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The role of services in globalisation

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1 | INTRODUCTION

Empirical trade research is focused on manufactured goods despite the rapid growth of services trade (Feenstra, 2016). To a large extent, this is caused by data restrictions on services trade. Services are not only directly traded but also indirectly embodied in manufacturing exports (Drake-Brockman & Stephenson, 2012). The indirect contributions of (domestic) services inputs in exported manufactured goods are not captured by traditional statistics such as balance of payments statistics.[1] Gross exports thereby—potentially—understate the significance of services, and also the extent of globalisation (Johnson, 2014).

This paper focuses on the role of services and addresses the following two questions to highlight the growing importance of services trade. First, it is often stated that the growing usage of information and communication technologies has expanded the scope of services and enhanced their tradability (Baldwin, 2016). Is this trend reflected in a rising importance of trade in services relative to trade in manufactured goods over time? Second, assuming relatively low transport barriers related to services, trade in services (when compared to manufacturing) could be more important in interregional trade than in intraregional trade. The ICT revolution reduces trade barriers and facilitates fragmentation of the production process (Baldwin, 2016). Do services, which we define in a broad sense to include both embedded services and direct services exports, therefore travel further than manufactured goods? These questions follow Low's (2013) call for more analytical research on the characteristics of services in global value chains. They also serve the goal of Baldwin and Lopez-Gonzalez (2015) to stimulate more empirical and theoretical work on how the internationalisation of production has altered the nature and impact of globalisation.

The analysis is primarily based on trade in value-added. The trade in value-added perspective employs a different method than does a standard trade analysis based on gross trade. This approach involves using input–output analysis to measure the value-added produced in one country that ends up in the consumption bundle of another country. In the case of services trade, this captures the direct value-added of domestic services industries that is embodied in a product traded by

[1]Trade in services data is collected according to the Extended Balance of Payments System (EBOPS) in the International Monetary Fund's *Balance of Payments Statistics*, but the quality is lower than for goods trade; in addition, few countries provide bilateral data or much product level detail (Ahmad, Bohn, Mulder, Vaillant, & Zaclicever, 2017).

the same industry, the indirect value-added of domestic services industries that is embodied in traded manufactured goods, and the indirect value-added of services industries that is embodied in all other traded products (including agricultural products and products traded by downstream services industries). The final demand approach is inclusive as it accounts for all sources of value-added and does not separate out the direct from indirect value-added contributions of domestic services industries in trade. We use two indicators to capture the significance of services both from an upstream and a downstream viewpoint.

Previous research shows that three-quarters of all services embodied in value-added trade are embedded services rather than directly traded (Heuser & Mattoo, 2017). To provide a complementary analysis that considers only directly traded products, we compare the value-added data to a more conventional approach that draws upon gross exports. Gross exports provide only the value of all products directly exported by services industries and manufacturing industries (even if there are industries from other sectors that contribute to their respective total export values). The distinction between embedded services and directly traded services is important when the relative distances of services and manufactured goods in trade are analysed in Section 4.2. The main source for the analyses is the World Input-Output Database (Dietzenbacher, Los, Stehrer, Timmer, & de Vries, 2013), containing time-series data on trade linkages for 43 countries and 56 industries.

In general, we find that trade in value-added created in services increased more than trade in value-added created in manufacturing during the period 2000–14. This holds especially for the European Union and North America. Second, trade of value-added in services is traded over longer distances than trade of value-added in manufacturing. That is, services had a larger share in the interregional exports of value-added than in the intraregional exports of value-added and the opposite held for manufacturing. In Europe, it was especially the value-added created in financial intermediation services and business services (IT and consulting) that was more important in interregional trade in value-added. The findings hold not only for trade in value-added indicators (which account for the large indirect value-added created by services industries) but also when indicators are used that capture the direct exports of services industries themselves (gross export figures). These findings add to our knowledge of globalisation: trade is increasing worldwide, and interregional globalisation in the sense of rising trade between countries from different regions is related to the role of services being more truly global than the role of manufacturing.

The paper is structured as follows. Section 2 explains why services may be growing in importance in trade. It is explained how a value chain-based approach provides a better statistical depiction of the services embodiment of trade. Section 3 describes the approach to measure services trade and presents the methodology and data sources. Indicators are introduced to measure a country's dependence on trade as a share of its GDP and final demand. Section 4 applies the indicators to answer the research questions. Section 5 concludes and discusses some implications.

2 | LITERATURE

2.1 | The growing importance of services

Recent growth in world trade is closely intertwined with the emergence of global production networks.[2] Specialisation no longer refers to sectors within countries but to specialisation in different activities within production networks. This implies that international trade is characterised by trade

[2]Equivalent terms commonly used to refer to the importance of international production networks include the unbundling or fragmentation of production, supply chain trade, trade in tasks and vertical specialisation.

in intermediate products (Jones & Kierzkowski, 2001). The international fragmentation of production has been helped by the ICT revolution that came on top of the sharp decline in trade barriers since the late 1980s. Baldwin (2006, 2016) refers to this phenomenon as the "second unbundling" and argues that it represents the transition to a new era of globalisation.[3] These developments can be illustrated from the perspective of global value chains (GVCs). A GVC encompasses all productive (value-adding) activities across countries involved in bringing a product to the final consumer. This includes initial conception (e.g., R&D), production, assembly, marketing and distribution, final delivery and support (Gereffi & Fernandez-Stark, 2016). While the final product in a GVC is completed in one country only and then sent to the consumer, the product contains intermediate inputs and value-added contributions sourced from one or more countries.

The "second unbundling" is not just a technological revolution in manufacturing but also a revolution in services as the use of services is pivotal in the spatial unbundling of tasks. The rise of information and communication technologies (ICT) reduced the coordination costs of complex production processes, enabling the global fragmentation of production. Embodied services were also traded in antiquity (see O'Rourke & Williamson, 2002; who debate how long ago globalisation began), but sophisticated ICT services, transport and financial services have in recent decades helped to facilitate highly fragmented production processes that source inputs (parts and components) from all over the world. For these reasons, services have been referred to as the "glue" linking fragments within production chains together (Drake-Brockman & Stephenson, 2012; Low, 2013). So, services can be expected to play an increasingly essential role in trade.

This also has policy consequences. The National Board of Trade (2012) of Sweden, for instance, indicates how GVCs have implications for trade policy and management of trade agreements. The authors argue that trade negotiators should not focus on manufactured goods or services in isolation but rather consider the interdependencies of the two and take the value chain into account.[4] Recent research also suggests that trade liberalisation in services, broadly defined as opening up the domestic market for foreign services providers, can induce a comparative advantage for downstream production processes that rely heavily upon services inputs. Countries that reduce trade restrictions for services and have complementary domestic regulatory policies are more likely to gain a comparative advantage in producing manufactured goods that depend on services (Van der Marel, 2016). Furthermore, liberalisation in services can stimulate productivity in manufacturing (Arnold, Javorcik, Lipscomb, & Mattoo, 2016).

Services account for 75% of GDP and 80% of employment in OECD countries (Nordas & Rouzet, 2015). However, the role of services in cross-border trade and production networks remains less understood. This is mainly caused by a lack of reliable data at the aggregate level and conceptual difficulties as to how to define a service and what the balance of payments measure (Broussolle, 2014, 2015). The rise of GVCs adds to this statistical challenge. Take for example, a Boeing 787 aircraft composed of parts and components produced in 5,000 factories worldwide before being assembled in the US (Kelly, 2012). The production of each component in turn requires subcomponents sourced from even more countries. In the current accounting system based on gross exports, these intermediates are counted each time they cross the border, including when embodied in downstream goods and services. This raises issues related to multiple-counting.

[3]Globalisation's "first unbundling" began in the 1820s with the spatial separation of production and consumption. One prominent study calls this first unbundling, fueled by the transport revolution, the "big bang" of globalisation (O'Rourke & Williamson, 2002).

[4]This discussion refers indirectly to the effective rate of protection (Bhagwati, Panagariya, & Srinivasan, 1998). This concept of protection explicitly includes supply chain effects.

The current accounting system retains legitimacy as long as countries exist because actual trade is still bilateral and these are the transactions that are registered by customs officials. However, relying solely on gross exports may lead to misleading interpretations when they are used by policymakers to assess trade competitiveness because sophisticated inputs may have been imported. The Boeing 787's final assembler, for example, contributes considerably less to the plane's production value than what is suggested by the plane's final export price. A GVC perspective can identify the largest value creators and also identify the final consumers in the end-market, whose demand triggers value-added production in other countries through their consumption of final goods and services. For these reasons, both the standard and GVC views have their legitimacy and contribute in complementary ways to the analysis of trade.

2.2 | Two questions

Manufacturing industries that are involved in trade—especially those involved in the production of elaborately transformed and high-value-added goods—depend on domestic services (Drake-Brockman & Stephenson, 2012). This implies that there are more services being traded than what is suggested by gross export statistics. Gross export statistics report the directly traded services, such as communications services, but not the domestic services that are embodied in the export of manufactured goods, commodities or even other services (which are hence traded indirectly). Therefore, focusing on the trade of value-added in service industries has two advantages. First, value-added trade has a higher correlation with domestic non-tradable services that are used as inputs than gross exports trade data. The latter only reflects the total value of the traded product and does not separate out the domestic non-tradable services component that contributes to its final value, such as embedded software in aircraft. Second, inputs passing through multiple countries within production networks are not double counted.

Whenever we refer to exports (or imports) of value-added, for example, the trade of value-added in services industries, we refer to the domestic value-added generated by the industries of this sector (i.e., services) that is consumed abroad (respectively imported and consumed domestically). In this way, there can be trade in value-added between two countries even if there is no bilateral trading relationship because the value-added may be delivered to final consumers via a third country. The final demand approach provides the location where the value-added is ultimately consumed, home or abroad, but does not decompose gross exports. Thus, while all value-added contributions of services industries to trade are accounted for, this inclusive approach does not distinguish between the trade of value-added in services that is embodied in products traded by manufacturing industries, traded by the same or different services industries or traded by other sectors (e.g., agricultural production). Similarly, the trade of value-added in manufacturing is considered to be all domestic value-added created in manufacturing industries—even if the value-added is embodied in a traded service—that ends up in the foreign consumption of final products. The industries included in the manufacturing sector, services sector and other production sector are provided in Appendix Table S1 in the online Supplementary Material. A more detailed explanation of the method and computations are provided in Section 3 on analytical framework.

The first question considers the increased tradability and importance of services over time, which Saez, Taglioni, van der Marel, and Zavacka (2014, p. 2) refer to as "one of the most important changes in trade patterns over the last quarter of the 20th century." Value-added trade of services industries is growing relative to value-added trade of manufactured goods industries. The growth of services in value-added trade is documented in previous studies (Heuser & Mattoo, 2017; Miroudot & Cadestin, 2017). For example, Heuser and Mattoo (2017) show that the share

of services in world value-added exports increased from about 30% to more than 40% since 1980. Our approach differs in that we use a final demand perspective and decompose the trade in value-added and gross exports on a regional basis (Europe, North America and East Asia). This could demonstrate how patterns in different regions may differ and whether the overall growth in services is a truly global phenomenon. Therefore, we ask the following question:

> *Question 1: Has trade of value-added in services industries become more important relative to trade of value-added in manufactured goods industries between 2000 and 2014?*

Next, we will focus on the distance traversed from the point of value creation to the point of consumption. In other words, does the value-added contributed by services or by manufacturing industries travel "further"? A clear difference in their average distances (in connection to the answer to the first question) may contribute to our understanding of the spatial reach of trade; the ICT revolution could have facilitated services trade of longer distances. Here too, value-added trade refers to both direct cross-border services trade and services embodied, for example, in the trade of manufactured goods. Due to data limitations on services, no existing study has looked into this issue.

Direct (non-embedded) services exports are by themselves not subject to transportation costs and this should in theory facilitate their trade over large distances. But also embedded services may traverse a longer distance because they add value to the exports of manufactured goods. Customised and elaborated products that embody more services (such as software) might reduce the impact of distance by decreasing relative transport costs. Even manufactured goods that do not embody many services, but which travel a longer distance will increase the role of services for the simple fact that transport costs are themselves considered a service.

On the other hand, recent studies have shown that trade costs for direct services trade are several times higher than for goods (Anderson, Milot, & Yotov, 2014; Miroudot, Sauvage, & Shepherd, 2013). Significant regulatory burdens, non-tariff barriers and trade restrictions for services persist and these are magnified as barriers for trade in goods decline. Impediments to services trade are highlighted by the OECD's Services Trade Restrictiveness Index. One could argue that regulatory burdens are greater across larger distances if the well-known liability of foreignness equally applies to trade in direct services. Restrictions on direct services trade also have an effect on embedded services because exported goods may depend on services inputs that need to be imported. This would suggest that value-added created by service industries may not travel further than value-added created by manufacturing industries.

Another factor that could play a role is that countries belonging to regional agreements may have a higher level of regulatory convergence in services. This suggests they may trade more direct services and also more embedded services because it would be easier to import foreign services inputs. Deeper agreements that also provide provisions for services are more common amongst geographically proximate countries (e.g., the EU), and hence, this could lead to a stronger regional nature of services trade. However, deeper regional agreements that promote regulatory convergence in services would likely also have provisions that stimulate the trade of manufactured goods. Thus, it is not clear whether the trade facilitating effect of regulatory convergence would be stronger on the services sector or on the manufacturing sector.

> *Question 2: Does trade of value-added in services industries travel further than trade of value-added in manufactured goods industries?*

3 | ANALYTICAL FRAMEWORK AND DATA SOURCES

To investigate the two research questions, we use world input–output tables (WIOTs). WIOTs illustrate flows (i.e., sales and purchases) of industry outputs (final and intermediate) within an economy.[5] WIOTs enable researchers to trace interdependencies in global production and the division of income in trade between industries, countries and regions. Value-added refers to the "difference between the value of output minus the sum of required intermediate inputs of goods and services" (Escaith, 2014a, p. 1). This is equivalent to total compensation for labour and capital.

There are two main approaches to measure value-added trade. The demand-side absorption approach (or "trade in value-added") computes how much value-added that is created in industry i in country r is contained in the demand for final products by country s (Johnson & Noguera, 2012). Final demand consists of the categories household consumption, government expenditures and investments. Note that it is possible that country s does not import from country r, whereas s's consumption bundle still embodies much value-added generated in r. In that case, there is no dependence in gross trade between r and s, whereas dependence in terms of trade in value-added does exist. Hence, even country pairs that have no gross bilateral trade may still be mutually dependent via third countries.

By comparison, the supply-based approach (or "value-added in trade") estimates country r's value-added embodied in its bilateral or total gross exports (Koopman, Wang, & Wei, 2014). The domestic value-added in gross exports is decomposed into three parts. First is direct domestic value-added created by the exporting industry in country r. Second is indirect domestic value-added through the exporting industry's use of inputs from domestic upstream industries. Third is re-imported domestic value-added. This is relevant in certain outsourcing arrangements such as circular trade. Semi-finished products may be shipped from the United States to Mexico for assembly before returning to the US for re-export. This method separates foreign value-added embodied in a country's exports from domestic value-added—also solving double-counting. Both demand-side and supply-side approaches are consistent in that they lead to similar total trade figures on the global level (Escaith, 2014b). A country's total trade surplus or deficit will be the same using either method, but bilateral trade balances between countries may differ.

This study applies the demand-side absorption approach which essentially answers the question "who generates how much value-added for whom?". The answer can be viewed from two different perspectives. These are the seller's or downstream viewpoint (which traces where the value-added goes to) and the buyer's or upstream viewpoint (which traces where the value-added—that composes all final demand—comes from). We employ measures that consider both upstream and downstream value-added based dependencies, formalising the concepts introduced by Johnson and Noguera (2012). Our starting-point is the WIOT in Table 1 with m countries, each with n industries.

The $mn \times mn$ matrix $\mathbf{D}$ of intermediate deliveries,[6] the $mn \times m$ matrix $\mathbf{F}$ of final demands, the mn-element output vector $\mathbf{z}$, and the mn-element value-added vector $\mathbf{v}$ are (in partitioned form) given by

[5]This follows the OECD's definition: http://www.oecd.org/trade/input-outputtables.htm.

[6]Matrices are in bold capital letters (e.g., $\mathbf{D}$ or $\mathbf{D}^{rs}$), vectors are in bold lower case letters (e.g., $\mathbf{z}$ or $\mathbf{z}^r$), and scalars are in italicized letters (e.g., n, z_i^r, or d_{ij}^{rs}). A circumflex (or "hat") is used to indicate a diagonal matrix (e.g., $\hat{\mathbf{z}}$ or $\hat{\mathbf{z}}^r$) and an apostrophe (or "dash") for transposition (e.g., $\mathbf{z}'$ or $(\mathbf{z}^r)'$).

TABLE 1 WIOT with m countries

	Intermediate deliveries							Final demands							
	1	⋯	***r***	⋯	***s***	⋯	***m***	**1**	⋯	***r***	⋯	***s***	⋯	***m***	**Total**
1	$\mathbf{D}^{11}$	⋯	$\mathbf{D}^{1r}$	⋯	$\mathbf{D}^{1s}$	⋯	$\mathbf{D}^{1m}$	$\mathbf{f}^{11}$	⋯	$\mathbf{f}^{1r}$	⋯	$\mathbf{f}^{1s}$	⋯	$\mathbf{f}^{1m}$	$\mathbf{z}^{1}$
⋮	⋮	⋱	⋮		⋮		⋮	⋮	⋱	⋮		⋮		⋮	⋮
r	$\mathbf{D}^{r1}$	⋯	$\mathbf{D}^{rr}$	⋯	$\mathbf{D}^{rs}$	⋯	$\mathbf{D}^{rm}$	$\mathbf{f}^{r1}$	⋯	$\mathbf{f}^{rr}$	⋯	$\mathbf{f}^{rs}$	⋯	$\mathbf{f}^{rm}$	$\mathbf{z}^{r}$
⋮	⋮		⋮	⋱	⋮		⋮	⋮		⋮	⋱	⋮		⋮	⋮
s	$\mathbf{D}^{s1}$	⋯	$\mathbf{D}^{sr}$	⋯	$\mathbf{D}^{ss}$	⋯	$\mathbf{D}^{sm}$	$\mathbf{f}^{s1}$	⋯	$\mathbf{f}^{sr}$	⋯	$\mathbf{f}^{ss}$	⋯	$\mathbf{f}^{sm}$	$\mathbf{z}^{s}$
⋮	⋮		⋮		⋮	⋱	⋮	⋮		⋮		⋮	⋱	⋮	⋮
m	$\mathbf{D}^{m1}$	⋯	$\mathbf{D}^{mr}$	⋯	$\mathbf{D}^{ms}$	⋯	$\mathbf{D}^{mm}$	$\mathbf{f}^{m1}$	⋯	$\mathbf{f}^{mr}$	⋯	$\mathbf{f}^{ms}$	⋯	$\mathbf{f}^{mm}$	$\mathbf{z}^{m}$
VA	$(\mathbf{v}^{1})'$	⋯	$(\mathbf{v}^{r})'$	⋯	$(\mathbf{v}^{s})'$	⋯	$(\mathbf{v}^{m})'$								
Total	$(\mathbf{z}^{1})'$	⋯	$(\mathbf{z}^{r})'$	⋯	$(\mathbf{z}^{s})'$	⋯	$(\mathbf{z}^{m})'$								

$$\mathbf{D}=\begin{bmatrix}\mathbf{D}^{11} & \cdots & \mathbf{D}^{1r} & \cdots & \mathbf{D}^{1s} & \cdots & \mathbf{D}^{1m}\\ \vdots & \ddots & \vdots & \ddots & \vdots & \ddots & \vdots\\ \mathbf{D}^{r1} & \cdots & \mathbf{D}^{rr} & \cdots & \mathbf{D}^{rs} & \cdots & \mathbf{D}^{rm}\\ \vdots & \ddots & \vdots & \ddots & \vdots & \ddots & \vdots\\ \mathbf{D}^{s1} & \cdots & \mathbf{D}^{sr} & \cdots & \mathbf{D}^{ss} & \cdots & \mathbf{D}^{sm}\\ \vdots & \ddots & \vdots & \ddots & \vdots & \ddots & \vdots\\ \mathbf{D}^{m1} & \cdots & \mathbf{D}^{mr} & \cdots & \mathbf{D}^{ms} & \cdots & \mathbf{D}^{mm}\end{bmatrix},\mathbf{z}=\begin{pmatrix}\mathbf{z}^{1}\\ \vdots\\ \mathbf{z}^{r}\\ \vdots\\ \mathbf{z}^{s}\\ \vdots\\ \mathbf{z}^{m}\end{pmatrix}$$

$$\mathbf{F}=\begin{bmatrix}\mathbf{f}^{11} & \cdots & \mathbf{f}^{1r} & \cdots & \mathbf{f}^{1s} & \cdots & \mathbf{f}^{1m}\\ \vdots & \ddots & \vdots & \ddots & \vdots & \ddots & \vdots\\ \mathbf{f}^{r1} & \cdots & \mathbf{f}^{rr} & \cdots & \mathbf{f}^{rs} & \cdots & \mathbf{f}^{rm}\\ \vdots & \ddots & \vdots & \ddots & \vdots & \ddots & \vdots\\ \mathbf{f}^{s1} & \cdots & \mathbf{f}^{sr} & \cdots & \mathbf{f}^{ss} & \cdots & \mathbf{f}^{sm}\\ \vdots & \ddots & \vdots & \ddots & \vdots & \ddots & \vdots\\ \mathbf{f}^{m1} & \cdots & \mathbf{f}^{mr} & \cdots & \mathbf{f}^{ms} & \cdots & \mathbf{f}^{mm}\end{bmatrix},\mathbf{v}=\begin{pmatrix}\mathbf{v}^{1}\\ \vdots\\ \mathbf{v}^{r}\\ \vdots\\ \mathbf{v}^{s}\\ \vdots\\ \mathbf{v}^{m}\end{pmatrix}$$

Element d_{ij}^{rs} of the $n \times n$ matrix $\mathbf{D}^{rs}$ gives the money value (say in million dollars, m$) of intermediate deliveries from industry i in country r to industry j in country s, element f_i^{rs} of the n-element vector $\mathbf{f}^{rs}$ gives the deliveries from industry i in country r for final demands in country s, element z_i^r of the n-element vector $\mathbf{z}^r$ gives the output of industry i in country r and element v_i^r of the n-element vector $\mathbf{v}^r$ gives the value-added generated in industry i in country r. The $mn \times mn$ matrix with input coefficients is given by $\mathbf{A}=\mathbf{D}\hat{\mathbf{z}}^{-1}$, implying $\mathbf{A}^{rs}=\mathbf{D}^{rs}(\hat{\mathbf{z}}^{s})^{-1}$or $a_{ij}^{rs}=d_{ij}^{rs}/z_j^s$ which gives the intermediate inputs per unit of the receiving industry's output. In the same fashion, the value-added coefficients are given by $\mathbf{g}'=\mathbf{v}\hat{\mathbf{z}}^{-1}$, implying $(\mathbf{g}^{r})'=(\mathbf{v}^{r})'(\hat{\mathbf{z}}^{r})^{-1}$ or $g_i^r=v_i^r/z_i^r$ which gives the value-added in industry i in country r per unit of its output.

From the WIOT in Table 1, it follows that $\sum_{s=1}^{m}\mathbf{D}^{rs}\mathbf{e}+\sum_{s=1}^{m}\mathbf{f}^{rs}=\mathbf{z}^{r}$, where $\mathbf{e}$ is a summation vector (consisting of ones) of appropriate length. Using the definition of the input coefficients ($\mathbf{D}^{rs}=\mathbf{A}^{rs}\hat{\mathbf{z}}^{s}$) yields $\sum_{s=1}^{m}\mathbf{A}^{rs}\mathbf{z}^{s}+\sum_{s=1}^{m}\mathbf{f}^{rs}=\mathbf{z}^{r}$, or $\mathbf{z}=\mathbf{A}\mathbf{z}+\mathbf{F}\mathbf{e}$. Its solution is given by $\mathbf{z}=\mathbf{L}\mathbf{F}\mathbf{e}$, where the $mn \times mn$ matrix $\mathbf{L}\equiv(\mathbf{I}-\mathbf{A})^{-1}$ is the Leontief inverse, which—in its partitioned form—is given by

$$\mathbf{L} = \begin{bmatrix} \mathbf{L}^{11} & \cdots & \mathbf{L}^{1r} & \cdots & \mathbf{L}^{1s} & \cdots & \mathbf{L}^{1m} \\ \vdots & \ddots & \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{L}^{r1} & \cdots & \mathbf{L}^{rr} & \cdots & \mathbf{L}^{rs} & \cdots & \mathbf{L}^{rm} \\ \vdots & \ddots & \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{L}^{s1} & \cdots & \mathbf{L}^{sr} & \cdots & \mathbf{L}^{ss} & \cdots & \mathbf{L}^{sm} \\ \vdots & \ddots & \vdots & \ddots & \vdots & \ddots & \vdots \\ \mathbf{L}^{m1} & \cdots & \mathbf{L}^{mr} & \cdots & \mathbf{L}^{ms} & \cdots & \mathbf{L}^{mm} \end{bmatrix}$$

For any final demand vector, we can calculate the outputs in each country and next how much value-added is involved. Take the final demands in country s (i.e., $\mathbf{f}^{ts}$, with $t = 1, \ldots, m$). The production in country r that is necessary to satisfy these (and only these) final demands is $\sum_{t=1}^{m} \mathbf{L}^{rt}\mathbf{f}^{ts}$. Premultiplying this production in country r with the value-added coefficients gives the vector $\sum_{t=1}^{m} \hat{\mathbf{g}}^{r}\mathbf{L}^{rt}\mathbf{f}^{ts}$. Its ith element gives the value-added generated in industry i in country r that is embodied in the final demands in country s. The total value-added generated in country r that is embodied in the final demands in country s then is $\sum_{t=1}^{m} (\mathbf{g}^{r})'\mathbf{L}^{rt}\mathbf{f}^{ts}$. If $r \neq s$, it gives the value-added of country r that is ultimately absorbed by the final users in country s or, in other words, the exports of value-added from r to s. For the value-added exports, we thus have $VAX^{rs} = \sum_{t=1}^{m} (\mathbf{g}^{r})'\mathbf{L}^{rt}\mathbf{f}^{ts}$.

We can now create an $m \times m$ matrix with VAX^{rs} (including the diagonal elements with $r = s$). It can be shown that its rowsums equal the GDP of the corresponding country (i.e., $\sum_{s=1}^{m} VAX^{rs} = GDP^{r}$). Taking the downstream perspective, the answer to the question "where does the value-added of country r go to?" is: VAX^{rr} is for the own final users, $\sum_{s \neq r} VAX^{rs}$ is exported and is for final users abroad. Normalising the rows of the matrix with VAX^{rs} gives percentages or ratios. The exports of value-added indicator is defined as:

$$XVA^{rs} = \frac{VAX^{rs}}{GDP^{r}}. \tag{1}$$

It expresses the share of country r's GDP that is exported to country s and is embodied in its final demands. The share of GDP^{r} that is exported yields (by summing over all destination countries) $XVA^{r} = \sum_{s \neq r} XVA^{rs}$.

In the same fashion, it can be shown that the column-sums equal the total value of final demands of the corresponding country (i.e., $\sum_{r=1}^{m} VAX^{rs} = \sum_{r=1}^{m} \sum_{i=1}^{n} f_{i}^{rs} = FD^{s}$). Note that all final demands consist of pieces of value-added that are consumed by final users. The upstream perspective thus asks "where does the consumed value-added in country s come from?" and the answer is: VAX^{ss} is by the own producers, $\sum_{r \neq s} VAX^{rs}$ is imported (and is thus generated by producers abroad). Normalising the columns of the matrix with VAX^{rs} gives the shares again. The imports of value-added indicator is defined as:

$$MVA^{rs} = \frac{VAX^{rs}}{FD^{s}}. \tag{2}$$

It expresses the share of country s's total value of final demand (FD) that is imported from and generated by country r. In other words, the value-added imports from r as a share of total final demands in country s.

To assess whether services travel further than manufactured goods (Section 4.2), it is necessary to distinguish between dependence on intraregional and interregional trade. In the empirical

application we will focus on three regions: EU, which consists of all 28 members of the European Union; North America, which consists of the three NAFTA countries Canada, Mexico and the United States; and East Asia, which consists of China, Japan, Korea and Taiwan. These are also the regions analysed in the two studies most closely related to this paper, Los, Timmer, and de Vries (2015) and Baldwin and Lopez-Gonzalez (2015).

The XVA and MVA indicators are split into intraregional and interregional components. Let us indicate a region with a capital letter. Then, the intraregional XVA for region R is obtained by summing the value-added exports of all members of R to all other countries in R, and taken as a share of regional GDP. Hence, for the intraregional XVA we have:

$$INXVA^R = \frac{\sum_{r\in R}\sum_{s\in R}(VAX^{rs} - VAX^{rr})}{\sum_{r\in R} GDP^r}. \tag{3}$$

The interregional XVA (IRXVA) measures the value-added exports to countries outside the region. We have:

$$IRXVA^R = \frac{\sum_{r\in R}\sum_{s\notin R} VAX^{rs}}{\sum_{r\in R} GDP^r}. \tag{4}$$

Note that $INXVA^R + IRXVA^R = XVA^R$, with:

$$XVA^R = \frac{\sum_{r\in R}\sum_{s}(VAX^{rs} - VAX^{rr})}{\sum_{r\in R} GDP^r}. \tag{5}$$

The split of the MVA indicator into an intraregional and an interregional component is similar. That is, $INMVA^R = \sum_{r\in R}\sum_{s\in R}(VAX^{rs} - VAX^{rr})/\sum_{s\in R} FD^s$ and $IRMVA^R = \sum_{r\notin R}\sum_{s\in R} VAX^{rs}/\sum_{s\in R} FD^s$.

When discussing the results, we will distinguish between the contributions of three sectors to trade flows in value-added and dependency shares. These are manufacturing, services and other production. Recall that $\sum_{t=1}^{m}\hat{\mathbf{g}}^r\mathbf{L}^{rt}\mathbf{f}^{ts}$ is an n-element vector and its ith element gives the value-added generated in industry i in country r that is embodied in the final demands in country s. Denote this by VAX_i^{rs}. Then, we can split XVA^R for region R as: $XVA^R_{Manuf} + XVA^R_{Services} + XVA^R_{Other}$, with, for example,

$$XVA^R_{Manuf} = \frac{\sum_{r\in R}\sum_{s}\sum_{i\in Manuf}\left(VAX_i^{rs} - VAX_i^{rr}\right)}{\sum_{r\in R} GDP^r} \tag{6}$$

There is online Supplementary Material with a set of Appendix tables (Tables S2–S7) that contain the results at industry level.

We use the 2016 release of the World Input-Output Database (WIOD) (Timmer, Dietzenbacher, Los, Stehrer, & de Vries, 2015). This database contains annual time-series of WIOTs for the period 2000–14. The consistent and harmonised tables include detailed data for 43 countries (including all 28 EU members and the major advanced and emerging economies) and 56 industries. In this paper, services are defined in a broad sense and include financial services; real estate; business services; transport services; post and telecommunications; education; public administration; health and social work; and wholesale trade and retail trade services. According to this broad definition, 29 of the 56 industries in the database are considered services industries. These 29 industries—numbered 28–56 in Table S1 in the online Supplementary Material—are considered part of the services sector in this analysis.[7] The

[7]Industries numbered 5–23 in Appendix Table S1 in the online Supplementary Material are considered part of the manufacturing sector; and industries numbered 1–4 and 24–27 are considered part of the other production sector.

2016 release of the WIOD is an update of the 2013 version of the database, which covered 40 countries and a slightly earlier timeframe. The 2016 version offers more industry-level detail than the initial WIOD release. For example, the new version includes a disaggregation of business services. Reliable and detailed data for business services are useful, because business services are known to play a key role in global value chains (Berry, Bohn, & Mulder, 2016).

Services data are the weakest part of current trade databases. This is because of the intangible characteristic of services output and the resulting challenge in capturing services trade flows. These challenges also hold for the WIOD and certain balancing procedures and assumptions were necessary for the construction of internally consistent tables. Services data in the WIOD use alternative data sources than standard balance of payments statistics (customs information) because the database builds on international supply-use tables, which are sometimes regarded as providing more reliable data for services (Miroudot & Shepherd, 2016). For these reasons, the WIOD is regarded as a comprehensive, reliable and consistent database.

4 | EMPIRICAL RESULTS

This section investigates evolving dependencies of the European Union, North American and East Asian regions on trade in value-added by applying the XVA and MVA indicators. Section 4.1 examines the extent to which trade of value-added in services industries is (or is not) becoming more important relative to trade of value-added in manufactured goods industries over time. This involves deriving sectoral shares of both value-added based indicators. Section 4.2 considers whether services or manufactured goods travel "further" in value-added trade. The results based on gross exports (from the same database) serve as a benchmark.

4.1 | Identifying the relative importance of services trade over time

Table 2 reports the indicators XVA and MVA for the European Union's, North American and East Asian trade in value-added. The exports of value-added as a share of regional GDP were given by Equation (6), and the imports of value-added as a share of regional final demand are obtained from using a similar equation. The results are given for the years 2000 and 2014, and by sector. The sectors (that account for the entire economy) are: manufacturing (M), services (S) and other production (O), which includes agriculture, mining and quarrying, electricity and construction. The two years are the first and last year in the database.[8]

Using Equation (5), we have (note that XVA is a weighted average of the XVAs of the individual countries):

$$XVA^R = \sum_{r\in R}\left[\sum_s (VAX^{rs} - VAX^{rr})/GDP^r\right]\frac{GDP^r}{\sum_{r\in R} GDP^r} = \sum_{r\in R} XVA^r \frac{GDP^r}{\sum_{r\in R} GDP^r}. \quad (7)$$

Table 2 shows that the average EU country exported 23.3% of its GDP in 2000, which rose to 27.6% in 2014, an increase of 4.3 percentage points (p.p.). That is, foreign final users (responsible for household consumption, private investments and government expenditures) generate

[8]Only the results for 2000 and 2014 are displayed and the results are aggregated on a regional level to illustrate the most important trends. However, results for individual countries within each region and for all 15 years are available upon request.

TABLE 2 Trade in value-added and gross exports for three regions (European Union, North America and East Asia) and sectors

	European Union				North America				East Asia			
	M	S	O	T	M	S	O	T	M	S	O	T
XVA												
2000	10.0	11.3	2.1	23.3	3.7	4.3	0.9	9.0	7.4	5.0	1.0	13.3
2014	10.2	15.0	2.4	27.6	3.6	5.5	1.8	10.8	9.6	7.1	2.3	19.0
Change	0.2	3.7	0.4	4.3	−0.2	1.2	0.9	1.9	2.2	2.2	1.2	5.7
MVA												
2000	9.3	9.9	3.3	22.5	5.1	4.1	1.8	11.1	4.3	4.0	2.4	10.8
2014	8.7	11.5	4.3	24.6	5.0	4.8	2.7	12.6	5.2	5.5	4.7	15.4
Change	−0.6	1.6	1.0	2.0	−0.1	0.7	0.9	1.5	0.9	1.5	2.3	4.6
XGT												
2000	23.7	8.4	1.8	33.9	7.9	3.3	0.9	12.0	13.8	3.0	0.2	17.1
2014	27.2	14.0	2.3	43.5	8.0	4.5	1.7	14.1	21.5	4.2	0.3	26.1
Change	3.5	5.6	0.5	9.6	0.0	1.2	0.8	2.1	7.7	1.2	0.1	9.0

Notes: The European Union includes all 28 EU members, North America includes Canada, Mexico and the United States, and East Asia consists of China, Japan, Korea and Taiwan. The sectors are as follows: M = manufacturing; S = services; O = other production; and T = total/sum of all sectors. XVA refers to value-added exports as a share of GDP, averaged over the countries in the region. MVA refers to value-added imports as a share of total final demand, averaged over the countries in the region. XGT refers to total gross exports as a share of GDP, averaged over the countries in the region. Note that all data are rounded to the nearest tenth.

approximately one quarter of an EU country's GDP. The "earnings" triggered by foreign final demand is further split into the value-added generated in each sector. The exports of value-added generated by services amounted for the average EU country to 11.3% of its GDP in 2000 but to 15.0% in 2014, an increase of 3.7 percentage points. The results for all 56 industries are given in Appendix Table S2 in the online Supplementary Material. From these tables, it appears that approximately two-thirds of the overall increase (of 4.3 p.p.) in XVA was attributable to business services (1.8 p.p.) and wholesale/retail trade (0.9 p.p.).[9] The export of value-added has remained more or less constant for the sectors manufacturing and other production in the average EU country. Services have thus become more important over time for the generation of value-added triggered by foreign final demand.

Whereas the XVAs indicate the foreign dependence on EU production, inputs and value-added, the MVAs indicate the EU dependence on foreign value-added. Of the total final demand in the average EU country, 22.5% was accounted for by foreign value-added in 2000, increasing to 24.6% in 2014. Observe that the dependence on manufacturing value-added declined (with 0.6 p.p.) and the largest increase was for services (with 1.6 p.p.). Also the increase in other production was substantial (1.0 p.p.), and it turns out that this was largely due to mining and quarrying. It

[9]The following industries make up business services: "Legal and accounting activities, activities of head offices, management and consultancy activities" (M69/M70); "Architectural and engineering activities, technical testing and analysis" (M71); "Scientific R&D" (M72); "Advertising and market research" (M73); "Other professional, scientific and technological activities, veterinary activities" (M74/M75); "Administrative and support service activities" (N), and "Computer programming, consultancy and related activities; information service activities" (J62/63). See Appendix Table S1 in the online Supplementary Material for the classification of all services industries.

was the industry responsible for the single largest percentage point increase in dependence (0.6 p.p.). This reflects a greater reliance of EU's final demands on natural resource imports. The growing importance of the other production sector (and of the mining and quarrying industry in particular) might be partly explained by higher commodity prices and not only by volume changes.

Returning to Question 1 ("Has trade of value-added in services industries become more important relative to trade of value-added in manufactured goods industries between 2000 and 2014?"), the answer is clearly affirmative for the European Union. The rising contributions of services industries to trade in value-added could be a reflection of the growing importance of services overall in the EU and other developed regions. This development may systematically boost the trade triggered by services industries. Another explanation may be the liberalisation of services trade during the time period, such as via services trade negotiations, which have led to the rise of services-related GVCs (Heuser & Mattoo, 2017).

The bottom part of Table 2 gives the results for the gross export figures. These data have the advantage of providing the industry of the products actually crossing the border (both intermediates and final). The products exported by these industries may contain value-added created in other industries or sectors, but only the industry of the actually exported products is reflected in the data. Let $\mathbf{p}^{rs} = \sum_{s \neq r} \mathbf{D}^{rs}\mathbf{e} + \sum_{s \neq r} \mathbf{f}^{rs}$ indicate the vector of gross exports from country r to country s, and define $\mathbf{p}^{rr} = 0$ for all r. For example, $XGT^{R}_{Manuf} = \sum_{r \in R} \sum_{s} \sum_{i \in Manuf} p_i^{rs} / \sum_{r \in R} GDP^{r}$ then gives, for the average EU country, its gross exports as a share of its GDP. Observe in Table 2 that the role of manufacturing is much more important than the role of services when exports are measured directly (as is the case with XGT). The role of services is to a large extent indirect. Still, also when using the direct export figures it is true that exports in services have become more important relative to exports in manufactured goods.

For North America, the findings are similar but not as pronounced as for the EU. The trade in value-added has grown more for value-added created in the services sector than in manufacturing (which has even fallen). The same applies to the services trade itself (see XGT). However, the changes were not very large. For instance, total exports of value-added nudged up from 9.0% to 10.8% as a share of GDP between 2000 and 2014. Furthermore, the sector other production (agriculture, mining and quarrying, construction, and electricity) contributed almost equally to this change. This is almost exclusively due to mining and quarrying, which was the single industry that had the greatest impact on the increases in trade in value-added. Rising commodity prices in the mining and quarrying industry may play a role, which reinforces the decision to focus the comparison on the services and manufacturing sectors. Both the XVA and the MVA of mining and quarrying grew by +0.7 p.p. over the time period. In explaining the increased importance of services, business services and wholesale trade were particularly influential, just as they were for the EU.

In East Asia, exports of value-added are still dominated by manufacturing although services catches up. The percentage point changes in XVA were 2.2 for both sectors. Value-added abroad triggered by final demands in the East Asian countries sketches a different picture. Imports of foreign value-added (MVA) increased considerably (on average with 4.6 p.p.), but the increase was the largest for value-added created in other production and the smallest for manufacturing. The findings with regards to the XVA indicator are in line with the idea of Factory East Asia. The region is still dependent for its value-added creation on exporting manufactured goods, although the indirect contribution of services grows steadily.

Business services played a relative large role in explaining rising dependencies of the three regions on trade. On the import side, this may be related to the increased domestic offshoring of business services activities in developed countries to emerging and developing countries. Balance of payments data provides some information on disaggregated trade flows in the business services

industries, which corroborates what we find using WIOD. For example, the United States and Germany outsourced especially in the computer services, business consulting, advertising and market research, R&D, and legal services sectors (Berry et al., 2016). Emerging and developing countries have increased their world export share in these business services categories between 2002 and 2012. At the same time, however, business services exports by developed countries have also increased in importance. This indicates that countries may be increasingly specialising in different types of business services.

Finally, two remarks are relevant. First, the results highlight the increasing disparities between indicators for trade in value-added and for gross exports. In Table 2, the XVA outcomes for services are always larger than the XGT outcomes. For manufacturing, the differences are in the opposite direction and larger than for services. Indicators largely based on direct trade (like XGT) overestimate manufactured goods (which embody more services) compared to indicators that fully account for indirect trade (like XVA).

Second, almost all indicators are the largest for the EU and the smallest for North America. One should be careful to give too much weight to this observation, as it depends on the number of countries that are included in a region.

4.2 | Did services travel further than manufactured goods?

This section addresses the question whether trade of value-added in services industries travelled further than trade of value-added in manufactured goods industries in 2014. This is measured by the share of services vis-à-vis manufacturing in intraregional and interregional trade in value-added. The intraregional XVA ($INXVA^R$) was defined in Equation (3). Just like the XVA^R in (5) was split into $XVA^R = XVA^R_{Manuf} + XVA^R_{Services} + XVA^R_{Other}$, we now have $INXVA^R = INXVA^R_{Manuf} + INXVA^R_{Services} + INXVA^R_{Other}$. The results in Table 3 then report the shares, that is, $INXVA^R_{Services}/INXVA^R$ for example. Of the total value-added (created in the average EU country) that was embodied in the final demands of all other EU countries, 50.6% was created in the services sector and 39.2% in the manufacturing sector. Similar calculations and interpretations apply to interregional trade in value-added. For example, 57.1% of the value-added in the average EU country that was embodied in final demands outside the EU was created in the services sector. The services sector in the EU thus had a larger share in the interregional exports of value-added than in the intraregional exports of value-added (i.e., IR > IN) and the opposite held for the manufacturing sector (IR < IN). We conclude that exports of value-added in EU services industries travelled further than exports of value-added in EU manufacturing industries. It should be noted that this is a de facto, aggregated result because the findings may vary depending on the geographic and structural orientation of countries in trade.

The row TOT gives the shares of the sectors in XVA^R. For example, for the services sector, we have $XVA^R_{Services}/XVA^R = 15.0/27.6 = 0.542$, where the 15.0 and 27.6 are from Table 2. The results are only for 1 year (2014) because the outcomes for other years sketch a similar picture.[10]

The observation for the EU's exports of value-added (i.e., services travelled further than manufactured goods) also holds for the exports of value-added of the other two regions. For the imports of value-added (MVA), the story is slightly different in the case of the EU even if the conclusions are the same. Both for the services and the manufacturing sector, the share of interregional trade is smaller than the share of intraregional trade (IR < IN). This is due to the role of the sector other

[10]The results for 2014 for the full 56-industry classification are provided in Appendix Tables S5–S7 in the online Supplementary Material.

TABLE 3 Shares for sectors in total, intraregional and interregional trade in value-added for three regions in 2014

	European Union				North America				East Asia			
	M	S	O	T	M	S	O	T	M	S	O	T
XVA												
IN	39.2	50.6	10.2	100	42.3	32.4	25.3	100	58.9	30.6	10.4	100
IR	35.4	57.1	7.6	100	28.5	59.1	12.4	100	48.9	39.0	12.1	100
TOT	37.0	54.2	8.7	100	32.8	50.7	16.5	100	50.6	37.6	11.8	100
MVA												
IN	39.2	50.6	10.2	100	42.3	32.4	25.3	100	58.9	30.6	10.4	100
IR	31.4	43.2	25.4	100	39.1	40.8	20.1	100	27.6	36.8	35.6	100
TOT	35.4	47.0	17.6	100	40.0	38.6	21.5	100	34.0	35.7	30.3	100
XGT												
IN	66.8	26.6	6.5	100	74.4	7.7	17.9	100	94.0	5.2	0.8	100
IR	57.5	38.5	4.0	100	45.0	47.2	7.9	100	79.3	19.2	1.4	100
TOT	62.5	32.1	5.4	100	56.4	31.8	11.8	100	82.5	16.2	1.3	100

Notes: Calculations are based on the world input–output database. The European Union includes all 28 EU members, North America includes Canada, Mexico and the United States, and East Asia consists of China, Japan, Korea and Taiwan. Shares are rounded to the nearest tenth. XVA refers to VA exports of a particular sector (M = manufacturing; S = services; O = other production) as a share of all VA exports contributions (T = total/sum of all sectors = 100). MVA refers to VA imports as share of all VA import contributions. XGT refers to regional gross exports as a share of regional GDP. IN = intraregional trade in value-added (or gross exports), IR = interregional trade in value-added (or gross exports), TOT = total trade in value-added (or gross exports).

production. Comparing IR with IN, we find IR/IN = 43.2/50.6 = 0.85 for services and IR/IN = 31.4/39.2 = 0.80 for manufacturing. Also for imports of value-added by the EU, it is thus true that services value-added travelled further than manufacturing value-added. For North America and East Asia, the findings for the imports (through MVA) are similar to the findings for exports of value-added (through XVA).[11] Hence, for every region and indicator (including the EU MVA indicator), the result held that trade in value-added created by services industries travelled further than trade in value-added created by manufacturing industries. We add that transport services, which could be expected to increase the share of services in interregional trade, only explain a small share of the more global nature of services. The four transport industries together (land, water and air transport, and support activities) accounted for less than a quarter of the increased importance of services in the EU's interregional exports of value-added relative to intraregional exports of value-added. The 2000 figures (not shown in the table) reveal similar patterns.

The distributions of the intraregional and interregional shares of the sectors in XVA and MVA appear to be time invariant. The only observable difference over time was that services grew as a share of total trade. One possible explanation for the lack of a stronger interregional pattern over time for services could be that the ICT revolution increased more generally the services content of manufactured goods. Given that the majority of exports of value-added created in services industries are embodied in products traded by other sectors (e.g., in manufacturing), there is less reason to believe an interregional trend in services would predominate relative to manufactured goods

[11]Note that intraregional imports of value-added (MVA) by definition sum up to the intraregional exports of value-added (XVA) for each region. Hence, INXVA and INMVA values are identical in Table 3.

over time. This is because changes in the geographic orientation of manufactured goods trade would trigger (corresponding) changes in the geographic orientation of services trade. Another explanation could be that the effect of an expanded geographic scope of production fragmentation on services might have been offset by regulatory convergence in services if convergence has been the strongest within regions.

Observe that the sector other production plays a substantial role in the case of imports of value-added (MVA). The industry-level results (see Appendix Tables S5–S7 in the online Supplementary Material) reveal that this was overwhelmingly due to mining and quarrying, for which interregional imports of value-added embodied in final demand were much more important than intraregional imports (except for North America). This shows that Europe and East Asia were relatively dependent on raw materials imported from outside the own region.

The sectoral embodiments of gross exports (intraregional, interregional and total) of the three regions were also calculated for total gross exports (XGT). The trade of value-added in services is typically indirect, because services are embodied in the gross exports of manufactured goods (Heuser & Mattoo, 2017). The XVA and MVA indicators capture both the direct and indirect services linkages. Direct export figures using the XGT approach may provide additional insights because these data only report services and manufactured goods that cross the border, aggregated by sector, and are not embodied indirectly in products traded by other sectors. Two conclusions can be drawn when comparing the results for XGT with those for XVA. First, gross exports were dominated by manufacturing. Services were considerably more important in value-added terms relative to gross exports in each of the regions. Second, also for gross exports it was the case that services travelled further than manufacturing.

Observe that there are significant differences in the intraregional vs. interregional shares of services. The services share in intraregional exports of value-added was between two and six times higher than the services share in gross intraregional exports in each region. However, discrepancies between the share of services in interregional value-added exports and gross interregional exports were considerably less. This provides an additional motivation for an analysis of services trade based on value-added. The role of services is already understated when gross exports are considered, but it is even more underrepresented when gross intraregional exports are employed.

5 | CONCLUSION AND DISCUSSION

This study employed several trade indicators and different levels of industry aggregation to study the role of services in globalisation patterns. This was done by examining the cases of the European Union, North America and East Asia between 2000 and 2014, and distinguishing between intraregional, interregional and total trade. There are two key findings. First, in Europe and North America trade of value-added in services industries rose more than trade of value-added in manufactured goods industries. In relative terms, this was also the case in East Asia. Second, by comparing intraregional and interregional trade in value-added on a sectoral level, value-added created in services industries always travelled further than value-added created in manufacturing industries.

Our results also underscored the increasing disparity between gross exports and exports of value-added over time (supporting the original finding of Johnson & Noguera, 2012), which is especially acute for services. This greater discrepancy for services reflects the fact that gross trade only captures direct but not indirect services exports—understating their importance. That could cause one to misinterpret where value is created. Disparities between the services share in gross

exports and the services share in value-added exports were considerably larger within regions than between regions. The results also indicated that world trade is more global when measured in value-added terms than in gross exports. Although analysing trade in value-added is extremely useful in exposing indirect dependencies, actual trade is the action that takes place. Thus, gross export statistics remain important themselves and are also necessary to determine the trade in value-added figures.

The importance of services is even greater in interregional trade than in intraregional trade. This has policy implications. First, trade policy should explicitly be aimed at lifting services barriers (Berry et al., 2016; Saez et al., 2014). The Trade in Services Agreement (TiSA) that is currently being negotiated by 23 members of the World Trade Organization (representing 50 countries) is a positive step in this direction. Research based on firm-level data finds that allowing for the participation of foreign services providers improves the performance of downstream manufacturing firms (Arnold, Javorcik, & Mattoo, 2011; Duggan, Rahardja, & Varela, 2013). Second, it is important to improve the regulatory environment for domestic services because services are embodied in the output of other sectors. Regulatory reform in the services sector can contribute in establishing comparative advantage for firms relying on services inputs (Van der Marel, 2016). Improved access to services, which may accompany trade liberalisation and domestic policy reform efforts, raises competitiveness and productivity of manufacturing industries (Arnold, Mattoo, & Narciso, 2008; Arnold et al., 2016) and contributes to economic growth (Mattoo, Rathindran, & Subramanian, 2006).

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

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