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Antecedents and Implications of Territorial Servitization

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ABSTRACT

This article examines the key antecedents and implications of territorial servitization in central Europe and the Mediterranean. Territorial servitization is analysed using 17 Spanish and 38 German NUTS-2 regions during the period 2010-2014. The results indicate that, in terms of market size and economic activity, territorial servitization is significantly higher in regions with more Knowledge-Intensive Business Services (KIBS) deepening and where air and maritime transport have positive effects on territorial servitization. Interestingly, while our results confirm a positive relationship between patents and territorial servitization, patents show decreasing returns. Important implications for research, firms and policy makers are discussed.

Keywords: servitization, product-service innovation, KIBS, territorial servitization; knowledge, regional development.

Subject classification codes: O14; O52; R10

Note: This is a post peer-review accepted version, please cite:

Gomes, E., Bustinza, O.F., Tarba, S., Khan, Z., & Ahammad, M. (2018). Antecedents and Implications of Territorial Servitization, *Regional Studies*, *in press*.

INTRODUCTION

Expansion of manufacturing activities is a topic of growing interest (Ohuallachain, Douma, & Kane, 2017; Vendrell-Herrero, Gomes, Bustinza, & Mellahi, 2018) with critical implications for regional development (Koch & Stahlecker, 2006). The inability of manufacturers from developed markets to compete against their counterparts from developing markets on the basis of cost advantages, has increased the need for the former to integrate value-adding services and digital upgrading into their offerings, therefore shifting the basis for competition from cost to innovative differentiation (Baines et al., 2017). Defined as *servitization*, this process encompasses a competitive strategy for competing in differentiation (service innovation) and cost leadership (Ulaga & Reinartz, 2011). The percentage of manufacturing companies from Western countries offering integrated products-services is 60% of all manufacturing firms (Crozet & Milet, 2017). Nevertheless, servitizing manufacturers face critical strategic decisions whether to develop service innovation internally or through strategic partnership (Rabetino, Kohtamäki, & Gebauer, 2017). Even when large manufacturers have enough resources to develop services in-house, recent studies show that revitalization of certain manufacturing sectors is associated with a dynamic Knowledge-Intensive Business Service (KIBS) sector (Bustinza, Gomes, Vendrell, & Baines, 2017a; Kohtamäki & Partanen, 2016). From the perspective of economic geography (Howells, 2002; Goto, Atris, & Otsuka, 2018), manufacturers' expansion activities open interesting research avenues for understanding the interaction of knowledge sets between manufacturing and KIBS sectors, and the effects of this interaction on regional development.

Local KIBS companies give manufacturers access to a vast stock of knowledge and help them develop value-adding services (Lafuente, Vaillant, & Vendrell-Herrero, 2017). Scholars thus highlight the benefits of interconnectedness and interaction between complementary and closely located manufacturing and service companies: creating integrated, differentiated innovative product-service offerings; enhancing both company and local value chain competitiveness; generating regional economic development (e.g., Becattini, Bellandi, Dei Ottati, & Sforzi, 2003; Bryson, 2009; Cusumano, Kahl, & Suarez, 2015; Kowalkowski, Gebauer, Kamp, & Parry, 2017; Vendrell-Herrero & Wilson 2017) and increasing global trade (UNCTAD, 2015). Although this body of knowledge provides evidence of the value of shifting from product to product-service offerings (Tukker, 2004), researchers have little understanding of the territorial impact of increasing interaction of KIBS and manufacturing companies (e.g., Lafuente et al., 2017). Our study focuses on this topic.

Previous studies of servitization focused on identifying the main drivers (Vandermerwe & Rada, 1988), barriers (Baines et al., 2017) and success factors of the servitization implementation process, and the possible outcomes for manufacturing companies (Visnjic & Van Looy, 2013). When evaluating the impact of servitization strategies, however, emphasis has been placed primarily on organization-level benefits and competitiveness (Smith, Maull, & Ng, 2014). One exception is the recent study by Lafuente et al. (2017), which provides evidence of the territorial impact of servitization on the development of vigorous manufacturing sectors and, consequently, on job creation. Considering the priority that governments and policymakers from developed countries have recently placed on the need for manufacturing revitalization and resilience (Bailey & Turok, 2016), the lack of studies on the territorial impact of servitization is surprising.

Despite some recent efforts, relatively little is known about the drivers and effects of territorial servitization—i.e., the “aggregated outcomes resulting from the various types of mutually dependent associations that manufacturing and knowledge-intensive service businesses create and/or develop within a focal territory” (Lafuente et al., 2017, p. 2). Whereas other studies highlight the impact and virtuous circle involved in territorial servitization—how a local manufacturing sector simultaneously stimulates and is stimulated by developing a complementary knowledge-intensive service sector, (Lafuente et al., 2017)—our study aims to investigate the antecedents of territorial servitization.

To address this research question, we created a unique dataset drawn from different sources. Data on (company-level) KIBS deepening and territorial servitization were obtained from ORBIS (a dataset covering over 200 million companies worldwide). (Regional-level) aggregate information was provided by Eurostat. The data obtained from these sources enabled us to create a panel dataset including 17 Spanish and 38 German NUTS-2 regions for 2010–2014. The differences observed in these central European and Mediterranean regions provide an interesting context with clear implications for EU funding outcomes. Although these regions are both located in highly decentralized countries, the German state and regions share decision structures and investment costs, whereas Spain’ regions have strong autonomy in both decision making and cost allocation (Bürzel, 1999; Charron, 2016). Such facts are important to analysing whether KIBS deepening is an antecedent of territorial servitization in the context of two heterogeneous regions.

This study makes three contributions: (1) It develops the first global measure of territorial servitization and tests that measure in different regions, a contribution important to advancing academic understanding of the concept and providing more

robust policy implications (Acs, Anselin, & Varga, 2002). (2) It evaluates the impact of two other antecedents of territorial servitization, exposure of a region to international trade and availability of a knowledge stock in the region, thus contributing to the emerging literature on KIBS and territorial servitization at regional level. (3) It contributes to the policy debate and helps policymakers to understand some conditions necessary to enhance development of territorial servitization and resulting regional socio-economic growth, providing knowledge that is particularly important for developed economies attempting to revitalize innovative local manufacturing sectors (De Propris, 2016).

The paper is structured as follows. First, it presents theoretical background to explain how our investigation builds on and extends existing knowledge of servitization. Second, it explains in detail the context, key variables used, and methods for data collection and analysis. Third, it presents the results, followed by discussion of the key findings, their implications for theory and policymaking, and the conclusions drawn.

THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

Servitization, understood as the process of adding value by integrating service and product offers (Wise & Baumgartner, 1999), has been acknowledged as a valid means to enhance manufacturing companies' competitive advantage. Servitization enables companies to differentiate themselves by providing integrated product-service solutions (Baines & Lightfoot, 2013). Vandermerwe and Rada (1988:315) highlight the importance of servitization, noting that "servitization is happening in almost all industries on a global scale. Swept up by the forces of deregulation, technology,

globalization and fierce competitive pressure, both service companies and manufacturers are moving more dramatically into services”. This business model has increased in popularity across the globe, but especially in developed markets, in which manufacturers cannot compete with their counterparts from developing markets in terms of cost (Crozet & Milet, 2017).

As services are becoming important drivers of companies’ competitive advantage, developed market governments in Europe and the US have acknowledged the critical importance of service innovation for national and regional competitiveness (European Commission, 2014; Rubalcaba, 2015). Whereas prior studies focussed more on the role and impact of servitization at company level, servitization of manufacturing in the current context is driven by various factors, ranging from company strategy and profitability motives to the changing attitudes of consumers (Swedish National Board of Trade, 2016). Extensive research has examined the main drivers of servitization (Baines et al., 2017; Swedish National Board of Trade, 2016) and success factors associated with the implementation of servitization processes (Bustinza, Vendrell-Herrero, & Baines, 2017b). Evidence from previous firm-level studies seems to demonstrate an association of higher servitization levels with more stable earnings, higher revenues, long-term growth rates and profitability (Cusumano et al., 2015; Meliciani & Savona, 2015).

The potential competitive advantages provided by a vertically integrated product-service strategy (Kowalkowski et al., 2017) tend, however, to be temporary, especially in contexts of fast-changing high-technology industries and fine slicing of value chains (Mudambi, 2008; Rothaermel, Hitt, & Jobe, 2006). In such contexts, characterized by high levels of uncertainty, internalization of knowledge-intensive service provision can have several disadvantages. Due to the cutting-edge know-how

required for dispersal of innovation trends across different companies, continuous innovation in fast-changing industries usually involves reaching beyond a company's boundaries (Rothaermel & Deeds, 2004; Rothaermel et al., 2006). Recent studies demonstrate that manufacturing companies have been servitizing by engaging in collaborative concentric partnerships with local KIBS companies (Bustinza et al., 2017a; Paiola, Saccani, Perona, & Gebauer, 2013).

Several scholars have studied the activities of companies located in geographically proximate regions and their positive impacts on regional economic development (Aranguren et al., 2014; Bailey & De Propris, 2014; Lafuente et al., 2007; Rocha & Sternberg, 2005). Evidence suggests that regions benefit from interconnections and complementarities between companies in such areas (Boix & Vaillant, 2010). Proximity creates relational capital and social embeddedness, as companies benefit from tacit and explicit knowledge spillovers resulting from co-location (Capello & Faggian, 2005). Marshallian industrial districts exemplify how smaller companies can overcome internal disadvantages of economy of scale relative to larger competitors. Interconnectedness, complementarity and synergetic interaction between closely located small companies facilitate development of external economies of scale, enabling these companies to compete with larger ones and to develop regional economic competitiveness (Marshall, 1890).

Following similar logic, Becattini (1990) argues that the interaction between closely located manufacturing and service companies can help them to overcome cost disadvantages faced by lower-cost-based manufacturing companies dependent on a large-scale mono-productive manufacturing model. High interconnectedness and interaction between complementary and closely located manufacturing and service companies facilitate knowledge flows and creation of integrated, differentiated

innovative product-service offerings, enhancing company and local value chain competitiveness and regional development (Becattini et al., 2003; Kohtamäki & Partanen, 2016; Lafuente et al., 2017). It is thus argued that territorial servitization contributes to consolidation and resilience of the regional industrial fabric through interactive agglomeration economies and knowledge spillovers (Rocha & Sternberg, 2005), especially in knowledge-intensive sectors (Lafuente, Vaillant, & Serarols, 2010).

KIBS companies as antecedents of territorial servitization

The interconnected local coexistence of manufacturing and related service companies is at the core of territorial servitization. Several studies provide evidence of the advantages derived from mutually beneficial relationships between related manufacturing and service companies. These advantages range from reduced transaction costs (Visnjic & Van Looy, 2013) and economies of scope (Teece, 1980) to higher innovation levels (Castaldi, Frenken, & Los, 2015; Vendrell-Herrero, Bustinza, Parry, & Georgantzis, 2017; Vendrell-Herrero et al., 2017). At regional level, such interactions promote knowledge flows, not only between manufacturing and service companies but also across the various players in the local value chain, strengthening both the regional industrial fabric and local economic development and resilience (Vaillant, Lafuente, & Serafols, 2012). Through such interactions, companies can develop absorptive and relational capabilities (Zahra & George, 2002). Since servitization is a network-based activity, they can also improve value co-creation by adding services for their regional and global clients (Tukker, 2004). Baines & Lightfoot (2013, p. 22), for example, support the network-based view of servitization as “a capability delivered through product performance and often featuring relationships over extended life-cycle, extended responsibilities and regular revenue payments”. We argue that such network interactions and territorial servitization can create competitive

advantages for companies, leading to regional competitiveness. This argument agrees with those of existing studies that highlight the role of servitization as key source of competitive advantage for companies (Visnjic & Van Looy, 2013).

Arauzo-Carod (2005) find that thriving regional economic activity is also an important driver of new business creation, since a buoyant manufacturing sector nurtures creation and/or attraction of service companies capable of providing IT, R&D and other KIBS to local manufacturing companies (Lafuente et al., 2010; Vaillant et al., 2012). A recent study by Lafuente et al. (2017) seems to indicate the existence of a mutually reinforcing virtuous circle, however. Evidence from this study suggests that, while a competitive manufacturing sector can attract new KIBS companies, local KIBS companies are also conducive to creation and attraction of new manufacturing companies in the same region. As value chains are commoditized and finely sliced (Mudambi, 2008), region-level KIBS deepening (understood as a density variable measuring number of KIBS over total firms in a specific region) provides benefits for the development of competitive advantages through territorial servitization (e.g., Lafuente et al., 2017). Such a shift is particularly relevant to governments and policymakers of developed countries attempting to develop new manufacturing sectors and regions or to revitalize declining ones. Based on the arguments above, we hypothesize that:

H1: A strong local industrial fabric characterized by higher levels of KIBS deepening is conducive to higher levels of territorial servitization.

Trade exposure and territorial servitization

We have argued that a strong industrial fabric characterized by high levels of interconnectedness and interaction between manufacturing and KIBS companies is a key condition for regional development and resilience. We would also assert, however,

that regions may become more resilient not only due to interconnectedness between local manufacturing and service companies but also by developing external trade relationships with companies and buyers from other regions and countries. For instance, the capacity to export to other countries enables local companies to attenuate the negative effects of saturated local markets. Yet recent studies show that the resilience level of service companies is higher than that of manufacturing companies (Ariu, 2016; Borchert & Mattoo, 2010). Borchert and Mattoo (2010) provide evidence that service companies proved much more capable than manufacturers of withstanding the 2008 crisis. While export levels of US and Indian service companies did not decline as a result of the 2008 crisis, those of their goods-trading counterparts experienced the sharpest decline ever recorded. Similarly, by comparing trade levels of manufacturing companies that exported both products and services, Ariu (2016) provides further evidence that servitized companies that export products and services are more resilient to negative externalities. Regions characterized by higher levels of territorial servitization thus achieve not only higher levels of trade but also higher levels of resilience. UNCTAD's World Investment Report (2015) highlights the increasing role of services in trade, indicating servitization of manufacturing—such as transportation—as important in enabling foreign trade (Lodefalk, 2014). Based on the foregoing, we posit that:

H2: Higher levels of exposure to trade are associated with higher levels of territorial servitization.

Knowledge, innovation and territorial servitization

Previous studies on the spatial implications of knowledge creation have widely demonstrated the innovation resulting from interaction and interconnectedness between local economic agents (Acs et al., 2002). This paper has already discussed the role of

KIBS companies in supporting manufacturing innovation and developing regional competitiveness, arguing that the knowledge shared between manufacturers and KIBS companies—and with other local value chain participants such as buyers, suppliers, distributors, facilitators and even end users—is conducive to higher levels of innovation and regional development (Castaldi et al., 2015). Although no consensus currently exists on how to measure regional innovation levels, some authors argue that patents provide a reliable and objective method (Acs et al., 2002). Based on a study of innovation levels across several US regions, Acs et al. (2002) found that the number of patented inventions per region was a good measure of regional innovation levels.

Previous studies on regional innovation systems suggest that innovation levels vary across regions because technological knowledge tends to be concentrated in specific regions and clusters (Varga, 2000) and because geographical proximity facilitates knowledge flows and spillovers among local companies (Acs & Varga, 2002). One example is the case of the multi-technology cluster in Sophia Antipolis (southern France), which is used by high-tech companies from various sectors as a collaborative “platform of knowledge” that facilitates creation and diffusion of knowledge and technology. The synergetic and complementary interactions that occur among companies in that region result not only in inter-company flows of knowledge and product service innovation but, ultimately, in enhanced regional competitiveness (Rychen & Zimmermann, 2008). Evidence from previous studies demonstrates that local technological and scientific knowledge is a critical factor in attracting new knowledge-intensive companies to a region (Zucker, Darby, & Brewer, 1998), thereby increasing the potential for territorial servitization and regional innovation and development (Tavassoli & Jienwatcharamongkhol, 2016). Nevertheless, even when knowledge is widely considered as an input that increases marginal productivity

(Romer, 1986), the effect of knowledge varies according to the scale of production (Isoard & Soria, 2001). Such variation suggests the existence of a turning point at which a knowledge stock could show decreasing returns, ultimately reaching a point at which additional knowledge would not increase territorial servitization. Based on these arguments, we hypothesize that:

H3a: In any given region, a higher knowledge stock leads to higher levels of territorial servitization.

H3b: The positive relationship between knowledge stock and territorial servitization exhibits decreasing returns.

Figure 1 provides an overall view of the model variables and respective hypotheses.

PLEASE INSERT FIGURE 1 ABOUT HERE

CONTEXT AND METHODS

This study is based on the Nomenclature of Territorial Units for Statistics (NUTS) classification, a standard providing a harmonized hierarchy of regions at three different levels (NUTS 1 to NUTS 3) according to area size. These areas are termed *statistical regions* following the European Free Trade Association (EFTA). NUTS 2 region classification is the basis for allocating EU regional funds through the “EU Cohesion Report”.

In our study, territorial servitization is analysed in the context of central European and Mediterranean regions. This approach to analysis of the variable is interesting because it incorporates heterogeneity to increase the potential and impact of the conclusions to be obtained. The decision to compare regions from different

European countries follows that of other studies focusing on regional development (Hervás-Oliver et al., 2017). Important differences illustrate the heterogeneity between regions in these two countries. For example, although both countries are highly decentralized, the German state and regions share decision structures and investment costs, while Spanish regions have a strong autonomy in decisions and cost allocation (Bürzel, 1999). Understanding such heterogeneity is valuable in analysing the differences in EU funding outcomes (Charron, 2016). To this end, 17 Spanish and 38 German regions were selected using the appropriate NUTS 2 codes for 2010-2014, to provide a total of 275 potential region-year observations from which to develop a data panel.

This study's main objective is to analyse the antecedents of territorial servitization. The sample is composed of two regions with different decision structures and investment costs to enable better understanding of unique antecedents of territorial servitization. Still, we must analyse the unbalanced subsamples using the Student-Newman-Keuls test, a test that uses group harmonic means (Lea & Fredendall, 2002) to detect reliable intergroup differences. As no statistical differences were found (at $p < 0.05$), the two regions are suitable for analysing KIBS as antecedent of territorial servitization. Separate analysis of the two regions is thus unnecessary if the focus is to understand the role of KIBS density as unique antecedent of territorial servitization.

Territorial servitization and KIBS deepening

Territorial servitization was determined by percentage of manufacturers that servitized in a specific region and year. *KIBS deepening* was determined as a density variable measuring percentage of KIBS companies in a specific region and year. Information on territorial servitization and KIBS deepening at regional level was obtained from ORBIS for the years 2010-2014 (five years). This dataset contains

information on over 200 million private companies worldwide, thus representing a highly-valued source of information (see <https://www.bvdinfo.com> for more information). Combining ORBIS at company-level with aggregate information provided by Eurostat, we constructed a unique, balanced data panel that included robust information on territorial servitization, KIBS deepening, total number of products traded (input and output), patents and a number of control variables.

To determine the economic activities that could be classified as services and relevant to manufacturing companies, we drew on Wong & He (2005), who established the North American Industry Classification System (NAICS) codes relevant to servitization. These codes are linked to the following economic activities: a) IT and related services, b) engineering and technical services, and c) business and management consulting.

Since ORBIS provides information on primary and secondary economic activities, it was possible to determine the number of servitized companies in a region. These were the manufacturing companies (as described by the first industry category, NAICS codes 31-33 “Manufacturing”) that offered services in addition to products (as described by the second industry KIBS category, NAICS codes 518-519 “IT services” and 54 “Professional, Scientific, and Technical Services”). Finally, we selected codes related to “circular economy” (codes 56 “Administrative and Support and Waste Management and Remediation Services” and 811 “Repair and Maintenance services”). We defined territorial servitization as the percentage of servitized manufacturing companies in a region, and KIBS companies as those that provided IT, engineering, or consulting services as their primary economic activity. *KIBS deepening* was thus measured as percentage of KIBS companies in a region. Table 1 summarizes the key percentages, providing descriptive statistics of the firms and variables in the study.

PLEASE INSERT TABLE 1 ABOUT HERE

Other relevant variables

Data for additional independent variables came from Eurostat. This dataset offers detailed regional data suited to analysing cohesion policies within the EU. The data obtained helped to monitor €352 billion in EU funding—nearly one third of the total budget allocated for 2014-20. Regional variance in business formation rates is usually controlled using time, economic growth and unemployment rates (Reynolds et al., 2007). Eurostat also measures the other variables relevant to our empirical analysis: a) maritime and air transport of freight (in thousands of tonnes), and b) patents (counted by the years in which they were filed at the European Patent Office). We include regional gross domestic product as the control variable in this study, since only one control condition is required for the case of a single exogenous variable.

Assesing territorial servitization

Territorial servitization has recently been depicted as territorial development based on synergetic co-location between manufacturing Small-Medium Enterprises (SMEs) and KIBS companies (Lafuente et al., 2017). KIBS companies increase the competitive positions of manufacturers when they develop advanced services (Bustinzá et al., 2017a). Both European policymakers' attention (European Commission, 2012) and the interest of the bodies governing regional development (Keating & Wilson, 2014) are driven by the economic relevance of KIBS companies. To assess the economic relevance of KIBS companies and their impact on the fabric of regional manufacturing, we considered KIBS deepening as a driver of territorial servitization. The main challenge with this variable was its endogeneity to the model due to a potential problem of reverse causality between the dependent and independent variables

(Greene, 2012). Recent research by Lafuente et al. (2017) finds both that higher numbers of KIBS companies attract more manufacturers and that manufacturers are magnets for KIBS companies. To resolve this problem, we proposed a 2SLS model (Greene, 2012). Equation 1 represents a model in which territorial servitization is explained by quantity of air and maritime freight received, patents and concentration of KIBS in a region. This last variable was estimated in the first stage of analysis by number of manufacturing businesses in the region. The subscript i identifies each region, the subscript t the time period, and e_{it} the error term:

$$\begin{aligned} \text{Territorial servitization}_{it} = & b_0 + b_1 \text{KIBS/total businesses}_{it} + b_2 \text{Total freights}_{it} + \\ & b_3 \text{patents} + b_4 \text{Control variables}_{it} + b_5 T_t + h_i + e_{it} \quad (1) \end{aligned}$$

where:

$$\begin{aligned} \text{KIBS/total businesses}_{it} = & \\ = & d_0 + d_1 \text{Manufacturing businesses}_{it} + d_2 \text{Control variables}_{it} \\ & + d_3 T_t + h_i + e_{it} \end{aligned}$$

Descriptive analysis

We consider the evolution of territorial servitization in various Spanish and German regions from 2010 to 2014. Territorial servitization was significantly higher in Germany than in Spain (10% vs. 4%), but there was a tendency toward convergence during the period analysed. While Germany showed a slow decrease in territorial servitization levels, Spain's levels showed a gradual increase.

Figures 2a and 2b divide the various German and Spanish regions by evolution of territorial servitization and KIBS deepening. Interestingly, these figures present regional evolution as an average, providing an average annual measure of territorial

servitization and KIBS activity between 2010 and 2014, with increase in some regions and decrease in others. The details by country for 2014 locate Germany's highest percentage of servitized manufacturers in Bremen (44.4%, against a German average of 9.8%), and highest percentage of KIBS activity in Mittelfranken (17.9%, against a German average of 3.9%). These regions have previously been distinguished for having unusually high concentrations of economic activity in their largest cities (Nitsch, 2000). As to Spain, Navarre showed the highest percentage of servitization of manufacturing companies (9.5%, against a national average of 3.9%), while Madrid had the highest percentage of KIBS activity (62.5%, against a national average of 35.33%). This result is consistent with previous research on Spain, which emphasizes the strength of Navarre and Madrid as leaders in innovation (Gonzalez-Pernia et al., 2012). The data clearly show that product-service innovation developed mainly in-house in Germany and was distributed homogeneously throughout all regions. In Spain, in contrast, product-service innovation developed primarily in partnership with KIBS that were heterogeneously distributed across specific regions. Still, the highest levels of territorial servitization occur in Bremen and Navarre, regions characterized by having the highest geographical proximity between innovation and production networks. These results provide further confirmation of recent general developments in servitization research (Aquilante et al., 2017) and with specific analyses of these two regions (Gonzalez-Pernia et al., 2012; Koch & Stahlecker, 2006).

PLEASE INSERT FIGURE 2a ABOUT HERE

PLEASE INSERT FIGURE 2b ABOUT HERE

RESULTS

The results obtained after running Equation (1) are shown in Table 2. The question considers two-stage least squares (2SLS) estimators following Huber and White's robust standard errors estimation. This estimation is useful when the independent variable (KIBS deepening) is theoretically endogenous to the independent one (territorial servitization). In the first step, KIBS deepening is estimated by means of a control variable (industry size). This KIBS deepening estimation is introduced in the second step to estimate territorial servitization, excluding industry size as control variable.

PLEASE INSERT TABLE 2 ABOUT HERE

Since the variable patents was missing some values, we estimated two models. One model included freight and KIBS deepening (columns 1 and 2) and the other the information on patents in addition to freight and KIBS (columns 3 and 4). The results presented in Table 2 (columns 1 and 3) indicate a consistently positive relationship between KIBS deepening and freight with territorial servitization. The third column shows a positive relationship in which patents decrease marginal returns between patents and territorial servitization.

If we develop the connection between these results and our hypotheses in greater detail, territorial servitization—in terms of market size and economic activity—is significantly higher in KIBS deepening regions ($b_1 = 0.27$; $p - value < 0.05$), supporting Hypothesis 1. According to our estimation, *ceteris paribus*, an increase of 1% in KIBS deepening would produce an increase of 0.27% in territorial servitization.

Hypothesis 2 proposed that freight—air and maritime transport—has a positive effect on territorial servitization. The results for this parameter ($b_2 = 0.005$; $p - value < 0.05$) support this Hypothesis 2. Since the variable freight is transformed into logarithms, the parameter can be interpreted as elasticity. According to the estimation in

column 1, therefore, an increase of 1% in maritime and air freight would cause an increase of 0.0047% in territorial servitization.

Hypothesis 3a argued that higher territorial servitization is achieved through an increase in patents. When we tested this linear relationship, the results (available upon request) were not statistically significant. The figures reported in column 3 show, however, a quadratic (inverse U-shaped) relationship between patents and territorial servitization. The results of the parameter estimation were ($b_3 = 0.0640$; $p - value < 0.05$) $b_{31} = -0.0047$; $p - value < 0.05$. Using these parameters, we can calculate that maximum territorial servitization is achieved when the logarithm of patents equals 6.88 ($=0.064/0.0047*2$), or patents equals $e^{6.88} = 792$ —that is, within the 90th percentile in the sample distribution. Thus, only 10% of the observations fall within percentile range that predicts a negative relationship between patents and territorial servitization.

We interpret this result to indicate that patents show decreasing returns. That is, each additional patent registered in a given region-year vector provides a smaller benefit to the region in terms of territorial servitization. Our evidence thus seems to support Hypothesis 3a (since nearly all regions' patents increase territorial servitization) and 3b (since patents exhibit decreasing returns). Therefore, whereas regions with a relatively low number of patents should develop policies to encourage patent registration as a means to enhance territorial servitization, regions with a relatively high number of patents should ensure they can maintain the number of patents registered.

DISCUSSION AND CONCLUSIONS

The main aim of this paper was to examine the key antecedents and implications of territorial servitization in two different central European and Mediterranean regions, regions also constituting two of the most important economies of Western Europe, Spain and Germany. The extensive research on servitization—as well as concepts

related to it, such as product-service systems (Baines & Lightfoot, 2013) and product-service innovation (Bustinza et al., 2017a)—currently adopts an internal organizational perspective. Relatively few studies have examined servitization impact at meso-level (Lafuente et al., 2017). Our study sheds light on the regional impact of the levels of KIBS deepening, trade, and accumulated knowledge and innovation resulting from territorial servitization. This paper contributes to the field of servitization processes (Baines et al., 2017), the role of KIBS in territorial development (Lafuente et al., 2017) and economic geography as it explains manufacturer-KIBS interactions to create a regional context of common knowledge (Howells, 2002).

This research contributes to the field primarily by developing critical measures that determine territorial servitization. Firstly, KIBS deepening, a density variable that measures the percentage of KIBS companies operating in a specific region and year, is closely related to territorial servitization. Hypothesis 1 is supported, meaning that an increasing number of KIBS in a region has a positive effect on servitization of companies. This finding is in line with those of Marshall (1890), who predicted the generation of economies of scale through the complementary and synergetic interaction of closely located companies—in the case of this study, between manufacturing and KIBS companies. Our findings also support the logic of Becattini (1990) and Baines et al. (2017), which favours close relationships between manufacturing and service companies to overcome the cost disadvantages that manufacturers suffer for their usual large-scale mono-productive models. Since value addition is important for manufacturing companies to compete and develop innovative solutions for customers, the role of KIBS becomes extremely important in providing value. Adding knowledge-enabled services to manufacturing companies (Cusumano et al., 2015; UNCTAD, 2015) can provide customers with hybrid solutions (e.g., Ulaga & Reinartz, 2011). Our

findings highlight the importance of geographical proximity between innovation and production networks, supporting previous studies on regional development (Koch & Stahlecker, 2006). The results also favour, however, the logic of close relationships between manufacturing and KIBS companies, explaining how degree and type of collaboration could influence the outcome of such collaborative arrangements. Future studies should thus investigate how the level, type and number of collaborative arrangements between manufacturing firms and KIBS companies impacts the degree of territorial servitization. Although our study corroborates Lafuente et al. (2017), who argue that the existence of local KIBS companies is one condition of a strong manufacturing region, future research should attempt to determine which factors are conducive to poor industry conditions for KIBS companies, ultimately jeopardizing the success of manufacturing firms.

Secondly, exposure to trade—measured as quantity of freight—also has a positive influence on territorial servitization, supporting Hypothesis 2. This finding corroborates previous research on the determinants of territorial servitization (Lafuente et al., 2017), while extending the analysis to different regional economic contexts—i.e., central European and Mediterranean regions located in Germany and Spain. These countries have different decision structures and investment costs (greater sharing in Germany, greater dispersal in Spain) (Bürzel, 1999). This finding opens an interesting avenue for future research to clarify both the outcomes of EU funding decisions aimed at achieving greater cohesion between regions (Charron, 2016) and the contextual effect of territorial servitization in a specific region, for example, a developing one.

Thirdly, territorial servitization is positively related to accumulative knowledge—measured by number of patents. Hypothesis 3 is supported, and the results reinforce those of previous studies on the positive effect of knowledge accumulation on

regional development in a specific industry (Aranguren et al., 2014; Boix & Vaillant, 2010). Our study extends these results to different industries—manufacturing and KIBS companies. Accumulated knowledge thus leverages the positive effect of complementary industries’ interconnectedness, ultimately promoting territorial servitization. Our investigation has novel implications for understanding territorial servitization. Our finding that accumulated knowledge yields decreasing returns—an inverted U-shape function—constitutes an original contribution in demonstrating the importance of considering learning curves and returns to scale in territorial servitization. This finding reinforces those of previous studies arguing that learning effects and returns to scale are critical issues when implementing any technological regional policy (Isoard & Soria, 2001).

This research has implications for policymakers. On the one hand, it presents an opportunity for a European *manufacturing renaissance* grounded in the dynamics of manufacturing, based on innovation and differentiation (De Propris, 2016) rather than on pure cost, to prevent manufacturers from relocating to countries with lower costs. This renaissance should be based on upgrading innovative manufacturing competencies, an underlying characteristic of servitization (Baines & Lightfoot, 2013). This research also shows that policymakers must consider regional autonomy and cost allocation in their decisions if they are to achieve the outcomes desired.

For manufacturing and KIBS companies, our study supports previous findings that support collaboration between SMEs and local KIBS companies as a way to develop the economies of scale needed to enable them to compete with larger manufacturing companies. Large manufacturers tend to develop product-service innovation in house (Bustinza et al., 2107a). Policymakers must thus stimulate collaboration between SMEs and local KIBS companies by providing R&D and

innovation-related incentives to interacting and collaborating companies. Our findings indicate the possibility that decreasing returns on patents registered in a region could coincide with territorial servitization. The resulting implications for policymakers are that regions with relatively low numbers of patents must develop patent support policies to enhance territorial servitization, whereas regions with relatively high numbers of patents must maintain the optimal number of patents registered to facilitate and benefit from territorial servitization. Lastly, policymakers must strengthen industrial strategy by encouraging SMEs to co-locate with KIBS companies and provide specialized regional knowledge by establishing training and learning institutions to facilitate sharing and co-development of knowledge between SMEs and KIBS companies.

This analysis is limited to regions from only two countries, based on the premise of differences in the autonomy levels of policy decision-making. Other formal and informal institutional variables such as regulations, trust and informal ties should be considered to complement the determinants of territorial servitization. This approach could combine network-related variables such as strong versus weak ties, social embeddedness, and structural, cognitive and relational capital, as well as how these variables influence the interaction between KIBS companies and territorial servitization. Moreover, this analysis considers KIBS deepening from the increasing number of KIBS companies per region. Future research could follow a different line by considering regions with high numbers of KIBS companies as attracting specific functions developed by manufacturing companies. Such an approach would enable analysis of territorial servitization from a different regional development perspective. There is also room to examine the open service innovation model developed through collaboration between SMEs and KIBS companies, and the effect of information technologies based on the ability of employees from remote locations to work in, and even increase,

knowledge spillovers despite non-collocation. Such an approach would open a debate on whether the need to collocate would decrease due to the “non-collocality” of many services. Future studies could adopt a longitudinal approach to measuring performance differences between large and small/medium-sized servitizing manufacturing companies in terms of their make-or-buy decisions. Lastly, as the measures used in this study introduce some inherent limitations, future studies may need to develop finer-grained direct measures instead of relying on ORBIS measures.

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Appendix

Tables and Figures

Table 1. Descriptive statistics.

	2010	2011	2012	2013	2014
<i>Panel A: Spain (17 regions)</i>					
<i>Manufacturers (%)</i>	10.35%	10.29%	10.21%	9.83%	9.71%
<i>Territorial Servitization (%)</i>	3.65%	3.73%	3.81%	4.02%	3.89%
<i>KIBS deepening (KIBS / total businesses) (%)</i>	46.92%	47.05%	46.74%	45.66%	45.33%
<i>Total freights transported (#)</i>	21,636	23,271	24,320	23,075	23,764
<i>Patents (#)</i>	87.84	85.82	74.81	76.22	78.92
<i>Panel B: Germany (38 regions)</i>					
<i>Manufacturers (%)</i>	20.64%	20.52%	20.59%	19.14%	19.01%
<i>Territorial Servitization (%)</i>	9.93%	10.08%	10.08%	9.85%	9.79%
<i>KIBS deepening (KIBS / total businesses) (%)</i>	3.71%	3.78%	3.80%	3.44%	3.91%
<i>Total freights transported (#)</i>	7,177	7,715	7,793	7,892	8,012
<i>Patents (#)</i>	609.62	597.13	483.70	497.82	502.11
<i>Panel C: Total (55 regions)</i>					
<i>Manufacturers (%)</i>	17.46%	17.36%	17.38%	16.26%	16.14%
<i>Territorial Servitization (%)</i>	7.99%	8.12%	8.14%	8.05%	7.97%
<i>KIBS deepening (KIBS / total businesses) (%)</i>	17.07%	17.15%	17.07%	16.49%	16.71%
<i>Total freights transported (#)</i>	11,646	12,523	12,901	12,585	12,881
<i>Patents (#)</i>	448.34	439.09	357.32	367.51	371.31

Table 2. 2SLS regression results: Territorial servitization

	<i>Full sample</i>		<i>Sub-sample with patents information</i>	
	Territorial servitization	KIBS deepening (KIBS / total businesses)	Territorial servitization	KIBS deepening (KIBS / total businesses)
<i>KIBS deepening (KIBS / total businesses)</i>	0.2665 (0.1361)** <i>p-value = 0.049</i>		0.5324 (0.02381)** <i>p-value = 0.026</i>	
<i>Industry size (ln number of manufacturers)</i>		0.0251 (0.0057)*** <i>p-value = 0.000</i>		0.0250 (0.0065)*** <i>p-value 0.000</i>
<i>Total freights transported (ln)</i>	0.0047 (0.0014)*** <i>p-value = 0.001</i>		0.0051 (0.0019)*** <i>p-value 0.010</i>	
<i>Market size (ln total businesses)</i>	-0.0264 (0.0086)*** <i>p-value = 0.002</i>		-0.0559 (0.0264)** <i>p-value 0.035</i>	
<i>Patents (ln)</i>			0.0640 (0.0282)** <i>p-value 0.024</i>	
<i>Patents squared (ln)</i>			-0.0047 (0.0022)** <i>p-value 0.039</i>	
<i>Country servitization level</i>	2.5811 (0.4387)*** <i>p-value = 0.000</i>	-2.4602 (0.2475)*** <i>p-value = 0.000</i>	2.6817 (0.5272)*** <i>p-value = 0.000</i>	-2.4488 (0.2670)*** <i>p-value 0.000</i>
<i>GDP growth</i>	0.0018 (0.0076) <i>p-value = 0.810</i>	0.0173 (0.0073)** <i>p-value = 0.017</i>	-0.0063 (0.0091) <i>p-value = 0.485</i>	0.0210 (0.0080)*** <i>p-value 0.009</i>
<i>Time dummies</i>	Yes	Yes	Yes	Yes
<i>Intercept</i>	-0.0324 (0.0396) <i>p-value = 0.438</i>	0.2577 (0.0309)*** <i>p-value = 0.000</i>	-0.1280 (0.0685)* <i>p-value = 0.063</i>	0.2601 (0.0335)*** <i>p-value 0.000</i>
<i>F-test</i>	11.45***	20.82***	7.46***	19.24***
<i>R2 (overall)</i>	0.2967	0.3775	0.2493	0.3799
<i>RMSE</i>	0.0769	0.0757	0.0797	0.0753
<i>Observations</i>	216	216	162	162

Figure 1. Model of relationships and hypothesis.

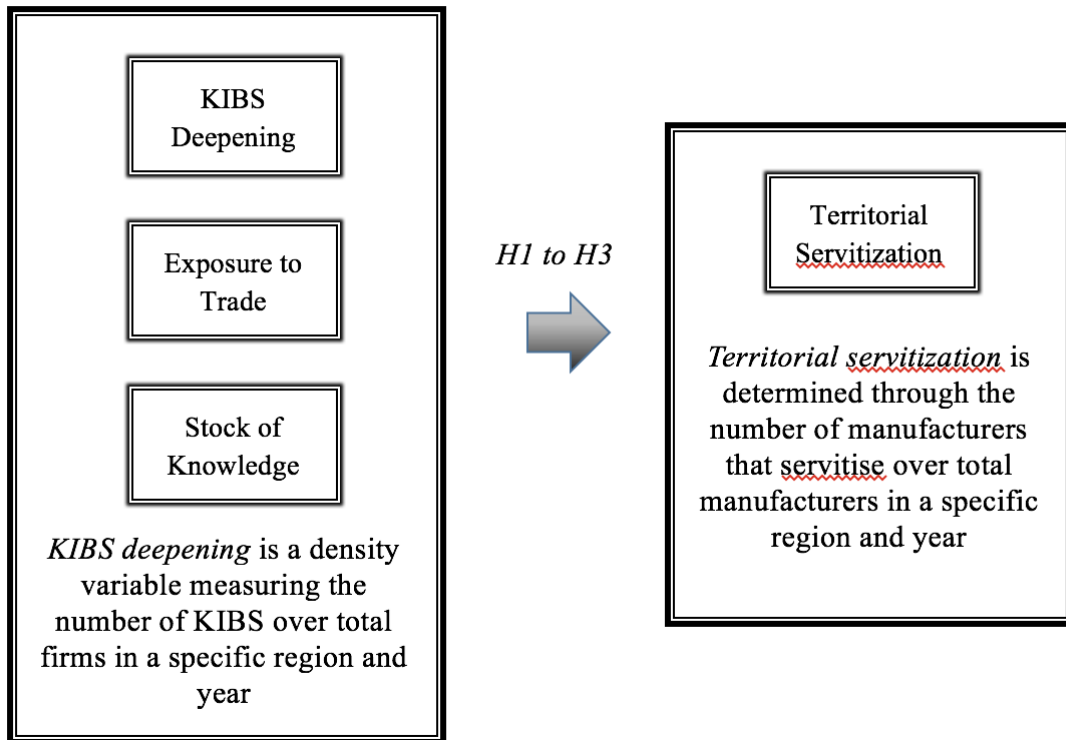
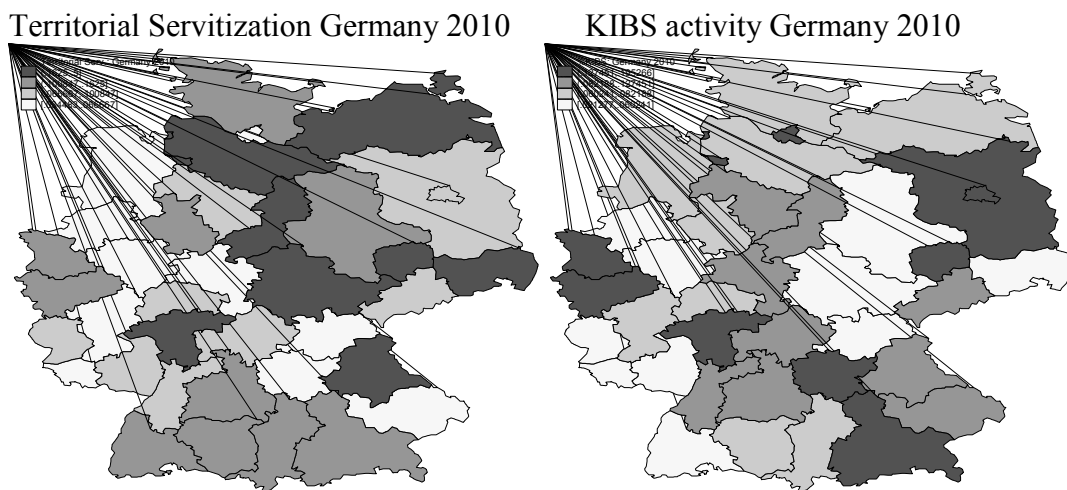
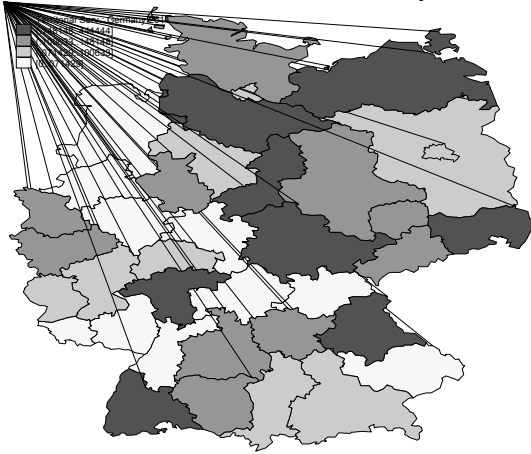


Figure 2a. Evolution of territorial servitization and KIBS activity in NUTS 2 German regions



Territorial Servitization Germany 2014



KIBS activity Germany 2014

