_{i,t}$ is an error term capturing the idiosyncratic shocks.

Model I in Table 3 is a firm fixed effects model that attempts to control for unobserved firm heterogeneity. In the FE regression, a firm's operating margin is positively associated with last year's operating margin, firm size, and the rate of growth in sales. In addition, our service variables come up significant; *servp* has a negative sign, whereas *servp2* is positive, lending some support to our argument that the relationship between service revenues and profits is not necessarily linear or negative.

Unfortunately, the FE regression is not equipped to deal with dynamic panel bias. To deal with this latter problem, Table 4 presents results from regressions using the Arellano–Bover/Blundell–Bond system GMM estimator. In Model II, we use Stata's XTABOND2 routine to run system GMM. The signs and significance levels of the system GMM regression are similar to those obtained with the fixed effects estimation. Moreover, the GMM coefficient for the lagged dependent variable seems to behave as expected. In the FE estimation in Table 3, the lagged dependent variable will be negatively correlated with the error, and thus the coefficient for the lagged dependent variable will likely have a downward bias (Roodman 2006). Consistent with this observation, the coefficient for the lagged variable in our system GMM estimation (Model II, Table 4) falls above that of the FE estimation.[3]

Although system GMM is an IV methodology designed precisely to deal with endogeneity and dynamic panel bias, the use of additional, non-GMM-generated instrumental variables can improve the robustness of the estimation (Mileva 2007). Models III and IV in Table 4 present such an approach. Finding suitable instrumental variables for panel data sets can be difficult, but in building our instruments we follow the identification and instrumentation strategy contained in the paper by Berry et al. (1995; hereafter, BLP).[4] These authors, working with panel data of product characteristics in the auto industry, suggested that suitable IVs for prices charged for product j can be constructed from data from all other products except j. Their argument is based on the rationale that decisions to price product j will be influenced by the existence of competing substitutes, but that consumer demand (their dependent variable) will only be influenced by product j's attributes.

A significant number of articles have used this approach to create IVs in dynamic panel data contexts. For instance, Nevo (2001) used the BLP approach to create IVs to explain profit margins of different types of cereals. We use such an approach and rationale in this paper to instrument for our main predictor, *servp*. The profit margin of firm i in the software products industry is likely to be influenced by the percentage of its sales that come from products versus services, and by the other regressors in our model: firm i's size, its market share, etc. However, firm i's operating margin will not be directly influenced by the number of employees or the sales composition of firm j. More likely, firm i will react to competitor's moves by changing its size, revenue mix, and service capabilities to gain advantage over or avoid falling behind competitors. For instance, as noted in the introduction, many product firms have bought service companies to boost their total sales and gain service capacity in reaction to competitors that moved earlier on such acquisitions. The Dell–Perot System deal, for instance, followed the acquisition of EDS by Hewlett-Packard. The effect of

[3] It can be shown (not reported here) that the coefficient for the lagged dependent variable in our GMM models falls between the FE and ordinary least squares coefficients, as described by Roodman (2006).

[4] This article has received 412 Web of Science citations as of July 2010.

Table 4 Results of GMM Dynamic Panel Data Estimations

	GMM estimations			Sensitivity analysis (starting from Model IV)	
	Model II	Model III	Model IV	Model V	Model VI
lag *opmargin*	0.491***	0.458***	0.494***	0.535***	0.620***
	(0.056)	(0.056)	(0.057)	(0.059)	(0.053)
mktsharecat	−0.096	−0.397	−0.151	−0.376	−0.097
	(0.269)	(0.248)	(0.226)	(0.247)	(0.209)
maturitycat	−0.006	−0.003	−0.006	−0.006	−0.002
	(0.009)	(0.008)	(0.009)	(0.010)	(0.010)
ln *sales*	0.063**	0.082***	0.063**	0.069**	0.033†
	(0.019)	(0.019)	(0.020)	(0.020)	(0.007)
salesgrowth	0.039†	0.031**	0.040*	0.036**	0.038**
	(0.015)	(0.010)	(0.018)	(0.010)	(0.011)
servp	−0.601**	−0.717**	−0.591*	−0.595*	−0.628†
	(0.262)	(0.256)	(0.268)	(0.304)	(0.164)
servp2	0.523†	0.640*	0.514*	0.471	0.547
	(0.278)	(0.276)	(0.296)	(0.320)	(0.385)
servp × *maturitycat*	0.209	0.012	0.021	0.009	0.004
	(0.018)	(0.017)	(0.020)	(0.020)	(0.021)
Year dummies	Yes	Yes	Yes	Yes	Yes
Instruments	GMM instruments	GMM instruments *employeeIV1*+ *employeeIV2*	GMM instruments *salesIV1*+ *salesIV2*	GMM instruments *employeeIV1*+ *employeeIV2*	GMM instruments *employeeIV1*+ employeeIV2
Number of observations	2,880	2,469	2,880	2,469	2,469
Number of groups	389	366	389	366	366
Number of instruments	834	836	836	385	212
F-statistic	29.92***	31.60***	36.31***	36.97	35.02***
(degrees of freedom)	(23, 388)	(23, 365)	(23, 388)	(23, 365)	(23, 365)
Difference-in-Hansen test (*p*-value)	$p = 0.997$	$p = 1.000$	$p = 0.397$	$p = 0.676$	$p = 0.274$

Note. Standard errors are in parentheses, except where indicated.
†Significant at the 10% level; *significant at the 5% level; **significant at the 1% level; ***significant at the 0.1% level.

these acquisitions on Dell's or HP's margins, then, would come from the direct effect of adding a new service arm under their wing and therefore changing their proportion of total sales that come from services.

We follow BLP and use the following IVs in our analysis below:

The variable $employeeIV1_{i,t}$ is defined as the total number of employees in all firms except firm i at time t.

The variable $employeeIV2_{i,t}$ is defined as the mean number of employees per firm in year t, excluding firm i from the calculation.

The variable $salesIV1_{i,t}$ is defined as the aggregate sales of the industry in year t, excluding firm i from the calculation.

The variable $salesIV2_{i,t}$ is defined as the average sales per firm in year t, excluding firm i from the calculation.

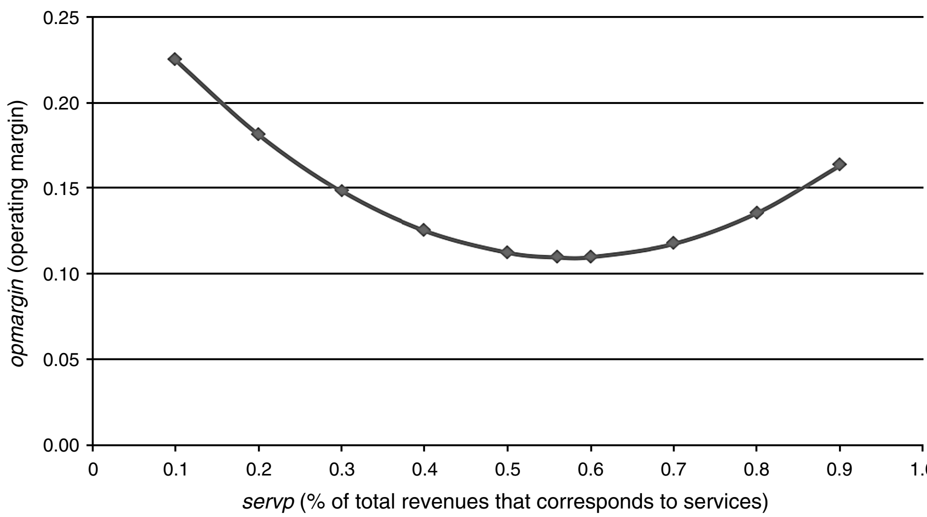
Table 5 presents the correlations between these four instrumental variables and the service variable *servp*. A variable is said to be a good instrument if it is correlated with the endogenous regressor but uncorrelated with the unobserved determinants of the dependent variable—i.e., the regression's errors—as suggested by the rationale we discuss in the previous paragraph.

Model III in Table 4 presents the results from running system GMM to fit our model while adding *employeeIV1* and *employeeIV2* as exogenous instrumental variables. Model IV in the same table uses *salesIV1* and *salesIV2* instead of *employeeIV1* and *employeeIV2* as instrumental variables in the model. Although using the employee-based IVs reduces somewhat the number of available observations (we do not have employment data for every firm in the sample), the results from using both sets of instrumental variables are similar and consistent with those of Model II, which

Table 5 Correlation Between *servp*, *opmargin*, and Additional Instrumental Variables

	servp
employeeIV1	0.25
employeeIV2	0.23
salesIV1	0.26
salesIV2	0.24

Figure 3 Effect of Services on Operating Margin



Note. Percentages are displayed in decimal format.

relies exclusively on the GMM instruments. Our results, therefore, seem to hold for different estimations: fixed effects, system GMM, and system GMM plus additional instruments. In particular, a firm's operating margin is positively associated with its own past realizations, lending support to the "persistence of profits" argument, which states that profits are not independent of their initial level (Mueller 1977, Geroski and Jacquemin 1988). The coefficient for the lagged dependent variable suffers little change in all GMM models, suggesting that an increase in one percentage point in the operating margin of the previous year is associated with an increase of four- to five-tenths of a percentage point in the margin of the following year. The logged expression of total sales (ln *sales*) has a positive, and significant coefficient that fluctuates between 0.063 and 0.082 in Models II to IV. According to this result, doubling the size of the firm is associated with a firm's operating margin that is about six to eight percentage points higher. The coefficient of *salesgrowth* is also fairly stable, positive, and significant, suggesting that an increase in one percentage point in the rate of sales growth with respect to the previous year is associated with an increase of three- to four-tenths of a percentage point in the margin for the current year.

The coefficients of *servp* and its square term *servp2* both achieve significance and are negative and positive, respectively, in Models II to IV, Table 4, pointing to a nonlinear relationship between *servp* and *opmargin* that is consistent with our earlier discussion. Also note that, given our model, a negative effect of *servp* on overall margins may be produced by one of two situations: (a) when service margins are negative or (b) when service margins are lower than product margins. We discuss below which of these two scenarios tends to prevail in our sample. The coefficient of *servp* then looks at the relative margin contributions of services versus products in the case of product firms.[5] Thus, other things being equal, when firms focus on products (low values of *servp*), service margins tend to be negative or lower than product margins. As *servp* increases, at some point this relationship changes, and service margins start to be positive or higher than those of products. We can estimate that "inflection point," i.e., the point where there is a change in the relative effect of services on operating margins, by calculating the semielasticity:

$$\frac{\partial opmargin_{i,t}}{\partial servp_{i,t}} = \beta_1 + 2\beta_2 servp_{i,t}. \tag{2}$$

Using the coefficients for *servp* and *servp2* in Model III we can estimate the inflection point to be at $servp = 56\%$ (the inflection point remains almost the same if we use the coefficients in Model IV);[6] that is, for the whole sample and using the GMM estimations, at low levels of services and up to a level where services represent 56% of sales, an increase in services tends to lower overall firm margins. When services top 56% of sales, their effect on overall margins turns positive. Figure 3 provides a visualization of the nonlinear effect of *servp* on *opmargin*. The figure plots the resulting *opmargin* values for different values of *servp* (and consequently *servp2*) when all other variables are kept at their mean levels. Given that our model has

[5] We thank an anonymous referee for helping us present our model this way.

[6] The 95% confidence interval for the inflection point of 0.56 is (0.406, 0.735).

Table 6 Products and Services Contribution to Operating Margins by Service Orientation

Dependent variable: *Operating margin*	Whole sample		*servp* ≤ 56% (product oriented)		*servp* > 56% (service oriented)	
	System GMM Model VII	Fixed effects Model VIII	System GMM Model IX	Fixed effects Model X	System GMM Model XI	Fixed effects Model XII
productsales	0.384*** (0.007)	0.370*** (0.002)	0.408** (0.142)	0.409*** (0.003)	0.304*** (0.079)	0.218*** (0.046)
servicemaintenancesales	0.224*** (0.049)	0.290*** (0.010)	−0.309 (2.515)	−0.361*** (0.033)	0.302*** (0.067)	0.368*** (0.017)
othersales	−2.597† (0.969)	−1.51*** (0.209)	−1.616 (6.790)	−1.007*** (0.225)	−3.021 (3.292)	−0.180 (0.535)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Instruments	GMM instrum.		GMM instrum.		GMM instrum.	
Number of observations	3,273	3,273	2,341	2,341	932	932
Number of groups	394	394	364	364	212	212
Number of instruments	473		451		470	
F-statistic (degrees of freedom)	1,653.67 (3, 393)	1,063.52 (19, 2860)	34.45*** (24, 363)	927.13** (19, 1958)	71,871*** (19, 211)	107.65*** (19, 701)
Difference-in-Hansen test (*p*-value)	$p = 0.998$		$p = 0.012$		$p = 1.000$	

Note. Standard errors are in parentheses, except where indicated.
†Significant at the 10% level; **significant at the 1% level; ***significant at the 0.1% level.

time dummies, we have arbitrarily chosen the midpoint year in our sample, 1998, to create the graph. In Figure 3, an increase in the percentage of service revenues from 10% to 20% is associated with a reduction in operating margin of about 4.4%; however, a similar 10% increase in the percentage of services is associated only with a 1.3% increase in operating margin if it happens when the services percentage rises from 40% to 50%. At the right of the inflection point, an increase of 10 percentage points in service revenues increases the operating margin by 0.8% if it happens when service revenues rise from 60% to 70%, and by 2.8% when services rise from 80% to 90%.

We conducted several robustness tests to further check our results. We followed a procedure described by Roodman (2007) to run additional GMM regressions restricting the number of instruments to observe possible changes in parameter significance. These restricted-instrument regressions are reported in Models V and VI in Table 4. As seen in the table, the sign and significance levels of the coefficients for most variables remain fairly consistent as the number of instruments decreases—another indication that our GMM model is appropriate. The variable *servp2* barely misses the significance level (p-value $= 0.13$), but its coefficient size and sign remain consistent during the exercise.

We ran additional robustness tests not reported in this paper. We tested for the specific effect of R&D expenditures by creating a *share of industry R&D* variable. This was not significant. We tested for possible effects from the "dot-com" period through the use of a dummy variable, but this was not significant either. As noted, we also tried different specifications for the "industry maturity" variable, including using industry density and creating an "onset of maturity" dummy variable that took the value of 0 for data points before 1998 and 1 otherwise. The main effect of these failed to achieve significance, as did that of the *maturitycat* variable used in our models here. We also checked for the possibility of attrition bias, by testing whether operating margin and our key variables were correlated with the probability of attrition. The analysis, not reported here, suggested no significant attrition issues in our sample.

One interesting question coming from our analysis above is how the relative contribution of services and products to firm performance varies as firms become more service oriented. Table 6 provides some information on this. In the table, we regress operating margin against product sales, service sales, and other sales (all variables in thousand dollars). The coefficient in this regression represents expected margins on each type of revenue. The first two regressions (Models VII and VIII) are run on the whole sample. Consistent with our discussion above, the coefficient for products is larger than that of services, suggesting that, for the whole sample, products have a higher contribution to operating profits. However, dividing the sample into product-oriented and service-oriented firms based on the inflection point we calculated reveals (Models IX and X) that the expected margins for products are higher for product-oriented firms than for the whole sample. Perhaps as expected, services also have a negative contribution to operating margins for this group. But the picture changes dramatically when only the service-oriented firms are considered in the analysis (Models XI and XII). For

Table 7 Results of GMM Dynamic Panel Data Estimations with Alternative Dependent Variables

	ROA as dependent variable Model XIII	ROE as dependent variable Model XIV	Sales (ln) as dependent variable Model XV	Sales growth as dependent variable Model XVI
Lagged dependent variable	0.052	−0.069*	0.961***	0.128***
	(0.077)	(0.028)	(0.012)	(0.042)
mktsharecat	−1.082	−3.977		1.658
	(1.284)	(2.874)		(1.899)
maturitycat	−0.001	0.156†	−0.010	0.092
	(0.030)	(0.092)	(0.018)	(0.078)
ln *sales*	0.164	0.415†		−0.125
	(0.107)	(0.231)		(0.133)
servp	−0.908	−3.182	−0.224	1.753
	(1.043)	(2.672)	(0.515)	(2.300)
servp2	0.782	3.705	−0.262	−1.542
	(0.601)	(2.703)	(0.456)	(1.616)
servp × *maturitycat*	0.047	−0.189	−0.003	−0.250
	(0.079)	(0.198)	(0.037)	(0.198)
Year dummies	Yes	Yes	Yes	Yes
Instruments	GMM Instruments + *employeeIV1 employeeIV2*	GMM Instruments + *employeeIV1 employeeIV2*	GMM Instruments + *employeeIV1 employeeIV2*	GMM Instruments + *employeeIV1 employeeIV2*
Number of observations	2,311	2,311	2,473	2,303
Number of groups	360	360	366	359
Number of instruments	732	732	494	716
F-statistic	6.10***	2.21**	380.30***	17.14***
(degrees of freedom)	(22, 359)	(22, 359)	(20, 365)	(21, 358)
Difference-in-Hansen test (p-value)	$p = 0.422$	$p = 0.664$	$p = 0.913$	$p = 0.764$

Note. Standard errors are in parentheses, except where indicated.
†Significant at the 10% level; *significant at the 5% level; **significant at the 1% level; ***significant at the 0.1% level.

firms in this subsample, not only do services have a positive contribution to operating margins, but also their contribution is as high as or even higher than that of products.

Finally, Table 7 presents additional analyses using alternative measures for firm performance, other than operating margins. We have argued that operating margin is a superior measure of firm performance in the specific context of the software products industry. To a large extent, the regressions in Table 7 seem to be consistent with this argument. Both ROA and ROE measures present negative averages well below the averages for most other industries, and also a high dispersion. The regression for ROA (Model XIII) fails to achieve significance for all of the predictors, including our service variables. ROE (Model XIV) also seems unaffected by a firm's service orientation, but it appears to be positively associated with firm size and the level of maturity in the firms' main product category. Despite the fact that they do not achieve significance in either the ROA or ROE regressions, we note that the sign of the *servp* and *servp2* coefficients are consistent with those found in our main regressions in Table 4. When sales (Model XV) or sales growth (Model XVI) are used as dependent variables, none of the predictors are significant other than the lagged dependent variable. The fact that the effect of service orientation on firm performance does not seem to come from changes in firm sales or sales growth lends additional support to our claim here that the effect of service orientation on operating margins most likely comes from the fact that, by increasingly focusing on services, firms learn to improve their service operations and make them more profitable at the same time as they benefit from spreading some of the fixed costs of service production on a larger volume of service sales.

7. Discussion

Based primarily on anecdotal and case evidence, several authors in the last decade have heralded the rising importance of services. They have assumed that product firms should or could emphasize services more than in the past as their business models and industries evolve and mature. Services can, the argument goes, represent a more profitable long-term source of revenue than initial product sales (Anderson et al. 1997, Wise and Baumgartner 1999). Some case-based studies specific to the software products industry also have pointed out that although services in most instances have lower margins than products, it makes sense for individual firms to emphasize services if their product business is declining due to falling prices, such as from free software or due to the difficulty of finding new customers versus the ease of collecting maintenance payments (Cusumano 2004, 2008; Lah 2005). Our empirical study sheds additional light on this discussion. For the sample as a whole, we find that firms that remain focused on products tend to have higher profitability than product firms that rely more heavily on services. This basic result would suggest that the claims of the services literature about the benefits of services for product firms are somewhat overstated. However, remaining a product-focused firm may not be an option open to all managers; in the software products industry, for example, only a handful of companies, most notably Microsoft and Adobe, have been able to do this. More importantly, our results also show that services can indeed improve the profitability of product firms under certain situations, as the sign and extent of services' contribution to margins compared to that of product sales can vary depending on certain factors specific to the firm and industry. In addition, one should look not only at the separate contribution of services versus products, but also at the relationship and dynamics between the two.

Our results extend the existing theoretical treatment of services. In prior literature, services have been considered important for product firms mainly in the mature stage of an industry (see, for example, Teece 1986). Our data suggest that such a view is not necessarily true: none of the industry-level maturity variables achieved significance in our models. The analyses represent a potentially important finding for managers and researchers. The role of services for product firms may increase not necessarily due to industry maturity, but to a conscious effort by firms to grow or improve the service business once managers realize that services have become a large and strategically relevant part of the overall business. At a broad level, our results suggest the valuable role strategy can play in the impact of services on firm performance that should be considered in conjunction with industry maturity effects. It is possible that as services become a larger part of their business, product firms may actually master the creation, production, and delivery of services to a point where service margins become attractive, even after controlling for maturity effects. We do recognize that a particular firm's business may be mature in the sense that it becomes difficult to find new customers or to increase product prices; software and digital media businesses in particular have had trouble raising prices, given trends such as free and open-source software or free access to many publications and videos on the Web. But the lack of support for a product industry maturity effect on services holds even when we try to control for software product segments that can be expected to have a higher reliance on services, such as business applications and business intelligence products. These tend to need more customization, integration, and training than other software products.

We do find that, at least in the early years after service revenues first appear, additional services tend to worsen the margins of a product firm. Why would firms continue to provide services when these can worsen their overall margins? We suggest that product firms may offer services soon after their establishment because they need services to reduce customer reluctance to buy and use their products. At the same time, product firms may find that services help them learn more about customer needs as well as transfer useful product knowledge to customers. Although we need additional research on this topic, some product firms may invest in services early on to improve their product business.

The finding that additional services can have a negative impact on overall operating margins for product-focused firms and a positive impact for those firms whose businesses rely more heavily on services—even after controlling for firm size and maturity—is new to the services literature and a potentially important strategic finding for practitioners, particularly in that we find a specific inflection point when services reach 56% of sales. This point varies slightly by product segment, but not by much. Not surprisingly, when an organization focuses on a specific set of activities and accumulates more experience in those activities, it often gets better at doing them. For instance, improved practices may make it easier to transfer service delivery processes from one customer engagement to another, as in the case of the commonly adopted good practices in software engineering that help software firms offer custom development or systems integration services in a cost-effective way (Humphrey 1989, Cusumano 1991, Upton and Fuller 2005).

But the search for best practices in services may not be confined to the delivery side of service activities. Product firms may also search for better ways to design and reuse service modules, write more complete and specific service contracts, or more accurately charge customers for the different services they offer, all of which would result in higher service margins. This would be true even though a "service focus" may not be the intended strategy for many of these product firms, but rather a strategy defined by ex post observation of a "pattern of actions," such as defined by Mintzberg and Quinn (1987, p. 15): "Strategy is consistency in behavior, whether or not intended . . . patterns may appear without preconception . . . plans are intended strategy, whereas patterns are realized strategy." Additional research is needed to understand how deliberately product firms may turn toward services as well as to tease apart potential explanations for why an increased level of services improves operating margins in our sample.

We believe our findings have important implications for managers in product firms who want to better understand the advantages and disadvantages of providing services to their customers. We also believe that many product firms do not pay enough attention to developing and offering new services or to understanding the impact that services can have on their performance and long-term survival. As described above, services can be important to the success of a new product or technology even if they may worsen overall margins at first. Managers at product firms need to better comprehend the relationship between service and product margins over time to devise an effective services strategy.

Anecdotal evidence suggests that most product firms, far from strategically managing their service transitions, focus on products and mainly consider services as an afterthought when competitors start to move decisively into services or when products can no longer sustain healthy margins. Such reactive and late interest in services can result in much ground lost to the competition. The experience of Dell Computers in the mid-2000s may be a good example of this. A successful product company for many years, Dell did not pay much attention to how services might help it sell products or generate more revenue until its product business started to falter. Despite a predominant position in hardware, catching up with companies like IBM and Hewlett-Packard, which emphasized services earlier, has not been easy for Dell (Hansell and Vance 2009). Indeed, sorting out the role of strategy in the relationship between services and profitability in product firms from that of the deterioration of product margins (the traditional maturity explanation) is a rich and interesting avenue for future research.

Our results should still be interpreted with caution because of the nature of the industry we have studied. Software products are information-intensive goods with a peculiar cost structure (Shapiro and Varian 1998). In particular, replicating an information good is a trivial expense, whereas services can either be highly labor intensive or highly automated, such as at search firms like Google or travel agencies like Expedia. As noted earlier, gross margins on the products business (that is, sales minus direct expenses for producing and delivering the product, but not including R&D, sales and marketing, or general administrative expenses) can be extremely high. At the same time, we must note that large R&D, sales, and marketing expenses may erode much of these potential profits, and, because of the same marginal cost characteristics, price competition can get extremely fierce in bad economic times. In addition, given the unrelenting pace of change in information technology, the software products industry may not lend itself very neatly to the traditional phases of industry evolution (although Figure 2 does show a pattern similar to that seen in other industries).

In spite of these caveats, there may be more similarities than differences between prepackaged software and other product industries. For instance, many product industries are governed by high fixed costs that generate competitive dynamics not too different from what we see with software products. Also, many product industries experience "dematurity" trends or important changes in innovation dynamics even during their mature stages. Thus, although we cannot claim strong external validity from a single-industry study, we believe that our results will probably hold in at least some other industrial contexts. Further empirical research in other product industries will help sort out these important issues.

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