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Vendrell-Herrero, Ferran; Bustinza, Oscar F.

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2 Servitization in Europe

Ferran Vendrell-Herrero and Oscar F. Bustinza

2.1 Introduction: motivation, definitions and research objectives

As a result of a reduction in transport costs, a rise in offshoring of European and US production to developing economies in the 1990s changed the way the global economy was conceptualized during the twentieth century (Krugman and Venables, 1995). Countries like China, India, Turkey and Mexico benefited from production offshoring and other foreign direct investments from Western economies, significantly improving their manufacturing industry. Over the years, these countries have become increasingly competitive and could threaten the manufacturing leadership of Europe and the US as the latter functioned during the twentieth century (Baldwin, 2016).

Advanced economies are characterized by high wages, high skills and high disposable income. Business models that focus on the exploitation of economies of scale thus became obsolete for European manufacturers at the turn of the twenty-first century. With the rapid rise of Asia's global production, firms in advanced economies must increase customization while maintaining high levels of scalability and efficiency in order to develop and maintain a competitive advantage. New competitive conditions require a better understanding of what drivers and bottlenecks can enable manufacturing sectors to transition to more innovation-intensive and difficult-to-imitate business models. One way of sustaining the competitive advantage of these sectors in the medium and longer term is through bundling products and services and/or through digital upgrading of product features (Porter and Heppelman, 2014). This chapter endeavours to better understand and to quantify the use of these business models in Europe.

Product and service firms have conventionally been thought of as largely independent entities. Evidence suggests, however, that potential synergies between products and services could ultimately enhance consumer satisfaction. The business strategy of bundling products and services in manufacturing sectors is known as the *servitization* of manufacturing (Bustinza, Vendrell-Herrero and Baines, 2017). In servitization, production firms attempt to enhance product features and capabilities, as well as consumer satisfaction, and

to increase product differentiation by including services that support product capabilities during the product's entire life cycle in their business portfolio. By incorporating services as an integral part of the product to be sold, firms gain more customizable offerings. The services provided are not homogeneous; they differ substantially in their levels of risk and competition, and their potential to create competitive advantages. Some manufacturers create wealth by offering a wide range of 'break-fix' services (e.g., maintenance), while others develop more sophisticated outcome-based contracts (Visnjic, Neely and Jovanovic, 2018). Successful examples of the latter include Rolls-Royce's TotalCare solution and Xerox's delivering 'pay-per-click' scanning, copying and printing of documents.

In Europe, the rise of servitization is evidence of a business environment that has significantly dented the weight of manufacturing's contribution to GDP. The European manufacturing industry has been in relative decline for the last 30 years and has recently reached an all-time minimum of 15% of total GDP, a share that the European Commission has been committed to raise to 20% as part of its 2020 Agenda (Veugelers, 2013). European initiatives have also been devoted to promoting servitization across manufacturing firms (Hojnik, 2016). Despite this growing interest, no research as yet grounds how to map the heterogeneities in servitization activity across Europe (Lafuente, Vaillant and Vendrell-Herrero, 2018).

One stream of research does, however, focus on the territorial aspect of servitization (Vendrell-Herrero and Wilson, 2017). This research underscores the importance of the Knowledge-Intensive Business Services (KIBS) sector (Horvath and Rabetino, 2018; Seclen-Luna and Barrutia-Güenaga, 2018) and provides some isolated pictures of servitization activity in Europe (Crozet and Millet, 2017; Gomes et al., 2018; Sforzi and Boix, 2018). This research stream focuses on secondary datasets and thus considers a large and broad set of representative firms. A summary of these methods is given in Table 2.1.

Crozet and Millet (2017) use data from the French fiscal authority to differentiate between sales from products and sales from services. These authors visualize that 70% of French manufacturers are servitized, but their method suffers from two limitations. Firstly, the sample can be neither extrapolated (data from different fiscal authorities might not be comparable) nor scalable (data are confidential; no repositories exist to merge data from various countries). Secondly, the data could over-represent servitization, as they account for all types of services (basic as well as advanced) and do not consider the option of bundling products and services.

The figures obtained by Gomes et al. (2018) and Sforzi and Boix (2018) are considerably more pessimistic, although their methods are scalable to all EU-28 countries and consider only knowledge-based (advanced) services. Both articles use ORBIS, a Bureau van Dijk (BvD) service that provides firms' balance sheet statements and covers a wide spectrum of countries. The method used by Sforzi and Boix (2018) focuses on searching keywords in the description of the business. By examining firms located in specifically industrial districts

Table 2.1 Measuring servitization using secondary sources

Method	*Source*	*Articles*	*Range*	*Advantages/limitations*
Identifies product firms with positive service sales	Compustat	Suarez, Cusumano and Kahl (2013)	42% (US)	Does not include firms selling bundles of products and services. Inflated by multi-sector firms. The method is rich for firm-level analysis but not scalable or extrapolable to other territories Intensive and extensive margins of servitization.
	Fiscal Authorities and Central Banks	Crozet and Millet (2017)	70% (France)	
		Ariu (2016)	8% (Belgium)	
Identifies product firms with service business in their description*	BvD (any)	Neely (2008)	10–60%#	Depends largely on the firm's description. Only extensive margin of servitization
		Sforzi and Boix (2018)	3.4% (Italy) and 5.7% (Spain)	
Identifies product firms with a secondary service sector**	BvD (ORBIS)	Gomes et al. (2018)	3.9% (Spain) and 9.8% (Germany)	Secondary sectors are not compulsory to declare, so it is difficult to build a firm-level control sample. Only extensive margin of servitization. The information is highly reliable when it comes to representing territories.
		Opazo et al. (2018)	n.a.##	
		Sforzi and Boix (2018)	3.6% (Spain)	

Notes:

* Usual keywords for knowledge-based services: research, development, scientific, advertising, design, software, programming, consultancy, streaming, engineering, leasing, usage, creative, intermediation and brokerage.

** Commonly used secondary NAICS codes for knowledge-based services: 518 'Data Processing, Hosting, and Related Services'; 519 'Other Information Services'; 54 'Professional, Scientific, and Technical Services'; 56 'Administrative and Support and Waste Management and Remediation Services'; and 811 'Repair and Maintenance'.

\# The study has a large number of countries.

\## The study does not have a control sample of non-servitized firms.

for 2011, the authors conclude that 5.7% of Spanish manufacturing firms and 3.4% of Italian manufacturing firms are servitized. Gomes et al. (2018) delve more deeply into ORBIS, exploiting the full capacity of the sample by identifying the firms' secondary sector. This method enables identification of firms with manufacturing as the primary industry and knowledge-based services as a secondary industry. In comparing Germany and Spain, Gomes et al.'s (2018) study obtains figures in the same range as Sforzi and Boix (2018). For 2014, they find that 3.89% and 9.79% of product firms are servitized in Spain and Germany, respectively. Conceptually and methodologically, this method seems superior to the others. Our chapter thus aims to estimate current servitization activity for all EU-28 countries with the methodology proposed by Gomes et al. (2018), thereby making an important academic contribution to the literature.

Beyond mapping servitization in Europe, another objective of this study is to depict what inputs drive servitization activities in a given country. We focus on the role of two inputs: manufacturing and digital territorial capabilities. By collecting reliable information on these constructs from the World Bank (manufacturing) and Eurostat (digital exposure), we test three important postulates, two of them bivariate relationships and the third testing multivariate and joint effects.

The first question we attempt to answer is how the manufacturing fabric in a country relates to the percentage of product firms implementing service business models in the same territory. For the case of Spanish autonomous communities, Lafuente, Vaillant and Vendrell-Herrero (2017) identify a virtuous circle of KIBS activity and employment growth in manufacturing sectors. Similarly, for a sample of 121 European regions, Horváth and Rabetino (2018) find that a solid industrial fabric correlates highly with the development of entrepreneurial projects based on the implementation of knowledge-based services. This research stream seems to indicate a positive link between manufacturing and servitization activities at the country level, but this relationship has not yet been explicitly tested. We help to fill this knowledge gap by representing graphically the correlation between these variables and considering the level of economic development as a moderator of this relationship.

Our second goal is to determine whether a direct relationship exists between digitization and servitization activities. Since digital upgrading and smart products are key elements for servitization, these variables are clearly linked at the firm level (Coreynen, Matthyssens and van Bockhaven, 2017; Vendrell-Herrero et al., 2017a). No empirical studies have demonstrated this relationship with a spatial analysis, although the theory of digital dark matter has been proposed (Greenstein and Nagle, 2014; Vendrell-Herrero et al., 2017b). This theory suggests that digitization activity correlates positively with servitization activity at the country level, since more digital infrastructure increases the capacity of businesses and customers in the region to develop more complex business models. We test this suggestion by picturing the digitization–servitization link

and considering economic development as a moderating variable. Our final exercise evaluates graphically and through simple regression analysis whether the industrial fabric and digital infrastructure should be seen as substitutes for each other or as complementary.

The following sections provide more details on the data and measurement of the different concepts used, including their geographical mapping. The relationships explained above are then tested. Subsequently, the results and provides various policy recommendations are discussed.

2.2 Mapping servitization across the EU-28: sources, data and variables

To analyse the European geography of servitization activity, as well as this activity's correlation with other country-level variables, we construct a unique database. The data are drawn from multiple sources, including ORBIS (BvD), the World Bank and Eurostat. The sample focuses on the 28-country European Union (including the UK) and collects information for the most recent year available for each variable considered.[1]

As discussed in the previous section and in Table 2.1, there are various ways to compute a country-level measure of servitization activity through secondary databases. We understand the best approach to be that followed by Gomes et al. (2018) and Opazo, Vendrell-Herrero and Bustinza (2018). This approach consists of identifying the percentage of manufacturing firms with a secondary sector in the knowledge-based service sector.[2]

We cleaned the data to ensure comparability between the different countries. After downloading the data from ORBIS for 2017, we identified outliers that required correction. The outliers were three countries with very low values and three countries with extremely high values. The countries at the bottom of the group were Estonia, Malta and Italy, with a percentage of servitized manufacturers of 1% or lower. The countries at the top were Hungary, Slovakia and the Czech Republic, with over 35% servitization,[3] exactly double that of the next-lowest country, Belgium (18%). The figures for all six of these countries were adjusted following the quartile imputation technique (Muñoz and Rueda, 2009). We imputed the average of the bottom quartile (1.97%) to the three countries at the bottom and the average of the top quartile (10.34%) to the three countries at the top.

Figure 2.1 maps the servitization activity in Europe. To simplify the visual analysis, the variable is divided into quartiles. Countries with the highest servitization activity include some of the usual suspects and reflect the apparent concentration of servitization in central Europe. These countries include the Benelux countries, Germany, Hungary Slovakia and the Czech Republic. The top three countries are Belgium (18.5%), Germany (12%) and the Netherlands (11%). The second quartile includes countries with 4.7–9% servitized manufacturers – very rich countries such as Austria (6.5%) and Sweden (5.5%), and relatively poor ones such as Greece (5.5%) and Bulgaria (4.8%). The third

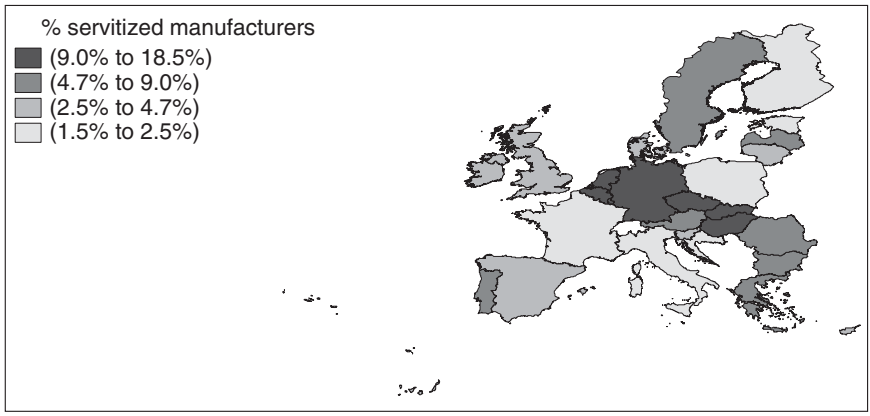

Figure 2.1 Mapping servitization intensity, EU-28.

quartile includes Spain (4.2%), Ireland (3%), the UK (3.1%) and Denmark (3.7%), and the bottom quartile countries like France (2%) and Finland (1.6%).

This study approximates the manufacturing activity of a country as the manufacturing value added as a percentage of GDP. The literature widely accepts this measure as a way to understand the manufacturing strength of an economy (Aquilante, Bustinza and Vendrell-Herrero, 2016; Haraguchi, Cheng and Smeets, 2017). The data were obtained from the World Bank's open data (https://data.worldbank.org/indicator/NV.IND.MANF.ZS) and are from 2016, which is the most recent year available.

Figure 2.2 maps the manufacturing activity in Europe, dividing the data in this figure into quartiles. The manufacturing industry in the countries in the top quartile generates 20–35% of the GDP. Among these countries we find Ireland (35%), the Czech Republic (27%), Hungary (24%) and Germany (23%). The second quartile represents countries with manufacturing value added representing 15–20% of GDP. This category includes countries such as Italy (16%), Finland (17%), Austria (18%) and Poland (20%). Countries with manufacturing value added of 12–15% of GDP compose the third quartile, exemplified by the Netherlands (12%), Spain (14%), Sweden (15%) and Denmark (15%). The bottom quartile contains countries with manufacturing value added of 5–12% of GDP. Surprisingly, countries with a long tradition in manufacturing, such as France (11%) and the UK (10%), are now at the bottom of the classification.

This study computes an economy's level of digitization using the Digital Economy and Society Index (DESI) provided by Eurostat (https://ec.europa.eu/digital-single-market/en/desi). DESI is a composite index that takes values between 0 and 1. It contains information from relevant indicators of country-level digital performance and infrastructure, providing information

Figure 2.2 Mapping manufacturing intensity, EU-28.

on connectivity, digital skills, the use of internet by citizens and businesses, availability of digitalized public services and development of the ICT sector. This index has been used in previous research that attempts to map the digital capabilities of European countries (Moroz, 2017). Here, we use the DESI for 2017, in which the maximum was 0.67 (Denmark) and the minimum 0.31 (Romania).

Figure 2.3 maps the DESI for the EU-28. The colours of the countries indicate the quartile to which other variables of interest belong. The DESI ranges from 0.56 to 0.67 for the leading group, which includes mostly Scandinavian countries (Sweden, Finland and Denmark lead, with very similar values), the Benelux countries (the Netherlands with 0.64, followed by Belgium with 0.58 and Luxembourg with 0.57) and the UK (0.58). The second quartile (0.51–0.56) is exemplified by German-speaking countries (Germany and Austria both have an index of 0.54) and Ireland (0.55). The third quartile countries, with a DESI of 0.41–0.51, are the Latin countries (Spain and Portugal with an index of 0.51, followed by France with 0.48). With the exception of Italy (0.38), the bottom quartile (0.31–0.41) is composed of EU emerging economies, including Romania (0.31), Bulgaria (0.35) and Poland (0.40).

2.3 Measuring servitization across the EU-28

Our first objective is to disentangle whether manufacturing and servitization are positively correlated, as implied by Lafuente, Vaillant and Vendrell-Herrero (2017), and Horváth and Rabetino (2018). Figure 2.4 shows the possible correlations between these variables for the full sample and three subsamples based on level of income.[4] Our results show a weak (not statistically

Figure 2.3 Mapping digitization intensity, EU-28.

significant) but positive correlation between servitization and manufacturing (0.091). Interestingly, this correlation is considerably stronger for low- and medium-income groups (0.414 and 0.649, respectively), and even statistically significant at 5% for medium-income groups. However, it is negative for the high-income group (-0.363). Our results thus show that income level moderates the relationship between manufacturing and servitization. Manufacturing drives servitization for relatively poor countries, but has the opposite effect once countries reach a certain income threshold. One explanation for this result is that the richest countries are less dependent on the manufacturing-installed base to deploy service business models. As these countries have more resources, they can obtain manufacturing knowledge from other business ecosystems.

Another consideration is whether digitalization drives servitization (Coreynen, Matthyssens and van Bockhaven, 2017; Greenstein and Nagle, 2014; Vendrell-Herrero et al., 2017b). We analyse this issue in Figure 2.5. The correlation of digitization and servitization is also weak, but slightly higher than that of manufacturing and servitization (0.115 vs. 0.091). In the case of digitization, however, the moderating effect of income groups is practically non-existent. Medium-income groups show essentially no correlation (0.002), and this correlation becomes moderately negative for low- and high-income groups (-0.121 and -0.372, respectively). None of these correlations is statistically significant.

Our bivariate analysis seems to reflect that servitization is not strongly linked to manufacturing and digitization. However, bivariate analysis is limited and introducing more correlates sometimes uncovers new relationships. To better evaluate the relationship between these variables, we undertake multivariate analysis.

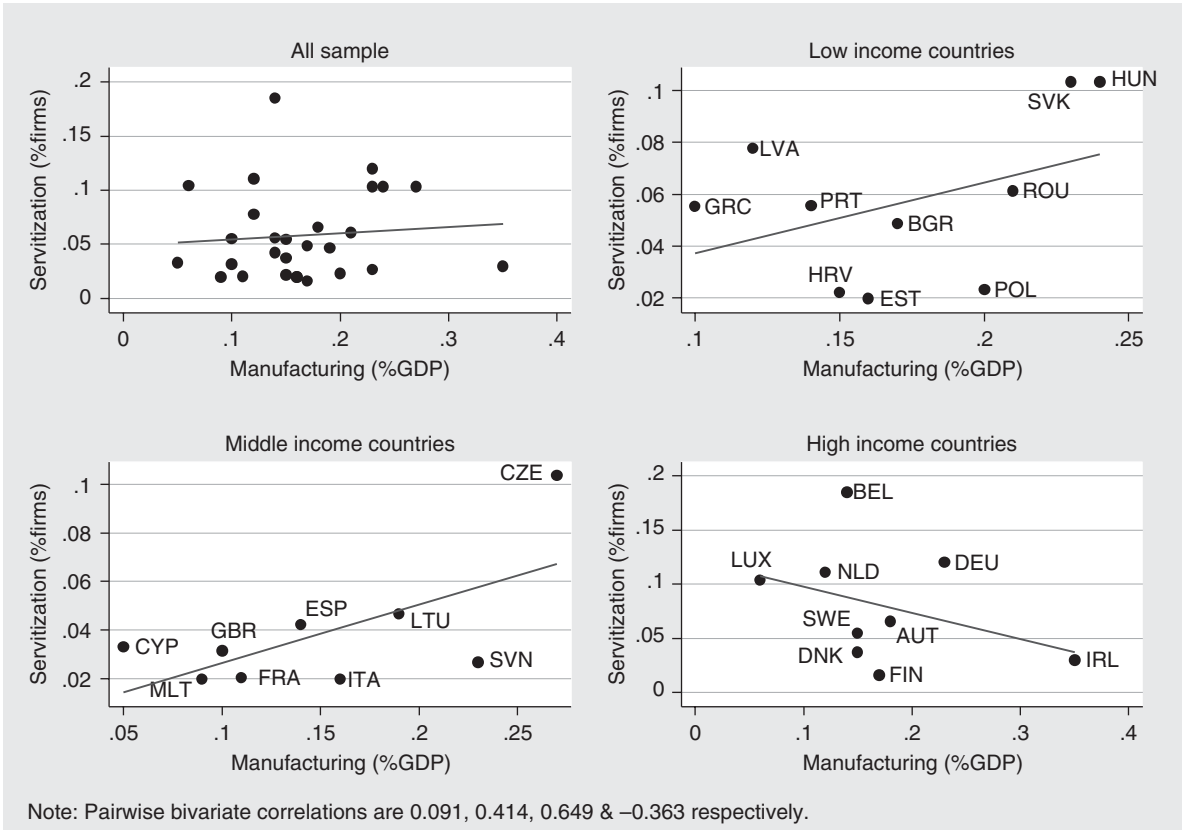

Figure 2.4 Manufacturing and servitization, by income groups.

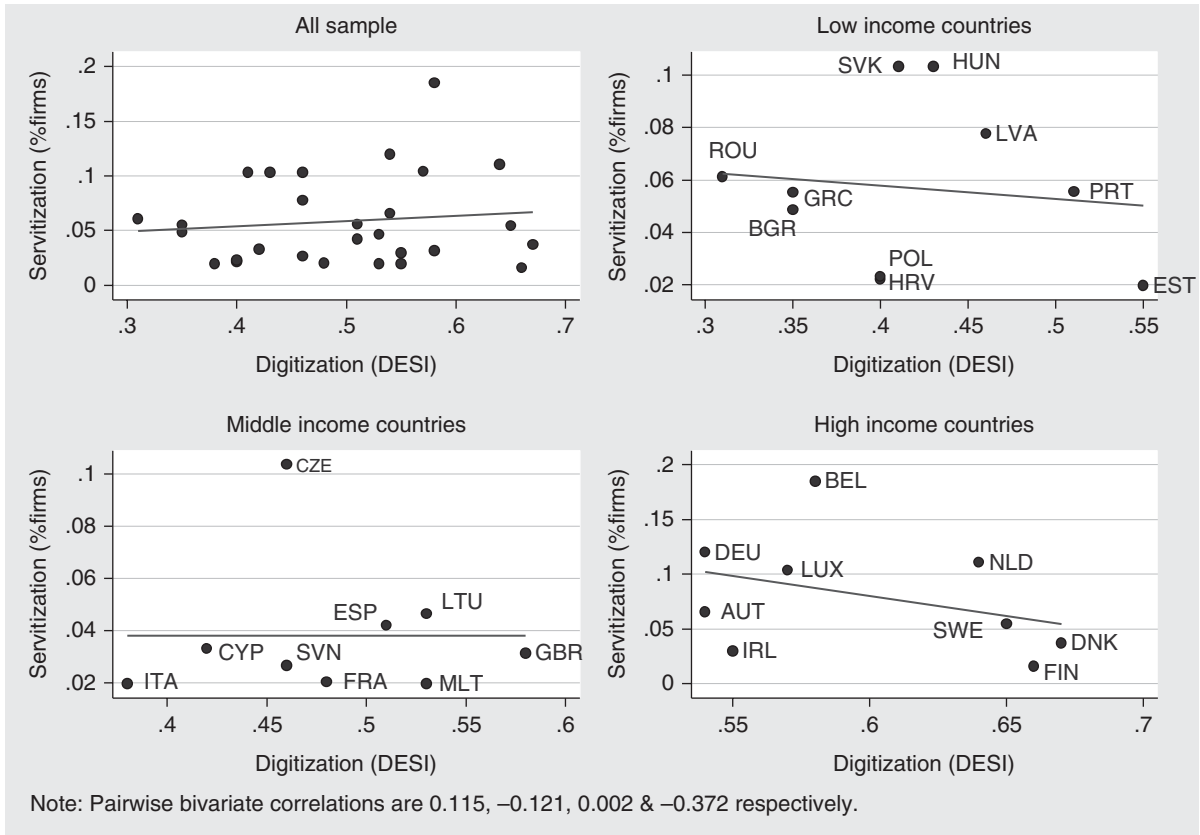

Figure 2.5 Digitization and servitization, by income groups.

The multivariate analysis proposed in this chapter has two phases. First, we attempt to explain graphically how manufacturing, digitization and servitization are interrelated. This analysis already shows some tendencies that require confirmation through statistical inference. In the second phase, we thus undertake regression analysis to confirm/reinforce the results obtained in the initial graphical analysis.

Graphical representation of three variables is complex. One method is to produce a scatter plot of two variables and represent the third by the size (or form or colour) of the marker. Figure 2.6 does precisely this. The horizontal and vertical axes show the DESI values and manufacturing value added as percentages of GDP, respectively. Panel A contains the information on distribution of the 28 EU countries in the scatter plot. One characteristic of this plot is that dotted lines represent the median values of manufacturing and digitization variables, roughly defining four quadrants. Countries positioned in the upper-right quadrant are characterized by relatively high manufacturing and high digitization (e.g., Ireland), whereas countries in the lower-left quadrant are characterized by low manufacturing and low digitization (e.g., Greece). The other quadrants present mixed options; the upper left identifying countries with high manufacturing and low digitization (e.g., Hungary), and the lower right countries with low manufacturing and high digitization (e.g., Belgium).

The size of the circles in Panel B (Figure 2.6) indicates the degree of servitization in the country. It is thus worth examining which quadrant has the largest markers. Theoretically, there are three answers to this question. First, synergetic effects could occur between manufacturing and digitization, making the quadrant with the largest circles the upper right. Secondly, manufacturing and digitization could be seen as substitutes for each other, making the quadrant with the largest circles one of the mixed solutions (upper left or lower right). Thirdly, manufacturing and digitization could exert a negative effect on servitization, making the quadrant with the largest circles the lower left. A visual analysis of Panel B suggests that the quadrants with the largest circles are the mixed solutions. This result implies that manufacturing and digitization are substitutes for each other and that policy makers should focus on stimulating only one of those inputs if the aim is to boost service business models across the industrial fabric. A complementary graphical analysis to show how the three variables are inter-related would use three-dimensional graphs. To this end, Figure 2.7 presents a 3D bar graph in which the lower axes represent a binary measure of manufacturing and digitization variables, and the upper (high) and lower (low) axes the median (Panel A in Figure 2.6). The vertical axis represents the average degree of servitization. This analysis shows even more clearly that mixed (low-high or high-low) combinations boost servitization activity.

As a final exercise, we conduct a regression analysis to validate the results obtained in the graphical analysis (Figures 2.6 and 2.7) through statistical inference. Table 2.2 reports the results of the regression analysis. The dependent

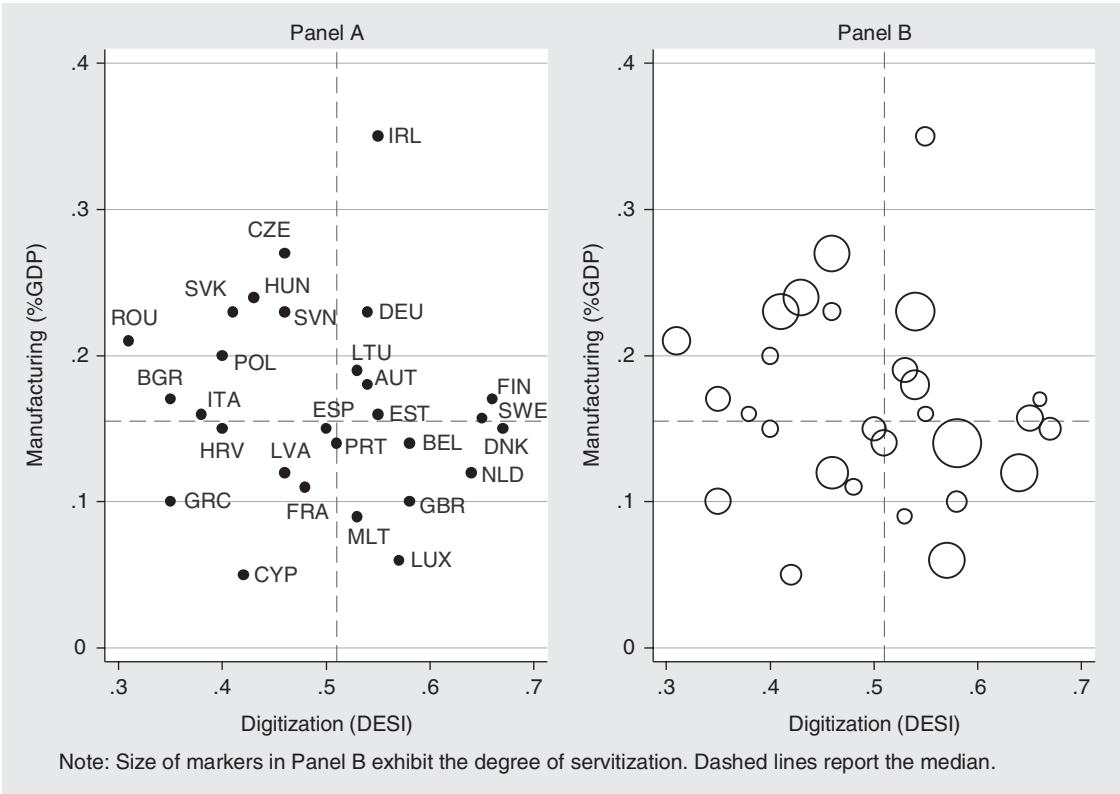

Figure 2.6 Digitization and manufacturing distribution.

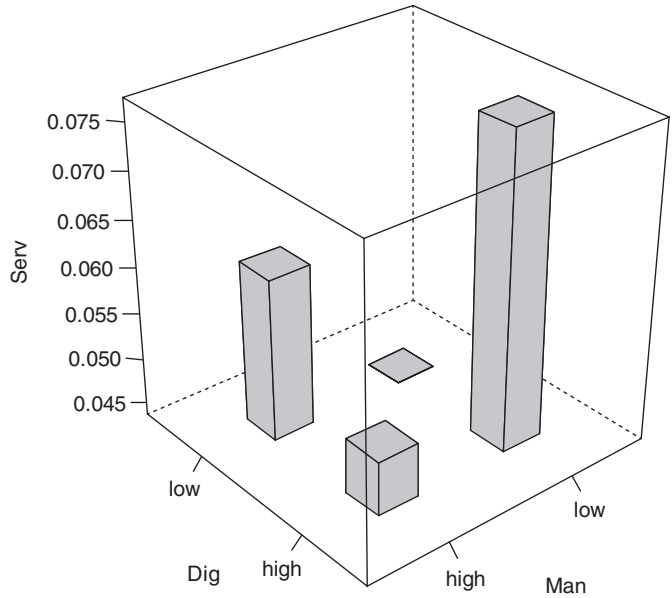

Figure 2.7 The relationship between digitization, manufacturing and servitization.

Table 2.2 Regression analysis

	(1)	*(2)*
[1] DESI	0.479**	0.451*
	(0.220)	(0.228)
[2] Manufacturing (% GDP)	1.395**	1.423**
	(0.618)	(0.603)
[1] * [2]	-2.669**	-2.804**
	(1.247)	(1.179)
Constant	-0.193*	-0.177
	(0.108)	(0.111)
Income group FE	NO	YES
N	28	28
R^2	0.114	0.159

Notes:
Robust standard errors in parentheses.
Dependent variable: % of manufacturing firms that are servitized.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

variable is servitization, and the independent variables are manufacturing value added as a percentage of GDP, the digitization index (DESI) and the interaction between these two variables. To control for income heterogeneity, we include income group fixed effects in column 2. The model's fit is good, as the R^2 ranges from 11% to 16%.

In both columns, the parameters of manufacturing and digitization are positive and statistically significant (at 5% in most cases). However, the combined effect captured by the interaction term is negative, indicating that increasing both variables (manufacturing and digitization) at the same time has damaging outcomes in terms of the servitization level.

So, the results of the regression analysis confirm that digitization and manufacturing in isolation are positive enablers for servitization, but our results suggest that combining both in the same territory can produce negative consequences in terms of servitization activity. Our graphical and regression analysis suggest that countries with a focus in developing a territorial servitization strategy should specialize in developing manufacturing strength or digital capabilities, but not both at the same time.

2.4 Discussion and conclusions

The implementation of services in the manufacturing industry (servitization) is an increasingly relevant topic. A consolidated academic community currently focuses on how these business models are deployed (Bustinza, Vendrell-Herrero and Baines, 2017) and what drivers and bottlenecks enable and hinder successful implementation of product-service innovation (Bustinza et al., 2018).

The literature also pays increasing attention to the territorial aspects of servitization (Lafuente, Vaillant and Vendrell-Herrero, 2017, 2018). More studies seek to determine how many manufacturers in a territory are servitized. This question is hard to answer because no formal registers are available to catalogue firms deploying these business models and secondary sources are not designed to collect direct information on servitization. Some research examines the data repositories of central banks or fiscal authorities to quantify indirectly the degree of servitization in specific countries (Ariu, 2016; Crozet and Millet, 2017), but this method is usually non-scalable, as it is nearly impossible to access this type of data for more than one country. Other studies use ORBIS (or other BvD data sources) to measure servitization activity (Gomes et al., 2018; Neely, 2008; Opazo, Vendrell-Herrero and Bustinza, 2018; Sforzi and Boix, 2018). Ours is the first research study to provide a cross-country comparison of servitization activity in the EU-28 – a major contribution to the literature.

The cross-country exercise is instructive. We learn that servitization activity seems to be concentrated in Central Europe, particularly in the Benelux countries, Germany, Hungary, Slovakia and the Czech Republic. According to

these results, servitization is led by neither the 'old European historical glories' (France, the UK, Spain and Italy) nor the Scandinavian countries. Our study is consistent with current research highlighting the economic emergence of the Visegrád Group (Piotrowicz, 2015; Prokop, Stejskal and Kuvíková, 2017) and the political and economic European leadership of Germany and the Benelux countries (Nurgent, 2017).

A second aim of this study is to identify what causes a country's level of servitization. As we operate with a small sample, our analysis contains three main regressors: income level; the degree of manufacturing; and digitization exposure. As these variables were extracted from very reliable sources, including Eurostat and the World Bank, our findings are relevant for industrial policy.

We find that the countries with the highest servitization specialize in either the industrial fabric or digitization infrastructure and that these inputs of servitization seem to be substitutes for each other. The only country that excels in servitization activity and has high degrees of both manufacturing and digitization exposure is Germany. The other leaders in servitization, such as Belgium and Hungary, specialize in either digitization or manufacturing, respectively.

Our results must be taken with caution. The measure of servitization used has several advantages, but also drawbacks. For instance, legislation governing firms of a certain size whose operations and sales are divided among different sectors is not homogeneous throughout Europe, and our method may produce some outliers. We have made an effort to avoid this problem by cleaning the database of this noise through the quartile imputation method, but the data collected are still subject to bias and criticism. With more homogeneity in future legislation, the method used here will become significantly more reliable. Another limitation of this research is its cross-sectional design. This design is intentional, since the primary aim of this chapter is to produce a preliminary mapping of servitization activity in Europe.

Our goal is to pave the way for future studies of territorial servitization that uncover the geographical composition of servitization inside and outside European boundaries. To this end, we designed a benchmark methodological context as the basis for future longitudinal work, seeking to estimate not only the degree of servitization activity at the country level, but also its rate of growth.

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Notes

1 The most recent year is 2017 for servitization and digitization and 2016 for manufacturing value added.
2 Following standard practice (see the bottom of Table 2.1), we used the following secondary NAICS codes to identify knowledge based services: 518 'Data Processing, Hosting, and Related Services'; 519 'Other Information Services'; 54 'Professional, Scientific, and Technical Services'; 56 'Administrative and Support and Waste Management and Remediation Services'; and 811 'Repair and Maintenance'.
3 The best explanation of these values is that declaring secondary industry codes is legally binding in these countries.
4 The income level is obtained by sorting the countries by GDP per capita and clustering them into three groups (high, medium and low) based on their ranking.

References

Aquilante, T., Bustinza Sánchez, O.F. and Vendrell-Herrero, F. (2016). Services in European manufacturing: servinomics explained. *Bruegel Blog*. Available at: http://bruegel.org/2016/03/services-in-european-manufacturing-servinomics-explained.

Ariu, A. (2016). Services versus goods trade: a firm-level comparison. *Review of World Economics*, 152(1), 19–41.

Baldwin, R. (2016). *The Great Convergence*. Cambridge, MA: Harvard University Press.

Bustinza, O.F., Vendrell-Herrero, F., Parry, G. and Myrthianos, V. (2013). Music business models and piracy. *Industrial Management & Data Systems*, 113(1), 4–22

Bustinza, O.F., Vendrell-Herrero, F. and Baines, T. (2017). Service implementation in manufacturing: an organisational transformation perspective. *International Journal of Production Economics*, 192, 1–8.

Bustinza, O.F., Vendrell-Herrero, F., Gomes, E., Lafuente, E. et al. (2018). Product-service innovation and performance: unveiling the complexities. *International Journal of Business Environment*, 10(2), 95–111.

Coreynen, W., Matthyssens, P. and van Bockhaven, W. (2017). Boosting servitization through digitization: pathways and dynamic resource configurations for manufacturers. *Industrial Marketing Management*, 60, 42–53.

Crozet, M. and Milet, E. (2017). Should everybody be in services? The effect of servitization on manufacturing firm performance. *Journal of Economics & Management Strategy*, 26(4), 820–841.

Gomes, E., Bustinza, O., Tarba, S., Khan, Z. and Ahammad, M. (2018). Antecedents and implications of territorial servitization. *Regional Studies*. DOI: https://doi.org/10.1080/00343404.2018.1468076.

Greenstein, S. and Nagle, F. (2014). Digital dark matter and the economic contribution of Apache. *Research Policy*, 43(4), 623–631.

Haraguchi, N., Cheng, C.F.C. and Smeets, E. (2017). The importance of manufacturing in economic development: has this changed? *World Development*, 93, 293–315.

Hojnik, J. (2016). The servitization of industry: EU law implications and challenges. *Common Market Law Review*, 53(6), 1575–1623.

Horváth, K. and Rabetino, R. (2018). Knowledge-intensive territorial servitization: regional driving forces and the role of the entrepreneurial ecosystem. *Regional Studies*, DOI: https://doi.org/10.1080/00343404.2018.1469741.

Krugman, P. and Venables, A. J. (1995). Globalization and the inequality of nations. *Quarterly Journal of Economics*, 110(4), 857–880.

Lafuente, E., Vaillant, Y. and Vendrell-Herrero, F. (2017). Territorial servitization: exploring the virtuous circle connecting knowledge-intensive services and sustainable new manufacturing businesses. *International Journal of Production Economics*, 192, 19–28.

Lafuente, E., Vaillant, Y., and Vendrell-Herrero, F. (2018). Territorial servitization and the manufacturing renaissance in knowledge-based economies. *Regional Studies*, 3(3), 313–319.

Moroz, M. (2017). The level of development of the digital economy in Poland and selected European countries: a comparative analysis. *Foundations of Management*, 9(1), 175–190.

Muñoz, J.F. and Rueda, M. (2009). New imputation methods for missing data using quantiles. *Journal of Computational and Applied Mathematics*, 232(2), 305–317.

Myrthianos, V., Vendrell-Herrero, F., Bustinza, O.F. and Parry, G. (2014). Evaluating firm profitability during the servitization process of the music industry. *Strategic Change*, 23(5–6), 317–328.

Neely, A. (2008). Exploring the financial consequences of the servitization of manufacturing. *Operations Management Research*, 1(2), 103–118.

Nugent, N. (2017). *The Government and Politics of the European Union*. New York: Palgrave Macmillan.

Opazo, M., Vendrell-Herrero, F. and Bustinza, O.F. (2018) Uncovering productivity gains of digital and green servitization: implications from the automotive industry. *Sustainability*, 10(5), 1524.

Piotrowicz, W. (2015). Information technology and systems in the Visegrád group of countries (Czech Republic, Hungary, Poland, and Slovakia): a literature review. *Journal of Global Information Technology Management*, 18(2), 77–93.

Porter, M. E. and Heppelmann, J. E. (2014). How smart, connected products are transforming competition. *Harvard Business Review*, 92(11), 64–88.

Prokop, V., Stejskal, J. and Kuvíková, H. (2017). The different drivers of innovation activities in European countries: a comparative study of Czech, Slovak, and Hungarian manufacturing firms 1. *Ekonomicky Casopis*, 65(1), 31–45.

Seclen-Luna, J.P. and Barrutia-Güenaga, J. (2018). KIBS and innovation in machine tool manufacturers: evidence from the Basque country. *International Journal of Business Environment*, 10(2), 112–131.

Sforzi, F. and Boix, R. (2018). Territorial servitization in Marshallian industrial districts: the industrial district as a place-based form of servitization. *Regional Studies*, DOI: https://doi.org/10.1080/00343404.2018.1524134.

Suarez, F.F., Cusumano, M.A. and Kahl, S.J. (2013). Services and the business models of product firms: an empirical analysis of the software industry. *Management Science*, 59(2), 420–435.

Vendrell-Herrero, F., Bustinza, O.F., Parry, G. and Georgantzis, N. (2017a). Servitization, digitization and supply chain interdependency. *Industrial Marketing Management*, 60, 69–81.

Vendrell-Herrero, F., Myrthianos, V., Parry, G. and Bustinza, O. (2017b). Digital dark matter within product service systems. *Competitiveness Review*, 27(1), 62–79.

Vendrell-Herrero, F., and Wilson, J.R. (2017). Servitization for territorial competitiveness: taxonomy and research agenda. *Competitiveness Review*, 27(1), 2–11.

Veugeleres, R. (2013). Manufacturing Europe's future. *Bruegel Blog*. Available at: http://bruegel.org/2013/10/manufacturing-europes-future.

Visnjic, I., Neely, A. and Jovanovic, M. (2018). The path to outcome delivery: interplay of service market strategy and open business models. *Technovation*, 72, 46–59.