WIFO ■ WORKING PAPERS
637/2021

Servitization across Countries and Sectors: Evidence from World Input-Output Data

Klaus S. Friesenbichler
Agnes Kügler

Servitization across Countries and Sectors: Evidence from World Input-Output Data

Klaus S. Friesenbichler, Agnes Kügler

WIFO Working Papers 637/2021
August 2021

Abstract
We use the supply tables that underlie WIOT data to explore the provision of services by manufacturing sectors. The value-added shares generated by services differ substantially across countries and sectors, while they remain largely stable over time. A Bayesian classification assigns broadly defined manufacturing sectors to economy-wide growth models. It differentiates between service- and manufacturing driven models in catching up and developed economies. Servitization increase with labour productivity. The service intensities in the sectoral production mix are lower in countries with higher manufacturing shares. This holds for both catching up and developed economies. However, servitization is largely unrelated to productivity and employment growth. Hence, we argue that the degree of servitization is contingent on and an attribute of the respective economic model in which a sector operates.

E-mail: klaus.friesenbichler@wifo.ac.at, agnes.kuegler@wifo.ac.at

2021/W/1918

Medieninhaber (Verleger), Hersteller: Österreichisches Institut für Wirtschaftsforschung
1030 Wien, Arsenal, Objekt 20 | Tel. (43 1) 798 26 01-0 | https://www.wifo.ac.at
Verlags- und Herstellungsort: Wien

Servitization across countries and sectors: Evidence from World Input-Output Data[1]

Klaus S. Friesenbichler[2] Agnes Kügler[3]

This version: 28th July 2021

This is a draft version. The final paper will be published in a forthcoming issue of "Economic Systems".

Abstract

We use the supply tables that underlie WIOT data to explore the provision of services by manufacturing sectors. The value-added shares generated by services differ substantially across countries and sectors, while they remain largely stable over time. A Bayesian classification assigns broadly defined manufacturing sectors to economy-wide growth models. It differentiates between service- and manufacturing-driven models in catching-up and developed economies. Servitization increase with labor productivity. The service intensities in the sectoral production mix are lower in countries with higher manufacturing shares. This holds for both catching-up and developed economies. However, servitization is largely unrelated to productivity and employment growth. Hence, we argue that the degree of servitization is contingent on and an attribute of the respective economic model in which a sector operates.

JEL Classifications: L60, P51, O14

Keywords: servitiziation, employment, productivity, latent class analysis, WIOD

---

[1] For valuable comments we thank Werner Hölzl, Michael Peneder and Jens Südekum. For their support with the data compilation we are grateful to Nicole Schmidt-Padickakudy, Anna Strauss-Kollin and Stefan Weingärtner. We gratefully acknowledge support by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 822781 GROWINPRO – Growth Welfare Innovation Productivity.

[22] Austrian Institute of Economic Research (WIFO), Arsenal Objekt 20, 1030 Vienna, Austria; Tel.: +43 1 798 26 01 296; Fax: +43 1 798 93 86; Klaus.Friesenbichler@wifo.ac.at

[3] Austrian Institute of Economic Research (WIFO), Arsenal Objekt 20, 1030 Vienna, Austria; Agnes.Kuegler@wifo.ac.at

Servitization across countries and sectors: Evidence from World Input-Output Data

1. Introduction

In the last decades, researchers have documented both the growth contribution and the structural change dynamics of manufacturing. Manufacturing has been identified as a growth driver and its share in the overall economy follows an inverted U-shape as economies become more productive (Herrendorf, Rogerson, and Valentinyi 2013). Change has also occurred within the sector. According to management literature manufacturing firms increasingly offer *'fuller market packages or 'bundles' of customer focused combinations of goods, services, support, self-service and knowledge in order to add value to core corporate offerings'* (Vandermerwe and Rada 1988). The bulk of the evidence draws on firm-level data from single countries or takes a case-study approach (Kowalkowski, Gebauer, and Oliva 2017; Eloranta and Turunen 2015). However, cross-country and cross-sector evidence is rare, which makes the generalization of the results problematic.

The aim of this paper is to provide evidence about servitization across countries and manufacturing industries and its impact on performance. We use the supply sheets that underlie the World Input Output Data (WIOD) covering a total of 37 countries and eleven broadly defined manufacturing sectors for the period 2000-2014 to provide evidence based on internationally comparable data. The supply tables provide information on the goods and services which are produced in the domestic economy. This allows us to measure servitization as the value-added share of services provided by the manufacturing sector. We draw on a Eurostat classification to further split the share of services in manufacturing industries into groups of knowledge intensive services and other services.

We pursue two guiding research questions:

First, do changes in the intensity of services effect productivity or employment growth? Second, we ask if servitization is contingent on the economic context and on the economic regime in which a sector operates.

Linking the servitization indicators to economic performance reveals that offering more services is *per se* unrelated to performance. Moreover, ANOVA results show that mostly country and sector effects explain the variance in servitization intensities. A latent class analysis, a Bayesian classification method, assigns sectors to "servitization typologies". Even though implemented at the sector level and some within-country variance, countries' economic growth models become visible. These are manufacturing-based or service-driven economic models which again differ between catching-up and developed economies. The results indicate that servitization generally increases with development. Economies whose economic regime relies rather on services than manufacturing tend to have higher service shares in manufacturing industries as well.

We contribute to the literature in multiple ways. We differentiate the services offered by their knowledge intensities in an international empirical framework. This allows us to systematically study the extent and nature of servitization. Such information is yet rare, which is surprising given the large research interest.[4] We therefore contribute to the consolidation of the servitization literature. We explore if servitization is related to economic performance indicators such as productivity and employment growth. The literature almost exclusively focuses on firm-specific aspects such as idiosyncratic capabilities, resources, or firm-level contextual factors to optimally include services in the product portfolio. Eventually, we offer a novel way to assign sectors

[4] A Google Scholar search produced 16,700 results (accessed on April 29, 2021).

to economic models which have been defined by country-specific and sectoral characteristics. We use servitization as an example of demand changes across economic regimes.

2. Defining servitization

For decades, servitization of businesses has been discussed in management literature, but no clear-cut definition is available. Originally, servitization was referred to as a trend of firms to increasingly offer `fuller market packages or "bundles" of customer-focused combinations of goods, services, support, self-service, and knowledge' (Vandermerwe and Rada 1988). Since then the concept has received different notions. For instance, Baines et al. (2009a) defined it as an `innovation of an organization's capabilities and processes to better create mutual value through a shift from selling product to selling Product Service Systems (PSS)'. Altering business models that increasingly offer service can also be technology induced, especially through ICT or cloud based systems (Berman et al. 2012). However, the central idea of these market strategies always consists of manufacturing firms that add value added to their core (physical) products through services.

2.1 Quantifying servitization

We draw on input-output data which captures the production structure and the flows of goods and services between countries and industries. To construct a measure of the service content of manufacturing, we use data at the industry-level which underlie the World Input-Output Database (WIOD)(Dietzenbacher et al. 2013; Timmer et al. 2014). We draw on WIOD's supply and use tables (SUTs), which are the basic building blocks of the database that underwent extensive data cleaning and harmonization effort to render data comparable across countries and industries (Erumban et al. 2012). Hence, the supply and use tables are the precursory data used to construct the input-output data. Both WIOD and the supply and use tables are publicly available.[5]

Defining servitization, we use the supply sheets, which describe the supply the goods and services which are either produced in the domestic economy or imported.[6] WIOD contains 59 products based on CPA, a product classification. Hence, the supply tables depict the product portfolio of each sector-country-year combination. This allows us to compute the service share of each manufacturing industry included in WIOD across countries and years, and to further disaggregate the degree of servitization by computing a variety product groups capturing of knowledge-intensive services.

Unfortunately, supply tables are not available for all countries, which is why we cannot consider Mexico, France, Indonesia, Russia, China, and Taiwan. The final sample covers 37 countries and eleven broadly defined industries that are classified according to the International Standard Industrial Classification revision 4 (ISIC Rev. 4).[7]

The key variable is the servitization share, which we define as the value-added share generated by services, as opposed to physical products. We compute this ratio for eleven manufacturing sub-sectors in each country and year. Hence, we conceptualize the degree of servitization as the level of the service content in manufacturing in monetary terms as a share of each unit of value added. This measure resembles previous approaches used in the Input-Output literature (Falk and Peng 2013).

The mean of the degree of servitization in manufacturing industries is about 9.9%, which has slightly increased from 10.3% in the base year 2000 to 11.2% in the last year covered by our

---

[5] See http://www.wiod.org/database/nat_suts16 (accessed on April 26, 2021).

[6] For futher information on the definition of supply tables see https://www.oecd-ilibrary.org/economics/data/oecd-national-accounts-statistics/supply-and-use-tables-supply-and-use-indicators-edition-2018_5a109fe6-en (accessed on April 26, 2021).

[7] See http://wiod.org/home (accessed on April 26, 2021).

sample, 2014. The lower mean indicates a trough between the years 2001 and 2008, where the average share of services amounted to only 9%.

There is substantial cross-country variance. The countries with the lowest values in the sample are South Korea (0.7%), Cyprus (1.4%) and the highest values are reported for Luxembourg (42.5%), the Netherlands (20.1%) and Sweden (16%).

The servitization degrees also differ vastly across sectors. The mean of the service share in the manufacture of food products, beverages and tobacco is merely 4.3%. Then again, in the industry group consisting of the manufacture of wood and of products of wood and cork (except furniture), paper and paper products and printing and reproduction of recorded media, the servitization share amounts to 21.2%.

2.2 Types of services

Changes in the technology base, especially in the advent of ICT, not only induced changes in the overall composition of the economy, but also in the product range of the industrial sector itself (Ochel and Wegner 2019). This suggests that - given the vast differences between countries and sectors – both the degree and the composition of the services offered differs. The data structure allows us to apply taxonomies to differentiate services by their knowledge content. We draw on Eurostat indicators to split the service sector into different subsectors, for which we compute the respective fraction in the industry-year.[8]

- Knowledge-intensive market services (KIMS, e.g., testing and analysis, advertising and market research, consultancy, engineering, legal and accounting activities)
- High-tech knowledge-intensive services (HTKI, e.g., scientific R&D, computer programming, information service activities)

[8] See https://ec.europa.eu/eurostat/cache/metadata/Annexes/htec_esms_an3.pdf (accessed on January 4, 2021).

- Knowledge-intensive financial services (KIFS; financial and insurance activities)
- Other knowledge-intensive services (OKIS, e.g., publishing, education, veterinary activities)

First descriptive statistics reveal that most services offered by manufacturing industries are not knowledge intensive. The median service share is 5.8%, of which 3.8 percentage points are assigned to activities not classified as knowledge intensive. Among the subgroups of knowledge-intensive services, knowledge intensive market services and high-tech knowledge intensive services took the biggest share. Other knowledge-intensive services and especially financial services played minor roles with mean and median values at, or close to, nil (see Table 1).

Table 1 about here

2.3 ANOVA results and descriptive statistics across service types

These are novel indicators and the descriptive statistics indicate substantial differences in both levels and variance. It is likely that these differ across countries and sectors, but to a different extent. To provide first insights into the distributions, we ask if the servitization shares differ across countries, sectors, and years. We implement a multivariate, fixed effect analysis of variance (ANOVA). The estimated model explains approximately 45% of the total variance in servitization shares, of which 26 percentage points can be attributed to country- and 19 to sector-effects. This is broadly in line with firm-level evidence that finds that higher levels of development increases the manufacturing share over and above firm characteristics (Neely 2008). However, it does not support firm-level results that find that national differences play only a minor role in explaining the degree of servitization (Dachs et al. 2014). The presence of strong sectoral heterogeneity is a typical empirical result (Crozet and Milet 2017). The ANOVA results indicate that time effects account for less than one percent of the total variance in the period studied. Evidence from previous time periods till 2005/08 report stronger increases in the degree of servitization (Falk and Peng 2013).

We next implement the ANOVA for the individual types of services. Country and sector effects play a varying role, with time effects taking a minor position throughout the specifications.

Across the entire sample, the means of the high-tech knowledge intensive services (HTKI) such as R&D have increased from 2.5% in 2000 to 3.2% in 2014. Country and sector effects explain 15 percentage points each. The highest shares of high-tech knowledge intensive services are found in the Manufacture of computer, electronic and optical products, and the Manufacture of electrical equipment (6.6%). The lowest mean shares in the sample is found in the Manufacture of textiles, of wearing apparel and of leather and related products (1.2%). Using a pooled sample again, the highest mean values of high-tech service provision are reported by Luxembourg (7.6%), Finland (6.8%) and Sweden (5.6%), which are all members of the group of innovation leaders in the EU (European Commission 2020). At 1%, the lowest values are in Brazil, India, Japan, and South Korea.

Table 2 about here

The picture changes fundamentally for knowledge-intensive market services (KIMS), where the ANOVA explains 22% of the total variance, of which country effects make 15 and sector effects seven percentage points. At 4.7%, the sector with the highest share is the NACE Rev. 2 division group 16 through 18, consisting of Manufacture of wood and of products of wood and cork, except furniture; manufacture, the Manufacture of paper and paper products and Printing and reproduction of recorded media. The lowest mean share of knowledge-intensive market services is reported by Manufacture of computer, electronic and optical products, and the Manufacture of electrical equipment (1.7%). At the country level, the highest mean values are observable in Luxembourg (6.5%), Croatia (5.9%) and Australia and the USA (5.6% each).

The categories knowledge-intensive financial services (KIFS) and other knowledge-intensive services (OKIS) account for a substantially smaller share of output, 1.0% and 1.8%, respectively. These shares are stable over time. While financial services are largely explained by country effects which reflects the geographical clusters of financial service supply (e.g. Luxembourg), sector effects bear more explanatory power with OKIS.

3. Servitization and growth

Even though the roots of the debate about servitization can be traced back as far as the 1960s (Lightfoot, Baines, and Smart 2013), the current discussion has emerged in the late 1980s (Vandermerwe and Rada 1988). Typically, the product-service configuration is at the core of research, though, additional aspects like product-service differentiation or costumer relationships have been studied by a multitude of management disciplines. We seek to make an empirical contribution with respect to the link between servitization and performance (Eloranta and Turunen 2015; Kowalkowski, Gebauer, and Oliva 2017; Lightfoot, Baines, and Smart 2013; Baines et al. 2009b; Bustinza et al. 2015).

3.1 Growth conjectures

Many empirical findings recommend the integration of services into manufacturing firms' product range, because an increased provision of services is an instrument to differentiate from competitors and tap into yet unexplored markets. Servitization can create a competitive advantage, increase firms' profits and can thus be a reaction of firms in developed economies to low-cost competitors from emerging economies (Baines et al. 2009b; Eloranta and Turunen 2015; Wise and Baumgartner 1999; Vandermerwe and Rada 1988; Dachs et al. 2014; Neely 2008; Lightfoot, Baines, and Smart 2013).

However, servitization also entails risks and firms often struggle when seeking to establish an alternative business line to their core competencies in manufacturing (see Dachs et al. 2014 for an overview). Thus, the empirical results on the effects of servitization on economic performance have been mixed. While some studies report no systematic effects (Eloranta and Turunen 2015; Kowalkowski, Gebauer, and Oliva 2017), there is evidence for Germany (Eggert et al. 2011) and France that firms which sell services experience an increase in their profitability and employment (Crozet and Milet 2017). Fang, Palmatier, and Steenkamp (2008) find evidence for a U-shaped relationship, where servitization initially causes a slight decline in market value and increases at later stages. Further evidence shows that manufacturing firms that have servitized are larger in terms of sales revenues than comparable firms, but also generate lower profit to sales margins (Neely 2008).

Servitization may not only affect performance, but also the production function. By definition, offering services is more labor intensive than offering manufactured goods. Dachs et al. (2014) find that servitization is linked to firm size in a U-shape manner. Other quantitative findings show that servitization is not only linked to larger firms, but also that offering services increases employment growth (Crozet and Milet 2017). Based on this literature, we want to test the following two hypotheses:

Growth hypothesis I: A greater degree of servitization at the sector level is positively related to performance growth.

Growth hypothesis II: A greater degree of servitization at the sector level is positively related to employment growth.

3.2 Estimation strategy

To test the first and second hypothesis, we estimate a dynamic panel model with predetermined variables using a system GMM estimator as our preferred specification. We regress logarithmic performance growth on the lagged logarithmic level of the performance indicator, the level of servitization, which is treated as predetermined variable, and additional control variables. We estimate the following growth regression:

$$\Delta \ln (Y_{ijt}) = \beta_0 \ln (Y_{ijt-1}) + \beta_1 \ln (SERV_{ijt}) + \beta_2 \ln (CAP_{ijt}) + \beta_3 \ln (GAP_{ijt}) + \mu_c + \mu_j + \mu_t + u_{ijt}, \quad (1)$$

We are interested in the effect of servitization on changes in employment and performance, where the latter is measured by both labor productivity and total factor productivity. Hence, we use three types of economic outcomes (Y) in sector j, country i at time t: employment (number of employees obtained from WIOD), labor productivity (real value added divided by the number of employees, base year 2010, also obtained from WIOD) and total factor productivity obtained from the EUKLEMS database. SERV stands for the servitization indicators, which is in the baseline regression the logarithmic service share in manufacturing industries and in a second set of regressions the logarithmic shares of knowledge-intensive services. We assume that last year's growth of servitization shares are sequentially exogenous which implies an unpredictable negative productivity shock will be uncorrelated with past servitization shares but will surely be correlated with future and maybe also current servitization shares.

We control for changes in the real capital stock (base year 2010) when explaining employment and labor productivity growth. GAP denotes the output gap, which captures macroeconomic cyclical dynamics obtained from the AMECO database. The output gap is defined as the "Gap between actual and potential gross domestic product at 2010 reference levels". μ denotes fixed effects at the year (t), country (c) and sector (s) level. Robust standard errors (u) are estimated in all specifications. All nominal values were in local currency unit, deflated with value added deflators obtained from WIOD (base year 2010) and eventually converted into EUR using Eurostat's exchange rates.

Methodologically, we implement a system GMM estimator (Blundell and Bond 1998; Arellano and Bover 1995; Roodman 2009), in which we use the lagged dependent variable, the servitiziation shares and their first differences as GMM-style instruments. The logarithmic output gap, the capital stock as well as country, sector and year effects are exogenous regressors.

3.3 Regression results

The coefficients of the servitization shares are insignificant. Also, the coefficients for the knowledge-intensive services are mostly insignificant, apart from knowledge-intensive financial services, which are positively connected with employment growth. Besides, high-tech knowledge intensive services also show a positive, though very small and weak coefficient in the employment growth regression and are weakly associated with an labor productivity growth dampening effect (see Table 3).

Table 3 about here

Table 4 about here

Table 5 about here

In addition, we explore whether these effects vary across country groups and run the regressions separately for the (i) Central and Eastern European countries (CEE), (ii) the Old Member

States of the EU (EU15 include countries that were EU Members prior to 2004) and (iii) the OECD countries.[9]

The coefficients of servitization shares remain largely insignificant for total productivity growth (see Table 4). However, the relationship with employment and labor productivity growth become more nuanced when comparing country groups. While there is a weakly negative effect of servitization shares on labor productivity in CEE and EU15 countries, we observe a positive impact of servitization on employment growth in the EU15 and OECD countries, though the effect is much weaker in the latter country group.

Next, we distinguish between the different types of knowledge intensive services. We find that a higher share of high-tech, knowledge-intensive services is associated with higher employment growth in CEE countries, while it has a dampening effect on total factor productivity growth (Table 5). In contrast, knowledge-intensive market services show a negative but weak impact on employment growth in CEE countries.

The results in the CEE countries somewhat differ from those in Old EU Member States (i.e. the EU15) and in OECD countries. There is no significant effect of knowledge-intensive market services on employment or performance growth in the EU15 or the OECD. However, knowledge-intensive financial services are associated with a labor productivity growth dampening effect. Analogously, other knowledge-intensive services negatively affect total factor productivity growth, though the coefficients are small and only significant at a 10%-level. In comparison, the negative impact of knowledge-intensive financial services on total factor productivity is much larger in OECD countries, though also only weakly significant.

[9] The following countries are in the EU15 group: AT, BE, DE, DK, ES, FI, UK, GR, IE, IT, LU, NL, PT and SE. The group CEE consists of BG, CY, CZ, EE, HR, HU, LT, LV, MT, PL, RO, SI and SK. The OECD countries considered are AT, AU, BE, CA, CH, DE, DK, ES, FI, UK, GR, IE, IT, JP, LU, NL, NO, PT, SE, TR, and US.

The control variables perform as expected. The autoregressive terms indicate productivity catching-up processes. They are mostly statistically insignificant in the employment growth specifications. We obtain positive coefficients for the capital stock in the regressions for labor productivity, but they turn insignificant in the employment growth regressions. The output gap is positively related to employment growth, but often insignificant or weaker in the specifications explaining labor productivity or TFP growth.

3.4 Robustness checks

To ensure the validity of the results, we implement a series of robustness checks with respect to both the chosen estimator and the model specification.

First, one may argue that the country and sector fixed effects absorb much of the variance of the performance indicators so that the servitization indicators, which exhibit little variance over time (see ANOVA results above), turn insignificant. Therefore, we drop the country- and sector-fixed effects estimate the dynamic panel model using system GMM with only time- fixed effects.

Second, our preferred specification controls for short-run cyclical fluctuations by including the output gap. However, it is conceivable that the link between servitization and performance is a long-term phenomenon. We therefore provide additional least square regressions that take a longer-term perspective using the full sample to purge the coefficients from possible cyclical bias. We compute the long-term growth rate between 2004/05 (t_1) and 2013/14 (t_2), using two-year averages on either side to avoid outlier problems. On the right-hand side of the equation we use the log-levels of the dependent variables in 2000/01 (t_0) as starting values to account for possible endogeneity issues. All other explanatory variables on the right-hand side are average log-levels in 2004/05 (t_1). Hence, we estimate the following long-term growth model:

$$\Delta\ln\left(Y_{ij,t2-t1}\right) = \beta_0 \ln\left(Y_{ij,t0}\right) + \beta_1 \ln\left(SERV_{ij,t1}\right) + \beta_2 \ln\left(CAP_{ij,t1}\right) + \mu_c + \mu_j + u_{ij}. \quad (2)$$

Third, we implement Generalized Method of Moments (GMM) growth regressions (Greene 2003). We use growth rates on both sides of the regression equation, but we include the second lag of the growth rates of the explanatory variables. We implement two types of specifications, one that only considers time-fixed effects and one that additionally considers country- and sector- fixed effects.[10]

4. Servitization across economic regimes

The previous analysis shows that differences in servitization are explained by country and sector effects. Since our regressions find that changes of the intensity of servitization itself have little effect on economic performance indicators, the observed varying intensities suggest that servitization is rather an attribute which co-evolves as sectors grow. Indeed, firm level evidence suggests that national differences play a role in the degree of servitiziation. Developed countries such as the United States or Scandinavian countries show the highest servitization intensities. However, companies in countries such as Germany have lower servitization rates, which could mirror a different strategic orientation of firms. In addition, there is substantial cross-country variance, with catching-up economies showing lower servitization intensities (Dachs et al. 2014; Neely 2008).

Servitization has been argued to be contingent on a multitude of contextual factors at the country and sector level which also mirror demand conditions (Peneder 2009). These differ are

[10] Since differencing variables that are predetermined but not strictly exogenous renders them endogenous, we deal with the country- and sector-fixed effects by demeaning and include time-dummies.

likely to differ across development stages and economic regimes, which the following analysis seeks to explore.

4.1 Latent Class Analysis

To systematically identify differences between economic regimes, we group sectors using latent class analysis (LCA), which is a special case of structural equation models. Originally developed as a statistical tool in psychology (Lazarsfeld 1950) and later widely applied in political sciences and medical studies (Hagenaars and McCutcheon 2002), LCA is also known as Bayesian classification and has, for instance, been applied in economics in a Bayesian model averaging framework to uncover regularities in growth patterns (Cuaresma et al. 2016).

The basic idea of latent class analysis is to relate the observed variables to an unobserved, categorical latent variable. This latent variable captures the underlying dependency structure between the observed variables and allows to cluster observations by minimizing the dependency between variables. A class is characterized by a pattern of conditional probabilities indicating the chance that variables take on certain values.

We use variables typically linked to structural change patterns, to the production function and the position in the value chain of a given sector (Herrendorf, Rogerson, and Valentinyi 2013; Timmer, Miroudot, and de Vries 2019). Given the negligible explanatory power of time, we use country-industry means in the LCA. The total sample consists of 402 industry-country pairs.

Figure 1 about here

4.2 Variables related to servitization intensities

We use a set of indicators to paint a holistic picture, including contextual variables which have been argued to be underdeveloped in the servitization literature (Eloranta and Turunen 2015). These capture the degree of servitization, the level of development at the country level, the level of development at the sector level measured by both productivity and a sophistication indicator, the relevance of final demand and sourced services along the value chain for a sector, and the country-wide manufacturing share.

Servitization

We draw on three indicators of servitization described above. We use (i) the share of high-tech knowledge intensive services, (ii) the share of knowledge-intensive market services, and (iii) the share of all other services offered.

Country-level productivity

We use GDP per capita in natural logs as a proxy for the development level of a given sector's country context. It has been documented that the share of the service sector in the total economy increases with the level of development (Buera and Kaboski 2012), which renders it likely that the demand for general services, and especially knowledge intensive services, increases with economic development. It has been argued that wealthier economies tend to have more service-oriented manufacturing firms (Neely 2008)

Sector-level productivity

Sectoral labor productivity in natural logs is used as another proxy for the level of development that captures country-sector specific characteristics. The indicator is correlated with yet differs from GDP per capita.

Relevance of final demand

Especially in the 1980s and 1990s, it has been argued that manufacturing firms should build on their core competencies and expand their activities downstream to services. These activities were thought to be of higher value-added than manufacturing activities (Bowen, Siehl, and Schneider 1991; Wise and Baumgartner 1999). This implies that servitization is a downstream phenomenon whose provision is not independent of the position in the value chain. Hence, servitization is assumed to become more likely when a sector is closer to final demand. We therefore rely on a measure of the value chain positioning based on WIOD (see also Antràs et al. 2012; De Backer and Miroudot 2013). We use the share of outputs which is directly consumed by final demand, i.e. the fraction of final demand of gross output. The greater the share the lower the fraction of output that is used as intermediaries in international value chains.

Service sourcing

It has been argued that firms offering more complex products, which also rely on technologically sophisticated components, require more services such as maintenance or training (Oliva and Kallenberg 2003), which is also reflected by the sourcing of more complex capital goods (Davies 2004). We construct an indicator that hinges on the partitioning of the "induced value added" (IVA) that weights the IVA of the services sourced by a sector by its total sectoral IVA. Hence, we calculate a sector's intensity of sourced services by computing its upstream value chain integration, i.e. backward linkages. We draw on the value-added share of services used as inputs accumulated along the value chain. This indicator hinges on the partitioning of the induced value added of services, or IVA (IVA = vLf), where vector f denotes a sector's value of final demand in a given country and year, v is the value-added per unit of production (diagonal matrix) and L stands for the Leontief inverse. The Leontief inverse incorporates the structure of direct and intermediate inputs for the production process meeting the final demand. The vector IVA contains the value-added shares of all sectors of all countries required to produce the output. By summing up all value-added of service sectors in IVA we obtain the service share of the considered manufacturing output (Peneder and Streicher 2017; Johnson and Noguera 2012; K. Friesenbichler, Kügler, and Reinstaller 2021).

Manufacturing share

The share of the value added produced by the manufacturing sector in total value added poses a proxy of the relevance of manufacturing industry. This is the core indicator of the deindustrialization literature discussing structural change processes (Rowthorn and Ramaswamy 1999; Bernard, Smeets, and Warzynski 2017) which are also likely to affect a sector's product portfolio and therefore service intensity.

Sectoral sophistication

Firm-level evidence has shown that servitization is positively related to complexity of a firm's product portfolio (Dachs et al. 2014). We use a measure of sophistication of a sector's products based on "complexity scores" (Hidalgo and Hausmann 2009). These approximate the sophistication of a product line by recovering latent information from a bipartite network linking product lines to exporting countries. A higher score indicates that the country is exporting a specific product line with comparative advantage and/or only few other countries are capable of exporting the same product line. Hence, the complexity score may be interpreted as reflecting the breadth and the depth of the knowledge base required to become a significant exporter (Reinstaller and Reschenhofer 2019; Klimek, Hausmann, and Thurner 2012).

Table 6 about here

4.3 LCA results and discussion

Six latent classes were defined. Table 7 shows the marginal predicted means of the covariates within each latent class. Even though there is some sectoral variance across classes, country-specific factors dominate the results. This allows us to provide a first differentiation using the three variables that do not differ across sectors: GDP per capita, manufacturing share and sophistication. The sample can be roughly grouped into developing economies (Class I), catching-up economies (Class II and III), and developed economies (Class IV, V and VI). Combining these results with the manufacturing share and sophistication indicator, we obtain country groups that can be categorized based on stylized growth models: rather manufacturing-based (Class III and Class V) and service-driven groups (Class II, Class IV and Class VI). Class I and VI capture statistical outliers related to peculiar growth models. Class I consists of developing economies. Class VI consists of highly service-intensive industries in developed economies.

Table 7 about here

Next, we jointly interpret the results. We study differences in the sectoral characteristics between countries' economic model, even though there is within-country variance between sectors. For instance, the period analyzed assigns most sectors in Bulgaria to Class I, "Developing countries" (see below). However, the sector "Manufacture of coke and refined petroleum products" in Bulgaria has been assigned to Class II, exhibiting the sectoral characteristics of catching-up economies. Nevertheless, we draw on the median class at the country level, which allows us to assign countries to broadly defined economic models (see Table 8 and Table 8).

Table 8 about here

Class I consists of developing economies such as India, Turkey, Romania, and Bulgaria. These countries had not yet developed a growth pattern in the period covered by WIOD. Much of the output is consumed in final demand. The degree of servitization is low.

Class II is a group of catching-up economies like Spain, Portugal, or Greece, in which manufacturing plays a smaller role. The service share tends to be higher. A large share of the sectoral output is absorbed by final demand, which implies they are not used as intermediates, which again indicates that these sectors are integrated in value chains to a lesser degree than sectors in other countries that implement a more manufacturing-driven strategy.

Class III consists of catching-up economies that rely to a larger degree on manufacturing. The sophistication of their export portfolio is markedly higher. They produce for global value chains rather than for final demand directly. However, their servitization share is lower than in service-driven catching-up economies, except the high-tech service share which is marginally higher in manufacturing-driven than in service-driven catching-up economies. Countries assigned to this class are for instance Hungary, the Czech Republic, Slovenia, or South Korea.

Class IV comprises developed economies that implement a service-driven economic model. Both the manufacturing share and the sophistication of the export portfolio are lower than in manufacturing-driven economies. In contrast, the mean values of the shares of high-tech services, knowledge-intensive market services and of total services are higher. Countries such as the United States, United Kingdom, the Netherlands, or Belgium are assigned to Class IV.

Class V is a group of well-developed, manufacturing-based economies. This group has the highest value of product sophistication and the group's sectoral labor productivity is also slightly higher than in Class IV. Countries in this group are for instance Japan, Germany, Austria, or Finland.

Class VI is required to control for sectors that can be regarded as outliers due to the specific industry structure. For instance, many sectors of Luxembourg are clustered in this group. The underlying economic model is driven by the financial sector and administrative bodies of the EU.

Table 8 about here

Eventually, there are some observations across the classes. The output share that is directly absorbed by final demand is substantially lower in catching-up economies with an industry structure that is dominated by manufacturing sector. This mirrors the manufacturing-driven catching-up model that countries in CEE pursued. There is no difference between the classes with respect to the upstream accumulation of services along the value chain. Across regimes, product sophistication, a proxy for capabilities, is - by construction - positively related to the manufacturing share.

5. Conclusions

This paper provided a bird's eye view on servitization across countries and industries. We draw on the supply tables that underlie the World-Input-Output-Tables (WIOT). The supply tables describe the supply the goods and services which are produced in the domestic economy. This allows us to construct a measure of the intensity of servitization provided by broadly defined manufacturing sectors or industry groups, respectively. We next argued that servitization itself can take on multiple forms, which is why we used a Eurostat taxonomy defining knowledge-intensive services to consider the type of services. This allowed us to compute the composition of services provided by manufacturing. While slightly more than half of all services offered by manufacturing sectors are not knowledge-intensive at all, there is a slight trend towards the increased provision of high-tech services.

The shares of other knowledge-intensive services, such as market or financial services, remain rather stable. We find that knowledge intensive financial services play a minor role in the product range of manufacturing industries. This supports previous studies studying whether there was an increase in financial content per unit of output produced (Dávila-Fernández and Punzo 2020). While there was an overall increase in financial content per unit of output produced in the United States from 1950-2015, there is substantial heterogeneity between sectors. The financial content in the manufacturing sector, which is considered in the present study, had been strongly decreasing after the year 2000.

On average, we found service shares to vary significantly across countries and manufacturing industries. The servitization shares only changed little over time, so that time effects hardly explain any variance. This is not in line with input-output data until the mid-2000s which report an increase in both inputs and outputs of services for manufacturing sectors (Falk and Peng 2013).

The management literature has long recommended servitization as a means in increase performance (Neely 2008). Hence, we estimate a dynamic three-way fixed effect panel model using a system GMM estimator and regress productivity growth on the lagged level of performance and the servitization indicators. The regression results do not establish a systematic relationship. The coefficients are largely insignificant, which is in line with parts of the previous firm-level literature, which struggles to establish a relationship between servitization and economic performance (Eloranta and Turunen 2015; Neely 2008; Gustafsson, Edvardsson, and Brax 2005). This supports the notion that simply 'moving downstream' into services is not a viable strategy, which is, however, what some of the business strategy literature recommends (Davies 2004).

The provision of services also links to employment. A study for France linked increase in services to employment growth (Crozet and Milet 2017).Using the same regression framework, we seek to explain sectoral employment growth by changes in servitization and again find no statistically significant effect.

In addition, we split the sample into country groups and again obtained largely insignificant or only weak results. However, we found some evidence that increases in the knowledge-intensive financial services slow down both labor productivity and TFP growth in OECD countries and the Old Member States of the EU. This may point towards unfavorable specializations of which policy makers in especially developed economies should be aware.

If the notable differences in the degree of servitization are unrelated to growth but still differ across countries and sectors, we argued that servitization is contingent on the economic environment. This is, the economic model in which a sector operates shapes the intensity of servitization. A latent class analysis, i.e. a Bayesian classification, assigns sectors to "servitization typologies". Albeit implemented at the sector level, the emerging picture indicates countries' economic growth models with respect to servitization and its interplay with other economic structures such as the manufacturing share. Even though the sectoral classification exhibits some within-country variance, the method identifies manufacturing-based or service-driven economic models, which again differ between catching-up and developed economies. Altogether, we identified six economic classes, of which four shape the degree of services that a sector offers.

The economic regimes are service-oriented catching-up economies, manufacturing-oriented catching-up economies, developed service-based economies and developed manufacturing-based economies. Two additional classes control for statistical outliers with respect to their peculiar economic model. One class captures developing economies and another class countries that are extremely reliant on services (e.g., Luxembourg).

Servitization, and especially the provision of high-tech knowledge intensive services, tends to increase with the level of economic development. This effect is more pronounced in economies where the manufacturing share is smaller, i.e. where the economy-wide service share is more prominent. There are no differences in the share of services sourced along the value chain across regimes. Altogether, these results indicate shifts in the demand pattern that occur across economic regimes (Buera and Kaboski 2012). The increase in high-tech services with GDP per capita may indicate a greater degree specialization (Timmer, Miroudot, and de Vries 2019).

The present analysis covers one business cycle, including the run-up to the financial crisis 2008/09 and the aftermath, when especially manufacturing was readjusting in the aftermath of the crisis (Friesenbichler and Glocker 2019). Future research may explore longer time series and examine the switch from the catching-up to the developed country status.

Eventually, the results inform policy makers about structural change. The findings suggest that sectors in both service- and manufacturing-based economies intensify their knowledge-intensive market services and that high-tech knowledge intensive services become more important in service-based economies. Assuming that the growth model itself remains unchanged, this implies that policy makers need to adjust their research, technology, development, and innovation system accordingly to facilitate growth process, eventually leading to the switch from the class of catching-up countries to developed economies.

Literature

Antràs, Pol, Davin Chor, Thibault Fally, and Russell Hillberry. 2012. "Measuring the Upstreamness of Production and Trade Flows." *The American Economic Review* 102 (3): 412–16.

Arellano, Manuel, and Olympia Bover. 1995. "Another Look at the Instrumental Variable Estimation of Error-Components Models." *Journal of Econometrics* 68 (1): 29–51.

Baines, Tim S, Howard W Lightfoot, Ornella Benedettini, and John M Kay. 2009a. “The Servitization of Manufacturing: A Review of Literature and Reflection on Future Challenges.” *Journal of Manufacturing Technology Management*.

Baines, Tim S., Howard W. Lightfoot, Ornella Benedettini, and John M. Kay. 2009b. “The Servitization of Manufacturing: A Review of Literature and Reflection on Future Challenges.” *Journal of Manufacturing Technology Management* 20 (5): 547–67.

Berman, Saul J, Lynn Kesterson-Townes, Anthony Marshall, and Rohini Srivathsa. 2012. “How Cloud Computing Enables Process and Business Model Innovation.” *Strategy & Leadership*.

Bernard, Andrew B, Valerie Smeets, and Frederic Warzynski. 2017. “Rethinking Deindustrialization.” *Economic Policy* 32 (89): 5–38.

Blundell, Richard, and Stephen Bond. 1998. “Initial Conditions and Moment Restrictions in Dynamic Panel Data Models.” *Journal of Econometrics* 87 (1): 115–43.

Bowen, D, C Siehl, and B Schneider. 1991. “Developing Service-Oriented Manufacturing.” *Making Organizations Competitive, Jossey-Bass, San Francisco, CA*, 397–418.

Buera, Francisco J, and Joseph P Kaboski. 2012. “The Rise of the Service Economy.” *American Economic Review* 102 (6): 2540–69.

Bustinza, Oscar F., Ali Ziaee Bigdeli, Tim Baines, and Cindy Elliot. 2015. “Servitization and Competitive Advantage: The Importance of Organizational Structure and Value Chain Position.” *Research-Technology Management* 58 (5): 53–60. https://doi.org/10.5437/08956308X5805354.

Crozet, Matthieu, and Emmanuel Milet. 2017. “Should Everybody Be in Services? The Effect of Servitization on Manufacturing Firm Performance.” *Journal of Economics & Management Strategy* 26 (4): 820–41. https://doi.org/10.1111/jems.12211.

Cuaresma, Jesus Crespo, Bettina Grün, Paul Hofmarcher, Stefan Humer, and Mathias Moser. 2016. “Unveiling Covariate Inclusion Structures in Economic Growth Regressions Using Latent Class Analysis.” *European Economic Review* 81: 189–202.

Dachs, Bernhard, Sabine Biege, Martin Borowiecki, Gunter Lay, Angela Jäger, and Doris Schartinger. 2014. “Servitisation of European Manufacturing: Evidence from a Large Scale Database.” *The Service Industries Journal* 34 (1): 5–23.

Davies, Andrew. 2004. “Moving Base into High-Value Integrated Solutions: A Value Stream Approach.” *Industrial and Corporate Change* 13 (5): 727–56. https://doi.org/10.1093/icc/dth029.

Dávila-Fernández, Marwil J., and Lionello F. Punzo. 2020. “Financialisation as Structural Change: Measuring the Financial Content of *Things*.” *Economic Systems Research* 32 (1): 98–120. https://doi.org/10.1080/09535314.2019.1643294.

De Backer, Koen, and Sébastien Miroudot. 2013. “Mapping Global Value Chains.” OECD Trade Policy Papers 159. https://doi.org/10.1787/5k3v1trgnbr4-en.

Dietzenbacher, Erik, Bart Los, Robert Stehrer, Marcel Timmer, and Gaaitzen De Vries. 2013. “The Construction of World Input–Output Tables in the WIOD Project.” *Economic Systems Research* 25 (1): 71–98.

Eggert, Andreas, Jens Hogreve, Wolfgang Ulaga, and Eva Muenkhoff. 2011. “Industrial Services, Product Innovations, and Firm Profitability: A Multiple-Group Latent Growth Curve Analysis.” *Industrial Marketing Management* 40 (5): 661–70. https://doi.org/10.1016/j.indmarman.2011.05.007.

Eloranta, Ville, and Taija Turunen. 2015. “Seeking Competitive Advantage with Service Infusion: A Systematic Literature Review.” *Journal of Service Management* 26 (3): 394–425. https://doi.org/10.1108/JOSM-12-2013-0359.

Erumban, Abdul Azeez, Reitze Gouma, Gaaitzen de Vries, Klaas de Vries, and Marcel Timmer. 2012. “Sources for National Supply and Use Table Input Files.” *WIOD*, April, 32.

European Commission. 2020. “European Innovation Scoreboard Edition 2020.” 2020. https://ec.europa.eu/docsroom/documents/42981.

Falk, Martin, and Fei Peng. 2013. “The Increasing Service Intensity of European Manufacturing.” *The Service Industries Journal* 33 (15–16): 1686–1706. https://doi.org/10.1080/02642069.2011.639872.

Fang, Eric (Er), Robert W Palmatier, and Jan-Benedict E M Steenkamp. 2008. “Effect of Service Transition. Strategies on Firm Value.” *Journal of Marketing* 72 (5): 1–14.

Friesenbichler, Klaus, Agnes Kügler, and Andreas Reinstaller. 2021. “Does Value Chain Integration Dampen Producer Price Developments? Evidence from the European Union.” *The World Economy* 44 (1): 89–106. https://onlinelibrary.wiley.com/doi/10.1111/twec.12993.

Friesenbichler, Klaus S, and Christian Glocker. 2019. “Tradability and Productivity Growth Differentials across EU Member States.” *Structural Change and Economic Dynamics* 50: 1–13.

Greene, William H. 2003. *Econometric Analysis*. 5th ed. Upper Saddle River, N.J: Prentice Hall.

Gustafsson, Anders, Bo Edvardsson, and Saara Brax. 2005. “A Manufacturer Becoming Service Provider–Challenges and a Paradox.” *Managing Service Quality: An International Journal*.

Hagenaars, Jacques A, and Allan L McCutcheon. 2002. *Applied Latent Class Analysis*. Cambridge University Press.

Herrendorf, Berthold, Richard Rogerson, and Ákos Valentinyi. 2013. “Two Perspectives on Preferences and Structural Transformation.” *American Economic Review* 103 (7): 2752–89. https://doi.org/10.1257/aer.103.7.2752.

Hidalgo, César A, and Ricardo Hausmann. 2009. “The Building Blocks of Economic Complexity.” *Proceedings of the National Academy of Sciences* 106 (26): 10570–75.

Johnson, Robert C, and Guillermo Noguera. 2012. “Accounting for Intermediates: Production Sharing and Trade in Value Added.” *Journal of International Economics* 86 (2): 224–36.

Klimek, Peter, Ricardo Hausmann, and Stefan Thurner. 2012. “Empirical Confirmation of Creative Destruction from World Trade Data.” *PloS One* 7 (6): e38924.

Kowalkowski, Christian, Heiko Gebauer, and Rogelio Oliva. 2017. “Service Growth in Product Firms: Past, Present, and Future.” *Industrial Marketing Management* 60 (January): 82–88. https://doi.org/10.1016/j.indmarman.2016.10.015.

Lazarsfeld, Paul F. 1950. “The Logical and Mathematical Foundation of Latent Structure Analysis.” *Studies in Social Psychology in World War II Vol. IV: Measurement and Prediction*, 362–412.

Lightfoot, H., T. Baines, and P. Smart. 2013. “The Servitization of Manufacturing: Investigating Contributionsto Knowledge Production.” *International Journal of Operations & Production Management* 33 (11/12): 1408–34.

Neely, Andy. 2008. “Exploring the Financial Consequences of the Servitization of Manufacturing.” *Operations Management Research* 1 (2): 103–18. https://doi.org/10.1007/s12063-009-0015-5.

Ochel, Wolfgang, and Manfred Wegner. 2019. *Service Economies in Europe: Opportunities for Growth*. New York, Abingdon: Routledge, Taylor and Francis. https://books.google.at/books?hl=de&lr=&id=FGQPEAAAQBAJ&oi=fnd&pg=PP1&dq=%22service+demand%22+economic+growth+club++&ots=2g0kuQ24G-&sig=n3HwzkuZpVtY_Q9A-CCJziM2BdQ#v=onepage&q=%22service%20demand%22%20economic%20growth%20club&f=false.

Oliva, Rogelio, and Robert Kallenberg. 2003. “Managing the Transition from Products to Services.” *International Journal of Service Industry Management* 14 (2): 160–72. https://doi.org/10.1108/09564230310474138.

Peneder, Michael. 2009. *Sectoral Growth Drivers and Competitiveness in the European Union*. Office for Official Publications of the European Communities.

Peneder, Michael, and Gerhard Streicher. 2017. “De-Industrialization and Comparative Advantage in the Global Value Chain.” *Economic Systems Research*, 1–20.

Reinstaller, Andreas, and Peter Reschenhofer. 2019. “The Impact of the Scope of Technological Search on Path-Dependence in Export Specialization: Evidence for European Countries.” *Industrial and Corporate Change* 28 (6): 1611–35. https://doi.org/10.1093/icc/dtz026.

Roodman, David. 2009. “How to Do Xtabond2: An Introduction to Difference and System GMM in Stata.” *The Stata Journal* 9 (1): 86–136.

Rowthorn, Robert, and Ramana Ramaswamy. 1999. “Growth, Trade, and Deindustrialization.” *IMF Staff Papers* 46 (1): 18–41.

Timmer, Marcel P, Abdul Azeez Erumban, Bart Los, Robert Stehrer, and Gaaitzen J de Vries. 2014. “Slicing up Global Value Chains.” *The Journal of Economic Perspectives* 28 (2): 99–118.

Timmer, Marcel P, Sébastien Miroudot, and Gaaitzen J de Vries. 2019. “Functional Specialisation in Trade.” *Journal of Economic Geography* 19 (1): 1–30.

Vandermerwe, Sandra, and Juan Rada. 1988. “Servitization of Business: Adding Value by Adding Services.” *European Management Journal* 6 (4): 314–24.

Wise, Richard, and Peter Baumgartner. 1999. "Go Downstream." *Harvard Business Review* 77 (5): 133–133.

Tables and Figures

Table 1: Knowledge-intensive services: descriptive statistics

	Service share	HTKI	KIMS	OKIS	KIFS	Not KIS
Mean	9.86	1.66	1.66	0.77	0.00	5.76
Median	5.76	0.33	0.43	0.00	0.00	3.78
Std. Dev.	13.14	4.24	4.06	5.36	0.03	7.19

Note: This table provides the descriptive statistics for the share of services provided by manufacturing in the pooled sample and an ANOVA using sector, country, and time effects as explanatory variables. HTKI denotes "High-tech knowledge-intensive services", KIMS "Knowledge-intensive market services (excluding financial intermediation and high-tech services)", OKIS "Other knowledge-intensive services" and KIFS "Knowledge-intensive financial services".

Table 2: Knowledge-intensive services: Multivariate, fixed effect ANOVA results

	Service share	HTKI	KIMS	OKIS	KIFS	Not KIS
R^2	0.45	0.31	0.22	0.23	0.15	0.42
Sector	0.19	0.15	0.07	0.14	0.04	0.10
Country	0.26	0.15	0.15	0.09	0.11	0.32
Year	0.01	0.01	0.00	0.00	0.00	0.01

Note: This table provides the results of the multivariate, fixed effects ANOVA that show the fraction of the variance explained by the individual sector, country, and time effects. HTKI denotes "High-tech knowledge-intensive services", KIMS "Knowledge-intensive market services (excluding financial intermediation and high-tech services)", OKIS "Other knowledge-intensive services" and KIFS "Knowledge-intensive financial services".

Table 3: Dynamic panel regression (system GMM), full sample

	(1)	(2)	(3)	(4)	(5)	(6)
	Emp. Growth	Emp. Growth	Lab. Prod. Growth	Lab. Prod. Growth	TFP Growth	TFP Growth
Dep.Var., lag, levels	-0.03	-0.03*	-0.63***	-0.62***	-0.18***	-0.09***
	(0.020)	(0.016)	(0.048)	(0.050)	(0.040)	(0.011)
Service share, log	0.00		-0.14		-0.01	
	(0.011)		(0.091)		(0.016)	
HTKI share, log		0.01**		-0.11*		0.01
		(0.006)		(0.058)		(0.010)
KIMS share, log		-0.01		-0.06		0.01
		(0.007)		(0.061)		(0.008)
KIFS share, log		0.14**		0.33		0.11
		(0.058)		(0.468)		(0.115)
OKIS share, log		-0.00		-0.10		-0.00
		(0.006)		(0.063)		(0.005)
Capital stock, log	0.00	0.00	0.55***	0.54***		
	(0.004)	(0.004)	(0.059)	(0.060)		
Output gap, log	0.04***	0.04***	0.05	0.08***	0.05*	0.04*
	(0.007)	(0.007)	(0.031)	(0.031)	(0.029)	(0.023)
Sector effects	Y	Y	Y	Y	Y	Y
Country effects	Y	Y	Y	Y	Y	Y
Time effects	Y	Y	Y	Y	Y	Y
Observations	4,257	4,257	4,256	4,256	2,027	2,027
Hansen test	0.015	1.000	0.002	0.000	1.000	1.000
AR(1), p-value	0.000	0.000	0.000	0.000	0.002	0.001
AR(2), p-value	0.082	0.084	0.029	0.030	0.189	0.194

Note: This table shows the results of the system GMM regressions (Blundell and Bond 1998) across country groups. The dependent variable is estimated in logarithmic growth rates, and the level of the lagged dependent variable is included in the right hand side of the equation, i.e. the logarithmic level of persons employed in specification (1) and (2), the labor productivity in (3) and (4) and TFP in (5) and (6). HTKI denotes "High-tech knowledge intensive services", KIMS "Knowledge-intensive market services", KIFS "Knowledge-intensive financial services" and OKIS "Other knowledge-intensive services". The post estimation tests support the dynamic specification in most specifications. Robust standard errors are reported in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Dynamic panel regression (system GMM), country groups

	(1) Emp. Growth	(2) LP Growth	(3) TFP Growth	(4) Emp. Growth	(5) LP Growth	(6) TFP Growth	(7) Emp. Growth	(8) LP Growth	(9) TFP Growth
Country Group	CEE	CEE	CEE	EU15	EU15	EU15	OECD	OECD	OECD
Dep.Var., t-1, levels	0.00	-0.33***	-0.17***	-0.02***	-0.53***	-0.09***	-0.02***	-0.54***	-0.09***
	(0.006)	(0.032)	(0.043)	(0.007)	(0.076)	(0.010)	(0.007)	(0.076)	(0.010)
Service share, log	-0.00	-0.20*	-0.01	0.02**	-0.13*	0.01	0.01*	-0.11	0.02
	(0.013)	(0.107)	(0.018)	(0.007)	(0.065)	(0.014)	(0.008)	(0.069)	(0.013)
Capital stock, log	0.00	0.25***		0.02***	0.02		0.02***	0.03	
	(0.002)	(0.037)		(0.006)	(0.026)		(0.006)	(0.024)	
Output gap, log	0.03***	0.10**	0.11	0.03***	0.09**	0.04	0.03***	0.10**	0.05*
	(0.010)	(0.047)	(0.070)	(0.008)	(0.045)	(0.027)	(0.008)	(0.046)	(0.026)
Sector effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Country effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1,983	1,982	357	2,120	2,120	1,530	2,274	2,274	1,670
Hansen J-test	1.000	1.000	1.000	1.000	1.000	1.000	0.999	1.000	1.000
AR(1), p-value	0.000	0.000	0.013	0.028	0.006	0.009	0.027	0.006	0.008
AR(2), p-value	0.010	0.001	0.254	0.388	0.554	0.128	0.397	0.608	0.138

Note: This table shows the results of the system GMM regressions (Blundell and Bond 1998) across country groups. The dependent variable is estimated in logarithmic growth rates, and the level of the lagged dependent variable is included in the right hand side of the equation, i.e. the logarithmic level of persons employed in specification (1) and (2), the labor productivity in (3) and (4) and TFP in (5) and (6). The post estimation tests support the dynamic specification in most specifications. Robust standard errors are reported in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Dynamic panel regression (system GMM), country groups

	(1) Emp. Growth	(2) LP Growth	(3) TFP Growth	(4) Emp. Growth	(5) LP Growth	(6) TFP Growth	(7) Emp. Growth	(8) LP Growth	(9) TFP Growth
Country Group	CEE	CEE	CEE	EU15	EU15	EU15	OECD	OECD	OECD
Dep.Var., t-1, levels	-0.05***	-0.73***	-0.22**	-0.04	-0.75***	-0.09***	-0.04	-0.75***	-0.09***
	(0.019)	(0.055)	(0.084)	(0.025)	(0.069)	(0.009)	(0.025)	(0.071)	(0.009)
HTKI share, log	0.03***	-0.14	-0.06*	-0.00	0.07	0.01	-0.00	0.07	0.01
	(0.009)	(0.096)	(0.033)	(0.004)	(0.053)	(0.011)	(0.004)	(0.052)	(0.010)
KIMS share, log	-0.02*	0.06	-0.03	0.01	-0.04	0.01	0.01	-0.08*	0.01
	(0.013)	(0.100)	(0.032)	(0.006)	(0.045)	(0.010)	(0.006)	(0.045)	(0.007)
KIFS share, log	0.07	0.66	0.29	0.07	-0.96**	-1.72	0.08	-0.72*	-1.53*
	(0.100)	(0.723)	(0.214)	(0.059)	(0.395)	(1.056)	(0.058)	(0.410)	(0.925)
OKIS share, log	0.00	-0.10	0.00	0.00	-0.04	-0.01*	0.00	-0.05	-0.01*
	(0.008)	(0.147)	(0.013)	(0.004)	(0.045)	(0.005)	(0.004)	(0.042)	(0.004)
Capital stock, log	0.00	0.69***		0.02	0.16***		0.02	0.17***	
	(0.003)	(0.063)		(0.014)	(0.060)		(0.014)	(0.059)	
Output gap, log	0.03***	0.10**	0.08	0.04***	0.04	0.02	0.04***	0.04	0.02
	(0.010)	(0.045)	(0.092)	(0.007)	(0.039)	(0.027)	(0.007)	(0.038)	(0.025)
Sector effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Country effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	1,983	1,982	357	2,120	2,120	1,530	2,274	2,274	1,670
Hansen J-test	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
AR(1), p-value	0.000	0.000	0.010	0.0219	0.0218	0.009	0.021	0.022	0.008
AR(2), p-value	0.009	0.002	0.278	0.387	0.663	0.127	0.397	0.756	0.138

Note: This table shows the results of the system GMM regressions (Blundell and Bond 1998) across country groups. Countries are grouped into CEE countries (i.e. central and eastern European countries), EU15 and OECD countries. The dependent variable is estimated in logarithmic growth rates, and the level of the lagged dependent variable is included in the right hand side of the equation, i.e. the logarithmic level of persons employed in specification (1), (4) and (7), the labor productivity in (2), (5) and (8) and TFP in (3), (6) and (9). HTKI denotes "High-tech knowledge intensive services", KIMS "Knowledge-intensive market services", KIFS "Knowledge-intensive financial services" and OKIS "Other knowledge-intensive services". The post estimation tests support the dynamic specification for the productivity indicators, but not for employment. Robust standard errors are reported in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Descriptive statistics and correlation matrix of covariates of the LCA

		Mean	St. dev.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1)	GDP p.c. (log)	3.20	0.88	1								
(2)	Labor prod. (log)	2.87	1.67	0.6105*	1							
(3)	Manufacturing share	0.21	0.06	-0.1514*	-0.1855*	1						
(4)	Output in final demand, share	0.29	1.38	-0.0158	-0.0141	0.0695	1					
(5)	Sophistication	1.13	0.64	0.6535*	0.5185*	0.4234*	0.0228	1				
(6)	HTKI	2.64	3.98	0.1611*	0.0608	-0.0169	0.0325	0.1134	1			
(7)	KIMS	2.64	3.75	0.1873*	0.0486	-0.1083	-0.0476	0.0845	0.3425*	1		
(8)	Other Services offered	6.69	6.73	0.1811*	0.0029	-0.1722*	0.0368	-0.0419	0.4344*	0.3767*	1	
(9)	Backward, serv.	0.30	0.05	0.0594	0.0866	-0.127	-0.1167	0.0568	0.1	0.1231	0.0985	1

Note: The table reports the descriptive statistics and the correlation coefficients of the variables used in the analysis. * $p<0.05$.

Table 7: Marginal means across latent classes

	I	II	III	IV	V	VI
GDP p.c. in td. EUR	6.26	19.89	16.45	49.42	48.34	52.15
LP, in td EUR	1.39	21.35	7.14	52.70	54.21	31.04
Manufacturing share	0.21	0.16	0.29	0.17	0.26	0.17
Sophistication	0.34	0.59	1.36	1.49	2.00	1.42
Services sourced	0.29	0.32	0.29	0.31	0.31	0.31
Output in final demand	0.43	0.44	0.22	0.37	0.35	0.39
HTKI, share	1.50	2.07	2.28	2.68	2.20	16.16
KIMS, share	1.68	2.36	1.86	2.98	2.49	11.44
Other services, share	5.92	6.18	5.12	5.88	5.94	32.23

Note: The table provides both the GDP per capita and the sectoral labor productivity in thousand EURO in real terms (base year 2010). In the LCA, these variables were estimated in logarithmic terms.

Table 8: Median class assignment at the country level

Class	Economic model	Country (ISO2)
I	Developing economies	BG, EE, RO, TR, IN, LT
II	Catching-up, service based	CY, MT, AU, LV, PT, GR, BR, ES, HR
III	Catching-up, manuf. Based	KR, SK, SI, PL, HU, CZ
IV	Developed, service based	NL, GB, CA, BE, NO, IT, US, DK
V	Developed, manuf. Based	FI, SE, IE, JP, DE, CH, AT
VI	Developed, service driven	LU

Note: The table reports the median class obtained from the latent class analysis, indicating countries' growth models in the period analyzed.

Figure 1: Latent Class Analysis