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Services Development and Comparative Advantage in Manufacturing

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Abstract

Most manufacturing activities use inputs from the financial and business services sectors. But these services sectors also compete for resources with manufacturing activities, provoking concerns about de-industrialization—inancial services in industrial countries like the United States and the United Kingdom, and business services in developing countries like India and the Philippines. This paper examines the implications of services development for the export performance of manufacturing sectors. It develops a methodology to quantify the indirect role of services in international trade in goods and constructs new measures of revealed comparative advantage based on domestic value added in gross exports. The paper shows that the development of financial and business services enhances the revealed comparative advantage of manufacturing sectors that use these services intensively but not that of other manufacturing sectors. It also finds that a country can partially overcome the handicap of an underdeveloped domestic services sector by relying more on imported services inputs. Thus, lower services trade barriers in developing countries can help to promote their manufacturing exports.

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Services Development and Comparative Advantage in Manufacturing *

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I. Introduction

On the face of it, services play a relatively small role in international trade. Conventional trade statistics show that services trade accounts for only one-fifth of cross-border trade (Loungani et al., 2017). However, a significant part of goods trade includes trade in embodied services. In the United States, for example, more than a quarter of intermediate inputs purchased by manufacturers were from the services sector (USITC, 2013). For certain manufacturing sectors, such as computers and electronic products, this percentage — a measure of "services intensity" — is as high as 47.6 percent. Drawing on the Trade in Value Added Database (TiVA, 1995-2011), Miroudot and Cadestin (2017) show that services inputs account for about 37 percent of the value of manufacturing exports in the sample of countries covered. The development of the domestic services sector, as well as access to imported services inputs, can, therefore, be expected to influence comparative advantage in manufacturing trade. This paper seeks to understand this indirect role of services development drawing upon new data and new techniques.

The impact of services development is interesting because it is not straightforward. Since services are used as inputs in the production of manufactured goods, services development can help to increase manufacturing production. But since services and manufacturing compete for resources, the development of the former can be at the expense of the latter. For example, it is evident that the development of the services sector has drawn resources away from manufacturing not just in industrial countries like the United States and the United Kingdom, but also in developing countries like India.[1]

We focus on two key services sectors: financial services and business services. Both have emerged as skill-intensive, dynamic, internationally traded services. These two services sectors are often regarded as the pillars of modern economies, and their value added shares in GDP have a strong positive correlation with countries' income levels (see Figure 1). These are also the two sectors which represent the tension we discussed above in the sharpest form. On the one hand, manufacturing performance is critically dependent on the domestic availability of these services. On the other, these are the sectors that often provoke "de-industrialization" concerns – financial services in industrial countries like the United States and United Kingdom, and business services in developing countries like India and the Philippines.

[1] See, for example, Kochar et al. (2006).

Well-functioning financial sectors are critical in mobilizing resources, stimulating investment, and at the same time helping firms (and households) better manage their risks. As shown in Appendix 3C, the business services sector covers a variety of critical of services activities, ranging from software consulting and data processing to management consultancy, engineering and R&D services. Intensive use of these modern services can help manufacturing firms increase productivity, reduce the cost of doing business, expand their choices within a longer geographic distance, differentiate their products from those of their competitors,[2] strengthen their after-sale customer services, etc.[3] USITC (2013) shows that business services accounted for nearly half of all services purchased by manufacturing sectors in the U.S. in 2008.

Our first hypothesis is that, while the overall effect of services development on the performance of manufacturing sectors can be ambiguous, its effect is more likely to be positive for manufacturing sectors that use services inputs more intensively. Furthermore, we distinguish embodied domestic services inputs from embodied foreign services inputs. When domestic firms have access to foreign services, they may at least partially bypass their own inefficient services provision by relying more on imported services inputs. As our second hypothesis, we expect to see a more positive effect of access to foreign services inputs on manufacturing export performance in countries with lower levels of domestic services development.

We develop a methodology to quantify the indirect role of services in international trade in goods using a method developed by Koopman, Wang, and Wei (2014) and Wang, Wei, and Zhu (2013) that generalizes the vertical specialization measures proposed by Hummels, Ishii and Yi (2001). We use revealed comparative advantage (RCA) to measure the competitiveness of manufacturing sectors. Following Koopman, Wang, and Wei (2014) and Wang, Wei, and Zhu (2013), we improve on the traditional Balassa (1965) RCA and construct new measures of RCA based on domestic value added in gross exports by taking into account both domestic production sharing and international production sharing.

In our econometric analysis of the impact of services development on RCA of manufacturing sectors, the key explanatory variable is the interaction between a measure of the development of

[2] To differentiate a product from others, firms need to invest more in R&D, quality-upgrading, and advertisement. The groups of manufacturing sectors with high embodied financial and business services as listed in Appendix 4 indeed produce more differentiated products than those sectors with low services input intensity. In addition, combining pure manufacturing and after-sale services is also a way to differentiate itself from competitors.

[3] See the next section for discussion in the literature on how producer services may affect firms' productivity.

financial (or business) services and the financial (or business) services-intensity of each manufacturing sector. We find that domestic services development has a mixed effect on manufacturing export RCA: in manufacturing sectors with low embodied services, services development reduces manufacturing export RCA; however, in sectors with a high degree of embodied services, services development increases manufacturing RCA. Figure 2 provides a visual illustration of this relationship in the case of financial services. We see a negative association between manufacturing RCA and a measure of financial development for a sector with low embodied financial services, but a positive association for a sector with high embodied financial services.

In the second hypothesis, we consider the role of services imports in helping overcome the limitations of domestic services markets. We begin by showing that a country's access to foreign services markets measured by the share of foreign embodied services is negatively correlated to countries' services trade barriers. Using the World Bank Services Trade Restriction Indexes (STRI) (Borchert, Gootiiz and Mattoo, 2012), Figure 3 shows a negative relationship between financial services trade barriers and the share of embodied foreign financial services among embodied domestic and foreign financial services for the textile sector of 40 countries in 2000, using data from the World Input-Output Database (WIOD).[4] A similar pattern holds for other manufacturing sectors and years. We then find that in countries with lower levels of services development, manufacturing exports benefit more from access to foreign services inputs. Our result suggests that lower services trade barriers may help developing countries to bypass their inefficient domestic services provision and promote their manufacturing exports through inter-sectoral linkages.

The rest of the paper is organized as follows. We review the relevant literature in Section II. In Section III, we present our hypotheses and carry out the empirical analysis. We conclude in Section IV.

II. Literature review

This paper is related to at least two strands in the literature: one is on the estimation of services embodied in traded goods; the other is on the role of services in economic development.

[4] See Dietzenbacher et al. (2014) and Timmer et al. (2015) for more information on the construction of the WIOD.

Research on services embodied in traded goods, based on the Leontief inverse, can be traced back to Grubel (1988) who examined Canadian exports in 1973 and 1983. He found that, over that decade, Canadian embodied services exports had increased substantially to the point where Canada enjoyed a surplus in embodied services trade but had a deficit in direct trade in services. Urata and Kiyota (2003) examined the embodied services in total gross trade for several major services categories of five Asian economies – China, Malaysia, the Philippines, Singapore, and Thailand − in 1990. They found that embodied services accounted for a large share of total services trade for each country. Francois and Woerz (2008) examined the role of services as inputs in manufacturing sectors. They found a significant and strong positive effect of increased business services openness (i.e. greater levels of imports) on some industries, supporting the notion that offshoring of business services may promote the competitiveness of the most skill and technology intensive industries in the OECD countries. Recently, Francois et al. (2013) demonstrated that the ratio of value added exports to gross exports is significantly higher than one in services sectors, suggesting an important role of services sectors in downstream sectors through forward inter-industrial linkages. Their studies cover many countries and provide some interesting insights.

These early studies used single national input-output tables, rather than an international input-output table as in this paper, so they could not break down the inputs according to their origins or consider the mismeasurement in services inputs due to two-way trade in intermediate products. In addition, they can only consider how much a service sector's value-added is embodied in manufacturing exports regardless whether parts of the exported value-added return back to the exporting country or not. In the current paper, we make use of the newly constructed international input-output tables by the WIOD team to measure more precisely the embodied services and indirect trade through other sectors. With the multi-country input-output table and the information about the origins of inputs, we can study embodied domestic and foreign services and their interaction with domestic services development. Stehrer, Foster, and Vries (2012) and Timmer et al. (2013) also use a similar method and the WIOD data to estimate the shares of services, income and jobs in a country that are directly and indirectly related to the production of manufacturing goods, but their work is primarily descriptive without connecting embodied services to the performance of manufacturing sectors.

On the role of services in economic development, Hoekman and Mattoo (2008) review the literature, focusing on channels through which openness to trade in services may increase the productivity of a firm, an industry and an economy as a whole. The existing studies show that access to low-cost and high-quality producer services can promote economic growth. Based on an industry-level analysis of the U.S., Amit and Wei (2009a) find that services offshoring by high-income countries tends to raise their manufacturing sectors' productivity. While services offshoring has both positive and negative effects on domestic employment, Amiti and Wei (2009b) show that, at least for the case of the United States, it tends to enhance domestic employment on average. Arnold, Javorcik, and Mattoo (2011), using firm-level data from the Czech Republic for the period 1998-2003, find a positive effect of services sector reforms on the productivity of domestic firms in downstream manufacturing. The manufacturing-services linkage is measured using information on the degree to which manufacturing firms rely on intermediate inputs from services industries. Arnold et al. (2012) use a similar methodology to show that services reforms had significant and positive effects on the productivity of manufacturing firms in India. Fernandes and Paunov (2012), using the annual manufacturing survey of Chilean firms, find a positive effect of substantial FDI inflows in producer services sectors on the total factor productivity (TFP) of Chilean manufacturing firms. Their findings also suggest that services FDI fosters innovation activities in manufacturing and offers opportunities for laggard firms to catch up with industry leaders. Debaere et al. (2013) find that greater availability of services increases manufacturing firms' foreign sourcing of materials, which may in turn enhance manufacturing productivity. Using Swedish firm-level data, Lodefalk (2014) shows that in-house and outsourced services help to increase export intensity measured by the share of merchandise exports in total sales. Finally, a recent paper by Bamieh et al. (2017) shows that more intensive use of producer services appears to be positively associated with resilience to greater import competition.

In this paper, we study particularly the roles of financial services and business services in manufacturing production. On financial services, Rajan and Zingales (1998) and a number of follow-up studies find that industries that are particularly dependent on financing grow relatively faster in countries with more developed financial markets.[5] Our approach differs from Rajan and

[5] Based on a non-parametric estimation, however, Shen (2013) shows that the effect is even stronger for financially underdeveloped countries than financially developed countries due to diminishing returns.

Zingales (1998) in two major ways. First, we consider modern business services sectors in addition to financial services. For most countries in our sample, business services as a share of GDP are generally on par with or greater than financial services. Second, even for financial services, we measure the intensity of its use in manufacturing sectors differently from Rajan and Zingales in order to maintain consistency with our measure of business services intensity. In particular, their measure of financial dependence is about the intrinsic needs for externally raised funds relative to total funding needs for long-term investment. In an input-output context, the financial services sector only provides financial services in value added terms, rather than the amount of external finance raised. Financial services may facilitate an investment deal, but it is different from investment. Therefore, their measures and ours reflect two different concepts, and the scatter plot in Figure 4 shows a weak correlation between the two measures.[6]

Some more recent papers also examine the role of finance in the economy. Ju and Wei (2011) show in a general equilibrium model that, for economies with low-quality institutions, finance is a key driver of the real economy and a source of comparative advantage. Buera et al. (2011) demonstrate in a model that sectors with more financing needs are disproportionately vulnerable to financial frictions. A growing recent literature on credit constraints demonstrates that access to external finance helps to increase firms' export performance (see, Amiti and Weinstein, 2011, among others). Business services cover a wide range of activities as listed in Appendix 3C. There are many case studies on how a certain type of business services promotes economic performance at the firm, state or national level (see USITC, 2013). However, comprehensive empirical analyses covering most of the major economies at a detailed industry level are rare, probably owing to the lack of detailed services data.

In the existing literature, the estimation of embodied services and the recent empirical analyses on their linkage to manufacturing export performance are somewhat disconnected. The former estimates the embodied services but does not examine empirically how services input

[6] We compare our embodied financial services measures with the external financial dependence measures used by Rajan and Zingales (1998) for the U.S. and find a very weak correlation between them, using a concordance between ISIC Rev. 1 and the WIOD sectors (constructed by authors). The simple correlation coefficient is actually negative at -0.32 or -0.36, depending on whether we consider only embodied domestic financial services inputs or embodied domestic and foreign financial services inputs. A note of caution is that our sample period (1995-2007) differs from theirs (1970s and 1980s). Although we tried narrowing the gap as much as we can by picking their measure for year 1980 and ours for 1995, the weak correlation can be partially due to the different time coverages.

intensity affects the performance of downstream sectors. The latter, on the other hand, uses some proxies of inter-sectoral linkage or the direct inputs in gross output to examine the effects of services reforms on downstream manufacturing sectors without quantifying precisely services input intensity. The current paper connects the two literatures: we measure precisely services input intensity as the ratio of embodied services to manufacturing value-added, considering both direct and indirect input usages; then, we directly quantify the effect of services development on the export performance of manufacturing sectors. In addition, we also consider the interaction between embodied domestic services and embodied foreign services and how they affect manufacturing export performance, depending on countries' domestic services development and services input intensity.

Finally, the second hypothesis in this paper considers how access to foreign services markets may help developing countries to bypass their possibly inefficient domestic services provision. By distinguishing domestic from foreign services input, we implicitly assume that they are incomplete substitutes.[7] Such a bypass effect is also discussed in a theoretical model by Ju and Wei (2010), which derives the conditions under which financial globalization can serve as a substitute for reforms of the domestic financial system. This is also broadly consistent with the theory of comparative advantage – countries with underdeveloped services sectors benefit from imported services, but our paper shows that these benefits may go beyond services sectors through inter-sectoral linkages.

III. Empirical analysis

In this section, we test empirically the following two hypotheses.

Hypothesis 1: *the effect of domestic services development on manufacturing export competitiveness is larger* (*more positive*) *for manufacturing sectors that use services as inputs more intensively.*

[7] The magnitude of the Armington elasticity of substitution between domestic and foreign varieties depends on several factors such as the time windows (long run vs. short run) and the level of product disaggregation. In general, estimates of the elasticity are usually quite small at the macroeconomic level. This is why, for example, Obstfeld and Rogoff (2007) found that rebalancing the U.S. current account would require a 30 percent depreciation of the U.S. dollar. Even at the sector level, the suggested Armington elasticity in Global Trade Analysis Project (GTAP Commodity Model) is less than two for most of the services categories, generally lower than those of manufacturing sectors (Hertel, 1997). The U.S. International Trade Commission (e.g., USITC-128 Sector Model) uses similar estimates for financial and business services sectors (Donnelly et al., 2004).

Hypothesis 2: *the effect of embodied foreign services inputs on manufacturing export competitiveness is more positive in countries with lower levels of domestic services development, especially for manufacturing sectors with high services input intensity.*

Although the above two hypotheses seem to be straightforward, the theoretical predictions are actually not certain, as discussed in the introduction section. The development in services can draw resources away from manufacturing sectors and can also enhance the productivity of manufacturing when more productive services are used as inputs. Whether the net effect is positive or negative becomes an empirical question. As for the second hypothesis, the effects of foreign services on domestic manufacturing sectors can also be manifold and conflicting among them. The net effect depends on many factors, such as the development level of domestic services sectors. We expect to see a more beneficial role of imported services inputs in countries with less efficient services sectors.

In the following, we will lay out our empirical strategy, explain the measures of the key variables, describe the data, and discuss the regression results.

III.1 Empirical strategy

In our empirical analysis, we use RCA to measure the export competitiveness of individual manufacturing sectors. We will explain later in this paper how we modify the conventional definition of RCA after stating our specification.

To test Hypothesis 1, we estimate the effect of services development (*D*) on manufacturing export performance (*RCA*), and analyze how this effect depends on service input intensity as measured by the ratio of embodied domestic services in total final demand to manufacturing value-added (or simply *SII*; see a later subsection for more details). Our baseline regression specification is:

$$(1) \qquad RCA_{ist} = \beta_0 + \beta_1 D_{it} + \beta_2 SII_i + \beta_3 D_{it} * SII_{ist} + \boldsymbol{Z\gamma} + a_i + a_s + a_t + e_{ist}$$

where subscripts *i*, *s*, and *t* refer to country, manufacturing sector and year respectively; *SII* may measure a benchmark country's or each country's own services input intensity, being averaged over time or time-varying; $\boldsymbol{Z}$ is a vector for other control variables; a_i, a_s, a_t are the country,

manufacturing sector and year fixed effects; and e_{ist} is an error term. As a robustness check, we also use time-varying country and sector fixed effects (i.e., Country*Year and Sector*Year).[8]

Hypothesis 1 suggests a positive β_3. β_1 can be negative because a more developed services sector (a higher *D*) in a country could imply a higher services export RCA which in turn could lead to a lower manufacturing export RCA.

Our second hypothesis suggests that the effect of *D* on *RCA* depends not only on *SII*, but also on the access to foreign services markets. To capture the relative importance of foreign services inputs compared to domestic services inputs, we measure access to foreign services markets by the share of embodied foreign services in total embodied (domestic and foreign) services in a manufacturing sector of a country (*forsh*).[9] To ease the interpretation of the results, we run regressions using the subsample for only the manufacturing sectors with high services input intensity because services development and services inputs are less relevant when a sector uses little services as inputs. We also run the same regressions for all of the other sectors with low *SII* to show how the results differ. The specification of the regressions is similar to equation (1), except that we replace *SII* with *forsh* as follows:

$$(2) \qquad RCA_{ist} = \theta_0 + \theta_1 forsh_{ist} + \theta_2 D_{it} + \theta_3 D_{it} * forsh_{ist} + \boldsymbol{Z\gamma} + a_i + a_s + a_t + e_{ist}$$

According to Hypothesis 2, coefficient θ_1 is expected to be positive, while θ_3 should be negative.

III.2 Measures of RCA

[8] We do not use Country*Sector fixed effects for two reasons. First, the positions of countries in terms of RCA and key explanatory variables are quite stable during our sample period and there is limited variation in these variables' over time. For example, the variations of RCA within Country*Sector are less than a quarter of the variations between Country*Sector. Second, interpolation is often used to fill the data between benchmark years for the WIOD, so the within variations for a sector of a country may not be very informative (Timmer 2012). Nevertheless, we include in our regressions several variables that vary across countries and sectors to control for the heterogeneity at Country*Sector level. We also tried including other similar variables such as Sector*GDP/capita interaction term but they are always insignificant, and we choose to exclude them from our preferred specification.

[9] For instance, a country with low embodied foreign services does not necessarily mean that this country is not open to foreign markets, especially when it also uses limited domestic services inputs. The low foreign services input intensity of this country is probably just because the technology it adopts requires little services inputs. Therefore, the share of embodied foreign services can capture better a country's openness or access to foreign services markets.

The conventional definition of the RCA measure was first proposed by Balassa (1965). Export RCA of country j's sector *k* is defined as the share of exports (*X*) of sector *k* in j's total exports relative to the world average share of the same sector *k* in world exports as follows:

$$RCA_j^k = \left(\frac{X_j^k}{\sum_{k=1}^{K} X_j^k}\right) / \left(\frac{\sum_{i=1}^{G} X_i^k}{\sum_{k=1}^{K}\sum_{i}^{G} X_i^k}\right), \text{ where country } i, j = 1, 2, ..G; \text{ sector } k=1, 2, ..K$$

where G is the total number of countries in the world. The RCA measure has been used extensively in the literature to measure the competitiveness of a country in a particular sector. When the RCA exceeds one, the country is deemed to have a revealed comparative advantage in that sector; when it is below one, the country is deemed to have a revealed comparative disadvantage in that sector.

Koopman, Wang, and Wei (2014) and Wang, Wei, and Zhu (2013) point out that the traditional RCA ignores both domestic production sharing and international production sharing. First, it ignores the fact that a country-sector's value added may be exported indirectly via the country's exports in other sectors. Second, it ignores the fact that a country-sector's gross exports partly reflect foreign content. A conceptually correct measure of comparative advantage needs to exclude foreign-originated value added and pure double counted terms in gross exports, and to include indirect exports of a sector's value added through other sectors of the exporting country. When a country uses imported intermediate goods intensively to produce for its exports, Koopman, Wang and Wei (2014) show that RCA based on gross exports can be misleading. The problem of double counting of certain value added components in the official trade statistics suggests that the traditional computation of RCA could be noisy. The gross export decomposition method suggested by Koopman, Wang and Wei (2014) provides a way to remove the distortion of double counting by focusing on domestic value-added in exports. Following Wang, Wei, and Zhu (2013), we calculate RCA based on *domestic valued added (DVA) in gross exports*, rather than gross exports, for country i in sector k as follows (i = 1, 2, …, G; k = 1, 2, …, N).

$$RCA_k^i = \left(\frac{DVA_k^i}{\sum_{k=1}^{N} DVA_k^i}\right) \Bigg/ \left(\frac{\sum_{i=1}^{G} DVA_k^i}{\sum_{k=1}^{N}\sum_{i=1}^{G} DVA_k^i}\right)$$

The above new RCA measure is the share of a country-sector's forward linkage-based measure of domestic value added in exports in the country's total domestic value added in exports relative to that sector's total forward linkage-based domestic value added in exports from all countries as a share of global value added in exports. The domestic value added (DVA) in gross

exports in the above formula is the sum of value added exports (VAX) and returned domestic value added consumed at home (RDV). Because it describes the characteristics of a country's production or total domestic factor content in output, it does not depend on where the output is absorbed. By comparison, VAX are produced at home but ultimately absorbed abroad. For those applications in which a production-based RCA is the right measure as in this paper, we should use DVA in exports rather than VAX to compute RCA.

In addition, RCA based on gross exports (the dependent variable) can cause an endogeneity problem because the embodied services (an explanatory variable) are part of gross manufacturing exports. In our paper, manufacturing RCA is based on the value added by the factors employed in manufacturing sectors, not including the embodied services in gross exports which are contributed by the factors employed in services sectors, so our approach is free from the above-mentioned endogeneity problem. Intuitively, we focus on how services help factors employed in manufacturing sectors to create value by improving their productivity, reducing costs, or both.[10]

III.3: Measurement of embodied services and services input intensity (SII)

We compute embodied services in manufacturing sectors using a method developed by Koopman, Wang and Wei (2014) and Wang, Wei, and Zhu (2013) that generalizes the vertical specialization measures proposed by Hummels, Ishii and Yi (2001). Assume a world with G countries, in which each country produces goods in N tradable sectors. Goods and services produced in each sector can be consumed directly or used as intermediate inputs, and each country exports both intermediate and final goods to other countries. All gross outputs (X) produced by a country must be used as intermediate goods/services or as final goods/services (F), i.e.,

$$(3) \qquad X_i = \sum_j^G (A_{ij} X_j + F_{ij}), \qquad \text{i, j} = 1,2, \ldots \text{G}$$

where X_i is the N×1 gross output vector of country i, F_{ij} is the N×1 vector for final goods and services produced in country i and consumed in country j, and A_{ij} is the N×N input-output coefficient matrix, giving intermediate use in j of goods and services produced in i.

[10] Miroudot and Cadestin (2017) provide a detailed discussion on how services help manufacturing sectors to create values by facilitating exchange among users and by solving problems and bringing tailored solutions. See also Heuser and Mattoo (2017) for a review of services in global value chains.

The G-country, N-sector production and trade system can be written as an inter-country input-output (ICIO) model in block matrix notation as follows.

$$(4)\qquad \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_G \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} & \cdots & A_{1G} \\ A_{21} & A_{22} & \cdots & A_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ A_{G1} & A_{G2} & \cdots & A_{GG} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_G \end{bmatrix} + \begin{bmatrix} F_{11}+F_{12}+\cdots+F_{1G} \\ F_{21}+F_{22}+\cdots+F_{2G} \\ \cdots\cdots \\ F_{G1}+F_{G2}+\cdots+F_{GG} \end{bmatrix}$$

After rearranging, we have

$$(5)\qquad \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_G \end{bmatrix} = \begin{bmatrix} I-A_{11} & -A_{12} & \cdots & -A_{1G} \\ -A_{21} & I-A_{22} & \cdots & -A_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ -A_{G1} & -A_{G2} & \cdots & I-A_{GG} \end{bmatrix}^{-1} \begin{bmatrix} \sum_{j=1}^{G} F_{1j} \\ \sum_{j=1}^{G} F_{2j} \\ \vdots \\ \sum_{j=1}^{G} F_{Gj} \end{bmatrix} = \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1G} \\ B_{21} & B_{22} & \cdots & B_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ B_{G1} & B_{G2} & \cdots & B_{GG} \end{bmatrix} \begin{bmatrix} F_1 \\ F_2 \\ \vdots \\ F_G \end{bmatrix}$$

where I is an NxN identity matrix, and B_{ij} denotes the N×N block Leontief inverse matrix, which is the total requirement matrix that gives the amount of gross outputs in producing country i required for a one-unit increase in final demand in destination country j.

Let V_i be the N×1 direct value-added coefficient vector. Each element of V_i gives the ratio of direct domestic value-added to gross output (exports) for country i at the sector level. This is equal to one minus the intermediate input share from all countries (including domestically produced intermediates):

$$(6)\qquad V_i = (u - \sum_{j=1}^{G} A_{ji} u)$$

where u is an Nx1 unit vector of 1. Putting all V_i in the diagonal and denoting it with a hat-symbol ($\hat{V}_i$), we can define a GN×GN matrix of direct domestic value-added coefficients for all countries as,

$$(7)\qquad \hat{V} = \begin{bmatrix} \hat{V}_1 & 0 & \cdots & 0 \\ 0 & \hat{V}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \hat{V}_G \end{bmatrix}$$

Putting final demand in the diagonals, we can define another GN×GN matrix of all countries' final demand as

$$(8) \qquad \hat{F} = = \begin{bmatrix} \hat{F}_1 & 0 & \cdots & 0 \\ 0 & \hat{F}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \hat{F}_G \end{bmatrix}$$

Then the decomposition of value-added in final demand can be conducted by the following equation:

$$(9) \qquad \begin{aligned} \hat{V}B\hat{F} &= \begin{bmatrix} \hat{V}_1 & 0 & \cdots & 0 \\ 0 & \hat{V}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \hat{V}_G \end{bmatrix} \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1G} \\ B_{21} & B_{22} & \cdots & B_{2G} \\ \vdots & \vdots & \ddots & \vdots \\ B_{G1} & B_{G2} & \cdots & B_{GG} \end{bmatrix} \begin{bmatrix} \hat{F}_1 & 0 & \cdots & 0 \\ 0 & \hat{F}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \hat{F}_G \end{bmatrix} \\ &= \begin{bmatrix} \hat{V}_1 B_{11} \hat{F}_1 & \hat{V}_1 B_{12} \hat{F}_2 & \cdots & \hat{V}_1 B_{1G} \hat{F}_G \\ \hat{V}_2 B_{21} \hat{F}_1 & \hat{V}_2 B_{22} \hat{F}_2 & \cdots & \hat{V}_2 B_{2G} \hat{F}_G \\ \vdots & \vdots & \ddots & \vdots \\ \hat{V}_G B_{G1} \hat{F}_1 & \hat{V}_G B_{G2} \hat{F}_2 & \cdots & \hat{V}_G B_{GG} \hat{F}_G \end{bmatrix} \end{aligned}$$

where $\hat{V}B\hat{F}$ is a GN×GN square matrix that gives the estimates of sector and country sources of value-added in a country's total final demand. Each block matrix $\hat{V}_i B_{ij} \hat{F}_{jj}$ is an N×N square matrix, with each element representing the value-added from a source sector of a source country directly or indirectly used by an absorbing sector in a destination country's total final demand (both domestic and foreign). Because we assume that the same technology is used in the production meeting a country's domestic demand and foreign demand (exports), we use total final demand, which is the sum of domestic final demand and final export demand, to calculate embodied services ratios.

Based on equation (9), we create the following measure of domestic services input intensity in manufacturing sectors in country j:

$$(10) \qquad SII_j^{sm} = v_j^s b_{jj}^{sm} f_j^m / VA_j^m, \text{ j = 1, 2, …, G}$$

where $v_j^s b_{jj}^{sm} f_j^m$, an element in equation (10), refers to country j's domestic services (superscript s) values embodied in country j's total final demand in the manufacturing sector (superscript m); VA_j^m is the total value-added created by the factors employed in the manufacturing sector of the absorbing country j (or the manufacturing GDP in country *j*). *SII* defined in formula (10) is a scalar

if *s* and *m* refer to a specific services and manufacturing sector respectively, in a country *j* in a given year. The numerator on the right-hand side of formula (10) refers to the value added contributed directly and indirectly by the factors employed in a services sector, while the denominator measures the value added contributed by factors employed in a manufacturing sector. Therefore, the denominator is not a part of the numerator and the *SII* measure is not bounded by one, although it is always less than one in the data. It would be bounded by one if we used the gross manufacturing output in the denominator, and the *SII* of one services sector would likely be negatively correlated to the *SII* of other goods or services sectors, and so omitted variable bias can be a problem if we do not include all other sectors in our analysis. The strategy we adopt to measure *SII* as in formula (10) can help us to avoid this problem and keep our specification simple.

It is tempting to use a country's own services input intensity (*SII*) directly in the regression. But there are a number of issues with such a strategy. *SII* of a country with underdeveloped services sectors (e.g., financial repression) may not be able to capture the required services input intensity along the manufacturing production possibility frontier. Hence, instead of using countries' own services input intensities, we use U.S. services input intensity for all the countries under the assumption that the U.S. is among the countries with the least financial and business services transaction costs and frictions. If inter-sectoral linkage is considered as a feature of the production technology, it should be the same across countries in the absence of services under-development. Adopting a similar strategy, Rajan and Zingales (1998) measure industries' dependence on external funds using only U.S. data for all countries covered by their analysis. Figure 5 shows a scatter plot of the domestic financial services input intensity in manufacturing against the business services input intensity for each of the WIOD countries in 2005. As we expect, U.S. embodied services ratios are among the highest for both financial and business services.

Another problem of using countries' own services input intensity is a potential endogeneity issue because a country's embodied services and services development can also be affected by its own manufacturing performance. For example, a country like India with comparative disadvantage in manufacturing may choose to specialize in services, which in turn will promote services development and reduce embodied services due to the weakness of the manufacturing sectors. When we use only U.S. embodied services, the feedback or reverse causality to the U.S. embodied services from other countries' manufacturing export RCA will be less a concern. In addition, we

will drop U.S. observations from our regressions to further alleviate the endogeneity problem. Finally, as another justification for using U.S. measures, the U.S. is arguably one of the countries with the most reliable data.

We will either use the time-varying U.S. services input intensities or take their averages over years. An advantage of the former measure is that it retains the time variations, while the later measure can smooth temporal fluctuations and hence is less sensitive to outliers. The variations in the U.S. services input intensities over the years are small for most of the WIOD sectors and some of the input-output data in the WIOD are filled in based on interpolation, so we will take the averaged measure as the benchmark and use the time-varying measure only as a robustness check. When average U.S. SII_i is used, this variable will drop out of regressions with sector or time-varying sector fixed effects. When time-varying sector fixed effects are used, SII_{it} will also be dropped.

An important caveat is that even a measure based on U.S. data is still a proxy intending to capture the potential linkage between services and manufacturing sectors. A noisy measure, however, should create a bias against finding a significant effect of services intensity on manufacturing RCA. Should we be able to find a better measure, the effect is likely to be even stronger.

In our empirical analysis, we also use the share of foreign embodied services in the total embodied domestic and foreign services as follows (for country j):

$$(11) \quad forsh_j^{sm} = \sum_{i,i\neq j}^{G} v_i^s b_{ij}^{sm} f_j^m \,/\, \sum_{i=1}^{G} v_i^s b_{ij}^{sm} f_j^m$$

The denominator in equation (11) sums $v_i^s b_{ij}^{sm} f_j^m$ over all source countries i=1, 2, …, G, including j itself, while the numerator leaves out country j's own (domestic) embodied services.

III.4 Measures of domestic services development (D)

Our main services development measure (*D*) is defined as the ratio of services value-added to GDP. Figure 1 shows a clear positive relationship between income level and the shares of financial and business services in GDP. It seems reasonable to use their shares in GDP to measure the level of development of these sectors.

Alternatively, we use the average value added per worker to measure domestic services development. It is calculated as total value added divided by total number of employees for

financial or business services based on the data from the WIOD and its Socio Economic Accounts. It is commonly used as a measure for labor productivity in services sectors, which should be closely linked to the levels of services development.

We also use other measures of services development to check the robustness of our results when data are available. Following the tradition in the literature, as in Rajan and Zingales (1998), we adopt two alternative measures for financial services development using the data from the World Bank Global Financial Development Database (GFDD). GFDD is an extensive data set of financial system characteristics for 203 economies from 1960 to 2010. The first measure is the bank private credit to GDP ratio, which is defined as the share of financial resources provided to the private sector by domestic banks in a country's GDP, originally from the International Financial Statistics of the IMF.[11] The second measure is the share of bank private credit and stock market capitalization in GDP. Stock market capitalization refers to the total value of all listed shares in a stock market based on Standard & Poor's Global Stock Markets Factbook and supplemental S&P data.

III.5 Data and Some Stylized Facts on Embodied Services

The primary data source for this study is the WIOD (2013 Version) which covers 35 industries for 40 countries over 1995-2007, so our data structure is a panel at the country-sector level over 13 years (see Appendixes 2-3C for lists of WIOD countries and sectors).[12] The original 2103 version of the WIOD data covers years 1995-2009, but we drop the data for 2008-2009 to avoid potential complication resulting from the 2008 global financial crisis. We consider all the manufacturing sectors (WIOD sectors 3-16), and focus on two types of modern services in this paper: financial intermediation services (WIOD sector 28) and other business services sector (WIOD sector 30).

To illustrate the importance of embodied services and to motivate our empirical analysis, we first show in Appendix 1A some data on the gross exports (X) and value added exports (VAX) of

[11] Domestic money banks comprise commercial banks and other financial institutions that accept transferable deposits, such as demand deposits.

[12] China and Romania are not covered by the regressions due to missing wage or employment data. Because the U.S. is used as the benchmark country to define services input intensity, it is also dropped from most of the regressions to alleviate potential endogeneity problem as explained in Section III.2.

financial services for some WIOD countries over 1995-2007. We further separate VAX into direct value-added exports (dVAX) and indirect value-added exports through all other sectors (indVXP).[13] The last row reports the world total for all the WIOD economies. Overall, VAX of services are 53 percent higher than the gross exports, and indirect VAX are 88 percent higher than the direct VAX. Among the 40 WIOD countries/regions excluding ROW, only three of them (Ireland, Luxembourg, and U.K.) have direct VAX higher than indirect VAX. The BRICs (Brazil, the Russian Federation, India, and China), Japan, the Republic of Korea, Lithuania, Turkey, and Taiwan, China, have much higher indirect VAX than direct VAX (especially China, Russia, and Turkey). Financial services in these countries may have reached an intermediate level of development at which they can compete in the domestic market but not yet internationally. It could also be that restrictions on cross-border imports in these countries oblige goods producers to use domestically produced services. For instance, if domestic firms in China have no easy access to foreign financial services due to high trade barriers, they will have to use domestic financial services (e.g., loans from state-owned banks).

Appendix 1B for business services, analogous to Appendix 1A, offers a similar pattern. Some emerging economics (e.g., Mexico, Russia, and especially Turkey) and Japan have much higher indirect business services VAX than direct VAX.[14] Most of the high-income countries such as the U.S. and the U.K. export large magnitudes of business services both directly and indirectly. By comparison, developing or emerging economies export significantly less business services, with the exception of India. India has developed an internationally competitive business services industry which has large direct VAX but its indirect VAX are small due to the relatively weak manufacturing sectors.

Because financial intermediation services and other business services sectors cover many different types of services, as listed in Appendices 3B and 3C, measuring their level of development is not straightforward. In this paper, we measure financial or business services development as the share of financial or business services value-added in a country's total value-added in all sectors (or GDP). The logic is simple: services sectors, especially modern ones like

[13] *tvaexp* can be bigger than *gexp* because it includes not only direct exports of a service sector, but also the indirect value added exports of services through other sectors.

[14] Japan is well-known for its competitive manufacturing but relatively inefficient services sectors. See, for example, a report at https://www.economist.com/node/3219857. As a result, Japan exports business services mainly indirectly through manufacturing sectors.

financial and business services, usually account for larger shares in total value added in countries with more developed services sectors. Keeping in mind that this may not always be the case for other industries such as agricultural and manufacturing industries as suggested by the literature on structural change (see, e.g., Kongsamut, Rebelo and Xie (2001), among others).

We control for the levels of countries' overall development using the GDP per capita data from the Penn World Tables. Other determinants of manufacturing RCA considered in this paper include the following: productivity measured by total factor productivity (TFP), scale economy measured by a manufacturing sector's employment in logarithms, factor endowment variables including capital-labor ratio (K/L) and skill ratio (SKratio, defined as the share of the wage payment to high skill workers in total wage payment), relative wages in manufacturing sectors defined as a country's average wage per worker over world average wage per worker. These variables vary across countries and sectors. The data for these variables are obtained from or estimated based on the WIOD Social-Economic Account database (SEA). The total factor productivity (TFP) growth rate for each WIOD manufacturing sector is estimated using the dual approach as in Hsieh (2002). It is calculated as a weighted average of the growth rates of labor prices (w) and capital prices (r), weighted by the share of payment to labor (L) and capital (K). For this method to be valid, no assumptions are needed for the relations of factor prices to social marginal products or about the production function form as long as the total factor payments add up to total output (i.e., $Y = r*K + w*L$).

Finally, we also include a measure for GVC participation. Wang et al. (2017) propose a framework to decompose total production activities to different types, depending on whether they are for pure domestic demand, traditional international trade, simple GVC activities, and complex GVC activities. Then they construct indices of GVC participation to measure the degree of a sectors' GVC participation – a concept similar to the vertical specialization (VS1) as in Hummels, Ishii, and Yu (2001) but with a few important improvements. We include a measure of forward industrial linkage-based GVC participation to estimate how a country/sector's engagement in GVC activities strengthens its overall export performance.

Table 1 provides the descriptive statistics of these variables and their definitions.

III.6 Empirical results

In Table 2, we estimate the specification in equation (1). The dependent variable is manufacturing export RCA calculated based on DVA in gross exports. The U.S. domestic services input intensity is averaged over 1995-2007 and treated as time-invariant. The financial (business) services development measure is defined as the ratio of U.S. financial (business) services value-added to U.S. GDP. Because the embodied services measures are based on U.S. data, we drop the observations for the U.S. from the regressions to alleviate the potential endogeneity problem. In the first three columns, we consider financial services (*f*), business services (*b*), and the combined financial and business services (*fb*) respectively. Country fixed effects, year dummies, and manufacturing sector dummies are all included in the first three regressions. Standard errors are always robust to heteroscedasticity and are also clustered by country*sector to address the potential serial correlation in the error terms for a particular country-sector across years.

The coefficient of services development is negative and significant in the first regression for financial services, but not significant for business services in the second regression. The coefficient of the key interaction term is always positive and highly significant. The results imply that financial services development reduces manufacturing RCA when embodied financial services are sufficiently low. This is not surprising given the definition of RCA: services development tends to increase a country's services export RCA and in turn should lead to lower manufacturing export RCA when manufacturing sectors do not benefit much from services development due to low services input intensity. When embodied services are sufficiently high, services development can actually increase manufacturing RCA. These results provide strong support for our first hypothesis. We can calculate easily the cutoff value of *SII*. Taking regression (1) as an example, the cutoff SII_f is about 0.046 as compared to its average value (0.035) reported in Table 1. The last three columns of Table 2 are analogous to the first three regressions except that we include time-varying country and time-varying sector fixed effects. As a result, services development measures and log(GDP/capita) are dropped from the regressions. The three interaction terms remain positive and highly significant, with similar magnitude as in the first three regressions.

The control variables in Table 2 have the expected signs. Manufacturing productivity (*TFP*), the measure of scale economy (*log(emp)*), capital–labor ratio (*K/L*), and GVC participation

increase manufacturing RCA.[15] Other variables, including *log*(*GDP/capita*), relative wage, and the skill ratio, do not have significant effects.

In Table 3A, Table 3B and Table 4, we perform various robustness checks. In Table 3A, we use an alternative measure of services development defined as average value added per worker in financial or business services. Our previous results continue to hold well. The interaction term *D*SII* is always positive and significant at the 1% or 5% level. Their magnitude is much smaller because the average values of the new services development measures are much bigger as shown in Table 1.

In Table 3B, we replace the services development measures in Table 2 by another two alternative measures for financial services as discussed in Section III.4. Because such a measure is not available for the corresponding WIOD business services sector, we perform this robustness check only for financial services. Our previous findings hold very well with or without time-varying fixed effects. The estimated cutoff *SII* (about 0.04) is similar to what we got from Table 2.

In Table 4, we examine the sensitivity of our results to alternative measures of services input intensity. The time-varying country and sector fixed effects are used in all of the regressions, so both *SII* and *D* variables are dropped. We consider here financial and business services together. In the first regression, we replace the *average* U.S. SII with *time-varying* U.S. SII; our main findings remain unchanged, with a slightly smaller coefficient of the interaction term than the corresponding one reported in column (3) of Table 2. Although the services input intensity of the U.S. is arguably the best choice to capture the role of financial and business services in manufacturing sectors, it is still useful to check the robustness of the results when countries' own SII measures are used. Regression (2) in Table 4 is analogous to those in the first column, except that we replace U.S. SII with each country's own SII (time-varying). We no longer drop the U.S. observations from this regression. The interaction term remains positive and significant at the 1% level, but the magnitude of the coefficient is much smaller than the one reported in the first column, probably because a country's own SII may not capture well the potential role of services in manufacturing sectors if services sectors are under-developed as we would expect. In the last

[15] Wang et al. (2017) construct indices for shallow, deep and overall GVC participation. We use only the overall measure in our regressions. The results are robust to other measures.

column, we use the average SII of the U.K., another developed country with competitive services sectors. The results are similar to those when the U.S. data are used: the magnitude of the *D*SII*'s coefficient is similar to what is reported in Table 2 (30.3 vs. 27.72).[16]

Next, we test for the second hypothesis, which states that countries may bypass their own inefficient domestic services sectors by relying on imported foreign services. As defined in equation (11), the share of embodied foreign services in total embodied services (*forsh*) is used to measure the degree of a country's access to foreign services markets. Because our story is relevant only to the sectors that use a significant amount of services as inputs, we consider only the first seven manufacturing sectors with high services input intensity as listed in Appendix 4,[17] and expect to see a stronger bypass effect than from sectors with lower services input intensity. We examine how the interaction between foreign services and domestic services development affects manufacturing export RCA based on specification (2) and report the results in Table 5A. As in the previous table, in the first three columns, we include separate country, year, and sector fixed effects; the first two regressions consider financial and business services respectively; and the third regression combines the two types of services. The coefficients of *D*forsh* are always negative and significant at the 1% or 5% level. This shows that the benefit of foreign services inputs on manufacturing export RCA decreases with the level of domestic services development, suggesting that foreign and domestic services inputs are at least partially substitutable. Together with a positive coefficient of *forsh*, this also implies that the access to foreign services can help a country to bypass under-developed domestic services provision. In the last three columns of Table 5A, we include time-varying country and sector fixed effects. As a result, we cannot estimate the coefficient of *D* any longer. The absolute value of the estimated coefficients of the interaction term is even larger, although it is statistically less significant for financial services.

If we include some additional sectors with medium levels of services input intensity, the above results are still robust, although a bit weaker as expected. For instance, including also sectors 9 and 7 does not lead to a dramatic change in the results, except that the interaction term turns

[16] We use the export RCA as our preferred measure for the dependent variable. This measure has the advantage of being comparable across sectors and countries. Nevertheless, we also try an alternative measure for the dependent variable – domestic value added in manufacturing exports in logarithms. Our previous findings are robust to this alternative measure.

[17] The sector rankings are identical if we consider only financial or only business services, or if we consider both embodied domestic and foreign services.

slightly less significant in the regression for financial services. We also run similar regressions as in Table 5A for the other seven manufacturing sectors with low financial and business services input intensity as listed in Appendix 4. For these sectors, services development and access to foreign services markets should matter less. The results are reported in Table 5B. As expected, *forsh* and its interaction with *D* are mostly insignificant at the 10% level. Although the interaction term is significant at the 10% level for business services in column (2), the magnitude of the coefficient in absolute value is smaller than the corresponding coefficient in Table 5A. These results provide further support to the second hypothesis.[18]

IV. Concluding remarks

In this paper, we examine how the development of domestic services sectors may affect the export performance of downstream manufacturing sectors, taking into account the services input intensities of manufacturing sectors. We focus on two types of modern services, i.e., financial services and business services, whose shares in an economy normally increase with the level of a country's development.

We show that the indirect exports of services are surprisingly high for a number of countries, especially developing or emerging economies, even though most of these countries' direct exports of services are relatively small. We also find that the manufacturing sectors that use these services intensively as inputs benefit more from domestic services development. These findings suggest that policy makers should take into account the linkages among sectors, not look at them in isolation on a single sector basis as can happen with the "silo" approach to trade negotiations (Hoekman and Jackson, 2013).

Industrial countries have been strong in exporting services, both directly and indirectly. For example, according to Appendix 1B, the U.S. is not only the largest direct exporter of business services in the world, but also the largest indirect exporter of business services (actually twice as large), suggesting an important role of business services in U.S. manufacturing activities. However, developing and emerging economies have significantly lagged, with the only the exception of India in direct exports of business services. Services development in these countries not only strengthens

[18] Hypothesis 2 suggests a triple interaction between *D*, *SII* and *forsh*. With all their combinations as regressors in the regressions, it would be significantly more difficult to interpret the coefficients and partial effects. Therefore, we chose to run the regressions for subsamples using only one double interaction term.

their services sectors but also promotes manufacturing and other goods producing sectors. Countries like China that may be concerned with the sustainability of their manufacturing export success may consider building stronger services sectors as a way to upgrade their manufacturing sectors to an even higher level. According to Appendix 1B, China's business services exports in value added terms, relative to its exports in gross terms, are less impressive compared to the corresponding figure for financial services shown in Appendix 1A. Both its direct and indirect business services exports are only 8-9 percent of the corresponding numbers of the U.S. Drawing from the firm-level data in ORBIS, Miroudot and Cadestin (2017) show that China is the only country in their sample which has a majority of the manufacturing firms (77 percent in 2013) selling only goods, with little bundling of goods and services such as manufacturing and distribution services, as seen with Apple iPhones/iPads and Apple Stores. To strengthen the manufacturing sector, countries need to focus not just on manufacturing production, but also on services upgrading including but not limited to R&D, marketing, advertising, inventory management, quality control, production scheduling, after-sale technical supports, and follow-up customer services.

With significant improvement in transportation and communication technologies and increasing services outsourcing activities, some developing countries such as India have developed competitive services sectors. For example, Indian services RCA calculated based on DVA in gross exports are either greater than one (financial services) or close to one (business services), much bigger than the corresponding numbers for other developing economies such as China. For countries like India, our paper suggests that the manufacturing sectors that use these services intensively tend to have a comparative advantage. However, different from most of the other WIOD countries, Indian gross exports of business services are actually larger than its total value added exports, suggesting relatively little embodied business services in other sectors, as shown by the direct and indirect ratio of Indian business services exports in Appendix 1B. There is plenty of room left for India and similar countries to take advantage of their competitive services sectors during their industrialization process. This illustrates the importance for policy makers and entrepreneurs to understand the implications of inter-sectoral linkages.

We also provide evidence for a bypass effect, that is, countries may bypass their inefficient domestic services sectors by relying more on imported services inputs. This suggests that nations

with under-developed services may take advantage of globalization in services. Countries that hesitate to liberalize their services sectors in hopes of protecting their inefficient domestic services sectors may hurt the competitiveness of their manufacturing sectors.

Although this paper focuses only on the services-manufacturing linkages, many other important research questions could also be studied using a similar methodology. With the inter-country input-output tables, we have complete information on how countries and sectors are inter-linked to each other. We expect to see more and more studies along this line of research.

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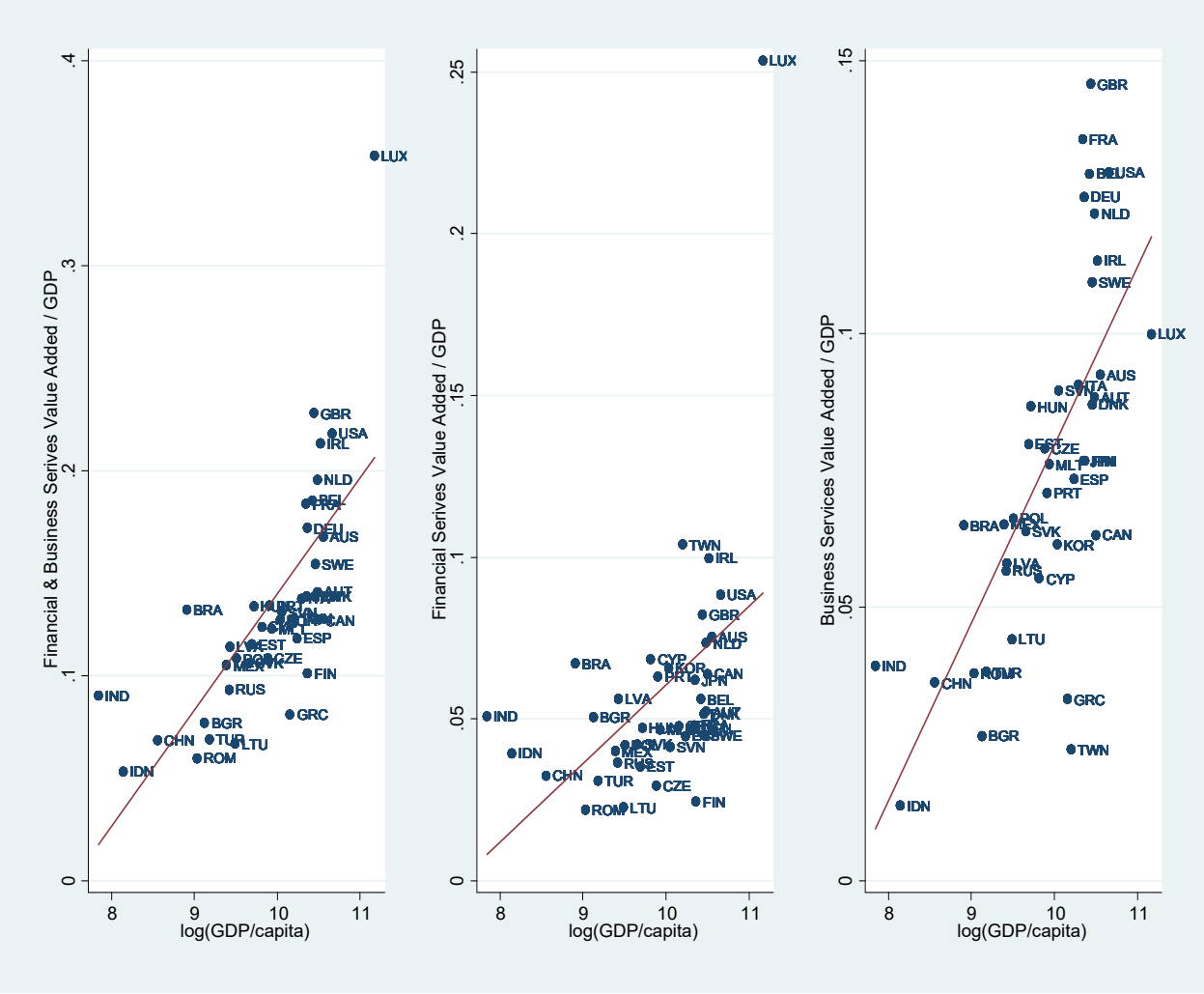
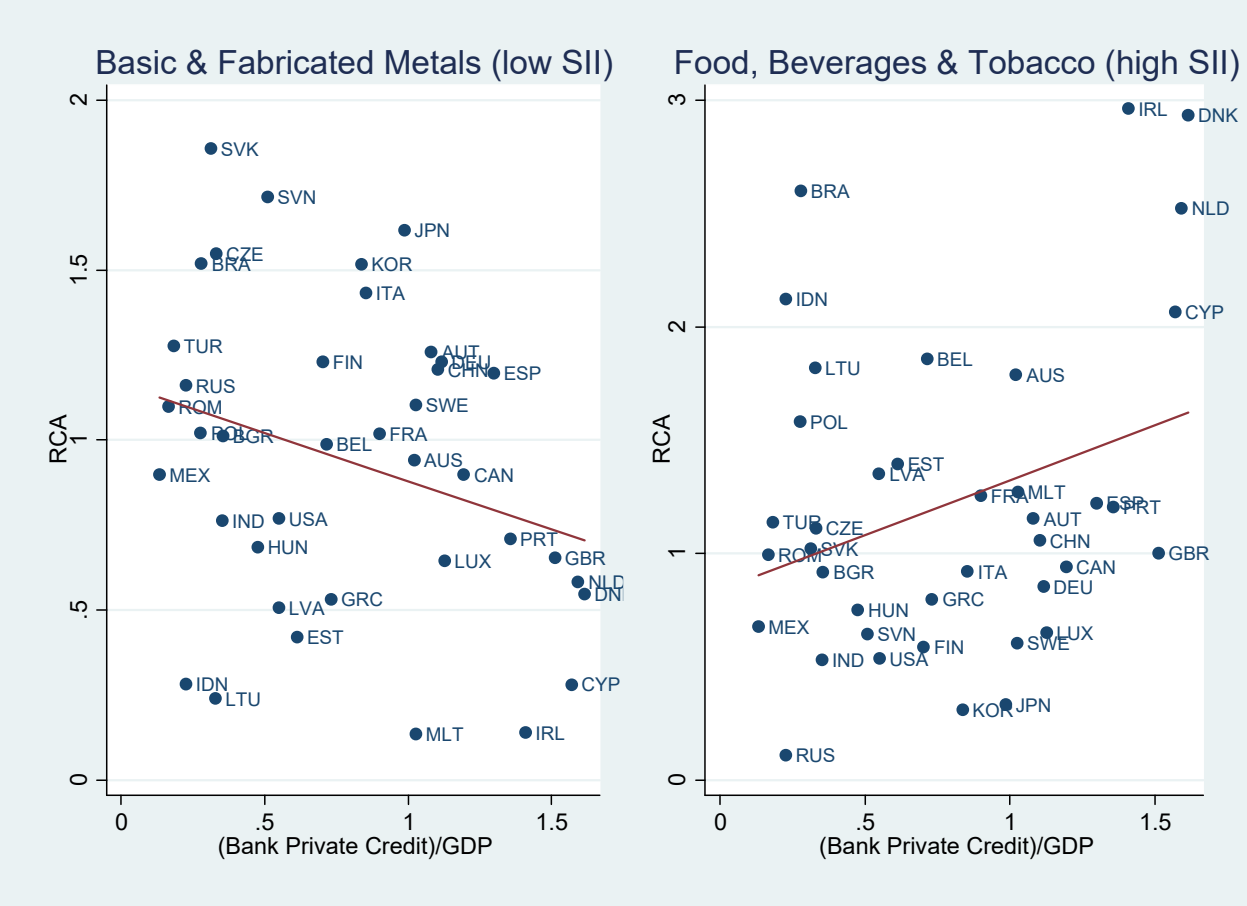
Figure 1: Scatter plots of the shares of services value added in GDP against income level, for financial and business services, year 2005



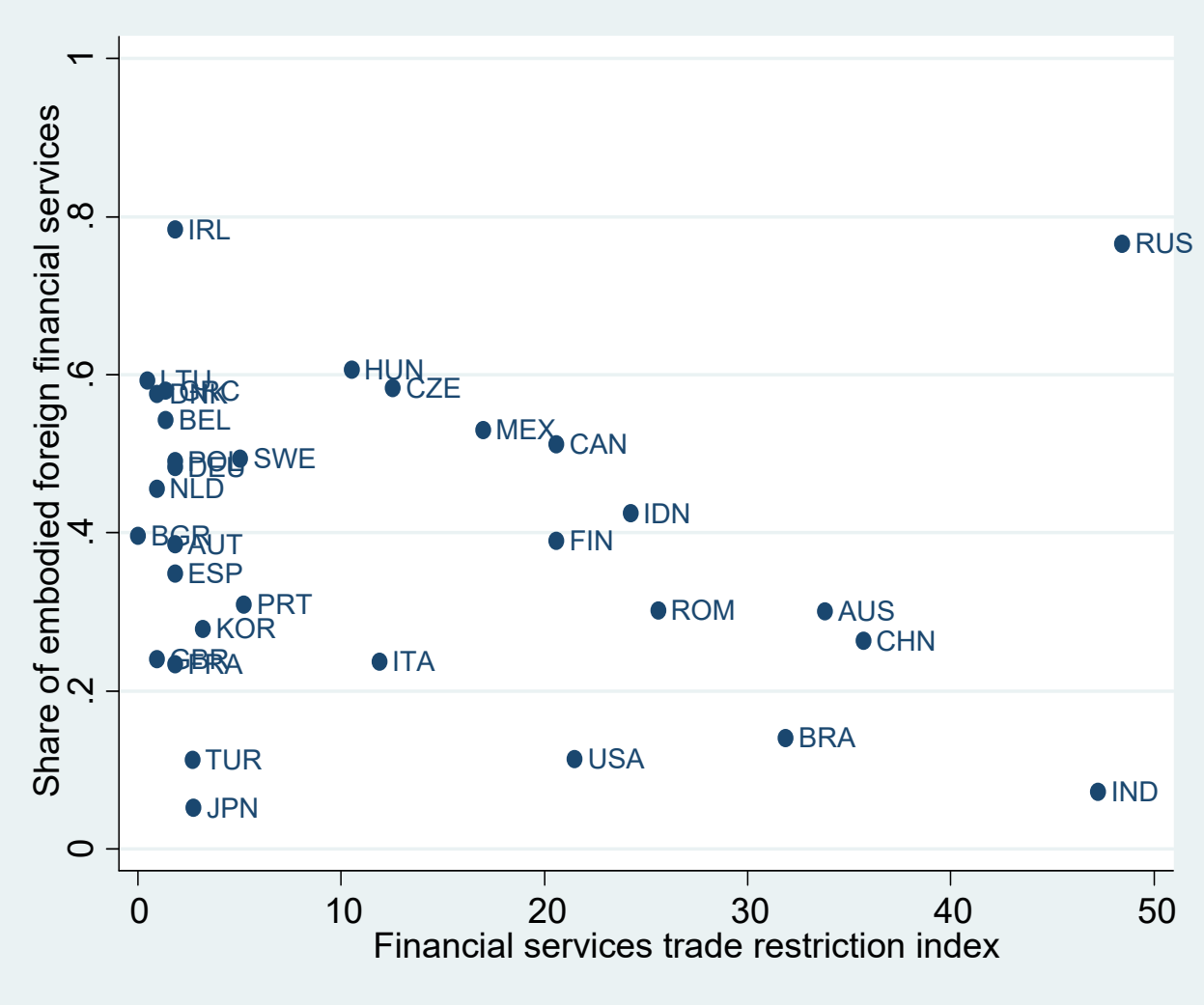
Notes: The vertical axis represents the share of services value added in GDP for financial & business services combined, financial services only, and business services only, respectively. The horizontal axis represents log(GDP/capita). Only the data for year 2005 are used. Data sources: WIOD and PWT.

Figure 2: RCA against Bank Private Credit to GDP (D_{fl}), 2005



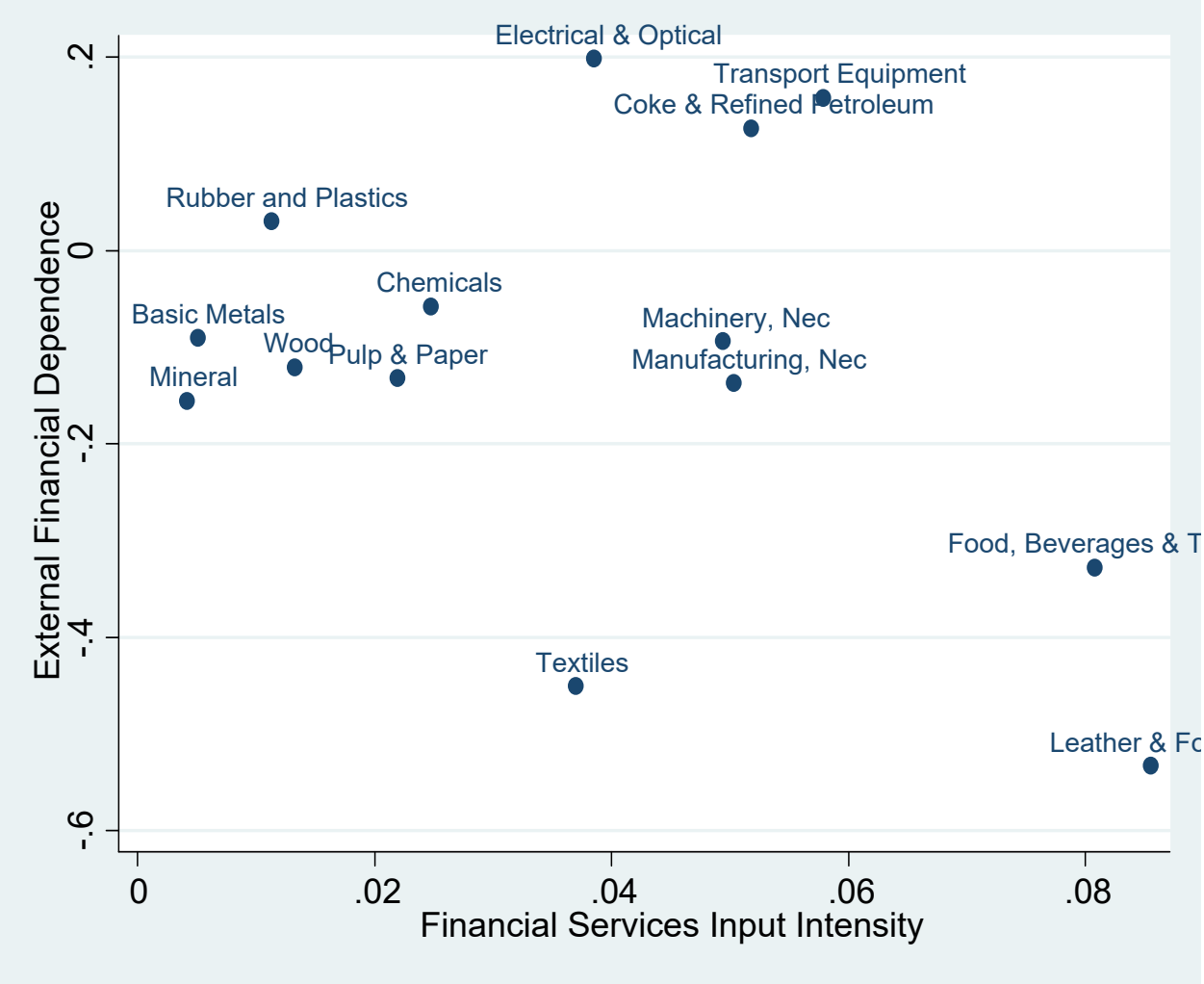
Notes: The vertical axis represents the RCA based on DVA in gross exports for Basic & Fabricated Metals sector and Food, Beverages & Tobacco sector, respectively. The horizontal axis represents a measure of financial development – the ratio of bank private credit to GDP. The data for bank private credit are from the World Bank Global Financial Development Database (GFDD). Only the data for year 2005 are used in this diagram.

Figure 3: Correlation between services trade barriers and the share of embodied foreign services for textiles sector in year 2000



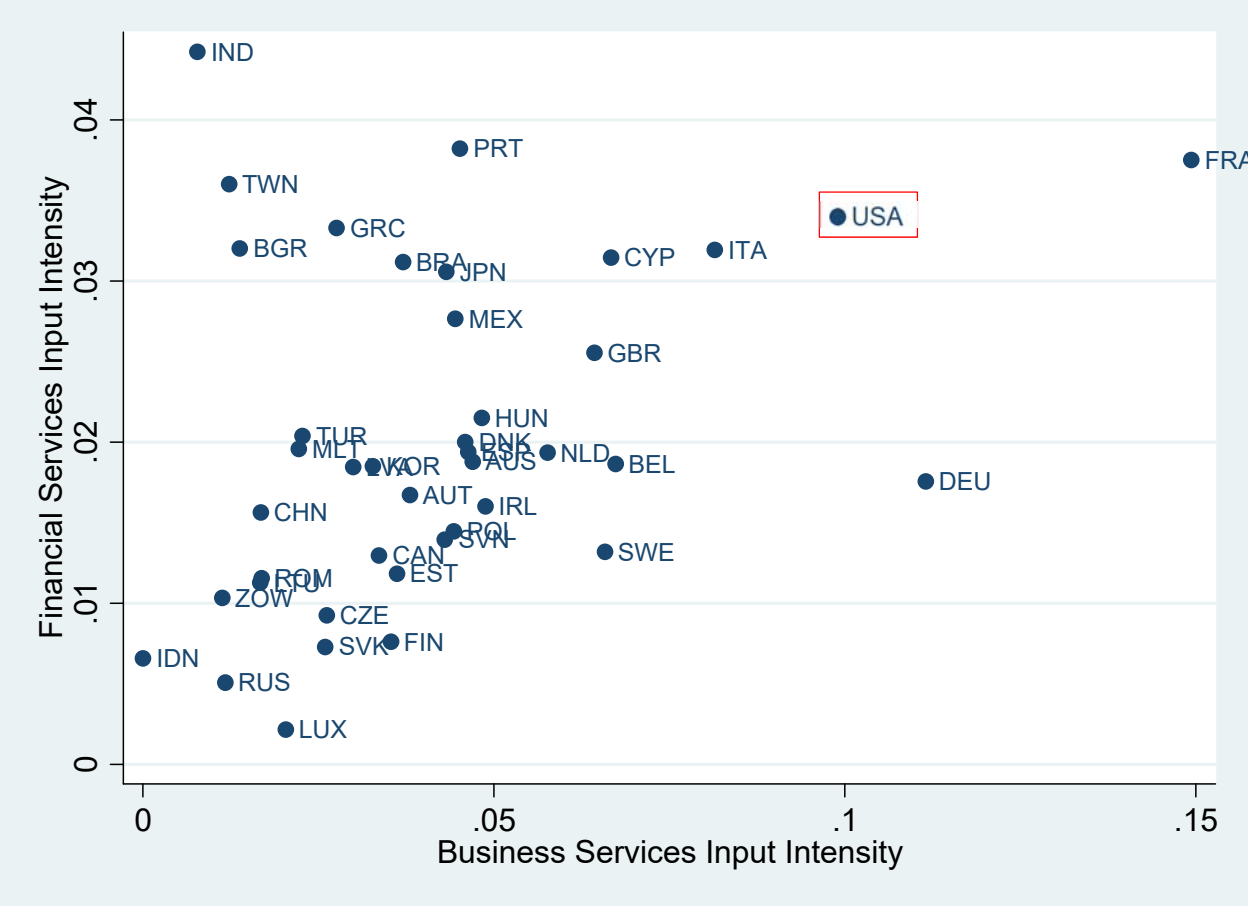
Notes: The vertical axis represents the share of embodied foreign financial services among the embodied foreign and domestic financial services for year 2000. The horizontal axis represents financial services trade restriction index, using the data from the World Bank Services Trade Restriction Indexes (STRI). See Appendix 2 for the country names corresponding to these country codes.

Figure 4: Scatter plot of our financial services input intensity against Rajan and Zingales (1998) external financial dependence measure for the U.S.



Notes: Our financial services input intensity measure is based on the WIOD data in 1995, while Rajan and Zingales (1998) external financial dependence measure is for year 1980.

Figure 5: Scatter plot of average SII_f against SII_b for all manufacturing sectors, 2005



Note: The services input intensity measures are based on the WIOD data in 2005.

Table 1: Descriptive statistics of key variables (for WIOD countries over 1995-2007)

Variables	Variable Description	Obs	Mean	S.D.	Min	Max
RCA	RCA based on manufacturing domestic value added (DVA) in gross exports	6,734	1.112	1.037	0.000	12.507
SII_f (U.S.)	ratio of U.S. embodied domestic financial (f) services to U.S. manuf. total value added (totva)	6,734	0.036	0.024	0.004	0.100
SII_b (U.S.)	ratio of U.S. embodied domestic business (b) services to U.S. manufacturing totva	6,734	0.109	0.074	0.011	0.309
SII_{fb} (U.S.)	ratio of U.S. embodied domestic financial & business (fb) services to U.S. manuf. totva	6,734	0.145	0.098	0.014	0.406
SII_f (U.S. avg.)	average U.S. SII_f over 1995-2007	6,734	0.035	0.023	0.005	0.080
SII_b (U.S. avg.)	average U.S. SII_b over 1995-2007	6,734	0.107	0.068	0.013	0.215
SII_{fb} (U.S. avg.)	average U.S. SII_{fb} over 1995-2007	6,734	0.142	0.089	0.018	0.294
SII_f	country's own SII_f, time-varying	6,704	0.026	0.031	0.000	0.530
SII_b	country's own SII_b, time-varying	6,704	0.044	0.044	0.000	0.352
SII_{fb}	country's own SII_{fb}, time-varying	6,704	0.070	0.062	0.000	0.559
$forsh_f$	share of embodied foreign financial services in total embodied domestic & foreign F services	6,674	0.416	0.192	0.036	0.999
$forsh_b$	share of embodied foreign business services in total embodied domestic & foreign B services	6,674	0.496	0.207	0.076	1.000
$forsh_{fb}$	share of embodied foreign F&B services in total embodied domestic & foreign F&B services	6,674	0.450	0.188	0.066	0.999
D_f (VA/GDP)	share of financial services totva among a country's GDP	6,734	0.056	0.035	0.012	0.289
D_b (VA/GDP)	share of business services totva among a country's GDP	6,734	0.069	0.031	0.011	0.154
D_{fb} (VA/GDP)	share of financial & business services totva among a country's GDP (= D_f + D_b)	6,734	0.125	0.050	0.036	0.391
D_f (VA/worker)	services value added per worker for financial services sector (in thousand USD)	6,720	4.053	0.807	1.607	5.882
D_b (VA/worker)	services value added per worker for business services sector (in thousand USD)	6,720	3.407	0.828	0.871	5.091
D_{fb} (VA/worker)	services value added per worker for financial & business services sectors (in thousand USD)	6,720	3.649	0.776	1.244	5.352
D_{f1}	Alternative measure 1 for D_f = ratio of bank private credit to GDP	6,300	0.693	0.457	0.072	2.010
D_{f2}	Alternative measure 2 for D_f = (Bank Private Credit + Stock market capitalization)/GDP	6,202	1.216	0.767	0.086	4.072
log(GDP/capita)	log(GDP/capita)	6,734	9.788	0.714	7.357	11.363
TFP	manufacture TFP estimated by the dual approach	5,686	-0.001	0.446	-4.282	4.656
log(emp)	log(manufacture employment)	6,704	4.070	2.026	-5.717	9.749
SKratio	Skill ratio = payment to high skill workers / payment to all workers (in manufacturing sectors)	6,734	0.200	0.091	0.028	0.631
K/L	capital/labor ratio in manufacture	6,697	0.932	1.917	-0.876	62.323
rwage	Relative wage = average wage per worker in a country / world average wage per worker	6,704	0.964	4.671	0.000	75.502
GVA Participation	GVC participation index based on forward linkage	6,704	0.304	0.196	0.000	3.870

Notes: This table is based on all of the available data for 14 manufacturing sectors of 37 WIOD countries over 1995-2007 (# of observations can be up to 14*37*13=6734). Three WIOD countries are not covered: U.S. is dropped as the benchmark country to define services input intensity; China and Romania are also dropped due to lack of wage and employment data. The statistics for the samples used in regressions are very similar.

Table 2: The effects of services development on manufacturing export RCA, using U.S. services input intensity averaged over 1995-2007

	(1)	(2)	(3)	(4)	(5)	(6)
D_f	-5.102***					
	(1.733)					
D_f*SII_f	**111.109*** **			**111.829*** **		
	(35.993)			**(37.762)**		
D_b		0.857				
		(2.066)				
D_b*SII_b		**38.719*** **			**39.306*** **	
		(12.895)			**(13.937)**	
D_{fb}			-3.240**			
			(1.405)			
D_{fb}*SII_{fb}			**27.217*** **			**27.721*** **
			(6.695)			**(7.182)**
log(GDP/capita)	0.153	0.008	0.084			
	(0.168)	(0.160)	(0.168)			
TFP	0.069***	0.075***	0.072***	0.064**	0.066**	0.065**
	(0.022)	(0.021)	(0.022)	(0.029)	(0.028)	(0.028)
log(emp)	0.938***	0.935***	0.952***	0.958***	0.952***	0.970***
	(0.091)	(0.092)	(0.092)	(0.098)	(0.099)	(0.099)
SKratio	0.588	0.521	0.542	0.802	0.833	0.796
	(0.621)	(0.636)	(0.638)	(0.801)	(0.826)	(0.822)
K/L	0.069***	0.066***	0.067***	0.071***	0.068***	0.069***
	(0.025)	(0.025)	(0.025)	(0.026)	(0.026)	(0.026)
rwage	-0.001	-0.001	-0.001	-0.000	-0.001	0.001
	(0.007)	(0.007)	(0.007)	(0.009)	(0.008)	(0.009)
GVC Participation	2.463***	2.452***	2.470***	2.577***	2.558***	2.584***
	(0.448)	(0.445)	(0.444)	(0.500)	(0.497)	(0.495)
Country FEs	Yes	Yes	Yes			
Sector FEs	Yes	Yes	Yes			
Year FEs	Yes	Yes	Yes			
Country*Year FEs				Yes	Yes	Yes
Sector*Year FEs				Yes	Yes	Yes
Observations	5,686	5,686	5,686	5,686	5,686	5,686
R-squared	0.575	0.575	0.581	0.593	0.593	0.599

Notes: The dependent variable is manufacturing export RCA. D_f (D_b) refers to the share of financial (business) services value added in GDP. D_{fb} equals the sum of D_f and D_b. S_f is the ratio of the U.S. embodied domestic financial services to U.S.' manufacturing value added, averaged over 1995-2007. All WIOD manufacturing sectors 3-16 are covered (not grouped together). Robust standard errors in parentheses, clustered by country*sector. *** p<0.01, ** p<0.05, * p<0.1.

Table 3A: Robustness check (1), alternative measure of services development (services value added per worker)

	(1)	(2)	(3)	(4)	(5)	(6)
D_f	0.050					
	(0.076)					
D_f*SII_f	**3.667****			**3.992****		
	(1.690)			**(1.948)**		
D_b		0.106				
		(0.068)				
D_b*SII_b		**1.237****			**1.247****	
		(0.574)			**(0.621)**	
D_{fb}			0.132*			
			(0.079)			
D_{fb}*SII_{fb}			**1.125****			**1.160****
			(0.457)			**(0.504)**
log(GDP/capita)	-0.221	-0.320**	-0.428**			
	(0.168)	(0.163)	(0.170)			
TFP	0.069***	0.062***	0.063***	0.063**	0.062**	0.062**
	(0.022)	(0.021)	(0.021)	(0.029)	(0.029)	(0.029)
log(emp)	0.937***	0.934***	0.939***	0.953***	0.950***	0.955***
	(0.093)	(0.092)	(0.093)	(0.100)	(0.099)	(0.100)
SKratio	0.586	0.512	0.514	0.788	0.708	0.689
	(0.629)	(0.630)	(0.629)	(0.823)	(0.822)	(0.823)
K/L	0.069***	0.068***	0.069***	0.070***	0.069***	0.070***
	(0.026)	(0.025)	(0.025)	(0.026)	(0.025)	(0.026)
rwage	-0.002	-0.000	-0.000	-0.001	-0.001	-0.001
	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
GVC Participation	2.428***	2.433***	2.425***	2.530***	2.512***	2.506***
	(0.445)	(0.443)	(0.442)	(0.495)	(0.490)	(0.490)
Country FEs	Yes	Yes	Yes			
Sector FEs	Yes	Yes	Yes			
Year FEs	Yes	Yes	Yes			
Country*Year FEs				Yes	Yes	Yes
Sector*Year FEs				Yes	Yes	Yes
Observations	5,674	5,674	5,674	5,674	5,674	5,674
R-squared	0.573	0.574	0.576	0.591	0.591	0.592

Notes: The dependent variable is manufacturing export RCA. D_f (D_b) refers to the share of financial (business) services value added per worker. D_{fb} is the services value added per worker for both financial and business services sectors combined. SII_f (SII_b) is the ratio of the U.S. embodied domestic financial (business) services to U.S.' manufacturing value added, averaged over 1995-2007. SII_{fb} is the combined measure for both financial and business services. All WIOD manufacturing sectors 3-16 are covered (not grouped together). Robust standard errors in parentheses, clustered by country*sector. *** p<0.01, ** p<0.05, * p<0.1.

Table 3B: Robustness check (2), alternative measures of financial development (D_{f1} & D_{f2})

	(1)	(2)	(3)	(4)
D_{f1}	-0.292**			
	(0.120)			
D_{f1}*SII_f	**7.724*** **		**7.668** **	
	(2.841)		**(3.065)**	
D_{f2}		-0.206***		
		(0.072)		
D_{f2}*SII_f		**4.962*** **		**5.121*** **
		(1.662)		**(1.863)**
log(GDP/capita)	0.175	0.097		
	(0.173)	(0.153)		
TFP	0.068***	0.061***	0.068**	0.059*
	(0.022)	(0.023)	(0.030)	(0.030)
log(emp)	0.935***	0.937***	0.954***	0.954***
	(0.094)	(0.093)	(0.101)	(0.100)
SKratio	0.629	0.662	0.866	0.845
	(0.636)	(0.635)	(0.823)	(0.811)
K/L	0.066***	0.065***	0.068***	0.066***
	(0.024)	(0.023)	(0.025)	(0.024)
rwage	-0.002	-0.002	-0.001	-0.001
	(0.007)	(0.007)	(0.009)	(0.009)
GVC Participation	2.549***	2.536***	2.668***	2.658***
	(0.473)	(0.466)	(0.528)	(0.518)
Country FEs	Yes	Yes		
Sector FEs	Yes	Yes		
Year FEs	Yes	Yes		
Country*Year FEs			Yes	Yes
Sector*Year FEs			Yes	Yes
Observations	5,758	5,678	5,758	5,678
R-squared	0.509	0.511	0.530	0.532

Notes: The dependent variable is manufacturing export RCA. D_{f1} refers to the ratio of bank credits to private sectors to GDP. D_{f2} is the ratio of bank credits to private sectors and stock market capitalization to GDP. SII_f is the ratio of the U.S. embodied domestic financial services in U.S.' manufacturing value added, averaged over 1995-2007. All WIOD manufacturing sectors 3-16 are covered (not grouped together). Robust standard errors in parentheses, clustered by country*sector. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Robustness check (3), using alternative services input intensity measures for financial & business services combined (fb)

	(1)	(2)	(3)
	Use time-varying U.S. services input intensity	Use countries' own time-varying services intensity	Use U.K.'s average Services input intensity
D_{fb}*SII_{fb}	**23.941*** **	**11.965*** **	**30.300** **
	(6.546)	**(4.147)**	**(14.332)**
TFP	0.064**	0.067**	0.067**
	(0.028)	(0.029)	(0.029)
log(emp)	0.964***	0.944***	0.969***
	(0.099)	(0.095)	(0.099)
SKratio	0.800	0.730	0.746
	(0.818)	(0.682)	(0.687)
K/L	0.070***	0.075***	0.070***
	(0.026)	(0.027)	(0.025)
rwage	0.000	-0.001	0.001
	(0.009)	(0.008)	(0.008)
GVC Participation	2.575***	2.572***	2.556***
	(0.496)	(0.499)	(0.498)
Country*Year FEs	Yes	Yes	Yes
Sector*Year FEs	Yes	Yes	Yes
Observations	5,686	5,855	5,714
R-squared	0.597	0.591	0.593

Notes: The dependent variable is manufacturing export RCA. D_{fb} refers to the share of financial & business services value added in GDP. In regression (1), SII_{fb} is the ratio of the U.S. embodied domestic financial & business services to U.S.' manufacturing value added (not averaged over years). In regression (2), SII_{fb} measures countries' own services input intensity (not averaged over years). In regression (3), SII_{fb} is the ratio of the U.K. embodied domestic financial & business services to U.K.' manufacturing value added, averaged over 1995-2007. All WIOD manufacturing sectors 3-16 are covered (not grouped together). U.S. observations are dropped from regression (1) and the U.K. observations are dropped from regression (3). Robust standard errors in parentheses, clustered by country*sector. *** p<0.01, ** p<0.05, * p<0.1.

Table 5A: Effects of embodied *foreign* services on manufacturing export RCA, for MORE services intensive manufacturing sectors

	(1)	(2)	(3)	(4)	(5)	(6)
D_f	2.445					
	(3.766)					
$forsh_f$	0.246			0.989		
	(0.499)			(1.295)		
D_f*forsh$_f$	**-8.962****			**-32.749**		
	(4.376)			**(22.928)**		
D_b		16.921***				
		(5.080)				
$forsh_b$		1.070			2.801**	
		(0.660)			(1.113)	
D_b*forsh$_b$		**-20.873*****			**-45.683*****	
		(8.025)			**(15.308)**	
D_{fb}			6.959**			
			(3.374)			
$forsh_{fb}$			0.991			3.265**
			(0.820)			(1.548)
D_{fb}*forsh$_{fb}$			**-12.261*****			**-35.116*****
			(4.499)			**(12.198)**
log(GDP/capita)	-0.183	-0.182	-0.168			
	(0.204)	(0.220)	(0.217)			
TFP	0.071**	0.078**	0.073**	0.051	0.057	0.050
	(0.034)	(0.032)	(0.034)	(0.050)	(0.050)	(0.051)
log(emp)	0.880***	0.888***	0.889***	0.894***	0.907***	0.918***
	(0.080)	(0.081)	(0.080)	(0.089)	(0.089)	(0.090)
SKratio	0.320	0.179	0.256	0.317	0.283	0.315
	(0.713)	(0.689)	(0.716)	(0.935)	(0.910)	(0.924)
K/L	0.145**	0.150**	0.151**	0.178**	0.189**	0.182**
	(0.072)	(0.072)	(0.072)	(0.090)	(0.088)	(0.088)
rwage	-0.018*	-0.016*	-0.017*	-0.021	-0.017	-0.018
	(0.010)	(0.010)	(0.010)	(0.014)	(0.013)	(0.013)
GVC Participation	0.913***	0.940***	0.928***	1.033***	1.004***	1.024***
	(0.289)	(0.293)	(0.290)	(0.335)	(0.338)	(0.337)
Country FEs	Yes	Yes	Yes			
Sector FEs	Yes	Yes	Yes			
Year FEs	Yes	Yes	Yes			
Country*Year FEs				Yes	Yes	Yes
Sector*Year FEs				Yes	Yes	Yes
Observations	2,901	2,901	2,901	2,901	2,901	2,901
R-squared	0.596	0.598	0.598	0.622	0.626	0.626

Notes: Dependent variable is manufacturing export RCA. We keep only the last seven sectors with high financial and business service input intensity, as listed in Appendix 4. Robust standard errors in parentheses, clustered by country*sector. *** p<0.01, ** p<0.05, * p<0.1.

Table 5B: Effects of embodied *foreign* services on manufacturing export RCA, for LESS services intensive manufacturing sectors

	(1)	(2)	(3)	(4)	(5)	(6)
D_f	0.359					
	(4.761)					
$forsh_f$	-0.233			-1.231		
	(0.560)			(1.549)		
D_f*forsh$_f$	**-2.248**			**15.603**		
	(9.165)			**(25.722)**		
D_b		9.509**				
		(4.404)				
$forsh_b$		-0.525			-0.390	
		(0.589)			(0.984)	
D_b*forsh$_b$		**-13.422***			**-17.385**	
		(7.452)			**(14.001)**	
D_{fb}			4.016			
			(3.735)			
$forsh_{fb}$			-0.120			0.334
			(0.786)			(1.844)
D_{fb}*forsh$_{fb}$			**-6.610**			**-10.217**
			(5.555)			**(15.852)**
log(GDP/capita)	0.371	0.284	0.325			
	(0.273)	(0.250)	(0.260)			
TFP	0.058**	0.056**	0.057**	0.067*	0.057	0.064*
	(0.028)	(0.028)	(0.028)	(0.038)	(0.035)	(0.036)
log(emp)	0.959***	0.931***	0.940***	0.966***	0.944***	0.963***
	(0.155)	(0.162)	(0.158)	(0.169)	(0.183)	(0.177)
SKratio	0.196	0.226	0.187	0.147	0.152	0.153
	(0.653)	(0.666)	(0.667)	(0.831)	(0.871)	(0.862)
K/L	0.068***	0.073***	0.071***	0.070***	0.076***	0.073***
	(0.023)	(0.025)	(0.024)	(0.022)	(0.025)	(0.024)
rwage	0.018**	0.019**	0.018**	0.022*	0.022*	0.021*
	(0.009)	(0.009)	(0.009)	(0.012)	(0.012)	(0.012)
GVC Participation	3.972***	4.098***	4.056***	4.254***	4.373***	4.306***
	(0.706)	(0.696)	(0.708)	(0.847)	(0.838)	(0.844)
Country FEs	Yes	Yes	Yes			
Sector FEs	Yes	Yes	Yes			
Year FEs	Yes	Yes	Yes			
Country*Year FEs				Yes	Yes	Yes
Sector*Year FEs				Yes	Yes	Yes
Observations	2,931	2,931	2,931	2,931	2,931	2,931
R-squared	0.637	0.644	0.640	0.665	0.669	0.666

Notes: Dependent variable is manufacturing export RCA. We keep only the first seven sectors with high financial and business service input intensity, as listed in Appendix 4. Robust standard errors in parentheses, clustered by country*sector. *** p<0.01, ** p<0.05, * p<0.1.

Appendix 1A: Total direct & indirect value added export (VAX) of financial service, 1995-2007

Country	X (gross export)	VAX	Ratio1 = VAX/X	dVAX	indVAX	Ratio2 = indVAX/dVAX
AUS	210	579	2.76	133	447	3.74
AUT	564	686	1.22	334	352	1.00
BEL	620	896	1.45	327	569	1.65
BGR	20	47	2.37	13	34	2.69
BRA	72	457	6.30	47	410	8.68
CAN	487	984	2.02	275	709	2.59
CHN	53	1774	33.62	34	1740	42.94
CYP	4	12	2.72	3	8	2.79
CZE	45	104	2.32	20	84	4.77
DEU	1151	2644	2.30	529	2115	3.56
DNK	122	282	2.30	76	206	2.83
ESP	438	847	1.93	284	563	1.82
EST	8	15	1.91	5	10	1.87
FIN	33	122	3.76	21	101	3.56
FRA	790	1925	2.44	405	1520	3.96
GBR	5050	4339	0.86	2591	1748	0.54
GRC	39	87	2.27	28	59	2.21
HUN	52	118	2.28	29	89	3.74
IDN	139	271	1.95	103	168	1.95
IND	101	683	6.77	78	605	7.46
IRL	1597	1171	0.73	831	341	0.38
ITA	552	1604	2.90	331	1273	3.57
JPN	789	3603	4.57	522	3081	6.25
KOR	199	976	4.91	119	857	6.58
LTU	2	12	6.45	1	11	9.35
LUX	2910	849	0.29	640	209	0.32
LVA	8	16	1.96	5	10	2.09
MEX	181	512	2.83	119	393	3.70
MLT	7	11	1.49	4	7	1.97
NLD	820	1244	1.52	442	803	1.58
POL	114	219	1.92	70	148	2.55
PRT	93	235	2.52	65	170	2.76
ROM	24	67	2.82	17	50	3.07
RUS	5	152	29.25	4	149	49.65
SVK	20	37	1.89	12	25	2.01
SVN	9	38	4.35	6	33	4.66
SWE	372	532	1.43	247	285	1.08
TUR	7	251	34.48	5	247	45.46
TWN	95	1197	12.55	75	1122	13.78
USA	10116	11897	1.18	5624	6273	1.07
ROW	2382	4798	2.01	1598	3199	1.93
TOT	**30300**	**46293**	**1.53**	**16070**	**30223**	**1.88**

Notes: The export values in this table are for financial services sector (WIOD sector 28) in 100 million U.S. dollars at 2005 constant price, using the U.S. GDP deflator from the Federal Reserve Economic Data (website address: http://research.stlouisfed.org/fred2). *X* is total gross exports. *VAX* is total value added exports. *dVAX* is direct value added exports. *indVAX* is indirect value added exports through other sectors.

Appendix 1B: Total direct & indirect value added export (VAX) of business service, 1995-2007

Country	X (gross export)	VAX	Ratio1 = VAX/X	dVAX	indVAX	Ratio2 = indVAX/dVAX
AUS	512	1128	2.20	250	879	3.60
AUT	1012	1184	1.17	579	604	1.11
BEL	1964	2657	1.35	964	1693	1.76
BGR	11	26	2.41	8	18	2.23
BRA	303	665	2.19	193	472	2.38
CAN	1322	2380	1.80	812	1568	1.93
CHN	1765	1921	1.09	757	1164	1.33
CYP	12	21	1.78	8	13	1.66
CZE	274	352	1.28	121	231	1.97
DEU	3821	12761	3.34	2596	10166	3.74
DNK	429	680	1.59	236	444	1.80
ESP	1576	1957	1.24	924	1033	1.08
EST	27	38	1.41	15	24	1.62
FIN	474	654	1.38	278	376	1.25
FRA	3138	8361	2.66	1801	6560	3.69
GBR	6748	9602	1.42	4635	4966	1.06
GRC	99	130	1.31	53	77	1.39
HUN	287	388	1.35	163	225	1.38
IDN	29	48	1.63	17	32	1.31
IND	1588	1279	0.81	1084	195	0.19
IRL	1563	1321	0.85	862	458	0.51
ITA	1713	4178	2.44	965	3212	3.29
JPN	1011	4660	4.61	608	4052	7.06
KOR	591	1624	2.75	374	1249	3.27
LTU	16	25	1.55	10	15	1.87
LUX	231	240	1.04	121	118	0.90
LVA	14	25	1.85	7	18	2.67
MEX	88	793	9.06	63	730	12.17
MLT	24	24	1.02	15	9	0.67
NLD	3266	3954	1.21	1896	2058	1.06
POL	258	511	1.98	148	363	2.28
PRT	175	299	1.70	92	206	2.16
ROM	106	119	1.12	52	66	1.23
RUS	72	524	7.27	45	480	12.01
SVK	85	121	1.42	43	78	1.86
SVN	50	99	2.00	27	72	2.68
SWE	1444	1903	1.32	811	1092	1.27
TUR	1.34	146	109.57	1	146	148.14
TWN	423	516	1.22	216	300	1.61
USA	9517	20777	2.18	6230	14547	2.20
ROW	9776	8234	0.84	5458	2776	0.51
TOTAL	**55815**	**96323**	**1.73**	**33535**	**62788**	**1.87**

Notes: The export values in this table are for business service sector (WIOD sector 30) in 100 million U.S. dollars at 2005 constant price, using the U.S. GDP deflator from the Federal Reserve Economic Data (website address: http://research.stlouisfed.org/fred2). *X* is total gross exports. *VAX* is total value added exports. *dVAX* is direct value added exports. *indVAX* is indirect value added exports through other sectors.

Appendix 2: Countries & Codes in WIOD

Code	Country	Code	Country	Code	Country	Code	Country
AUS	Australia	DNK	Denmark	IRL	Ireland	POL	Poland
AUT	Austria	ESP	Spain	ITA	Italy	PRT	Portugal
BEL	Belgium	EST	Estonia	JPN	Japan	ROM	Romania
BGR	Bulgaria	FIN	Finland	KOR	Korea, Rep.	RUS	Russian Federation
BRA	Brazil	FRA	France	LTU	Lithuania	SVK	Slovak Republic
CAN	Canada	GBR	United Kingdom	LUX	Luxembourg	SVN	Slovenia
CHN	China	GRC	Greece	LVA	Latvia	SWE	Sweden
CYP	Cyprus	HUN	Hungary	MEX	Mexico	TUR	Turkey
CZE	Czech Rep.	IDN	Indonesia	MLT	Malta	TWN	Taiwan, China
DEU	Germany	IND	India	NLD	Netherlands	USA	United States

Appendix 3A: Manufacture (sec 3-16) and service sectors (sec 28 & 30) covered by this paper

sec	**descriptions**
c3	Food, Beverages and Tobacco
c4	Textiles and Textile Products
c5	Leather, Leather and Footwear
c6	Wood and Products of Wood and Cork
c7	Pulp, Paper, Paper , Printing and Publishing
c8	Coke, Refined Petroleum and Nuclear Fuel
c9	Chemicals and Chemical Products
c10	Rubber and Plastics
c11	Other Non-Metallic Mineral
c12	Basic Metals and Fabricated Metal
c13	Machinery, Nec
c14	Electrical and Optical Equipment
c15	Transport Equipment
c16	Manufacturing, Nec; Recycling
c28	Financial Intermediation (see Appendix 3B for its coverage)
c30	Renting of M&Eq and Other Business Activities (see Appendix 3C for its coverage)

Appendix 3B: Detailed ISIC sectors inside financial services (WIOD sector 28)

6511	Central banking
6519	Other monetary intermediation
6591	Financial leasing
6592	Other credit granting
6599	Other financial intermediation n.e.c.
6601	Life insurance
6602	Pension funding
6603	Non life insurance
6711	Administration of financial markets
6712	Security dealing activities
6719	Activities auxiliary to financial intermediation n.e.c.
6720	Activities auxiliary to insurance and pension funding

Appendix 3C: Detailed ISIC sectors inside business services (WIOD sector 30)

7111	Renting of land transport equipment
7112	Renting of water transport equipment
7113	Renting of air transport equipment
7121	Renting of agricultural machinery and equipment
7122	Renting of construction and civil engineering machinery and equipment
7123	Renting of office machinery and equipment (including computers)
7129	Renting of other machinery and equipment n.e.c.
7130	Renting of personal and household goods n.e.c.
7210	Hardware consultancy
7220	Software consultancy and supply
7230	Data processing
7240	Data base activities
7250	Maintenance and repair of office, accounting and computing machinery
7290	Other computer related activities
7310	Research and experimental development on natural sciences and engineering (NSE)
7320	Research and experimental development on social sciences and humanities (SSH)
7411	Legal activities
7412	Accounting, book-keeping and auditing activities; tax consultancy
7413	Market research and public opinion polling
7414	Business and management consultancy activities
7421	Architectural and engineering activities and related technical consultancy
7422	Technical testing and analysis
7430	Advertising
7491	Labour recruitment and provision of personnel
7492	Investigation and security activities

7493	Building-cleaning activities
7494	Photographic activities
7495	Packaging activities
7499	Other business activities n.e.c.

Appendix 4: Manufacturing sector classification based on service input intensity

WIOD sector	Sector Description	Average ratio of embodied domestic financial & business services to total manufacturing value added for the U.S. over 1995-2007	High SII Sectors
5	Leather, Leather and Footwear	.315	0
3	Food, Beverages and Tobacco	.291	0
15	Transport Equipment	.236	0
13	Machinery, Nec	.196	0
16	Manufacturing, Nec; Recycling	.189	0
4	Textiles and Textile Products	.171	0
14	Electrical and Optical Equipment	.168	0
9	Chemicals and Chemical Products	.128	1
7	Pulp, Paper, Paper, Printing and Publishing	.122	1
8	Coke, Refined Petroleum and Nuclear Fuel	.091	1
6	Wood and Products of Wood and Cork	.045	1
10	Rubber and Plastics	.043	1
11	Other Non-Metallic Mineral	.020	1
12	Basic Metals and Fabricated Metal	.019	1