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The performance effects of innovative service transition strategies

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ABSTRACT

In recent years, the management research has increasingly discussed service transition. However, studies have not used sufficiently granular empirical data for valid quantitative evaluation of service-intensive strategies by, for example, examining the possible effects of resource slack on firm performance. To test the hypothesis that resource slack moderates the performance effects of a servitization-based strategy, a regression model was applied to data spanning several industrial and geographic sectors. Tobin's q and return on assets were applied as uniform measures of financial performance. The study shows some potential positive and negative effects of the servitization of manufacturing firms on their financial performance. However, resource slack on its own is not shown to moderate these effects. The conclusion is that servitization is not a panacea for manufacturing firms, nor is the combination of servitization with resource slack. The contribution of this article lies in providing further evidence of the positive performance effects of servitization, while showing that servitization can have negative effects on firm performance in certain circumstances.

Introduction

The servitization of firms has been investigated since the 1980s. However, researchers have not fully disentangled this phenomenon (Crozet & Milet, 2017). Several positive impacts such as financial success (e.g., higher revenues or higher profits), positive environmental impacts (e.g., higher-quality products and the reduction of resources), and positive global macroeconomics impacts (e.g., high importance for wealth creation) are associated with the servitization of businesses (Baines et al., 2009; Kastalli & van Looy, 2013). *Servitization* describes the process of changing from a pure product manufacturer that focuses on the production, sale, and delivery of a product to an integrated service provider that innovates, sells, and delivers services (M. Kohtamäki et al., 2018; Kowalkowski et al., 2017b). Because servitization is often achieved through digitally enriching existing processes and structures, the servitization trend is often linked to the broader trend of digital transformation. Servitization can help to establish more sustainable business practices, because products may have longer life cycles through better predictive maintenance or resources that can be saved through higher-quality products.

In the business literature, servitization is often described as a panacea for firms, with the argument being that servitized firms sustain profitability, earn stable revenues, and improve customer satisfaction (Valtakoski, 2017). Firms in traditional industries seek these effects, because they face high maturity levels in their industries and high employee wages (Vendrell-Herrero & Wilson, 2017). Further, shorter product life cycles and globalization lead to higher competition, which increases the challenge of achieving a competitive advantage. However, firms in advanced economies have access to highly skilled workers. As a result, traditional manufacturing companies such as General Electric (GE) or Siemens are focusing on servitization strategies and are investing in innovative business models that reduce comparability and make them less susceptible to imitations (Vendrell-Herrero & Wilson, 2017). Thus, firms use servitization to face current challenges and improve their chances of success (Kowalkowski et al., 2017b). The transformation of a firm from a product-centered business model to a service-centered one is linked to cultural and attitudinal changes (Häckel et al., 2021; Kowalkowski et al., 2017a). While servitization is already being carried out in

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manufacturing firms, the servitization phenomenon is highly debated in both academia and practice.

First, the theoretical constructs that underlie servitization are heterogeneous and are not fully defined (Rabetino et al., 2021a). Second, the current literature still lacks robust studies. Sousa and Da Silveira (2017) have pointed out the lack of differentiation of the different services, as well as focusing on only one firm, one sector, or one country. While servitization's performance effects have been seen to be positive in a meta-analysis (Wang et al., 2018), they have also been shown to be negative (Neely, 2008) or dependent on further factors such as product lifespan (Vendrell-Herrero et al., 2022).

Given a qualitative evaluation of the effects of servitization, a plausible conclusion is that investing in services can be a fruitful strategy for firms. To assess whether a strategy is viable, its effects need to be measured; there have been calls for such measurement (Kowalkowski et al., 2017b; Skaggs & Droege, 2004). To explore this issue, the following research question was formulated:

*Do servitization strategies **positively** influence a firm's financial performance?*

To assess whether or not a strategy is viable, it needs to be measured based on its effects. This measurement is important not only to measure progress toward strategic goals, but also to assess businesses' responsiveness (Maheepala et al., 2018). Because poor financial outcomes often lead to stopping the servitization process in a firm, it is important to fully understand servitization's impacts on firms' financial performance, including performance relationships with the different services, identifying the different phases and possible thresholds (Sousa & Da Silveira, 2017; Suarez et al., 2013).

Overall, the research on servitization's performance effects has yielded inconsistent results. We conducted a literature review to understand the reasons behind these results; it shows that numerous moderating factors can augment, diminish, or even negate servitization's generally positive performance effects. The literature shows the potential of resource slack as an additional moderating factor, not just in the context of servitization (Fang et al., 2008) but also for other strategic contexts such as technological diversification (Chen et al., 2013) or in the relationship between green process innovation performance and financial risk (Tariq et al., 2022). To test this hypothesis, we constructed a regression model, addressing servitization's performance effects.

Previous studies and quantitative publications have relied on reported business segments and their classification according to Standard Industrial Classifications (SIC) codes to assess service ratios. However, because firms choose the SIC classifications themselves, the data reveal quality defects owing to self-reporting bias. This article avoids these data quality defects by relying on primary data derived from in-depth research into annual financial statements, as well as relying on secondary data that were not SIC code-classified. This data set was analyzed for the impact of servitization on firm performance. To allow for a uniform and reliable measurement of financial performance, we applied the performance measures Tobin's q and return on assets (ROA).

This study's results show that there may be some positive and some negative effects between the servitization of manufacturing firms and their financial performance. However, contrary to indications from the literature, resource slack on its own is not shown to moderate these positive effects of servitization. While service transition strategies can benefit financial performance, focusing on them alone is not a panacea for manufacturing firms. If there are no further quantitative findings on other moderating effects, companies should develop their own company-specific capabilities case-by-case and should expand their resources in relation to their specific servitization strategy.

The remainder of this article is structured into several sections. Section 2 summarizes the relevant literature on the service transition strategies' performance effects. In Section 3, the hypotheses are derived. Section 4 outlines the research methodology and illustrates how the data were analyzed in the model. The results are presented in Section 5. In Section 6, the findings and the contributions are discussed, along with their limitations and suggestions for future research.

Literature review and conceptual framing

Literature review

First, a non-systematic literature review was performed regarding the current understanding of servitization in the manufacturing context, considering the present state of research, theory, and concepts. Second, this overview of the literature was complemented by a structured literature review (SLR), which was conducted to gain an overview of the current research on servitization's performance effects. This review was based on a keyword search relating to servitization and performance effects. The search was conducted in the Web of Science database, limited to publications from 2018 or later (to ensure currency), and included only articles from journals in the top 50 of the Scimago ranking of management journals (to ensure high-quality articles). In the first step, the titles were searched for relevant keywords, yielding 85 articles. Next, the articles' abstracts were checked for relevance; 76 articles were excluded, leaving nine relevant articles. To complete the literature search, forward and backward searches were conducted to supplement the results.

Servitization as a competitive advantage

Service transition has been widely discussed in the management literature (Baines et al., 2009; Kowalkowski et al., 2017b; Rabetino et al., 2018). As a result, several synonyms for this concept have emerged, such as *servitization, service diversification* (Vandermerwe & Rada, 1988), *service integration* (Fließ & Lexutt, 2016), and *service transition* (Rabetino et al., 2021a). Some authors even see the term *Industry 4.0* as a synonym for servitization (Abou-Foul, 2018; Frank et al., 2019). We use *service transition* and *servitization* interchangeably to describe this concept. The service literature often defines services as an economic and intangible commodity, and servitization as a "systems-led concept" focused on "business models, structural transformation processes, and supporting digital technologies" (Ulaga & Kowalkowski, 2022, p. 6). The marketing and operations literatures define services as intangible, simultaneously produced and consumed, perishable, and non-standardized. We follow the definition of Kowalkowski et al. (2017a), who defined servitization as a "transformational process of shifting from a product-centric business model and logic to a service-centric approach" (Kowalkowski et al., 2017a, p. 7).

The use of consumer goods and services with temporary access without ownership is not new in the literature. It was introduced into the management research >20 years ago; the concepts of servitization and product-service systems and the sharing economy have been identified by scholars as a subset of this body of knowledge (Annarelli et al., 2016; Ciulli & Kolk, 2019; Tukker, 2015). As companies that offer product-service systems have encountered significant barriers to consumer adoption, the growth of the sharing economy is seen as "a window of opportunity that can be exploited to favor the acceptance of SPSS (sustainable product-service-system)-oriented solutions" (Vezzoli et al., 2015, p. 4).

Several positive impacts—such as financial success (e.g., higher revenues or higher profits), positive environmental impacts (e.g., higher-quality products and the reduction of resources), and positive global macroeconomics impacts (e.g., high importance for wealth creation)—are connected to the servitization of businesses (Baines et al., 2009; Kastalli & van Looy, 2013). The literature argues that servitized firms sustain profitability, earn stable revenues, and improve customer satisfaction (Valtakoski, 2017). Firms in traditional industries seek these effects, because they face high maturity levels in their industries and high employee wages (Vendrell-Herrero & Wilson, 2017). Shorter product life cycles make it harder to distinguish oneself from competitors, leading to higher competition, which in turn makes it harder to

gain a competitive advantage. Firms in the advanced economies have access to highly skilled workers. As a result, particularly traditional manufacturing companies such as GE or Siemens are focusing on servitization strategies and are investing in innovative business models that reduce comparability, making them less susceptible to imitations (Vendrell-Herrero & Wilson, 2017). Thus, firms use servitization to face current challenges and to enhance their success (Kowalkowski et al., 2017b). Following the drivers of servitization, the conclusion is that investing in services may be a fruitful strategy for firms.

Surplus resources as an enabler of servitization and of competitive advantage

Following the resource-based view (Grant, 1991) and its extensions in the form of the knowledge-based view and the dynamic capabilities view (Ambrosini & Bowman, 2009), a company achieves competitive advantage through the composition of its resources for the generation of value. According to Hofer and Schendel (1978, p. 12), strategy is "the match an organization makes between its internal resources and skills and the opportunities and risks created by its external environment." In this context, capabilities are intangible resources that differ between firms and that develop through learning over time. They are defined as important for companies to gain a competitive advantage. They are special resource types that can change other resources (Helfat & Peteraf, 2009) and "socially complex routines that determine the efficiency with which firms physically transform inputs into outputs" (Collis, 1994, p. 145). Dynamic capabilities influence servitization processes' outcomes (Castka et al., 2024).

While resources can be used to explain performance differences, the *resource slack* phenomenon can be transferred to servitization's performance effects to explain these effects. Because far-reaching capabilities and resources are required for developing and offering services, it is assumed that a high resource availability is important for firms to be able to meet the challenges of offering services. The use of resource slack to explain firms' financial success is referred to in the literature (Lee & Grewal, 2004); it is also used to assess servitization's financial performance (Fang et al., 2008).

Previous studies on service transition strategies' performance effects

There have been many publications on servitization, from case studies (Davies, 2004) and strategies on how to implement services (Brax et al., 2021; Salonen, 2011) to managerial-oriented guidance (Kharlamov & Parry, 2021; Oliva & Kallenberg, 2003). However, to examine servitization's performance, quantifiable performance measures should be analyzed. There are many methods to measure firm performance. Common methods include return on investment (ROI), return on assets (ROA), and earnings before interest and taxes (EBIT), which measure firms' profitability. Tobin's q and different revenue approaches are also used. This multitude of methods creates controversy (Han et al., 2013; Neely, 2008; Skaggs & Droege, 2004). At the same time, a few core measures were used consistently in the literature.

Regarding the firm performance measures shown in Table 1, the most frequently used was firm profits, followed by revenue. Tobin's q was used least often. Reviewing the literature on quantitative measurements of servitization's performance effects shows that the relationship between servitization and firm performance is complex, and that the studies' results seem to conflict (Gebauer et al., 2012; Kohtamäki et al., 2013). While some authors implicitly described servitization strategies as always beneficial for firm performance, others stated that servitization strategies are either beneficial or harmful for a firm's performance (Gebauer et al., 2012). Others have examined whether the relationship between servitization and firm performance is linear or nonlinear (Kohtamäki et al., 2013). Further, while Fang et al. (2008, p. 1) stated that "the impact of a firm's transition to services on firm value (as measured by Tobin's Q) remains relatively flat or slightly negative

Table 1
Comparison of studies of servitization effects and applied performance measures.

	Firm profitability	Tobin's q	Revenue approaches
Skaggs and Droege (2004)	x		
Neely (2008)	x		
Fang et al. (2008)		x	
Kohtamäki et al. (2013)	x		x
Han et al. (2013)			x
Eggert et al. (2014)	x		x
Parida et al. (2014)	x		x
Suarez et al. (2013)	x		
Visnjic et al. (2016)	x	x	
Sousa and Da Silveira (2017)	x		x
Böhm et al. (2017)			x
Crozet and Milet (2017)	x		x
Ambroise et al. (2018)	x		
Kharlamov and Parry (2021)	x		X
Abou-Foul et al. (2021)	x		X
Li et al. (2023)	x		X
Yang et al. (2023)	x		X

until the firm reaches a critical mass of service sales," Crozet and Milet (2017, p. 832) stated that "most of the benefits from servitization are observed up to 1 year after starting to sell services." Jat et al. (2023) support these findings. Unlike other researchers (e.g., Fang et al., 2008; Kohtamäki et al., 2013, Suarez et al., 2013), Crozet and Milet (2017) identified a positive effect on the performance of weakly servitized firms. However, after reaching a threshold of approximately 30 % of service revenue compared to total production, servitization's positive performance impacts fade and turn into a disadvantage for performance. According to Gebauer et al. (2012), when investigating servitization's impacts on a firm's performance, it is important to distinguish between services, because customers value services differently, and different services have different effects on firm performance. Thus, when the measurement of services is simplified, results that contradict the theory can occur (Gebauer et al., 2012).

Lack of financial success can be understood as a failure of a servitization strategy, also referred to as *the service paradox* (Gebauer et al., 2012; Kohtamäki et al., 2018a; 2018b). One reason why firm performance does not always fulfill expectations may be the coexistence of two strategies in a firm, as well as the process of establishing a new culture, which is also referred to as *establishing new capabilities* (Kohtamäki et al., 2018a; 2018b; Sousa & Da Silveira, 2017). Traditional product-centric firms will have problems selling services, because this capacity requires different capabilities. For example, when starting the servitization process, decision-makers from product-centric firms may lack the experience and knowledge to accurately price newly offered services. Thus, they end up providing services for free or selling them below their initial costs. As a result, particularly during the starting phase of servitization, services will contribute only a little to a firm's financial performance (Kohtamäki et al., 2018b). Beyond that, Kharlamov and Parry (2021) stated that only firms that combine servitization and digitalization achieve higher performance, while firms that implement only one of these do not. Abou-Foul et al. (2021) and Yang et al. (2023) also confirmed the positive influences of digitalization and servitization on firm performance. Li et al. (2023) argued that supply chain integration moderates the relationship between servitization and performance. While supplier integration enhances the positive relationships between basic services and sales growth, customer integration strengthens the relationships between advanced services and return on sales (ROS) growth but weakens the relationships between basic services and ROS growth.

As stated, the research on servitization's specific performance effects has yielded inconclusive and ostensibly paradoxical results. To better

understand these results, an SLR of recent publications was conducted, as described. Table 2 shows the results regarding an observed positive or negative effect of servitization on firm performance and possible moderating effects.

As shown in Table 2, the SLR's first result was that servitization's performance effects were contingent on other moderating factors, including but not limited to such factors as product life cycle, supply chain integration, and organizational risk-taking tolerance. Further, as seen in Gomes et al. (2021), company maturity's moderating effect can lead to *either* negative or positive performance effects of deservitization. This finding opens the possibility that the research results for performance effects of servitization are not so much inconclusive or paradoxical but rather incomplete, as a full descriptive model would have to contain sufficient moderating variables. To date, performance effects have been examined depending on a singular, or a few, moderating effects.

The inconclusive results may be resolved (at least partially) by considering all the relevant moderating variables, which would require a full understanding of what they are. In the results of the non-systematic and structured literature reviews, three points emerged. First, the relationship between servitization and performance effects was inconclusive, which may also be due to moderating effects that are not fully understood. Third, the resource-based view and dynamic capabilities view allow for resource slack to be a relevant factor that augments performance effects.

Overall, and owing to these conflicting results, there is still the call for measurement of servitization's performance impacts by using more valid data over a long period of time (Kowalkowski et al., 2017b; Rabetino et al., 2021b; Skaggs & Droege, 2004). Further, it stands to reason that the conflicting results are due to hidden variables, specifically, the effects of moderating variables. In the following section, the possibility of such variables is incorporated in the derivation of the hypotheses.

Table 2
Results of the SLR for performance effects of servitization and moderating effects.

Authors	Servitization's performance effects	Moderating effects
Vendrell-Herrero et al. (2022)	Weak positive	Strong positive correlation with product lifespan
Yang et al. (2023)	Strong positive	Strong positive correlation with digitalization, network capacity, and organizational risk-taking tolerance
Gomes et al. (2021)	Positive performance effects of servitization, and positive or negative effects of deservitization, depending on the moderating variable	Low company maturity correlates with positive performance effects of servitization and negative performance effects of deservitization; high company maturity correlates with positive performance effects of deservitization and small effects of servitization
Wang et al. (2018)	Positive	Service operationalization factors, i.e., service orientation, service offering, service breadth, and service revenue
Li et al. (2023)	Basic services are positively related to sales growth; advanced services are positively related to ROS	Moderating role of supply chain integration; supplier integration enhances the positive relationship between basic services and sales growth; customer integration strengthens the relationship between advanced services and ROS growth
Jat et al. (2023)	Positive impact of servitization in the long term rather than in the form of instant financial benefits	Specific role of supply chain risk management, through which servitization has a positive impact on financial performance; negative direct impact of preventative risk management on financial performance
Brax et al. (2021)	Positive	Performance effects depend on how firms implement servitization strategies
Abou-Foul et al. (2021)	Positive	Digitalization
Kharlamov and Parry (2021)	Positive	Firms should combine servitization and digitalization to exhibit higher performance

Derivation of the hypotheses

Fig. 1 summarizes the three tested hypotheses and the variables in the statistical model.

The individual hypotheses are explained below.

Servitization has a positive effect on firm performance

Firm performance might be affected by servitization. Several positive impacts—such as financial success (e.g., higher revenues and higher profits), positive environmental impacts (e.g., higher quality of products and reduction of resources), and positive global macroeconomics impacts (e.g., high importance for wealth creation)—are connected to the servitization of businesses (Baines et al., 2009; Kastalli & van Looy, 2013). The theoretical constructs of the resource-based view, the dynamic capabilities view, and the knowledge-based view mentioned in Section 2.2 align with these effects, although following the knowledge-based view also allows for the possibility of servitization failure owing to different circumstances, namely superior knowledge and integrative capabilities on the customer side (Valtakoski, 2017). The business literature describes servitization as a panacea for firms, arguing that servitized firms sustain profitability, earn stable revenues, and improve customer satisfaction (Valtakoski, 2017). We interrogate these assertions by hypothesizing:

- H1: A service transition (the servitization of corporate business models) generally has a positive impact on a firm's performance.

This hypothesis was purposely limited to the question of whether any amount of servitization has a positive effect, regardless of the degree of servitization, so as to differentiate between positive effects and the degree of servitization in case of proportionality.

Increased servitization leads to better firm performance

The literature describes how, particularly for low servitization levels (a low service ratio), firm value is affected only slightly (Fang et al., 2008). Reasons for this low impact on firm performance can be the loss

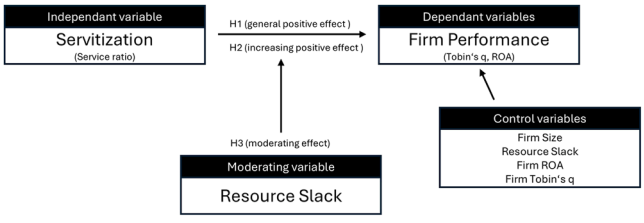

Fig. 1. Conceptual framework of the tested hypotheses and the statistical model.

of a strategic focus (Fang et al., 2008) or higher labor costs owing to knowledge-intensive and labor-intensive investments (Abou-Foul, 2018; Kohtamäki et al., 2013). Nonetheless, as soon as a servitizing firm crosses the threshold of a certain amount of service revenue, the servitization's positive effects (e.g., increased customer loyalty, better differentiation from competitors, and advanced cooperation with suppliers) lead to higher financial performance that should surpass the abovementioned negative effects (Abou-Foul, 2018; Baines et al., 2009; Fang et al., 2008; Valtakoski, 2017; Vendrell-Herrero & Wilson, 2017). Further, by reaching higher servitization levels, a firm also increases learning effects. Thus, with a higher number of services in its portfolio, a manufacturing firm does not need to build additional capabilities and can exploit its existing ones that make additional services even more profitable (Fang et al., 2008). Thus, firms must learn how to sell and price services (Baltuttis et al., 2021). Nonetheless, when a firm's decision-makers recognize that services are of growing importance for its performance, they will start paying more attention to the development of services. In turn, paying more attention to the development of services will lead to improved service design, an improved customer focus, and higher margins for services. Therefore, the profitability of services increases with the increasing importance of services to a firm's business model. In other words:

- H2: At higher service ratio levels, service transition strategies' effects on firm performance becomes increasingly positive.

Resource slack positively moderates firm performance

Slack resources take different roles in firms (Bourgeois, 1981). Slack resources can also be understood as a measure of a firm's ability to approve and comprehend new technologies (Lee & Grewal, 2004). Thus, slack resources can be used as a proxy to assess how many resources a firm is incorporating (Fang et al., 2008; Lee & Grewal, 2004). Key firm resources in the sample firms include capabilities that are needed to successfully launch digital services. High amounts of slack resources represent a high number of opportunities for a firm's managers to invest in strategically important decisions without claiming budget from other operational functions (Fang et al., 2008). Owing to opportunity costs of slack resources and decreasing marginal utility, it is also possible that slack resources have a negative impact on a firm's performance (Lee & Grewal, 2004). Nonetheless, Fang et al. (2008) suggested that resource slack's positive effects outweigh its negative effects. Thus, we propose:

- H3: Resource slack positively moderates service ratio's effects on firm performance.

Methodology

Measures

Independent variable: service ratio

Service sales were used to identify a firm's service transition level. The portion of a firm's service sales compared to its total sales provided insights into how important services are for its business model and its degree of servitization (Fang et al., 2008; Neely, 2008; Suarez et al., 2013). While we took the total revenues from the Compustat Database, the service revenues had to be derived via in-depth consultation of a firm's financial statement. For U.S.-based firms that are required to publish their financial results according to the 10-K rules, the service revenues could be found in *Item 8: Financial statements and supplementary data* of the financial statements. Whenever the service revenues were not published in USD, they were multiplied by the value of the USD exchange rate at the end of the year, which is in line with using the value of outstanding common stock prices at the end of the fiscal year.

Moderating variable: resource slack

Following Fang et al.'s (2008) suggestions, we assessed resource slack by using component scores derived from a principal components analysis (PCA) of two ratios (Fang et al., 2008). The PCA's results are shown in Table 3. First, the ratio of retained earnings to total assets (RE_TA) was applied. Retained earnings can be understood as a firm's safety stock for a future crisis (Lee & Grewal, 2004). Retained earnings can be used to finance the implementation of a newly created strategy. The ratio of RE_TA also indicates a firm's size, because large firms typically have higher retained earnings than smaller ones. Higher amounts of retained earnings also indicate better performance for a firm. Thus, firms that were successful in the past have higher slack resources (Lee & Grewal, 2004). Second, working capital to total assets was applied (WC_TA). Working capital is calculated by subtracting the current liabilities from the current assets (Fang et al., 2008). Analogously to the RE_TA ratio, the WC_TA ratio also reflects firm size, because larger firms also have (and need) more assets. Using working capital helps to control how effectively a firm is generating its profits (Lee & Grewal, 2004). Further, using these two ratios is also widely applied in the literature (Lee & Grewal, 2004). All numbers used in the ratios were derived from the Compustat database.

Dependent variable: tobin's q

Finding the right value to assess the added value of servitization posed challenges. While the literature has identified various methods of measuring servitization success in a firm (e.g., profitability, Tobin's q, revenue growth), each measure also has limitations (Gebauer et al., 2012). This article builds on the literature to assess servitization's financial performance in manufacturing firms (e.g., Fang et al., 2008; Neely, 2008; Parida et al., 2015; Skaggs & Droege, 2004; Sousa & Da Silveira, 2017). Measures that focus solely on profitability reveal several vulnerabilities. ROA and return on equity (ROE), for example, are not only backward-looking but are also inappropriate for measuring software firms, because software firms often do not build their business models on tangible assets. Software companies also reinvest huge amounts of their profits into growth opportunities (Suarez et al., 2013). Firm value assesses service revenues' performance effects. Regarding the studies of servitization's performance effects of Fang et al. (2008) and Visnjic et al. (2016) shown in Table 1, firm value was measured by means of approximation of Tobin's q by Chung and Pruitt (1994). Tobin's q has a long and well-accepted tradition in assessing firms' various investment decisions (Chung & Pruitt, 1994; Lee & Grewal, 2004; Yip et al., 2009). Tobin's q evaluates the ratio between a firm's market value and the replacement costs of its assets. The traditional Tobin's q ratio is:

$$q = \frac{Market\ value}{Replacement\ costs\ of\ assets}$$

Thus, a Tobin's q greater than 1 is an indicator of a firm's contribution of intangible assets (e.g., organizational value, monopolistic rents, servitization capabilities) to its market value (Lang & Stulz, 1994). Decisions by a firm's management can add value to or subtract it from a firm's tangible assets. Using Tobin's q for the evaluation of strategic decisions also has other advantages. As Tobin's q consists of stock market prices, it also encompasses estimated future performance. Further, the ratio between the replacement costs of a firm's total assets and its market value also reflects its long-term success (Lee & Grewal, 2004). Using Tobin's q also allows for comparing firms from various industries and countries, because it is not affected by different

Table 3
Results of the principal components analysis.

Variable	Comp1	Comp2
RE_TA	0.7071	
WC_TA	0.7071	–0.7071

accounting standards (Lee & Grewal, 2004). The cohesion of the additional value and servitization can then be measured. Chung and Pruitt (1994) identified a way of approximating Tobin's q by using less computational power and reducing the needed data input. Also, all the numbers in the following equation can be taken from a firm's annual financial statement (Chung & Pruitt, 1994). Chung and Pruitt (1994) define Tobin's q as:

$$q = \frac{MVE + PS + Debt}{TA}$$

Table 4 explains the components of Tobin's q (Chung & Pruitt, 1994).

Dependent variable: return on assets

Because Tobin's q relies on share price data, it is also a very capital market-oriented measure. Thus, Tobin's q tends to reflect expected rather than de facto firm performance (Ambroise et al., 2018). To obtain a thorough and reliable analysis, the capital market-oriented measure should be accompanied by a profitability measure which reflects de facto firm performance (Ambroise et al., 2018; Yip et al., 2009). Profitability measures are widely applied to measure the firm performance of servitization strategies (Crozet & Milet, 2017). Thus, we followed Skaggs and Droege's (2004) suggestions, using ROA to measure a servitization strategy's profitability. The ROA was calculated by dividing the firm's EBIT by the firm's total assets. The data used for this calculation were all taken from the Datastream database.

Control variable: firm size

Firm size was measured based on the number of employees. The logarithm of the number of employees was derived to eliminate short-term fluctuations and to accurately reflect the growth rate.

Data

Previous studies have revealed shortcomings in their data because the data sets lack the granularity and validity needed to assess service-intensive strategies. This study's data sets relied on reported business segments according to SIC codes to assess the service ratio; or they focused on one firm, one industry, or one country (Fang et al., 2008; Skaggs & Droege, 2004; Sousa & Da Silveira, 2017). We avoided these shortcomings because the data are derived via an in-depth analysis of annual reports and filings by the Security and Exchange Commission (SEC). We also used data from different firms, countries, and industries.

The basis of our samples consisted of manufacturing companies of the S&P Global 1200 index that competed in industries having the two-digit SIC codes 16 and 28 to 39. The manufacturing sector was chosen as a target, because it had low servitization in the past; thus, the servitization transition of past decades could be more clearly contrasted. We included heavy construction (SIC 16) owing to its potential for servitization models, and excluded the manufacturing sectors of food, tobacco, textiles, textile derivatives, wood, and wood derivatives (SIC 20 to 27), owing to their strong overlaps with the agricultural sector. Further, we included providers of prepackaged software and computer integrated systems with four-digit SIC codes 7372 and 7373 because we assumed that prepackaged software and computer integrated systems are manufacturing businesses. The investigated period comprised 1999 to 2018 (20 years). We chose this timeframe because it covers the development of service transition and global digital industrial transformation. Owing to the introduction of more conservative disclosure practices in 1999, changes of disclosure patterns by firms, mergers and acquisitions, and bankruptcies, the investigated data set consists of 25 international companies, including 500 observations. We collected the data from the Compustat global database and a profound in-depth analysis of the sample firms' annual reports.

The sample's average service ratio steadily increased from 18.5 % in 1999 to 30.8 % in 2018, which illustrates the high service diversification and the strong prevalence of service transition strategies in the sample firms during the period under investigation.

Table 4
Explanations of the elements of the Tobin's q.

MVE	The number of the common outstanding shares x their closing price at the end of the fiscal year
PS	The liquidation value of the outstanding preferred stock
Debt	Instead of a verbal explanation, the formula is presented here for simplification reasons: short-term liabilities – short-term assets + long-term debt
TA	The book value of the total assets

The model

The financial data for the same 25 firms were observed for a 20-year period in a panel structure. Thus, we also applied the fixed-effects model regression applied by Fang et al. (2008). Using a panel data model with a fixed-effects regression model has an advantage over a cross-sectional analysis, namely, that the results for the 20-year period are compared within the same firm and then compared to the other results. As per Fang et al. (2008), a Hausman test was applied, and the results were found to be significant ($p < 0.05$). A fixed-effects model was preferable, owing to several factors: first, the small sample size; second, the Hausman test, which indicated that a fixed-effects model should be applied (Fang et al., 2008); and, finally, the fact that fixed-effects models consider that variables change over time (in this case, resource slack).

The limitations of using a fixed-effects model related to the time variance of the examined variables. First, fixed-effects models only allow for the reliable interpretation of effects that vary over time within the examined entities. However, servitization was made visible through examining the change of the servitization ratio over time. Thus, the examined effect being specifically visible through the variable changes over time indicated that using a fixed-effects model was appropriate. Second, fixed-effects models omit the (direct) effects of time-invariant control variables. We used resource slack as a control variable, and it would not have been useful if it was time-invariant. As resource slack also changed over time, the effects of the proposed interactions between resource slack and servitization could be tested with the fixed-effects model. If further research is conducted with a larger number of examined firms, the use of a random-effects model may have to be considered. The fixed-effects model was applied for both Tobin's q and the ROA for the sample firms.

Analogous to Fang et al. (2008), the model for the fixed-effects regression took the following form:

$$Y_{it} = \beta X_{it} + \alpha_i + \gamma_t + \varepsilon_{it}$$

The variables are defined as follows:

Y_{it} = the dependent variables (i.e., the Tobin's q and ROA for firm *i* in period *t*)

β = the coefficient for the independent variables

X_{it}= the independent variables (i.e., the servitization ratio)

α_i= the firm's specific constant (i.e., resource slack)

γ_t= the year-specific constant (i.e., the year in which the effect is measured)

ε_{it}= the error term.

For executing the calculations, we used two models. Model 1 contains the fixed effects. While Model 1 covers the main effects and the moderators as control variables, Model 2 involves the two interaction terms of the moderating variables. We tested the hypotheses in Model 2.

Results

First, a correlation matrix was constructed to check for multicollinearity issues among the independent variables, as shown in Table 5.

Table 5
The correlation matrix.

	Service ratio	ROA	Tobin's q	Total assets	Working capital	Retained earnings
ROA	***0.174991573773502	1				
Tobin's q	*0.0986530154682124	***0.302764114765193	1			
Total assets	***0.226815736668411	***–0.206865723079839	***–0.171530007176354	1		
Working capital	*–0.0996131652683129	–0.026361009	–0.077692773	–0.019642097	1	
Retained earnings	***0.240210495044174	–0.062703188	–0.094714587	***0.541472295709546	0.080659177	1
Firm size	***0.213237110874711	**–0.120113275486686	***–0.247565368413324	***0.677280685967102	0.074242303	***0.555672900770096

Notes:.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

We used the data points total assets, working capital, and retained earnings to construct the resource slack variable in the model. Although the servitization ratio showed statistically significant correlation for all other (dependent and independent) variables, all shown correlations were weak for the servitization ratio. The correlation between firm size and total assets is moderately high and statistically significant. This result is unsurprising and does not affect the interpretation of the model. The same is the case for the correlations between retained earnings and total assets, and firm size and retained earnings, respectively.

The results of the entire model are presented in Table 6. Model 2′s results are presented in Column 1 to better outline the results. Model 2 shows several significances for the hypotheses ($p < 0.05$). Thus, H1 was supported for the ROA of a firm with a negative unstandardized β, indicating that the servitization level was negatively related to a firm's profitability. H2 was supported for Tobin's q, and the positive β indicates that higher service transition levels improved firms' capital market performance. H3 must be neglected for both performance measures. In sum, one can conclude that a firm's service level has a negative impact on its profitability, while higher servitization levels can positively impact on its market performance. Thus, servitizing can have mixed results, at least regarding profitability. One reason could be the ongoing investments that must be made to foster the service offering. Interestingly, firm performance in the financial market improves with an increasing servitization level. One reason for this behavior could be that

Table 6
Results of the fixed-effects regression.

	Effects and Hypotheses		Model 2		Model 1	
Constant						
	Constant					
		B	10,266	0.2357893	0.9757032	0.2734136
		SE	1,772,849	0.1108353	1,758,068	0.1099932
		P	0.5630087	0.034262	0.5793442	0.013508
Main effects						
	Servitization ratio					
	H1	B	–2,975,895	–4,546,246	–2,824,764	–4,346,998
		SE	2,249,999	1,395,349	2241.29	1,396,968
		P	0.1870408	0.0012597	0.2085924	0.0020507
	Servitization ratio^2					
	H2	B	8,172,205	21,250.8	8,239,910	172,292.5
		SE	2,083,505	134,186.2	2,061,525	133,560.1
		P	0.0001104	0.115003	0.000082	0.1981075
Moderating effects						
	Service ratio × Resource slack					
		B	–1,345,634	623,467		
		SE	9,214,951	5,814,051		
		P	0.1453362	0.2844883		
	Service ratio × Resource slack^2					
	H3	B	1,693,259	–38,901.21		
		SE	1,060,877	67,081		
		P	0.111596	0.562493		
Control variables						
	Resource slack					
		B	0.0609545	0.0023719	–0.053852	0.0160787
		SE	0.1385929	0.008731	0.0722015	0.004467
		P	0.6604143	0.7860786	0.4563747	0.0003767
	Firm size					
		B	–0.0445234	–0.064926	–0.0468318	–0.0100001
		SE	0.1567331	0.0098654	0.1549507	0.0097782
		p	0.7765654	0.5110047	0.7626945	0.3073279
	Firm ROA					
		β	5,383,309		5,423,649	
		SE	0.8926343		0.88496	
		p	0.0000000		0.0000000	
	Firm Tobin's q					
		β		0.0213553		0.0216716
		SE		0.003541		0.0035361
		p		0.0000000		0.0000000

the market actors need to see that the strategic decision to servitize has already been (at least partially) implemented to consider this an increase of firm value. Another reason could be that market actors value the steady cashflow that servitized firms can generate, which guarantees steady dividends.

The coefficient for the servitization ratio shows significance for ROA (with a negative B) but not for Tobin's q. The inverse is true for servitization ratio squared, meaning that H1 is not ruled out for ROA, and H2 is not ruled out for Tobin's q. The coefficients for resource slack interactions show no statistical significance. In sum, the control variable coefficients show no results that are unexpected or that do not align with the underlying assumptions of this study.

Given the models' results, these modified hypotheses were supported:

A service transition (the servitization of corporate business models) generally has a negative impact on a firm's ROA. and

At higher service ratio levels, service transition strategies' effects on a firm's Tobin's q become increasingly positive.

H3 was not supported, that is, resource slack on its own did not further moderate service transition strategies' performance effects.

To reiterate and answer the initial research question—*Do servitization strategies positively influence a firm's financial performance?*—the results point to the answer *somewhat*. Service transition initially negatively influenced firm performance as measured by ROA; a higher servitization then increased firm performance as measured by Tobin's q. In other words, servitization up to a point lowered a firm's book value, but at a higher level increases the market value (relative to the book value) instead, which allows for the interpretation that, while some servitization negatively affects financial performance, a high servitization level increases only market performance.

Discussion

Comparison to and contrast with the previous research

While the general view of service transition strategies is positive regarding the performance effects, there has been conflicting research regarding these effects' sizes and directions. This conflict includes empirical evidence (as shown in the SLR in Section 2) as well as theory-based explanations on how servitization can fail owing to knowledge asymmetries (Valtakoski, 2017). We have added to the literature, because we have provided insights into the questions raised by previous studies regarding servitization's performance effects, using more valid data over an extended period. Specifically, this SLR provides a comprehensive overview of the visible performance effects of servitization as seen in the literature, as well as the utilized measures of firm performance. Further, the regression analysis shows the performance effects' sizes. The regression model aligns with the mixed effects that servitization generally has on firm performance, agreeing with the work of Gebauer et al. (2012), Kohtamäki et al. (2013), and Fang et al. (2008). However, H3, indicated by the literature review—that resource slack positively moderates these effects—was not supported by the regression analysis. This result particularly contradicts Fang et al.'s (2008) research regarding resource slack's moderating effects. However, given Fang et al.'s (2008) results, as well as the SLR, we are of the opinion that resource slack may well be a moderator, but that this moderating effect is more visible in interactions with other moderating factors, and that its moderating effect is time-sensitive. This finding is also aligned with Crozet and Milet (2017). To further examine this finding, longitudinal analysis could provide insights into whether resource slack moderates in different directions over time, or in different economic phases.

Theoretical implications

This study has provided more evidence of servitization strategies' mixed effects on firm performance. Further, it has shown that smaller servitization levels affected book value and financial performance more strongly (as seen in the ROA), while higher servitization levels affected market value and market performance more strongly (as seen in the Tobin's q). The differences between market and financial performance as they relate to servitization may be further examined, empirically and theoretically. Servitization's negative effect may well be time-sensitive and short-term. At the same time, the model did not show any moderating effects of resource slack. Thus, inconclusiveness remains about how (and in combination with which factors) servitization influences firm performance. This inconclusiveness points to a persisting theoretical gap in the understanding of the mechanisms that underlie servitization and firm performance, which should be addressed by means of theoretical and empirical methods.

Practical and managerial implications

Servitization strategies have been increasingly used to improve firm performance; this study's results do not strictly contradict this general strategy. However, our results point to some degree of negative effects on firm performance; positive effects happen more at higher servitization levels, which may also point to the negative effects being more visible in the short term. This situation aligns with the intuition that product-service portfolio adjustments take time until results are visible. Investing in long-lasting customer relationships or product-service bundles that foster collaboration with customers and selling the value of the offered goods would seem to pay off.

Limitations

While this study has shown that there may be some positive effects between manufacturing firms' servitization and their financial performance, we do not state that servitization is a panacea for manufacturers. In particular, the fact that services have a positive effect on profitability but that no significant positive effect on profitability can be found for higher service ratio levels is counterintuitive. One reason for these counterintuitive findings may be that there is no single ideal path that a firm can follow to successfully servitize. Thus, servitizing firms should focus on their capabilities in competencies when deciding to servitize.

Having considered the criticisms of Sousa and Da Silveira (2017), this study did not narrow the research by focusing only on one firm, one sector, or one country. However, our data set has the shortcoming of not representing smaller or less diversified firms. Further, the data set did not fulfill the claim of a "large-scale empirical study," and could benefit from being extended in further research (Sousa & Da Silveira, 2017). Nevertheless, we have referred to more reliable data, such as using primary data from the in-depth investigation of annual financial reporting and secondary data from different databases. However, we could not resolve the criticism that various service types (e.g., basic vs. advanced services) should be distinguished. According to the literature, it is important to distinguish between the different forms of services, because more advanced services are expected to be more valuable for firms than normal services (Gebauer et al., 2012). This aspect could also be considered more extensively in the future so as to better understand services' influences on manufacturing firms' performance. Nonetheless, servitizing firms may still undergo a learning phase, which may be accompanied by lower financial performance.

Further research

In addition to a longitudinal analysis, other questions raised by Skaggs and Droege (2004) as well as Fang et al. (2008) can be investigated: 1) Do service strategies pay off for manufacturing companies? 2) Is there a certain service intensity level at which service strategies increase manufacturers' performance? 3) Which factors lever service transition strategies' performance effects? Although we started from a threshold of about 18 % of service revenue, the results of Fang et al.

(2008), who highlighted the progressive increase in performance at higher service transition levels, could be verified in our sample for both applied performance measures (i.e., Tobin's q and ROA). Resource slack seemed to have a significant impact on financial performance for at least one of the two financial measures.

Potential avenues for future empirical research may include a longitudinal analysis and/or other moderating factors that may moderate in combination with resource slack. Further theoretical explorations could qualitatively assess the different servitization performance effects on financial versus market performance, as well as further examining the nature and causes of the empirical research's inconclusiveness on servitization's performance effects.

CRediT authorship contribution statement

Christoph Buck: Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Nils-Ole Floegel:** Writing – original draft, Methodology, Data curation, Conceptualization. **Maximilian B. Stöter:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Kevin C. Desouza:** Conceptualization. **Timothy Robb:** Writing – review & editing, Validation, Methodology.

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