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Bundling and exporting:
Evidence from German SMEs

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Bundling and exporting: Evidence from German SMEs

Abstract

Drawing on the intersection between the disciplines of operations management and international business, this paper evaluates the effect of bundling products and services on the firm's export intensity. After surveying more than 4,000 German SMEs, we report several findings. First, bundling is a relatively rare activity, which is unevenly spread across sectors. Second, SMEs that bundle products and services are more productive than those selling products and services separately. Third, using regression analysis and matching techniques, we find that product-service bundling is strongly associated to higher levels of export intensity. Fourth, the competitiveness-enhancing effect of bundling goes beyond manufacturing, affecting non-manufacturing firms as well.

JEL classifications: **D22, F10, F14, F23, L80.**
Keywords: Bundling, innovation, export, servitization, SMEs.

1 INTRODUCTION

By far the most popular way for firms to engage with international markets is exporting. Exporting now accounts for more than 29% of the gross domestic product in OECD countries (World Bank, 2020). Thus, any comprehensive answer about the increasingly important question of what drives firms' international competitiveness must encompass the factors that affect firms' ability to compete in export markets. With this in mind, international business scholars and trade economists have been exploring the drivers of export performance strategy for nearly fifty years (Leonidou and Katsikeas, 2010).[1] Within this research stream, previous studies highlight the importance of the link between firms' innovation and export performance in product and service firms separately (Falk and de Lemos, 2019; Lejpras, 2019). The goal of this study is to assess the exporting outcomes of hybrid firms (Ulaga and Reinartz, 2011), that is, firms that sell bundles of products and services in the form of integrated solutions (Davies, 2004). Previous studies have analysed conceptually (Vandermerwe and Rada, 1988) and empirically (Ariu et al., 2020) the positive relation of selling products and services abroad to a firm's export performance (e.g., bi-exporting). However, to the best of our knowledge, this is the first paper to consider how bundling products and services in the same offering affects the export intensity of Small and Medium-sized Enterprises (SMEs).[2]

The way firms implement an integrated solution depends on their primary sector. For example, manufacturers normally servitize by offering the use rather than the ownership of their products (e.g., outcomes-based contracts) to their clients (Baines et al., 2017; Crozet and Milet, 2017; Rabetino et al., 2018). (Knowledge-based) service firms, in contrast, package their services by adding tangible products to their offerings, including embedded sensors or other forms of hardware–productization (Harkonen et al., 2015; Rajanna, 2013). We argue that selling products and services as a package is positively associated with export intensity, irrespectively of the firm's primary sector. In light of the existing literature, our argument can be rationalized in two ways. First, integrated solutions are described as an innovation outcome (Bustinza et al., 2019; Vendrell-Herrero et al., 2020) because customization provides an opportunity to differentiate the offering. By enhancing the customer's understanding, product-service bundling ultimately raises firms' competitiveness in foreign markets (Aw et al., 2001; Bughin, 1996; Cassiman and Golovko, 2011). Second, integrated solutions can lock customers in to long-term agreements (Vargo and Lusch, 2008; Wise and Baumgartner, 1999). In line with this argument, more than 90% of the firms in our sample declare that bundling is indeed a way to increase customer loyalty. Consolidating such loyalty is

[1] Based on this definition, our study uses product-service bundling (or simply bundling) and integrated solutions as synonymous and interchangeably.

[2] Ariu (2016), for example, examine whether manufacturing firms have positive sales for services but cannot tell whether both goods and services are sold to the same buyer in a given market.

likely to generate stable revenue streams, leading firms to increase their engagement in specific foreign markets (Teece, 2014; Vahlne and Johanson, 2017).

We analyse the relation between product–service bundling and export intensity using a unique dataset that includes information about more than 4,000 German SMEs for the years 2011 and 2014. Our focus on Germany is important empirically, as Germany is leading the way to the Fourth Industrial Revolution (Brouthers et al., 2016; Gomes et al., 2019) and therefore constitutes an ideal setting to explore the implementation of SME's innovation practices (Mukherjee et al., 2013). The firms sampled operate in a wide range of industries, enabling us to study industry-level heterogeneities in the implementation of integrated solutions. Interestingly, we find that product–service bundling goes beyond manufacturing and service industries. In fact, the percentage of firms in transportation, construction, professional services, and retailing (to name a few) that offer integrated solutions is not negligible. Our findings show that selling integrated solutions increases export intensity, a result that is robust across several specifications.

Our contribution to the literature is threefold. First, although previous research has assessed the impact of innovation in products (e.g., Cassiman and Golovko, 2011) and services (e.g., Ganotakis and Love, 2011) on exporting, no research to date has analysed how product-service bundling affects a firm's export intensity. By uncovering a robust relationship between bundling and exporting, this study responds to recent calls for studies seeking to determine the relationship between servitization and firm internationalization (Bustinza et al., 2017; Knight and Liesch, 2016). Second, previous research has analysed servitization and productization separately. The present paper provides a comparison of performance-enhancement effects by industry, showing that the benefits of product-service bundling transcend industry boundaries. In doing this, we respond to calls for studies undertaking cross-industry comparisons within the context of exporting SMEs (Lahiri et al., 2020). Third, our study's focus on SMEs rather than large multinational enterprises (MNEs) makes another important contribution. From an international business standpoint, SMEs prioritize exporting as a way to enter foreign markets (Laufs and Schwens, 2014). Compared with foreign direct investment, exporting involves low levels of commitment, resources, risk, and complexity (Sui and Baum, 2014). Within the empirical literature on innovation, most studies of integrated solutions analyse large corporations (e.g., Kastalli and Van Looy, 2013; Suarez et al., 2013). Our paper takes a different approach by looking at smaller firms. This focus is important because SMEs face more difficult challenges than larger corporations when serving foreign markets (Paul et al., 2017).

This paper is organized as follows. The next section reviews the relevant literature and develops a conceptual framework on how integrated solutions and firm internationalization are connected, developing two hypotheses. The third section describes the data and the empirical model. The fourth section explains the empirical approach. The fifth section presents the results and various robustness checks. The paper then closes with discussion and conclusions.

2 BACKGROUND LITERATURE

2.1 PRODUCT-SERVICE BUNDLING

While products and services have conventionally been considered separately, evidence indicates synergies between the two. The traditional product–services dichotomy does not fully capture the fact that some firms actually bundle products and services into an integrated solution (referred to as 'product–service bundling' or simply 'bundling' in contexts where no confusion can arise), generating an integrated revenue stream (Davies, 2004). This type of bundling goes beyond the conventional product bundle, which tends to be composed of standardized components (Nalebuff, 2004). Product–service bundling is a customized combination of products and services that are delivered and priced to fulfil a specific customer's needs and can potentially increase a firm's competitiveness (Cusumano et al., 2015).

Integrated solutions share three fundamental characteristics with innovation.[3] Firstly, value creation is a pre-requisite for an innovation to exist, whereas as indicated by Brax and Jonsson (2009, p. 150) bundling products and services "provide more value than the parts alone". Secondly, innovation sets the grounding for firm differentiation, whilst integrated solutions are "unusually tailored to create outcomes desired by specific clients or client types" (Miller et al., 2002, p. 3), meaning that they are intrinsically different from the existing offer in the market and hence provide opportunities for enhanced differentiation. Lastly, product and service innovation are largely considered as technological innovations, whereas previous studies have found that product-service bundling is enhanced when it is combined with the use of digital technologies such as sensors and predictive algorithms (Kohtamäki et al., 2020). Hence, integrated solutions are associated with a larger degree of technological adoption than selling products and services separately (Davies, 2004; Ulaga and Reinartz, 2011). For all these reasons, the term 'product-service innovation' is increasingly popular in the various research streams that analyse product-service bundling (i.e., Bustinza et al., 2019; Vendrell-Herrero et al., 2020).

Product-service bundling can occur in two different scenarios depending on the primary industry. Manufacturing firms implement services to boost the capabilities of the product, a phenomenon referred to as servitization (Crozet and Milet, 2017). Service firms add tangible components to their offerings, a phenomenon termed productization (Harkonen et al., 2015). Despite sharing several features (e.g., both cases firms offer integrated solutions), servitization and productization differ in significant ways.

In the case of servitization, industrial manufacturing firms upgrade their products by offering

[3]See Baregheh et al. (2009)) for an extensive literature review on how innovation can be defined.

their customers outcomes-based contracts in order to generate revenues for the product's entire lifecycle (Baines et al., 2017; Rabetino et al., 2018). Outcomes-based contracts consist of selling use of the products rather than the products themselves in a transactional operation. For instance, Rolls Royce sells hourly use of its engines rather than the engines themselves; the French train producer Alstom has introduced train life services, offering maintenance and parts supply services to transport companies. This integral solution is particularly important for advanced economies, which are typically characterized by high wages, high skills, and high disposable income, since the offer permits such economies to resume growth in strategic industries and sustain long-term competitiveness (Aquilante et al., 2016).[4]

In the case of productization, in contrast, service companies embrace tangible products in order to standardize their offerings and enhance their overall efficiency through increased economies of scale (Harkonen et al., 2015). Productization of services usually focuses on packaging and delivering Information and Communication Technologies (ICT) services in an industrialised form (Spohrer, 2017). Examples of these strategies are embedding sensors in industrial equipment and hand-held devices to provide more real-time and high-precision information (see e.g., Ziaee Bigdeli et al., 2018).

Also, firms selling digital services to final consumers might include a product in the offer to leverage their competitive advantage. The American company OnePeloton is a good illustration of this productization approach. The company offers spinning classes for members online and in a limited number of studios. Additionally, the company offers a robust and nicely designed spinning bike, which includes a screen connected to the handlebar. Consumers can pay monthly fee to access classes online or on studio (only service), or alternatively purchase the bundle of bike plus classes (a larger monthly fee can include both). The model is very simple and successful, since no competitor is able to charge the same prices for the product or the service. All of the firm's competitive advantage is generated by the complementarity between product and digital service. The growth of the company has been boosted by the Covid pandemic that strictly limits social interaction in physical spaces.

The literature of integrated solutions and financial performance can be separated by the first industry of the firm. On the one hand, a growing literature assesses the financial benefits of servitization in advanced economies. According to a recent review, the relationship between servitization and financial performance is generally positive (Wang et al., 2018). On the other end, the literature on productization and firm performance is very scarce. Suarez et al. (2013), the only existing study, analyses almost 400 firms in the US software industry for the period 1990-2006 and con-

[4]For example, the most representative studies show that servitization can have positive effects on operating margins (Kastalli and Van Looy, 2013), employment creation (Crozet and Milet, 2017), and sales growth (Kohtamäki et al., 2013; Sousa and da Silveira, 2017). However, no research to date has analysed whether servitization strengthens a firm's export capacity.

cludes that selling software as a product provides higher operating margins than selling software as a service. In sum, the literature on integrated solutions and profit margin (financial performance) is extensive, but the link between integrated solutions and exports (international performance) is unexplored. Since the literature increasingly considers product-service bundling as a form of innovation (Bustinza et al., 2019; Vendrell-Herrero et al., 2020), we briefly review the literature on innovation and exporting to ground our theoretical arguments.

2.2 INNOVATION AND EXPORTING

A substantial body of literature suggests a positive link between innovation and exporting. This view is grounded theoretically in the underlying differentiation and competitive advantage obtained from improved products and processes (Roper and Love, 2002; Cassiman et al., 2010; Wheeler et al., 2008). A broad consensus exists that innovative firms boost their domestic competitiveness through product and process innovation, which in turn increases their ability to sell in foreign markets, whereas non-innovators must increase productivity before exporting. The empirical research by Cassiman and Golovko (2011) exemplifies this rationale. Analysing a sample of Spanish manufacturing firms over the period 1990–1998, Cassiman and Golovko conclude that innovative firms can begin exporting at a lower level of productivity than non-innovative ones: the exported product itself differentiates the firm from competitors in international markets.

Along similar lines Golovko and Valentini (2011) also find that product innovation and exporting are complementary in boosting an SME's growth. Using a slightly longer panel (1990–1999) for the same set of manufacturing companies analysed by Cassiman and Golovko (2011), Golovko and Valentini demonstrate through conceptual and empirical analysis that these business activities dynamically and mutually reinforce each other, enhancing the potential importance of exporting and innovation in isolation. Such reinforcement enables innovative firms to make exports more successful by selling better products, while exporting firms can similarly improve the quality of their products by selling their products abroad. This virtuous cycle enables manufacturing SMEs that export and innovate to grow faster than SMEs performing only one or none of these business activities.

Previous research also has examined the heterogeneity of innovation outcomes and its varied effects on exporting. For instance, Lewandowska et al. (2016) analyse the complementarity between technological innovations. They use a cross-section sample of 6,855 Polish firms surveyed in 2011 to show that there is a complementarity between product and process innovation. They report that product and process innovation in isolation enhance exporting intensity, but firms with combined product and process innovation have a larger export intensity than those firms having only one type of technological innovation (product or process). Using a different dichotomy, Saridakis et al. (2019) analyse the different impact on exporting of incremental and radical innovations. Using a

cross-section sample of 12,823 British SMES surveyed in 2015, they show that both incremental and radical innovations have positive effect on exporting intensity when compared to non-innovating firms, but that the degree of novelty also makes a difference, i.e. compared to incremental innovation, the effect of radical innovation on exporting intensity is significantly higher.

The firm's innovation capability also underlies its internal capabilities. Previous literature agrees on a number of internal enablers of the linkage between innovation and exporting (Bianchi and Wickramasekera, 2016). For instance, the set of skills within the workforce is an important internal enabler of exports and innovation. Firms that employ skilled labour (Brambilla et al., 2012) and have more managerial education (Ganotakis and Love, 2010) are more likely to succeed at exporting, whereas firms that innovate and export require a wider set of skills within the workforce, including technical, creative, and commercial skills (Herrmann and Peine, 2011). Overall, consensus exists that innovation and distinctive workforce knowledge-based capabilities lead to superior exporting outcomes due to a higher degree of product (or service) differentiation. The next subsection provides a series of arguments on how product-service bundling may (or may not) enhance firm's export intensity.

2.3 BUNDLING AND EXPORTING

The near absence of literature on bundling and exporting is somewhat surprising, since initial conceptualizations of product-service bundling indicated potential linkage between these two variables. For instance, the seminal paper on servitization posits that "because services are increasingly being embodied in and delivered by goods, it is easy to standardize core elements of services. It is also possible to trade these services without either the customer or the company having to leave home in the typical manufacturing export mode" (Vandermerwe and Rada, 1988, p. 321). This section provides a series of arguments on how product-service bundling should be connected to exporting.

Regardless of the primary sector, it seems logical to consider sales from product–service bundles as an independent source of revenue, different from sales generated by either products or services alone. We argue that bundling products and services is likely to yield foreign sales superior to those obtained by selling products and services separately, since it creates and captures more value. We find two major explanations for this argument: product differentiation and long-term commitment.[5]

First, integrated solutions enhance a firm's differentiation (Miller et al., 2002) through customer engagement and customization (Visnjic et al., 2016; Zhang et al., 2016). Entering export markets

[5]Like any other organizational change, we acknowledge that some aspects of adopting integrated solutions can damage or possibly harm firm competitiveness, opposing our theoretical prediction. For instance, dividing resources in the spirit of achieving an integrated solution may lead to a mediocre offering, or at least to one less valuable than that based on product (or service) specialization (Schott, 2004). However, we believe that the advantages of adopting an integrated solution will on average overcome the disadvantages.

requires internalizing sunk costs (Melitz, 2003), and overcoming these costs is challenging, as the competition with incumbent foreign firms quite often ends up in lower mark-ups than those obtained in domestic markets (Bughin, 1996). Product attributes and quality are the main determinants of a firm's capacity to raise profit margins abroad and strengthen its presence in foreign markets (Aw et al., 2001). Most differences in the capacity to reach foreign markets or organizational innovation can be explained by differences in product/service quality (Golovko and Valentini, 2011). By offering bundles of products and services, the firm likely moves towards selling more sophisticated packages that create additional value for foreign consumers, enabling a more sustainable stream of revenues from abroad. We can illustrate how bundling increase exports through differentiation using the example of OnePeloton. The company used their differentiated offer of online classes and spinning bikes to enter the markets of Canada, UK and Germany in the years after its foundation. The company took advantage that no similar product-service bundles were offered in those countries to quickly gain enough market share to set up a sustainable subsidiary.

Second, product-service bundling can lock in customers by signing long-term agreements with them (Ulaga and Reinartz, 2011; Wise and Baumgartner, 1999), enabling firms to obtain revenues over the entire product life span (Cusumano et al., 2015; Baines et al., 2017). According to the Uppsala model of firm internationalization, the firm's export capacity and underlying export performance are closely associated with the investment committed to serving foreign markets (Vahlne and Johanson, 2017). Securing stable market share and revenue streams in a given foreign market often provides the right incentives to increase investment commitment in that market (Skarmeas et al., 2008). By offering integrated solutions, firms may be able to lock a foreign customer in for a period of time. The promise of secured revenue streams is an incentive for allocating more resources to this market and eventually for increasing the firm's export intensity. The effect of locking in consumers is also relevant to the case of OnePeloton. Once consumers have made a financial commitment to purchase the spinning bike, consumers are locked in in the relationship. In this regard, consumer commits to continue paying for the streaming services indefinitely, so it assures a stable revenue stream over the years that can justify additional efforts in escalating the business in foreign markets. After the success of the spinning bike, the company has released a treadmill to have the capacity to lock in more consumers.

In sum, we add to the existing literature by showing that SMEs that bundle products and services into one commercial offering increase their competitiveness in foreign markets relative to firms that export only products, only services or products and services separately. We argue that bundling products and services increases a firm's ability to differentiate its export commitment, ultimately raising its export intensity. We thus hypothesize:

Hypothesis 1: *Firms bundling products and services exhibit higher export intensity than firms selling products and services separately.*

While no previous article has tested this hypothesis, two related streams of literature provide evidence consistent with our hypothesized relationship. The first stream examines bi-exporting firms, that is, firms that export both products and services, but as separate offerings. Ariu (2016) finds that bi-exporters are very rare (under 10% of all exporters), but account for over 30% of all worldwide exports. More recently, Ariu et al. (2020) show that Belgian bi-exporters can benefit from demand complementarities, which ultimately increase the firm's exporting capacity. The second stream examines the percentage of the labour force that works in services within manufacturing firms. Lodefalk (2014) shows that Swedish manufacturers with a higher percentage of labour in service jobs have higher export intensity.

The present study also seeks to explore the industry-specific effects of bundling. As mentioned earlier, manufacturing and service firms follow different pathways when implementing integrated solutions, i.e. manufacturers servitize (Baines et al., 2017) and service firms productize (Harkonen et al., 2015). We have argued that the main advantages of bundling products and services (i.e. differentiation through customization and lock-in consumers) are independent on the firm's primary industry; however productization has additional benefits. First and as mentioned earlier, by implementing products into their offer, service firms could have a more standardized offer, which enable to develop economies of scale and enhance their competitive advantage (Harkonen et al., 2015). Previous literature has extensively discussed the importance of reaching certain level of resources and employment in order to reach export markets (Melitz, 2003) and their subsequent increase in export sales (Bonaccorsi, 1992; Verwaal and Donkers, 2002). Taken together, the increase of scale resulting from a process of productization might enable service firms to reach the necessary internal resources to serve successfully foreign markets, suggesting that the export-enhancement effect of bundling is stronger in service firms. Second, previous studies suggest that compared to manufacturing firms, service firms rely more on partners and intermediaries for establishing export sales abroad (Doloreux and Laperrière, 2014; Lejpras, 2019). We argue that the increase of tangibility associated to the sale of product-service bundles experimented by service firms, might reduce their dependence on external partners and intermediaries, and hence might enable service firms to increase their presence in export markets. Altogether, we hypothesize:

Hypothesis 2: *Primary industry moderates the relationship between bundling and exporting. The export-enhancement effect of bundling is stronger in service firms.*

The conceptual model assessed in this study includes two hypotheses, shown in Figure 1. Additionally, our model includes a number of firm-level control variables that previous research identified as explanatory factors of export intensity, this includes firm size, productivity, R&D investment and investment abroad (Bandick, 2020; Ganotakis and Love, 2011; Melitz, 2003).

[Figure 1 about here.]

3 DATA

Our analysis tests the hypothesis of interest for the context of German SMEs. Since German SMEs are essentially leading the European journey to the fourth industrial revolution (Czarnitzki and Spielkamp, 2003; Muller and Zenker, 2001), Germany is a particularly interesting country to investigate the implications of product-service bundling.[6]

We used MARKUS dataset, a Bureau Van Dijk service that provide accounting and financial information of German firms, as a firm directory, and hence, a way of identifying a wide selection of German SMEs that will form the population of this study. The Cologne Institute for Economic Research (CIER) surveyed those firms. Prior to survey administration, a panel of industry experts validated the questionnaire. In order to obtain a longitudinal setting, the survey was implemented in two waves (2011 and 2014).

The survey was conducted in German to ensure that the respondents were able to provide precise answers. In both survey waves, the questionnaire was sent by e-mail. The e-mail contained an individual link, username and password to log in on an online platform. The first wave of the survey was sent in December 2010 and January 2011 to 35,730 recipients and the second wave was sent in July and August 2014 to 22,388 recipients. The answer rate obtained was 7.8% in the first wave and 6.7% in the second wave, which is not far from the 9.2% average rate across top journals in the field of international business (Chidlow et al., 2015).[7] Our working sample is a repeated cross-section of 4,268 SMEs in different industries. The 2011 wave contains information about 3,178 firms, whereas the 2014 one includes 1,090 firms. There were 527 firms that appeared in both waves, providing the possibility of conducting a longitudinal analysis for a sub-sample of firms (we will call this sub-sample 'the panel'). Respondents were in key managerial decision-making positions and had a good understanding of innovation practices and the firm's strategy, i.e., directors, operations managers or sales managers.

To ensure the representativeness of the sample, we have constructed size-sector weights which, when possible, will be used in the regressions and descriptive statistics.[8] Table 1 shows that the great majority of firms in our sample are micro enterprises (around 79% of the firms).

[Table 1 about here.]

[6] In fact, Germany's service jobs in the manufacturing industry have grown by 30% since 1975 (Boddin and Henze, 2014). Gomes et al. (2019) show that 10% of German manufacturing firms declare having a secondary industry code in services, much larger than, for example, the Spanish figure (4%).

[7] Note that these rates refer to the entirety of the sample, which also contains a small number of firms, 1% of the sample, with more than 249 employees that we exclude from the analysis given the focus on SMEs.

[8] A detailed illustration of the way the weights were constructed can be found in Section A of the Appendix.

The dependent variable, export intensity (e^f_{kjt}), is calculated as the ratio between sales in foreign markets and the the total turnover of firm f in sector k and state j, at time t. As shown in Table 2, exporters (44% of the sample) derive on average 10% of their turnover from selling abroad.

s^f_{kjt}, our variable of interest, is the ratio between revenues obtained from selling product–service bundles and total turnover. In particular, managers are asked to split total revenues into products (only), services (only), and integrated solutions (product and service together). So, for example, if a firm sells a product and its related maintenance service, this would be considered an integrated solution if and only if both the product and its maintenance are part of the same offer. If the maintenance service is offered independently of the product, then it will be part of the service revenues, and the product will be part of the product revenues.[9] Table 2 shows that 22% of the firms sell integrated solutions. The distribution of sales generated by bundling in each German state is provided in Figure 2. Given the cross-state variation in bundling activities, it is important to control for state characteristics as we do in the empirical analysis.

As discussed earlier in the conceptual framework, we introduce a number of firm-level control variables into the model that have been used extensively in previous literature as explanatory factors of exporting intensity (see e.g. Bandick, 2020; Ganotakis and Love, 2011; Melitz, 2003).

- **Firm size**. Since larger firms are more likely to export, firm size is a frequently used variable in empirical studies analysing exports (Bonaccorsi, 1992). Following Altomonte et al. (2013) we have used firm-size dummies based on the level of employment. Categories are exhibited in Table 1.

- **Labour productivity**. We include labour productivity because both the decision to export (see e.g. Bernard and Jensen, 1999; Melitz, 2003; Altomonte et al., 2012, 2013) and the choice to bundle products with services (see Ariu et al., 2020) are likely to be correlated with the productivity of the firm. lp^f_{kjt} is the logarithm of the turnover divided by the number of employees (labor productivity), which is a is a common way of defining productivity in both, the international trade (see e.g. Altomonte et al., 2012) and the international business (see e.g. Vendrell-Herrero et al., 2017) literature streams. [10]

- **Investment abroad**. Investing abroad enables learning about how foreign markets operate (Mukherjee et al., 2019). According to Bertrand (2011) firms with investment links in foreign markets are more capable of exporting and hence it is important to control for the investment abroad status when accounting for export intensity. inv^f_{kjt} is a dummy variable equal to 1 if firm f is in sector k and state j reports at time t having investment abroad, and 0 otherwise.

[9] Suarez et al. (2013) measure servitization in a similar way (service sales as percentage of total assets). However, they do not observe sales generated by integrated solutions, i.e. sales generated by selling bundles of products and services in one offer.

[10] In computing labor productivity we use GDP deflators (base year 2009) to deflate sales.

Clearly, the number of firms investing abroad is relatively small in our sample (9.4%), in line with the nature of the survey, which is focussed on SMEs (see Table 2).

- **R&D expenditure**. R&D and exports are highly interconnected. Firms that conduct more R&D are normally more innovative and as a result have higher export intensity (Di Cintio et al., 2017; Girma et al., 2008). Consistently with Ganotakis and Love (2011) we control for the fraction of exports that is explained by R&D by introducing the share of R&D expenditures on the turnover of the firm (rd^f_{kjt}). On average, firms in our sample invest on R&D the equivalent of 4.8% of their annual turnover (see Table 2).

[Figure 2 about here.]

[Table 2 about here.]

4 EMPIRICAL APPROACH

To investigate the relation between bundling and exporting (Hypothesis 1), we start by estimating linear models of the form

$$e^f_{kjt} = \alpha_0 + \alpha_1 s^f_{kst} + \mathbf{\Omega}^f_{kjt} + \vartheta_f + \vartheta_k + \vartheta_j + \vartheta_m + \vartheta_t + \varepsilon^f_{kjt} \quad (1)$$

where e^f_{kjt} is the export intensity of firm f in sector k and state j, at time t, computed as the ratio between sales in foreign markets and total turnover (as in the previous section). s^f_{ijt} is the variable of interest, i.e. the share of firm turnover generated by selling integrated solutions: we expect α_1 to be positive and significant. $\mathbf{\Omega}^f_{kjt}$ is a vector of time-varying firm characteristics which have been shown to be export determinants in the literature (i.e. lp^f_{kjt}, inv^f_{kjt} and rd^f_{kjt}). ϑ_f are firm fixed-effects (FEs). ϑ_k indicates sector dummies/FEs. ϑ_j refers to state dummies/FEs. ϑ_m are size dummies/FEs. ϑ_t are time dummies/FEs. ε^f_{kjt} is the error term.

We then challenge the results in two ways. First, we exploit the panel structure of our data and control for time-invariant unobserved firm heterogeneity (firm fixed-effects, ϑ_f in Equation 1). As mentioned in the previous section, a subset of the surveyed firms appear in both the years of our sample. So, for them, we create a panel that allows us to test our main hypothesis after controlling for any unobserved firm-level time-invariant characteristics (firm fixed-effects) that could be correlated both with bundling and exporting.

Second, we implement several doubly-robust propensity score matching (DR-PSM) procedures (Busso et al., 2014; Dehejia and Wahba, 2002; Lechner, 2002; Uysal, 2015). To do that we need to

look at the difference

$$[\eta_{kjt}^{1,f} - \eta_{kjt}^{0,f}] \tag{2}$$

where $\eta_{kjt}^{1,f}$ ($\eta_{kjt}^{0,f}$) is the outcome (exporting) for firm f in sector k and state j, at time t that sells (does not sell) product-service bundles. Notice that $\eta_{kjt}^{0,f}$ is not observable: we do not know what would have happened to the exports of firms that sell product–service bundles had they not chosen to do it. This boils down to building a counterfactual starting from the definition of the average effect of bundling on exporting, $\eta_{kjt}^{1,f} - \eta_{kjt}^{0,f}$. Defining the average effect of bundling on exporting as

$$E[\eta_{kjt}^{1,f} - \eta_{kjt}^{0,f}] = E[\eta_{kjt}^{1,f}] - E[\eta_{kjt}^{0,f}] \tag{3}$$

the probability model of bundling (the propensity score) can be written as

$$Pr[\eta_{kjt}^{0,f} = 1] = \Phi[g(\mathbf{\Omega}^*)] \tag{4}$$

where $\mathbf{\Omega}^*$ is a vector of firm, sector and state characteristics covariates. Imposing common support, if the balancing property holds, in each block the average propensity score is not different for treated and untreated.[11] Within each sub-sample, we can then analyse the data as if they came from a randomized experiment. Defining $\eta_{kjt}^{1,f,DR}$ and $\eta_{kjt}^{0,f,DR}$ as the counterfactual responses (DR stands for Doubly Robust), we can then evaluate

$$\begin{aligned} \zeta_{DR} = E[\eta_{kjt}^{1,f,DR}] - E[\eta_{kjt}^{0,f,DR}] = \\ = \frac{1}{f}\sum_f \left(\frac{s_{kjt}^{f,DR}\eta_{kjt}^f}{\lambda(\mathbf{\Omega}^*;\hat{\beta})} - \frac{s_{kjt}^{f,DR} - \lambda(\mathbf{\Omega}^*;\hat{\beta})}{\lambda(\mathbf{\Omega}^*;\hat{\beta})} \times \chi_1(\mathbf{\Omega}^*;\hat{\gamma}_1) \right) + \\ -\frac{1}{f}\sum_f \left(\frac{(1-s_{kjt}^{f,DR})\eta_{kjt}^f}{1-\lambda(\mathbf{\Omega}^*;\hat{\beta})} - \frac{s_{kjt}^{f,DR} - \lambda(\mathbf{\Omega}^*;\hat{\beta})}{1-\lambda(\mathbf{\Omega}^*;\hat{\beta})} \times \chi_0(\mathbf{\Omega}^*;\hat{\gamma}_0) \right) \end{aligned} \tag{5}$$

where f indexes firms as before; $\lambda(\mathbf{\Omega}^*;\hat{\beta})$ is a postulated model for the true propensity score; $\chi_0(\mathbf{\Omega}^*;\hat{\gamma}_0)$ and $\chi_1(\mathbf{\Omega}^*;\hat{\gamma}_1)$ are postulated regression models for the true relation between the vector of covariates ($\mathbf{\Omega}^*$) and the outcome within each stratum of treatment.

Since bundling is not a characteristic that is randomly assigned to firms but a strategy they choose to increase their competitiveness, the matching procedure relies on conditional independence: the treatment (bundling product and services) is as good as randomly assigned after conditioning on a set of covariates. In other words, we will have to show (as we do in Section 5) that after conditioning on those covariates, the treatment does not affect the means of the potential outcomes.

In Section 5, where we will present the DR-PSM results, we will show that this is the case and

[11] Note that this affects the set of covariates that one can include when estimating the effect of bundling on exporting. More details will be provided in Section 5.3.

provide details of how the procedure is practically implemented. This procedure provides us with two possibilities to assess the robustness of the relation between product–service bundling and a firm's exporting: either by matching and eliminating any association between the covariates and bundling, or with regressions by controlling for other factors that are correlated with the treatment. In the latter case, we will essentially estimate weighted linear regressions where we use the weights

$$\frac{s_{kjt}^{f,DR}\eta_{kjt}^{f}}{\lambda(\mathbf{\Omega}^{*};\hat{\beta})}; \qquad \frac{(1-s_{kjt}^{f,DR})\eta_{kjt}^{f}}{1-\lambda(\mathbf{\Omega}^{*};\hat{\beta})}$$

recovered from the PSM procedure.

Finally, our multi-industry data provides the opportunity to test whether the primary sector the firm belongs to plays a role in moderating the effect of bundling on exporting, hence to test Hypothesis 2. To do this, we first restrict the sample to firms in 'Manufacturing' and 'Services' industries.[12] The rationale behind this exercise is that when firms servitize, their primary sector is manufacturing, while in the case of productization, their primary sector is services. Restricting to these two sectors thus provides us with a relatively homogeneous group of service firms, more than, if we included all non-manufacturing firms in one group. To corroborate Hypothesis 2 we expect that the effect of bundling will be stronger in service industries.

5 RESULTS

The results section is divided in three parts. In Section 5.1, we establish several facts about the performance of firms that sell integrated solutions, including their higher propensity to export relative to firms that sell products or services separately. In Section 5.2, we present the regression results that tests for Hypotheses 1 and 2. Finally, in Section 5.3, we implement a robustness check on the regression analysis. More specifically, we present the results of several doubly-robust propensity score matching models that strength validity for Hypothesis 1 testing.

5.1 DESCRIPTIVE ANALYSIS

In this section, we present two facts about the firms that sell integrated solutions. First, their presence varies considerably from sector to sector. In particular, in our sample, on average only 22% sell product–service bundles (Table 3), ranging from 7.92 for 'Transportation and storage' to 37.48 for 'Information and communication'.

[Table 3 about here.]

[12]Here we define service industry as firms belonging to either ICT, Professional, scientific and technical services or wholesale and retailing. To ensure results robustness, other classifications of service industries have been used (e.g. only ICT), but results reported in Table 5 are qualitatively the same.

However, the share of product–service sales does not necessarily increase proportionally with the increase in the number of bundling firms. In the manufacturing sector, for example, around 21.44% of the firms generate 8.89% of the bundling sales. A slightly higher percentage of firms in Electricity (22.67%) generates instead a much larger share of sales (12.29%).[13]

Second, we show that SMEs which sell integrated solutions are more productive than those selling products alone or services separately (Figure 3, Panel A). Third, firms that sell integrated solutions exhibit larger exports (Figure 3, Panel B). Since our sample consists of SMEs, this is particularly interesting, as it suggests that product–service bundling benefits are not exclusive to large corporations (as argued for instance in Ariu et al. (2020)).

[Figure 3 about here.]

5.2 REGRESSION ANALYSIS

We start the regression analysis by estimating linear models of the type indicated in Equation 1. We thus begin with a parsimonious specification (first column of Table 4), where e^f_{ist} is regressed only on s^f_{kst} and a set of industry, state, size and time dummies. We subsequently include lp^f_{kjt}, inv^f_{kjt} and rd^f_{kjt} in columns (2)–(4). We then restrict the sample to only those firms that were surveyed in both years and estimate more demanding regressions that include firm, industry-time and size-time FEs in column (5) and firm, industry-time, size-time and state-time FEs in column (6).

Irrespective of the econometric specification used, we find that the estimated coefficient for the variable s^f_{kjt} is always positive and highly significant. Thus, firms that bundle products and services into integrated solutions are more likely to have larger exports than firms that sell goods and services separately. Moreover, the magnitude of the coefficient of interest varies little between the specifications, ranging from 7 to 9 percentage points. Importantly, we show that even after controlling for observed firm characteristics such as labour productivity (lp^f_{kjt}), investment in $R\&D$ (rd^f_{kjt}) and whether the firm invests abroad (inv^f_{kjt}), there is still a positive association between bundling and exporting. The same is true when we restrict the sample to only those firms that were surveyed in both years and estimate more demanding regressions that include firm, industry-time and size-time FEs in column (5) or firm, industry-time, size-time and state-time FEs in column (6). Overall, this result supports Hypothesis 1.

[Table 4 about here.]

[13] In the category 'Other' in Table 3 we group 11 firms from the following sectors: 2 firms in 'Accommodation and food service activities'; 1 firm from 'Agriculture, forestry and fishing'; 1 firm from 'Education'; 1 firm from 'Human health and social work activities'; 2 firms from 'Mining and quarrying' and 4 firms from 'Other service activities'.

As explained before, in order to test Hypothesis 2, we restrict the sample to 'Manufacturing' and 'Services' industries and use the interactive term between bundling and industry to corroborate the hypothesis.

The results are shown in Table 5, where σ^f_{kjt} is a dummy equal to 1 if the firm's primary sector is 'Services' and the coefficients of interest are those on s^f_{kjt} and the interaction $\sigma^f_{kjt} \times s^f_{kjt}$. The coefficient on $\sigma^f_{kjt} \times s^f_{kjt}$ is not significant while the one on s^f_{kjt} is, suggesting that it is bundling per se that is important for exporting, rather than the sector the firm belongs to. This result does not support Hypothesis 2, meaning that the export-enhancing effect of bundling transcends industry boundaries.

[Table 5 about here.]

All in all, the results in Tables 4 and 5 are in line with previous research, with at least three important novelties.

First, we go beyond what most of the existing literature focuses on, the effect of servitization on manufacturers' exports, showing that product–service bundling is export-enhancing also for non-manufacturing firms.

Second, as mentioned earlier, bundling is likely to increase a firm's competitive advantage either through product differentiation or by locking in customers in long-term agreements, or through a combination of the two. Our data allow us to look more closely into what leads firms to bundle. As we show in Table 6, 91% of firms sell integrated solutions to increase customer loyalty and 80.06% to acquire new customers. In other words, as postulated also by Ariu et al. (2020) for (relatively large) bi-exporters, bundling is primarily a strategy to capture demand. However, supply-side motives are also important, as 70% (68%) of firms declare that bundling is implemented to increase sales (earnings) per customer. To the best of our knowledge this is the first paper to show that bundling is not only a strategy for large firms, but can actually be viable also for very small firms.

[Table 6 about here.]

Third, since the firms in our sample are directly asked what share of their sales originate from selling products and services as a bundle (integrated solutions), we can be confident that our measure of bundling, although at the firm level, stems from bundles of product and services demanded by the same client (this is not the case in, for example, Ariu et al. (2020)).

5.3 MATCHING ANALYSIS

The results in the previous section point to a robust positive association between bundling and export intensity, which holds after controlling for several observed and unobserved firm characteristics. In this section we further challenge our results on Hypothesis 1 by implementing propensity

score matching techniques, as described in Section 4. To do this, we first compute the propensity score using a logit model where the treatment is a dummy which takes the value 1 if the firm sells integrated solutions and 0 otherwise: the sample is split between 876 treated and 3,202 untreated. In computing the propensity score, we use lp^f_{kjt}, size and 1-digit NACE dummies as covariates and always allow replacement.

We impose common support in two ways. One is by discarding firms that sell integrated solutions whose propensity score is higher than the maximum or less than the minimum propensity score of firms that do not sell integrated solutions. The propensity score is then estimated using the 3,679 on-support observations (69 are off support). By splitting the sample into 6 blocks, we make sure that the average propensity score is not different for treated and untreated, i.e. we make sure that the balancing property is satisfied. This is clear in Figure 4, where we compare the propensity score of treated and untreated firms (those that sell integrated solutions and those that do not) in the unmatched and matched samples.

While propensity scores for the two sub-samples are different from each other in the unmatched sample (top left hand side panel on Figure 4), for all the three matching techniques we use, i.e. 1:1 Nearest Neighbor Matching (1:1), Radius Matching, and Local Linear Regression (LLR), the scores are not statistically different from one another (top right hand side and down panels of Figure 4).

[Figure 4 about here.]

As an alternative way to impose common support, we trim 5% and 10% percent of the treatment observations at which the propensity score density of the control observations is the lowest. For conciseness, we do not show the propensity scores computed on the trimmed sample, but only the baseline estimates of the Average Treatment Effect (ATE). The ATE of bundling on export intensity ($ATE^{s,f}_{kjt}$) is estimated using the three techniques mentioned above. When we trim the sample, the ATE is indicated by $ATE^{s,f,5}_{kjt}$ and $ATE^{s,f,10}_{kjt}$. The results are shown in Table 7.

Irrespective of the matching technique used, the results from both PSM and DR-PSM strongly confirm the regression findings, with the export intensity of firms that sell integrated solutions being systematically larger than for those that sell only products or only services. However, the point estimates of the regression results are much larger than those of the matching results. This is because in the latter case, s^f_{kjt} is defined as a dummy equal to 1 if the firm sells bundles of product and services and 0 otherwise, thus capturing the effect of bundling vs the effect of not bundling. In Section 5.2, s^f_{kjt} is instead a continuous measure of bundling intensity and captures what the effect of higher or lower bundling intensity is on exporting. Overall, the matching analysis confirm Hypothesis 1.

[Table 7 about here.]

Note also that the set of covariates we include in the PSM procedure (columns (1)–(3)) is different than the one we include in the DR-PSM (columns (4)–(6)). In the former case, achieving

the balancing property requires a parsimonious specification, which only includes lp^f_{kjt}, size and 1-digit NACE dummies. The aim is to match and eliminate any association between the covariates and bundling. In the latter, we use weighted regressions to control for further causes of the exporting that are correlated with bundling and thus include a richer set of covariates.

6 DISCUSSION AND CONCLUSION

6.1 ACADEMIC IMPLICATIONS

There is a large literature on the interplay between innovation, productivity and exports (see e.g. Aghion et al., 2018; Altomonte et al., 2013; Cassiman and Golovko, 2011). However, to what extent innovation paradigms are transforming the ways SMEs internationalize remain under explored. This is particularly important in light of the hybridization underlying the fourth industrial revolution, which is transforming the competition in international markets (Alcacer et al., 2016). In this paper, we contribute to filling this gap by studying the effect of developing hybrid product-service bundles (Ulaga and Reinartz, 2011), also referred to as integrated solutions (Davies, 2004) and considered as a new form of innovation (Bustinza et al., 2019; Vendrell-Herrero et al., 2020), on the exporting intensity of German SMEs.

The present study accounts for the competitiveness-enhancing effect of product-service bundling in two mutually reinforcing ways. First, firms selling integrated solutions gain an international competitive advantage by differentiating their offer through increased customization (Golovko and Valentini, 2011). Such customized and upgraded offers can then provide the opportunity to lock in foreign customers for a longer period of time (Vargo and Lusch, 2008), giving the incentive to increase commitment in foreign markets and eventually increase a firm's export capacity (Skarmeas et al., 2008; Vahlne and Johanson, 2017).

Based on unique survey data, we have found a robust positive relation between bundling and exporting. In particular, our results hold after controlling for firm productivity and R&D investment as well as firm-level unobservable heterogeneity and to the implementation of several DR-PSM procedures, which leave the results qualitatively unchanged. The strength of this result is an important contribution to our understanding of innovation and exporting in the context of the fourth industrial revolution, i.e. the fact that incorporating hybrid bundles of products and services increase significantly a firm's exports.

While most of the literature on hybridization focuses on large manufacturing corporations (Gebauer et al., 2020), our research shows that much smaller firms sell integrated solutions too, and that a wide spectrum of industries are selling hybrid product-service bundles, including firms in

retailing or construction. Related to this, we also find that the benefits of product-service bundling transcend industrial boundaries, and therefore product and service firms can benefit equally by offer complementarities.

This result also seems to suggest that service firms cannot use bundling as a way to exploit economies of scale or as a mechanism to reduce dependency on exporting partners and intermediaries; leaving the underlying reasons for the export-enhancement effect of bundling on exporting found in service firms to the same identified for the rest of firms in our sample, i.e. differentiation and lock in customers.

This study contributes to the literature of international business, as it expands our understanding of factors that enhance export performance strategy (Leonidou and Katsikeas, 2010). Previous research has studied export intensity by analysing product and service firms independently (Falk and de Lemos, 2019; Lejpras, 2019), or analysing bi-exporting firms, which can sell products and services but they do it in a different offer (Ariu et al., 2020). The present study moves a step forward and examine firms with a multifaceted industrial activity that can offer products and services in the same offer. Additionally, the analysis addresses a call made by Knight and Liesch (2016), who argued that since hybridization *'engenders superior mutual value by shifting from selling product to selling product-service systems"* (p.100), it is necessary to examine how product-service offer optimize international performance.

Our research also contributes to the literature of operations management. To the best of our knowledge, it is pioneering in various ways. For one thing, our survey provides a breakdown of the bundling-generated sales, which differs from selling products or services separately, as has been considered in the previous empirical research (Ariu et al., 2020; Kastalli and Van Looy, 2013; Suarez et al., 2013). This ensures that the revenues come from product-service bundles demanded by the same client. Second, whilst previous studies have analysed multiple outcomes of hybridization (e.g. Crozet and Milet, 2017), this is the first research analysing the exporting-enhancement effect of selling bundles of products and services. This fact addresses a call made by Bustinza et al. (2017) who pointed out that '*to date the* [operations management] *literature is silent on the internationalisation of the service function* [by product firms], *an issue we consider of vital importance to better understanding the organisational transformation of many industrial companies*" (p.7). Third, this study is amongst the first that merge servitization and productization, two independent streams of literature that need to converge as they analyse the same type of business practice, i.e. product-service bundling, differing only on the firm's primary industry (Leoni, 2019).

6.2 MANAGERIAL IMPLICATIONS

Our research also provides important managerial implications. First, exporting SMEs and firms

seeking to participate in foreign markets can improve their export intensity by understanding the mechanisms that enable them to bundle products and services. As mentioned before, combining products and services in the same offer upgrades a firm's ability to differentiate its offers and might open the door to increased foreign market commitment. Importantly, this result transcends industrial boundaries. Second, evidence shows that integrated solutions are particularly relevant for those firms that need to increase consumer loyalty. This means that this business practice might be especially attractive for firms seeking to increase repeated purchases. Finally, our analysis finds that a number of control variables, including R&D investment and production abroad, also influence export intensity. The effect of integrated solution on exporting assumes that those control variables are on the mean, implying that integrated solutions should not work in isolation to other business practices that enhance exporting.

6.3 LIMITATIONS AND FURTHER RESEARCH AVENUES

This study is a first step towards studying the links between selling integrated solutions and exporting performance. As such, it leaves ample room for further research. For example, our data does not distinguish product-service bundles by their level of technology or the type of service. Future research might expand our analysis by examining the heterogeneities within product-service bundles, and disentangle the technological and the service elements that enhance firm's exporting capacity (La et al., 2005). For example, our data consists of only two waves and a reasonably large proportion of firms were surveyed twice, which provides the opportunity to control for firm-level unobservable factors. However, a longer time span would allow for a deeper understanding of how bundling affects a firm's export performance over time, not least because it would allow for the implementation of a wider range of causal methods.

Empirically, if firm- and transaction-level data were to increasingly include longitudinal information on product-service bundling, one could, for instance, borrow from the international trade literature and study whether bundling has larger effects on the intensive margin or on the extensive margin of trade. Moreover, having information about the buyers of the integrated solutions could help the theoretical characterization of this strategy in a buyer -seller repeated interaction setting. This would be particularly interesting in light of the emerging industrial organization literature, which shows that a seller's reputation is key to keeping demand when negative shocks hit (Macchiavello and Ameet, 2015).

Finally, while Germany is an ideal context for analysis, as it is one of the leaders of the fourth industrial revolution and in the implementation of hybrid offerings, future research should analyse bundling in a cross-country perspective that can extend our understanding of how business and institutional environments affect the relation between integrated solutions and export intensity. Again, if data were to be available, a lot could be borrowed from the international trade literature

also in this case. Similarly, it is important to analyse whether other firm- and industry-level factors moderate or mediate this relation.

APPENDIX

A WEIGHTS

A weighting scheme has been set up to ensure the representativeness of the sample. We constructed the dataset for the German population of firms from the Unternehmensregister. For each wave we sampled firms based on classes of size and sectors. Following Altomonte and Aquilante (2012), two types of weights (relative and absolute) have been constructed. For each wave, the relative (rw) and absolute (aw) weights for the firms in sector j and size class m were built as follows.

$$rw^{km} = \frac{\frac{\varphi^{km}}{\varphi}}{\frac{\varrho^{km}}{\varrho}} \quad aw^{km} = \left(\frac{\frac{\varphi^{km}}{\varphi}}{\frac{\varrho^{km}}{\varrho}}\right)\left(\frac{\varphi}{\varrho}\right) \tag{A.1}$$

Here, φ^{km} is the number of firms in industry k and size class m for the population of German firms in a given wave and ϱ^{km} is the number of firms in industry k and size class m in our sample. φ and ϱ are the numbers of firms in the population and our sample respectively.

The essential difference between relative and absolute weights is that for relative weights, the sum of weights over the firms is equal to the total number of firms in the sample by wave, whereas for the case of absolute weights, the sum of weights over the firms is equal to the total number of firms in the reference population. By construction, firms belonging to the same size/sector cell will share the same weights.

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Figure 1: Conceptual model

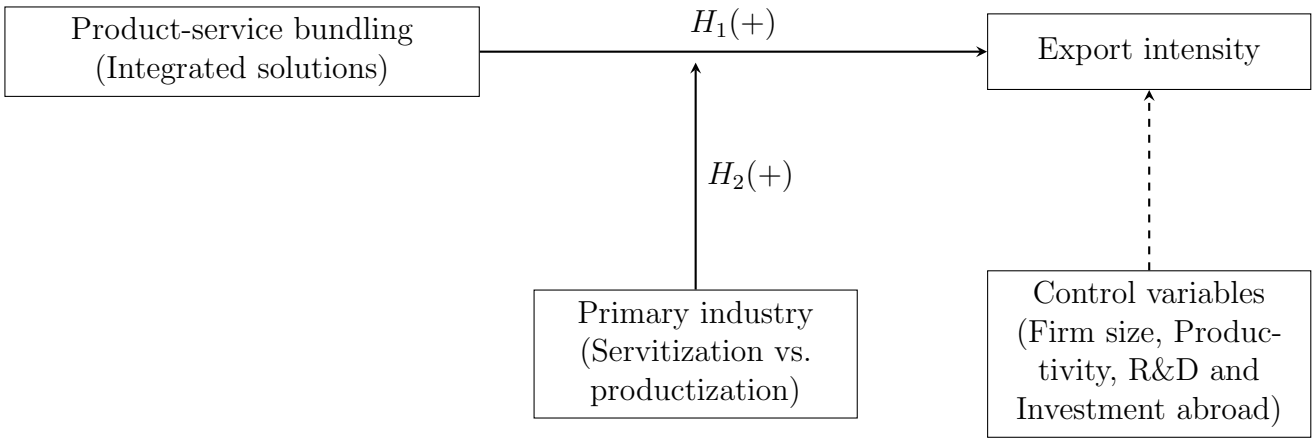
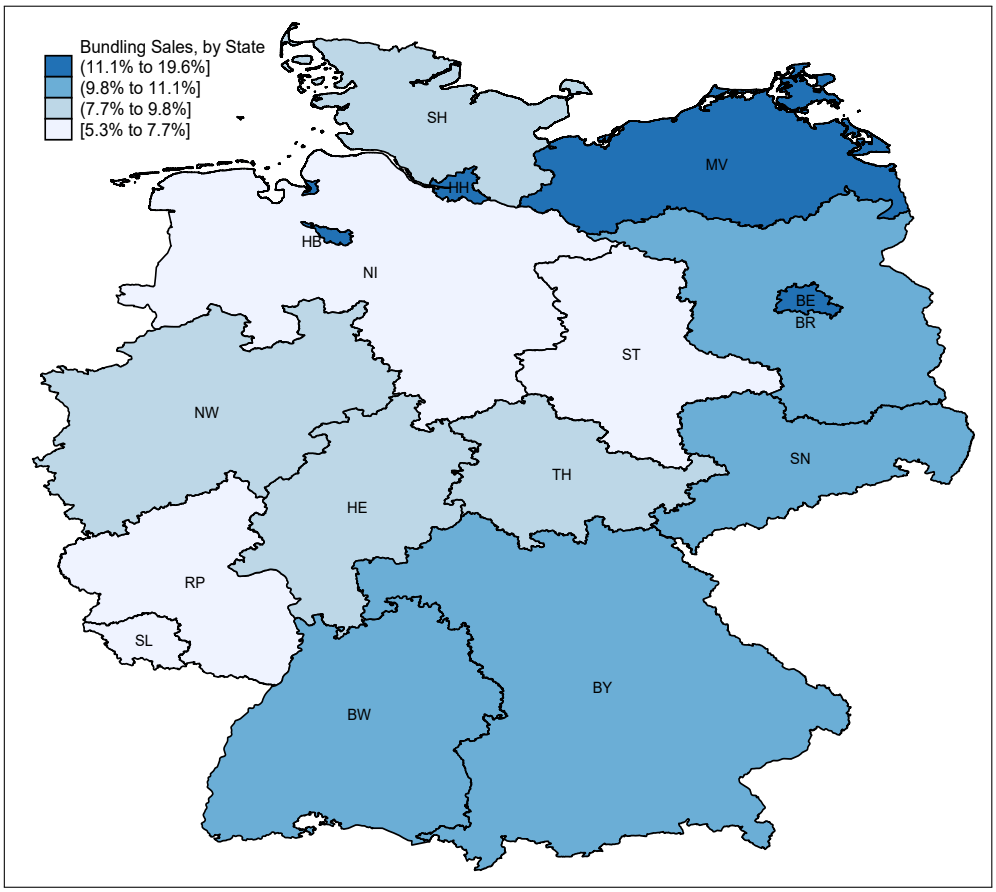
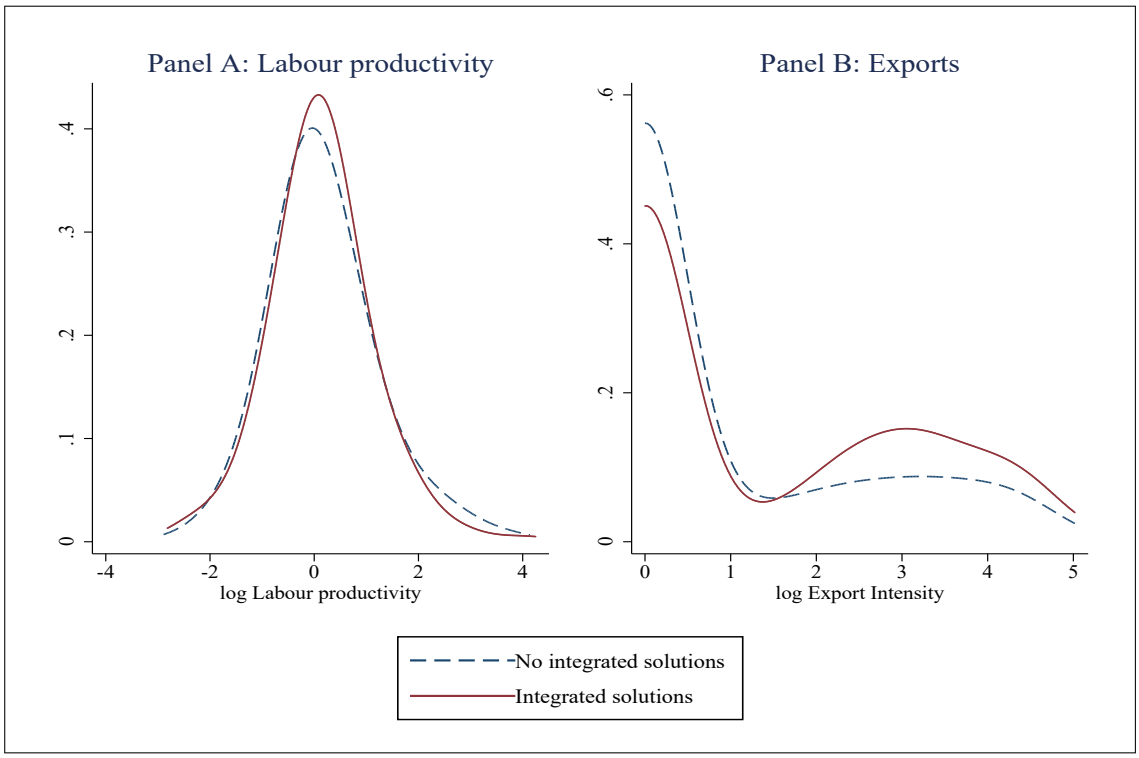


Figure 2: Sales generated by bundling, by German state



Notes: The 2-digit state codes appearing in the map correspond to the following names: Baden-Württemberg (BW) Bavaria (BY) Berlin (BE) Brandenburg (BB) Bremen (HB) Hamburg (HH) Hesse (HE) Lower Saxony (NI) Mecklenburg-Vorpommern (MV) North Rhine-Westphalia (NW) Rhineland-Palatinate (RP) Saarland (SL) Saxony (SN) Saxony-Anhalt (ST) Schleswig-Holstein (SH) Thuringia (TH)

Figure 3: Productivity, bundling and exporting



Notes: Panel A (Panel B) shows the distribution of firm-level labour productivity (export intensity), distinguishing between those selling integrated solutions and those which sell products alone or services alone. The distributions in the two panels are statistically different at 1%. Variables are in logarithms. Observations are weighted using sample weights as computed in Section A in the Appendix.

Figure 4: Propensity score: Matched vs unmatched sample (baseline)

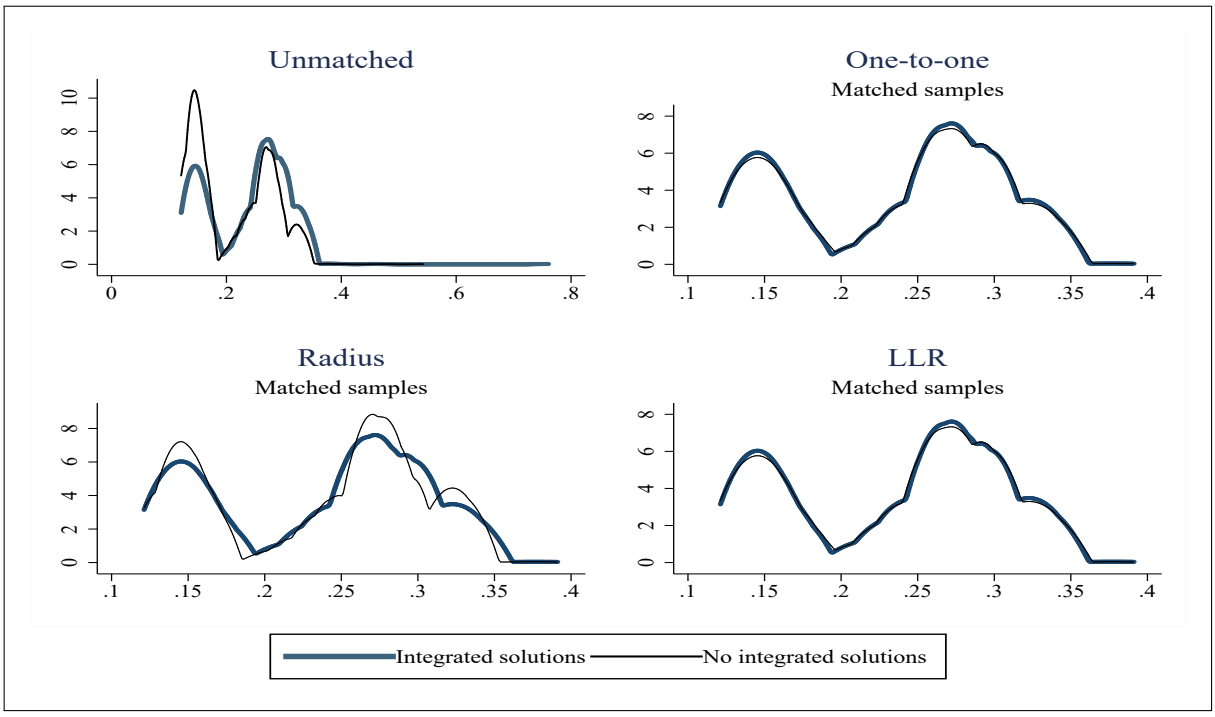


Table 1: Size distribution of firms

Class size	# of employees	# of firms	Percentage
Micro enterprises	[1 – 9]	3,356	78.63
Small enterprises	[10 – 49]	738	17.28
Medium-sized enterprises	[50 – 249]	175	4.09
Total		4,268	100

Firms are classified to be 'Micro', 'Small' and 'Medium-sized' enterprises according to the EUROSTAT definition. Observations are weighted using sample weights as computed in Section A in the Appendix.

Table 2: Summary statistics

Variable	Mean	Std. Dev.	Observations(%)
e^f_{kjt}	10.146	21.995	3,881
# of exporters(%)			1,724 (44)
s^f_{kjt}	8.627	23.367	4,200
# of bundling firms(%)			913 (22)
lp^f_{kjt}	0.18	1.224	4,140
inv^f_{kjt}	0.094	0.292	3,891
rd^f_{kjt}	4.786	12.657	4,102

e^f_{kjt} is the ratio between sales in foreign markets and the total turnover of firm f in sector k and state j at time t. s^f_{kjt} is the share of firm turnover generated by selling integrated solutions. lp^f_{kjt} is the logarithm of labour productivity of firm f in sector k and state j at time t. inv^f_{kjt} is a dummy equal to 1 if firm f belongs to sector k and state j and produces abroad at time t. rd^f_{kjt} is the share of R&D expenditure on turnover of firm f, in sector k and state j at time t.

Table 3: Bundling by sector

Sector	Description	Share of firms	Share of sales	Observations
58–63	Information and communication	39.20	16.54	432
35	Electricity, gas, steam, etc...	27.25	12.29	128
10–33	Manufacturing	23.34	8.89	1,744
45–47	Wholesale and retail trade, repair	20.96	7.32	265
69–75	Professional, scientific and technical	18.98	7.77	818
64–66	Financial and insurance activities	14.12	4.86	19
77–82	Administrative and support service	14.55	6.04	353
68	Real estate activities	11.02	2.19	35
37–39	Water supply, sewerage, waste	10.56	1.32	18
41–43	Construction	8.42	1.46	227
49–53	Transportation and storage	8.67	3.98	150
	Other	22.95	4.29	11
	Aggregate	21.81	8.63	4,200

Authors' calculation of CIER data. Observations are weighted using sample weights as computed in Section A in the Appendix.

Table 4: Bundling and exporting

	OLS (Full sample)				OLS (Fixed-effects)	
e^f_{kjt}	(1)	(2)	(3)	(4)	(5)	(6)
s^f_{kjt}	0.088***	0.093***	0.085***	0.079***	0.069***	0.089**
	(0.010)	(0.010)	(0.012)	(0.012)	(0.020)	(0.035)
lp^f_{kjt}		-0.002	-0.003**	-0.002**		
		(0.002)	(0.001)	(0.001)		
inv^f_{kjt}			21.398***	21.072***		
			(2.426)	(2.328)		
rd^f_{kjt}				0.177***		
				(0.049)		
Observations	3,829	3,736	3,726	3,626	994	994
R^2	0.064	0.064	0.143	0.152	0.044	0.094
$\vartheta_k, \vartheta_j, \vartheta_m, \vartheta_t$	Yes	Yes	Yes	Yes	No	No
$\vartheta_f, \vartheta_{k\times t}, \vartheta_{m\times t}$	No	No	No	No	Yes	No
$\vartheta_f, \vartheta_{k\times t}, \vartheta_{m\times t}, \vartheta_{j\times t}$	No	No	No	No	No	Yes

Estimates of linear regressions. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors, in parentheses, are clustered at the 2-digit NACE industry level. s^f_{kjt} is the share of firm turnover generated by selling integrated solutions. e^f_{kjt} is the ratio between sales in foreign markets and the total turnover of firm f in sector k and state j at time t. lp^f_{kjt} is the logarithm of labour productivity of firm f in sector k and state j at time t. inv^f_{kjt} is a dummy equal to 1 if firm f belongs to sector k and state j and produces abroad at time t. rd^f_{kjt} is the share of R&D expenditure on turnover of firm f, in sector k and state j at time t. ϑ_k, ϑ_j, ϑ_m and ϑ_t are sector, state, size and time dummies/FEs. Observations are weighted using sample weights as computed in Section A in the Appendix.

Table 5: Manufacturers vs. Services firms

e^f_{kjt}	(1)	(2)	(3)	(4)
s^f_{kjt}	0.095**	0.099**	0.084**	0.086*
	(0.013)	(0.014)	(0.015)	(0.023)
σ^f_{kjt}	-3.135	-6.180**	-4.890	-6.550*
	(1.435)	(1.114)	(1.797)	(1.830)
$\sigma^f_{kjt} \times s^f_{kjt}$v	-0.023	-0.014	-0.001	-0.013
	(0.012)	(0.013)	(0.012)	(0.016)
lp^f_{kjt}		-0.003	-0.003*	-0.002**
		(0.001)	(0.001)	(0.000)
inv^f_{kjt}			21.056**	20.708**
			(3.259)	(3.137)
rd^f_{kjt}				0.182***
				(0.013)
Observations	2,938	2,874	2,864	2,785
R^2	0.033	0.053	0.135	0.145
$\vartheta_k, \vartheta_j, \vartheta_m, \vartheta_t$	Yes	Yes	Yes	Yes

Estimates of linear regressions. The sample is restricted to firms in 'Manufacturing' and 'ICT'. Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors, in parentheses, are clustered at the 2-digit NACE industry level. s^f_{kjt} is the share of firm turnover generated by selling integrated solutions. e^f_{kjt} is the ratio between sales in foreign markets and the total turnover of firm f in sector k and state j at time t. σ^f_{kjt} is a dummy equal to 1 if firm f is in state j and belongs to the service sector at time t. lp^f_{kjt} is the logarithm of labour productivity of firm f in sector k and state j at time t. inv^f_{kjt} is a dummy equal to 1 if firm f belongs to sector k and state j and produces abroad at time t. rd^f_{kjt} is the share of R&D expenditure on turnover of firm f, in sector k and state j at time t. ϑ_k, ϑ_j, ϑ_m and ϑ_t are sector, state, size and time dummies/FEs. Observations are weighted using sample weights as computed in Section A in the Appendix.

Table 6: The drivers of bundling

Objective	Percentage
Acquisition of new customers	80.06%
Increase in sales per customer	70.46%
Increase in earnings per customer	68.22%
Increase in customer loyalty	91.75%

Table 7: Doubly-robust propensity score matching

e^f_{kjt}	*PSM*			*DR-PSM*		
	(1)	(2)	(3)	(4)	(5)	(6)
	1:1	Radius	Kernel	1:1	Radius	Kernel
$ATE^{s,f}_{kjt}$	5.31***	5.48***	5.16***			
ζ_{DR}				2.51**	3.84***	2.21**
Observations	3,679	3,679	3,679	3,573	3,570	1,127
R^2				0.19	0.17	0.19
Sample trimmed at the 5^{th} centile						
$ATE^{s,f,5}_{kjt}$	5.64**	6.18**	6.34***			
$\zeta_{DR,5}$				2.56***	4.29***	2.56***
Observations	3,561	3,561	3,561	3,460	3,452	1,067
R^2				0.25	0.16	0.24
Sample trimmed at the 10^{th} centile						
$ATE^{s,f,10}_{kjt}$	6.36**	6.61***	6.71**			
$\zeta_{DR,10}$				3.40**	4.44***	2.95***
Observations	3,374	3,374	3,374	3,267	3,269	962
R^2				0.26	0.16	0.26
lp^f_{kjt}	Yes	Yes	Yes	Yes	Yes	Yes
inv^f_{kjt}	No	No	No	Yes	Yes	Yes
rd^f_{kjt}	No	No	No	Yes	Yes	Yes
ϑ_k, ϑ_m	Yes	Yes	Yes	Yes	Yes	Yes
ϑ_j, ϑ_t	No	No	No	Yes	Yes	Yes

Estimates of the ATE of bundling on export intensity in columns (1)–(3) and coefficients of weighted linear regressions in columns (4)–(6). Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. In columns (1)–(3) observations are weighted using sample weights as computed in Section A in the Appendix. In columns (4)–(6) observations are weighted using PSM weights. Standard errors are clustered at the 2-digit NACE industry level in columns (4)–(6). lp^f_{kjt} is the logarithm of labour productivity of firm f is sector k and state j at time t. inv^f_{kjt} is a dummy equal to 1 if firm f belongs to sector k and state j and produces abroad at time t. rd^f_{kjt} is the share of R&D expenditure on turnover of firm f, in sector k and state j at time t. ϑ_k, ϑ_j, ϑ_m and ϑ_t are sector, state, size and time dummies