Measuring U.S. Manufacturing Services Trade Using U.S. Customs Records: A Proposed Methodology

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Abstract

To align with international standards for compiling balance of payments statistics, the value of goods exported for processing and imported after processing without a change in ownership should be excluded from exports and imports of goods; instead the processing fee should be included in imports of manufacturing services. The objective of this paper is to explore the feasibility of using U.S. customs records to estimate imports of manufacturing services. Since U.S. customs records do not identify exports or imports of goods for processing, my focus is on roundtrip trades where a U.S. firm engaged in both exports and imports with a country. The paper presents an example of a *profiling* approach to identify manufacturing services imports by using a set of profiling criteria to identify some of these firms and their roundtrip trades where intermediate inputs are exported to a country, processed, and imported back into the United States, for 2007-2013. I estimate that, for these firms, the value of imports of manufacturing services amount to approximately one-half of the value of their total imports. The treatment of goods for processing has implications for the measurement of trade in goods and trade in services, but not the overall goods and services trade balance. If and when the Bureau of Economic Analysis (BEA) incorporates manufacturing services into its balance of payments statistics using any of the ideas described in this paper, recorded trade in goods will decrease and recorded trade in services will increase but the overall balance will be unchanged.

JEL Classification: E01, F14, F15, F6
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I. INTRODUCTION

Balance of Payments (BOP) accounts record transactions between residents of different countries that imply a change in ownership of something with economic value, which is a guiding principle of current statistical guidelines on measuring global production (BOP Manual, 6th edition (BPM6), para. 3.35). Under previous statistical guidelines, and according to the treatment currently employed by the Bureau of Economic Analysis (BEA), when goods are sent abroad for processing with no change in ownership, transactions are recorded as trade in goods *as if* a change in ownership occurred. Consider the example as depicted in Figure 1: a garment manufacturer in the United States ships cotton yarn to Costa Rica where the processing firm manufactures cotton t-shirts, which are then shipped back to the United States. The U.S. firm retains the ownership of the cotton as well as the t-shirts and pays the processor a processing fee. According to BEA's current treatment, $100 of U.S. exports of goods and $190 of U.S. imports of goods are recorded in the BOP accounts (Panel A of Figure 1). According to BPM6, the value of the cotton yarn should be excluded from U.S. exports and imports of goods because ownership of the yarn did not change. Under this treatment, only the $90 processing fee would be included in the BOP accounts as "manufacturing services on physical inputs owned by others" (Panel B of Figure 1).[1]

This paper reports the findings of an ongoing project that explores the feasibility of estimating U.S. imports of manufacturing services using the Census Bureau's Longitudinal Firm Trade Transactions Database (LFTTD) that compiles, by firm, transaction-level data collected by the U.S. Customs and Border Protection.

[1] This is the simplest realization of manufacturing services that we are trying to tackle in this paper. The practice of manufacturing services trade, however, often involves many complicated transactions.

Because U.S. customs records do not identify processing trade or changes of ownership of traded goods, my goal is to identify the roundtrip trades where a U.S. firm exports intermediate inputs to a country and then, from the same country, imports goods that have been processed from these inputs. Assuming that ownership of the materials is retained by the exporting firm during the roundtrip trade, and that sourcing of materials either from the processing country or a third country is not significant, the difference between the import and the export values in a roundtrip trade may be a proxy for imports of manufacturing services. My objective, therefore, is to devise a set of criteria to identify firms for whom the above assumptions are likely to hold. I apply a "profiling approach" to identify a set of firms that engaged in roundtrip trades of manufacturing goods during the years 2007-2013.

As part of the profiling criteria, I use an index of product "upstreamness" – or average distance from final use – developed by Antràs, Chor, Fally, and Hillberry (2012). I apply this index to trade in goods at the 6-digit Harmonized System (HS) product level to identify potential firm-country pairs where firms are exporting products that are relatively upstream in the production sequence and importing products that are relatively downstream.

The profiling criteria applied in this paper are quite stringent. For example, one of the criteria is to restrict only to firms that import from a single country. These criteria are aimed at limiting this initial investigation to the simplest value chains. As a result, the methodology identifies a very small set of firms. I essentially construct an example to demonstrate how such an approach can be implemented.

The eventual goal of this research is to estimate U.S. imports of manufacturing services, which are effectively manufacturing services by foreign firms on physical inputs

owned by the U.S. firms.[2] The immediate objective, however, is to offer a practical solution to overcome the primary challenge that U.S. customs records do not identify processing trade or changes of ownership in roundtrip trades. My objective in this paper is to test this profiling methodology, laying the groundwork for recalibrating the methodology to profile a broader set of firms.[3]

II. Background Information and the Research Question

II.1. Importance of Global Value Chains

The recent decades have witnessed remarkable changes in the segmentation of production due to the emergence of global value chains (GVCs). The increase in segmentation of production is found in well-known anecdotes about the complex global production chains for products such as Nutella hazelnut spread, New Balance running shoes, iPhones and Boeing airplanes (Johnson 2017, OECD 2012). It is also seen in the steady decline in domestic value added as a share of gross exports since the 1970s (Johnson and Noguera 2012).[4]

Related to this phenomenon is the fact that firms that both import and export account for the lion's share of the U.S. trade flows.[5] Many of these firms are involved in processing trade either by importing finished products made from inputs they have exported or by exporting finished products to firms from which they have imported the inputs. According to the International Labour Organization (ILO), by 2006 there were already 60 million

[2] Ultimately, we also want to estimate U.S. exports of manufacturing services, which are likely smaller than imports of manufacturing services but not trivial for certain types of products.
[3] For example, I have started to relax the criteria of firms importing from a single country, which allows for a significantly larger set of profiled firms.
[4] In particular, for North America, in 1975, 1985, 1995, and 2005, domestic value-added as a share of gross exports (or the VAX ratios) for outside the region were 94 percent, 92 percent, 89 percent and 85 percent, respectively (inside the region: 81 percent, 78 percent, 66 percent and 64 percent, respectively).
[5] These stylized facts are underpinned by the following theoretical justifications: in the presence of fixed costs, the most productive firms will engage in both importing and exporting and tap into the complementarity benefits of the joint activity of importing and exporting (Johnson 2017).

workers worldwide employed in 3,500 export processing zones spanning 130 mostly developing countries (Boyenge 2007). There are over 300 "foreign-trade zones" in the United States accounting for 13 percent of the country's manufacturing output and almost $300 billion in imports (Grant 2017). Exports originating from the European Union's inward processing regime account for 10 percent of EU exports (Cernat and Pajot 2012).

Under these new realities of increasingly intricate global production chains, input sourcing and linkages have become key components of today's economic activities. As Johnson (2017) explains, at the micro level, GVCs influence the response of trade to frictions as well as gains from trade, impact firm performance and labor market outcomes, and alter government's incentives in formulating trade policies; at the macro level, GVCs impact macro-spillovers across countries and have implications for optimal monetary policies. Addressing measurement issues related to GVCs, therefore, is important not only for maintaining the accuracy and relevance of national and international economic accounts but also for a fundamental understanding of domestic and global economies.

II.2. Existing Global Estimates of Manufacturing Services Trade

Experiences vary widely across countries regarding their ability to identify and measure manufacturing services. Figure 2 presents the global estimates.[6] In 2007, 57 countries reported positive manufacturing services export values and 40 countries reported positive import values; by 2014, 86 countries reported positive export values and 67 countries reported positive import values. Table 1 presents more details about the reporting patterns of countries. The fact that more countries report exports than imports is reflected

[6] It is important to note that these estimates aren't necessarily confined to the simplest concept of processing trade discussed earlier (section I and Figure 1). These estimates reflect wide ranging methods different countries have adopted to measure processing trade. See www.imf.org/data for details.

in Figure 2 where the green bars represent the magnitude by which, globally, exports of manufacturing services exceed imports. It is noteworthy that none of the NAFTA countries report trade in manufacturing services and these countries are not included in these estimates. The United States, in particular, is arguably a purchaser of significant amounts of manufacturing services abroad.

China, France, Germany, the Netherlands and Belgium – the top five exporting countries – accounted for 42 percent of global manufacturing services exports in 2014; China alone accounted for 19 percent of global exports. Hong Kong, Korea, the Netherlands, Japan and France – the top five importing countries – accounted for 55 percent of total imports in 2014. Figure 3 presents the trends reported by a select set of countries for the period 2007-2014.

III. EFFORTS TO ESTIMATE MANUFACTURING SERVICES

Countries that estimate trade in manufacturing services have used customs records, enterprise level business surveys, trade in services surveys, and other administrative data sources to adopt the new treatment (Eurostat 2014, UNECE 2011 and UNECE 2015). Most countries, such as Belgium and Sweden, base their estimates by adding to existing enterprise surveys or conducting new surveys. Germany collects all BOP relevant service transactions via a survey directly from enterprises and other entities.

Many countries utilize multiple sources of information. France, for instance, uses data on international bank transactions in conjunction with other sources such as a survey of business enterprises. Japan supplements international bank transactions data with various data sources that include targeted enterprise surveys, administrative sources and data provided by private institutions.

Information about processing trade is sometimes available in the customs declarations of certain countries with special tax or import duty treatments related to processing activities. For example, China, which accounts for the largest amount of reported exports of manufacturing services with more than half of its exports reported under processing trade (Manova and Yu, 2012), has been able to use information from its customs forms that identifies transactions as either a processing trade (which is subject to preferential tariffs) or as an ordinary trade. Europe's Value-Added Tax (VAT) Information Exchange System has also been used to identify intra-EU processing trades for some European countries (Eurostat Manual 2014). Other countries, including the United States, continue to explore ways to produce estimates of trade in manufacturing services.[7]

Currently, detailed information on the processing fees received and paid by U.S. firms for manufacturing services and on the underlying goods transactions either are not available in the U.S. statistical system or are not identifiable in any of the source data (Borga and Howell 2014). BEA and the U.S. Census Bureau have explored measuring trade in manufacturing services. Most of the efforts by statistical agencies have focused on adding questions about manufacturing services to existing surveys. The responses to these surveys have yet to produce information that can be used to produce estimates of trade in manufacturing services.

[7] The UK and Canada, while yet to produce extensive estimates, are exploring a wide range of avenues to estimate manufacturing services. Starting with adding a new question to their International Trade in Services Survey, the UK is exploring other possibilities such as introducing a new survey on trade in manufacturing services, matching the business register to enterprises in the International Merchandise Trade Statistics (IMTS) database, and using partner country (mirror) information. In addition to identifying certain customs regimes for certain processing activities, Statistics Canada is undertaking various projects to identify manufacturing services and factoryless goods production.

For example, BEA introduced experimental questions about contract manufacturing services on the 2009 BE-10 benchmark survey of U.S. multinational enterprises and the 2011 BE-120 benchmark survey of trade in selected services. The questions on the BE-10 survey defined contract manufacturing services broadly to include all firms that paid for contract manufacturing services even if they didn't retain ownership of any of the inputs. Only about 840 of about 3,900 responding firms indicated that they purchased contract manufacturing services abroad and a significant number of large firms that are known purchasers of contract manufacturing services did not identify themselves as such. Self-identification by firms that purchase contract manufacturing services abroad has been low on responses to the BE-120 survey as well.

Questions specific to contract manufacturing services were asked in the 2007 Economic Census that includes both the Census of Manufactures and the Census of Wholesale Trade, as well as in the 2011 Report of Company Organization Survey (COS) (Kamal, Moulton and Ribarsky 2015). The COS covers large multi-unit companies with 250 or more employees and a selection of smaller companies. As Kamal, Moulton and Ribarsky (2018) explain, some respondents in these surveys may have had difficulty understanding the questions or their understanding was not always uniform. Many of the respondents that appeared to have understood the concept of contract manufacturing services indicated that they were unable to provide data on these services because their accounting or production management systems does not identify these services.

Revised questions have been included on the 2017 BE-120 benchmark survey and 2017 Economic Census that are expected to improve the quality of responses. For example, the 2017 BE-120 solicits information about the primary manufactured good produced by

manufacturing services and the inputs used to produce this primary manufactured good. Asking for this additional detail is expected to encourage responding firms to provide more realistic responses. It may also be possible to use reported customs data and other information to help validate these responses.

IV. Profiling Roundtrip Trades from U.S. Customs Records

IV.1. The Profiling Approach and Roundtrip Trade

The objective of this paper is to explore the feasibility of using the transaction-level micro data reported on U.S. customs declarations maintained by the U.S. Census Bureau and stored in the Linked Foreign Trade Transactions Database (LFTTD) to identify roundtrip trades involving manufacturing services imports. In certain roundtrip trades, a U.S. firm exports intermediate goods to another country and imports processed goods from the same country. The difference between the import and the export values of these roundtrip trades could be a proxy for manufacturing services, assuming that ownership of the materials is retained by the U.S. firm during these roundtrip trades and no significant amount of additional non-U.S. intermediate inputs, either from the processing country or from a third country, are used in processing. The objective of my profiling strategy is to construct a set of criteria to select a set of firms and roundtrip trades where these assumptions are reasonable.

The main components required to implement the profiling approach proposed in this paper are: identification of firms engaged in manufacturing services trade, identification of transactions involved in manufacturing services trade, and estimation of the processing fee.

Determining whether goods have changed ownership is often not very straightforward.[8] In fact, even if enterprises that engage in manufacturing services are identified, it does not automatically imply that the ownership of goods in each individual trade transaction is retained by the U.S. exporter. Not every transaction of a firm identified as an importer or exporter of manufacturing services is necessarily associated with manufacturing services trade. A U.S. principal firm can export and import goods that are not related to its processing activities from the same country where it does its processing. Although all these transactions would appear as potentially being part of the roundtrip trade, only some of these transactions will pertain to manufacturing services.

Another issue in identifying transactions that are part of a manufacturing services activity is the extent to which the materials were transformed by the processor. A firm may simply be exporting packaging materials to another firm abroad and importing final goods that the foreign firm produced. While this would appear as a roundtrip trade in the U.S. customs data, it is most likely related to wholesale and/or retail activities. Meaningful processing would require at least some transformation of the material exported to the processing country.

In some cases, the simple difference between the value of imports and the value of exports may not be a good proxy for the processing fee for a number of reasons. For example, the difference between imports and exports would be an underestimate of imports of manufacturing services if some of the processed goods are sold in the country of processing

[8] Under BPM6, paragraph 3.46, the best test of ownership is, "… to identify which location assumes the risks and rewards of ownership most strongly (e.g., from factors such as whether the goods are included in the accounts, and which location is responsible for subsequent sale of the goods)." See Eurostat Manual (2014) for a further discussion on this.

or a third country. On the other hand, the difference between imports and exports would be an overestimate of the processing fees if additional inputs are sourced from other countries and used in processing.

Additionally, when the value of imports includes the values of other activities that are not related to processing, it can lead to overestimation of processing fees. For example, the value of imports may include holding gains or losses that accrue to the owner of the goods (e.g., activities related to oil/petroleum), overhead costs accrued outside of the steps involved in processing (e.g., accounting fees, advertising, depreciation, and utilities), value provided by intellectual property owned by the principal, or value of the brand name, logo, etc. (MSITS 2017).[9]

IV.2. Data

While U.S. customs records do not identify processing trades, they provide disaggregated descriptions of products imported and exported that could be used to identify products that are being processed abroad.[10]

I also use the Longitudinal Business Database (LBD) which is the longitudinal version of the Business Register (BR), a database of all U.S. companies and their establishments, that also contains some key data items from the Census Bureau's business surveys and from administrative records. The LBD and BR identify names and addresses of the firms, which are useful in clerical screening. I also obtain employment information from the LBD that is

[9] Some of these differences arise because imports are typically valued at the total value of the shipment.
[10] U.S. customs records do provide information on trade in processing for special processing programs such as HS9802. This program allows firms to claim duty free treatment for the U.S. content of the goods processed abroad. While this information could be used to estimate some U.S. imports of manufacturing services, the program has not been utilized much since the late 1990s when duties on products that are processed abroad were reduced or eliminated.

useful for characterizing firm size and other firm attributes. I use data from 2007-2013 so that observations from both pre- and post-Great Recession are included in the analyses.

IV.3. A 'Case Study' Profiling Approach

Identifying the type of roundtrip trade where the crucial assumptions mentioned in section IV.1 would hold is particularly difficult for products that have complex production processes. For example, motor vehicle parts may cross borders multiple times during the manufacturing process of a motor vehicle. Also, the parts and materials used in manufacturing computing devices are frequently sourced from multiple locations. My first attempt with the profiling approach was to identify relatively simple products and partner countries that are known purchasers of manufacturing services abroad. I identified products and firms that are known importers of manufacturing services related to relatively simpler products – underwear, t-shirts and baby garments, and pharmaceutical products – from academic research, industry reports, and suggestions from industry analysts at the U.S. International Trade Commission. In each case, I isolated the leading U.S. firms and identified their international trade transactions from the LFTTD data for the period 2007-2013. The most granular analyses were done at the HS-6 level.

For example, I estimated the difference between the import and the export values for a set of selected U.S. manufacturers of cotton garments (t-shirts, underwear, and baby garments) and their trading activities that included Central American countries. I identified firms that exported cotton raw materials and imported cotton garments of substantially larger values. I also estimated the difference between the import and the export values for trade by selected pharmaceutical firms that we expect are exporting inputs abroad to be processed. Unfortunately, we cannot disclose much of these findings because of the high

concentration of a small number of firms in each of our case studies.

We have, however, obtained invaluable insights from these case studies. Even for the simplest products, the margin between imports and exports was typically unrealistically large, and even when the margins were realistic they often varied greatly across firms. The margin could have been magnified in cases where it included a significant amount of inputs being sourced outside of the United States. Additionally, it is important to recognize that a simple product can have production chains that are complex and spatially spread out. Consider Nutella®, the hazelnut and cocoa spread sold in 75 countries (OECD 2012).[11] Inputs such as packaging and skimmed milk are locally supplied while hazelnuts come from Turkey, palm oil from Malaysia, cocoa from Nigeria, sugar mainly from Brazil (but also from Europe) and the vanilla flavoring from China.

Additionally, many of the firms in these case studies are firms with large volumes of import and exports and are likely to be large. Larger firms with economies of scope may have complex multi-country production chains (Bernard et al. 2018).[12] These firms also often engage in trading goods outside the scope of the production chains that they are operating. For example, they could be exporting materials for processing and then importing the processed products along with other products unrelated to the processing activity. This is consistent with the argument made in Bernard et al. (2018) that a firm's decisions to participate in each intensive margin (imports, exports) and extensive margin (number of sourcing countries) are interdependent. Bernard et al. (2018) argue that incurring the fixed costs of

[11] Nutella® is a registered trademark used for Spread Containing Cocoa and Other Ingredients and owned by Ferrero SpA., P. Ferrero & C. S.p.A. (Piazza Pietro Ferrero).

[12] The multi-product firms with multi-country operations are less likely to be *measure zero* firms, i.e., they may have strategic market powers deviating from the idea of a monopolistically competitive firm (Bernard et al. 2018). Their behavior thus, can be more complex than those predicted by standard trade models.

expanding on one of these margins makes it more likely that the firm will find it profitable to also incur the fixed costs of expanding on other margins (i.e. "network effects" (Pontrandolfo and Okogbaa 1999)).

IV.4. A 'Semi-automated' Profiling Approach

The LFTTD data does not identify the ultimate end-user abroad for exports transactions, which means that we cannot currently determine if the U.S. firm is shipping goods to a single firm or multiple firms in a given country. This limitation is relevant since, as discussed earlier, firms may be trading items outside the scope of their processing activities.[13] Additionally, as discussed in section IV.1, roundtrip trades may involve goods that undergo little transformation. It is, therefore, important to take into account the nature of the products that are being traded. In a roundtrip trade involving processing we would typically expect shipments from the U.S. firm to a partner country of goods that are more unfinished, or "upstream," and imports from the same country of goods that are more finished, or "downstream."

I use an index that measures the *upstreamness* of products to identify the position of a product in the supply chain that was traded in a roundtrip trade. The index was developed by Antràs, Chor, Fally, and Hillberry (ACFH) (2012) and is based on relationships between inputs and outputs from BEA's input-output accounts. The input-output accounts offer rich descriptions of value chain linkages and the sequence of inputs used across industries that can help us identify the position of products in the production process.

[13] This can create obstacles in identifying roundtrip trades because the firm may be engaged in processing with one firms and simple exports with another firm in the same country.

IV.4.1. Antràs-Chor-Fally-Hillberry (*ACFH*) *Upstreamness Index*[14]

The relative upstreamness of a product can be measured by decomposing value added in the input-output accounts into direct value added from the industry from which output originates and indirect value added embodied in inputs sourced from industries further up the value chain. The indirect value added can be further decomposed into value added contributed by each industry accounted for in the production process. This decomposition can be used to count production stages, i.e., the number of stages an industry's output transits through prior to reaching final demand. This idea of counting stages can be used to characterize distance between industries and implemented in the context of global production (Dietzenbacher, Luna and Bosma 2005, Dietzenbacher and Romero 2007, Fally 2012, Antràs et al. 2012, Antràs and Chor 2013).

Antràs et al. (2012) estimate an index of the degree to which industries are upstream versus downstream in the value chain. An industry is relatively more downstream, i.e., close to final demand, when it produces final goods (or inputs that are directly used to produce those final goods). Alternatively, an industry is relatively more upstream the more inputs it produces that are used to produce other inputs. Thus, final goods are one step away from demand, inputs directly used to produce final goods are two steps away from demand, inputs used to produce inputs are three steps away from demand, and so on. The ACFH index is a value-weighted count of the number of stages that output of an industry passes through prior to reaching final consumers. Larger values of the index indicate that an industry is further upstream.

[14] The discussion in this subsection is based on Antràs et al. (2012), Antràs and Chor (2013), and Johnson (2017).

The ACFH index is constructed using BEA's 2002 U.S. benchmark Input-Output Tables (Antràs et al. 2012). It uses the detailed supplementary use tables after redefinitions which includes a total of 426 industries in the input-output tables (279 in manufacturing). The ACFH index ranges from a minimum of 1 (for 19 industries in which all output goes only to final uses) to a maximum of 4.65. Automobiles, furniture, and footwear manufacturing (ACFH=1) are among the most downstream of industries, with almost all of their output going to final demand. On the other hand, the most upstream industries such as petrochemicals manufacturing (ACFH=4.65) and plastic materials and resin manufacturing (ACFH=3.57) involve the processing of raw materials.

The ACFH index uses the NAICS industry classification used in the BEA input-output tables. The authors of the index provide a concordance table between the 2002 input-output classification and the 6-digit Harmonized System (HS) classification. I use this HS 6-digit version of the ACFH index and merge it with the HS 6-digit level trade data in LFTTD.

IV.4.2. Profiling Criteria: Semi-automated Profiling

I use the following profiling criteria to identify some firms, and their roundtrip trades, that most likely pertain to manufacturing services trade:

(a) Manufacturing firms only: North American Industry Classification System (NAICS) code 31 (food/textiles/leather), 32 (other nondurable goods) and 33 (durable goods). This restriction is used to lower the probability of inclusion of wholesalers and retailers.[15]

(b) Enterprise-country pairs where the firm is a net importer: A firm-country pair is

[15] While the NAICS classification can be useful in identifying manufacturers separately from wholesalers and retailers, many manufacturers engage in wholesale and retail sales and many wholesalers and retailers engage in manufacturing. Additionally, the NAICS classification was applied at the firm level that can have multiple establishments not all under the same NAICS classification.

classified as a net importer if total imports by firm *i* from country *j* is greater than the total exports by firm *i* to country *j*. If the firm-country pair is a net exporter it is more likely exporting items beyond the scope of the roundtrip trades.

(c) Enterprise-country pairs where the firm's exports equaled or exceeded $100,000 in value (in constant 2009 US$): This is to ensure that the materials exported have been significantly transformed and to avoid trades where the firm is simply shipping packaging materials abroad.

(d) Enterprises that import from only one country: These firms are likely to have relatively simpler production processes and a narrower scope of products (single product firms, or products belonging to very specific product classifications) as opposed to large firms with multi-country operations that are likely to produce a wide variety of products.

(e) Enterprise-country pairs that satisfy the following upstreamness criteria (based on the ACFH index): The largest valued export item has a higher ACFH index value than every product the enterprise-country pairs imports.[16] This ensures that exports are relatively more upstream than imports.

(f) Clerical screening: This screening rules out cases where the other criteria were satisfied by coincidence although the trades do not appear to be part of a production chain.[17] As mentioned above, this includes the issue of firms importing items outside the scope of

[16] I have used other forms of this criteria, e.g., the average (value weighted) upstreamness of the exports is greater than the average (value weighted) upstreamness of the imports. For this current version of the study where the profiling scope is very narrow, these kinds of perturbations in the application of ACFH do not make a lot of difference. When I expand the scope of profiling, they are likely to matter more.

[17] The set of firms without the clerical screening is not substantively different from the set of firms obtained after the clerical screening.

their processing operations.[18]

IV.4.3. Estimates of Manufacturing Services Trade for the Profiled Firms

Table 2 presents two illustrative (but not actual) examples of the profiled firms. In the first example, Varane Fabric exports fabric and related materials that are processed in the Dominican Republic into men's and women's shirts and blouses that are imported by Varane. In the second example, Umtiti Metals Inc. ships a variety of materials to Mexico that are processed into metal statuettes and ornaments that are imported by Umititi. In both examples, the ACFH indexes of upstreamness of these exported inputs are much greater than the ACFH indexes of the imported finished goods for both firms.

The profiled firms are not representative of all manufacturing firms. In table 3, I compare the profiled firms with a baseline of manufacturing firms (NAICS code 31, 32 and 33) that are net importers at the enterprise-country level with bilateral exports exceeding $100,000 in value. The set of profiled firms is a very small subset of the baseline. The profiled firms are also smaller: the typical baseline firm has 146 employees whereas the typical profiled firm has 44 employees. Across all years, on average, a typical baseline firm exported $10 million of goods and imported $44 million of goods while a typical profiled firm exported $0.8 million of goods and imported $1.8 million of goods.

The imports and exports of the baseline and the profiled firms are also concentrated in different industries. The products imported by the profiled firms are much more concentrated in apparel and metals compared with the baseline firms. In Table 4, about one-half of the roundtrip trade by the profiled firms was split between imports classified as

[18] It is important to acknowledge that the criteria (a)-(e) do not, by construction, rule out trading of items outside the scope of processing activity. Going forward, as we recalibrate our profiling criteria to accommodate more firms, this may require additional deliberation.

apparel and metals. In comparison, less than 10 percent of the imports of baseline firms were classified as apparel or metals.

Figures 4 and 5 show how the profiled firms help us better identify likely manufacturing services imports using roundtrip trades. On the left panel of Figure 4, exports are more upstream than imports for the profiled firms, while the average upstreamness of exports and imports for the baseline firms are almost the same. This difference shows that the profiling criteria is likely to correctly identify firm-country pairs with processing trade. The right panel of Figure 4 shows that Manufacturing Services as a Share of Imports or MSSI $\left(= \frac{Imports - Exports}{Imports} \times 100\right)$ is about 50 percent on average for profiled firms.[19] MSSI for the baseline firms is almost 25 percent larger on average than that of the profiled firms. Because baseline firms include firms with more complex production processes than the profiled firms, they may be more likely to procure inputs from multiple countries, the value of which would tend to increase their U.S. imports. In the case study approach described earlier, we also find the estimated manufacturing services to be very large. Figure 5 shows that the trade of profiled firms is more spatially concentrated than that of the baseline firms. Mexico is by far the largest trading partner followed by Canada, for both types of firms. However, trade by the profiled firms is much more concentrated in Mexico than that by the baseline firms. Mexican imports make up about 60 percent of the imports by profiled firms compared with 20 percent by baseline firms. Likewise, Mexican exports make up about 70 percent of exports by profiled firms compared with about 35 percent by baseline firms. Shares of trade with

[19] In the spirit of the idea of value added, we measure manufacturing services as the difference between imports and exports as a percentage of imports.

Europe and Asia (including China) are smaller for the profiled firms compared with the baseline firms.

V. CONCLUSION AND NEXT STEPS

The objective of the profiling approach described in this paper is two-fold: (a) Gaining insights into the data challenges in estimating manufacturing services, and (b) developing a mechanism that may subsequently be applied to a broader set of firms. It is important to emphasize that although this mechanism is an indirect approach to estimate manufacturing services it may offer a useful lower bound.

In using customs data to estimate manufacturing services trade it is important to emphasize that trading patterns can be very complex: firms are often engaged it multi-country operations and sourcing, firms may also be engaged in processing and non-processing trade with the same countries. Estimates can have large discrepancies if only the existing limited customs data are used.

The most effective solution, perhaps, is collecting information on processing trade in the customs form. This has been extremely effective for China where the customs forms identify processing trade. It is important to reiterate, however, that reporting in the Chinese case is incentivized by the duty savings from reporting processing trade. In the absence of such economic incentives, similar success is not necessarily assured. In the absence of any changes in customs forms, an alternative could be to incorporate information from other sources with the LFTTD. One data source that has the potential to be very useful is the Panjiva trade database of Standard and Poor's, which has transactions level customs records for some major trading partners of the United States, such as China and Mexico.[20]

[20] www.panjiva.com.

Going forward, I plan to develop a set of criteria that may be applied to a larger set of firms. I also plan to incorporate with the LFTTD some of latest and existing survey data from BEA as well as additional information from other sources.

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Tables

Table 1: Summary of Worldwide Estimates of Manufacturing Services in IMF Presentation

	Number of countries that ...		
Year	... reported both exports and imports	... reported only exports	... reported only imports
2007	33	24	7
2008	35	30	4
2009	38	28	6
2010	41	31	4
2011	47	32	7
2012	53	31	6
2013	55	28	10
2014	59	27	8

Notes: (a) Source: IMF - Balance of Payments Standard Presentation by Indicator: Current Account, Goods and Services, Services (Data extracted from IMF Data Warehouse 5/15/2018 5:55:32 PM). (b) As defined in the 6th Edition of the Balance of Payments Manual (BPM6). (c) The number of countries in IMF BOP presentation is 207.

Table 2: Fictitious Examples of Profiled Firms

Example 1: Varane Fabrics, Trading Partner: Dominican Republic

Upstre-amness	Exports ('000 $)	Imports ('000 $)	HS-6	Description
2.20	120	--	531100	Fabrics, woven
2.12	10	--	580710	Labels, badges and similar articles
1.08	--	140	620520	Shirts; men's or boys', of cotton (not knitted or crocheted)
1.02	--	100	620630	Shirts and shirt-blouses; women's or girls', of cotton (not knitted or crocheted)

MSSI = 46 percent.

Example 2: Umtiti Metals Inc., Trading Partner: Mexico

Upstre-amness	Exports ('000 $)	Imports ('000 $)	HS-6	Description
4.35	250	--	740322	Copper; copper-tin base alloys (bronze) unwrought
3.61	110	--	741121	Copper; tubes and pipes, of copper-zinc base alloys (brass)
3.46	6	--	381600	Refractory cements, mortars, concretes and similar compositions
3.36	8	--	251200	Siliceous fossil meals and similar siliceous earths; of an apparent specific gravity of 1 or less
3.03	27	--	680530	Abrasive powder or grain; whether or not cut to shape or sewn or otherwise made up
2.59	30	--	382490	Chemical products, preparations and residual products of the chemical or allied industries
1.14	--	920	830629	Statuettes and other ornaments; of base metal other than plated with precious metal

MSSI = 53 percent.

Notes: (a) These are made up examples of fictitious firms. They, however, represent some of the main properties of the typical profiled firm. (b) Manufacturing services as share of imports, MSSI$= \frac{Imports-Exports}{Imports} \times 100$.

Table 3: Profiled Firms and All Manufacturing with Net Imports 2007-2013

Year	Number of firms	Imports (mil 2009 $)	Exports (mil 2009 $)	Avg. employment (# of workers)
All manufacturing (NAICS = 31, 32, 33) with net importers				
2007	5,200	198,300	48,480	149
2008	5,300	231,400	50,330	149
2009	4,700	173,300	40,870	149
2010	5,000	219,200	50,330	142
2011	5,200	266,900	55,850	139
2012	5,300	249,000	56,410	149
2013	5,100	228,500	56,830	145
All years	---	1,567,000	359,100	---
Profiled firms				
2007	70	161	61	
2008	70	139	63	(s)
2009	60	84	40	(s)
2010	50	89	34	(s)
2011	60	131	55	(s)
2012	50	90	33	(s)
2013	50	87	40	(s)
All years	---	781	326	44

Table 4: Imported and Exported Items - Profiled Firms and All Manufacturing with Net Imports 2007-2013

Panel A: Imports

HS 2-digit	Description	Share of imports (%): all manufacturing with net imports	Profiled firms	
			Number of firms	Share of imports (%)
39,40	Plastics, rubber and articles thereof	4.2	50	10.9
42,44-49	Leather; travel accessories; wood; cork; plaiting materials; pulp of wood, cellulosic material; paper; printed materials	2.5	40	8.6
61-65	Apparel, clothing and accessories; textile articles; rags; footwear; headgears; umbrellas; feathers	1.6	40	25.0
72-76,79, 80,82,83	Iron, steel, copper, nickel, aluminum, zinc, tin, and articles thereof; tools, utensils; metal, base metal and parts thereof	6.4	70	23.6
84-89	Machinery & mechanical appliances; electrical equipment; sound recorders; railway, tramway, track fixtures; traffic equipment; vehicles, aircrafts, vessels, parts & accessories	38.8	100	16.1
94-97	Furniture; bedding, mattress; lamps; illuminated signs; prefabricated buildings; toys and sports requisites; works of art; collectors' pieces and antiques	2.9	30	3.7
	Rest of the products	43.5	100	12.1

Panel B: Exports

HS 2-digit	Description	Share of exports (%): all manufacturing with net imports	Profiled firms	
			Number of firms	Share of exports (%)
39,40	Plastics, rubber and articles thereof	9.2	100	18.2
42,44-49	Leather; travel accessories; wood; cork; plaiting materials; pulp of wood, cellulosic material; paper; printed materials	2.8	80	5.9
61-65	Apparel, clothing and accessories; textile articles; rags; footwear; headgears; umbrellas; feathers	0.6	20	2.3
72-76,79, 80,82,83	Iron, steel, copper, nickel, aluminm, zinc, tin, and articles thereof; tools, utensils; metal, base metal and parts thereof	6.9	100	27.7
84-89	Machinery & mechanical appliances; electrical equipment; sound recorders; railway, tramway, track fixtures; traffic equipment; vehicles, aircrafts, vessels, parts & accessories	45.5	150	10.9
94-97	Furniture; bedding, mattress; lamps; illuminated signs; prefabricated buildings; toys and sports requisites; works of art; collectors' pieces and antiques	1.3	40	0.9
	Rest of the products	33.6	150	34.2

Figures

Figure 1: The Simplest Example of Processing Trade and Balance of Payment Treatments

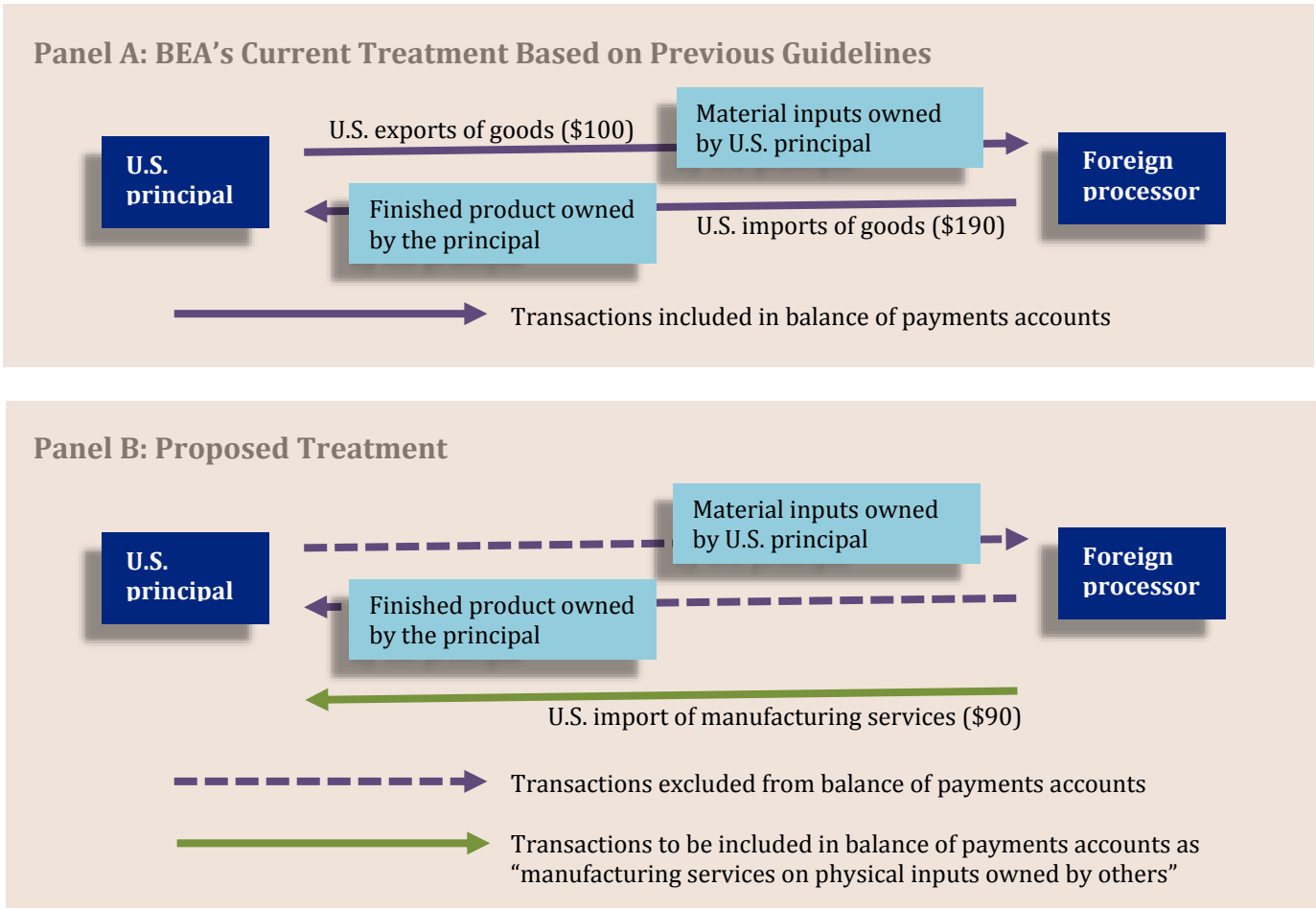
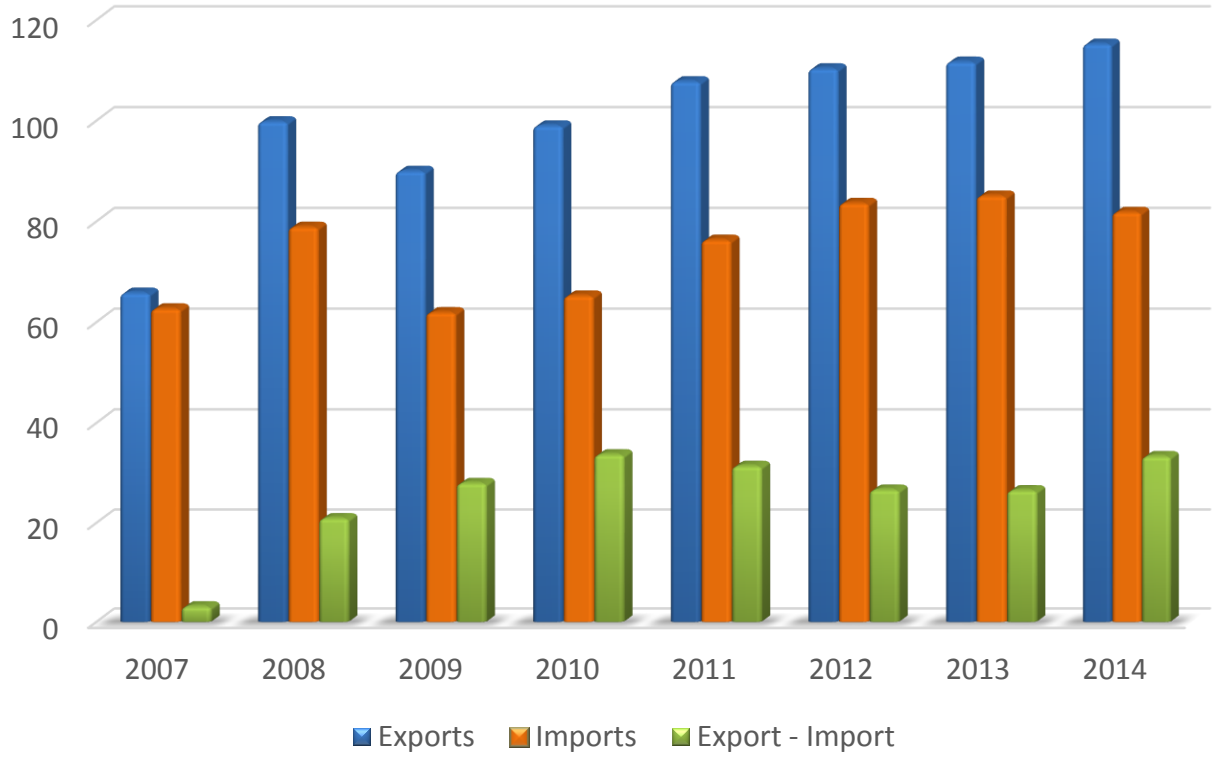


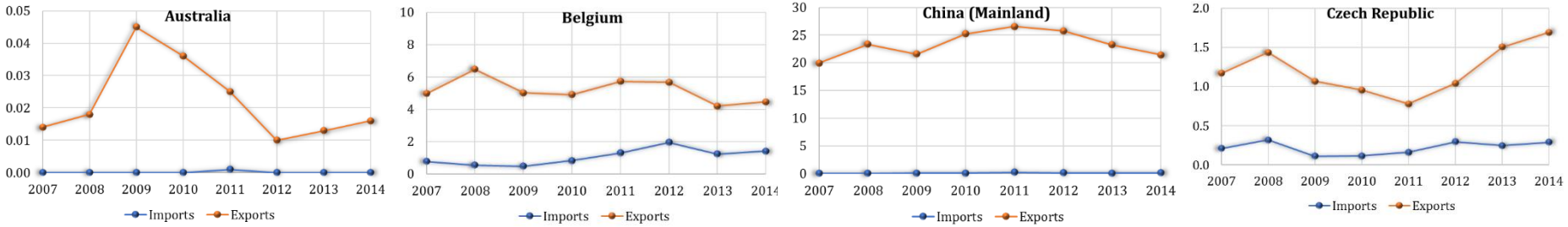
Figure 2: Total Estimated Manufacturing Services on Physical Inputs Owned by Others (Millions of Current USD)



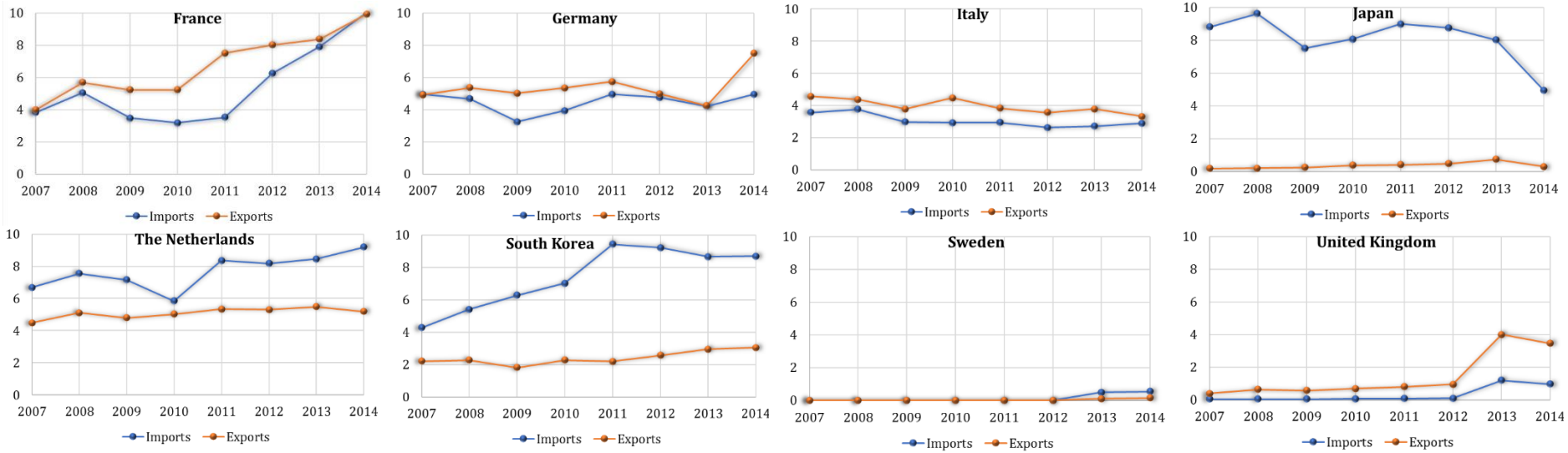
Notes: (a) Source: IMF - Balance of Payments Standard Presentation by Indicator: Current Account, Goods and Services, Services (Data extracted from IMF Data Warehouse 5/15/2018 5:55:32 PM). (b) As defined in the 6th Edition of the Balance of Payments Manual (BPM6).

Figure 3: Manufacturing Services on Physical Inputs Owned by Others (Billions of Current USD) – Selected Countries by Year

Panel A: Varying Range of Y-Axis

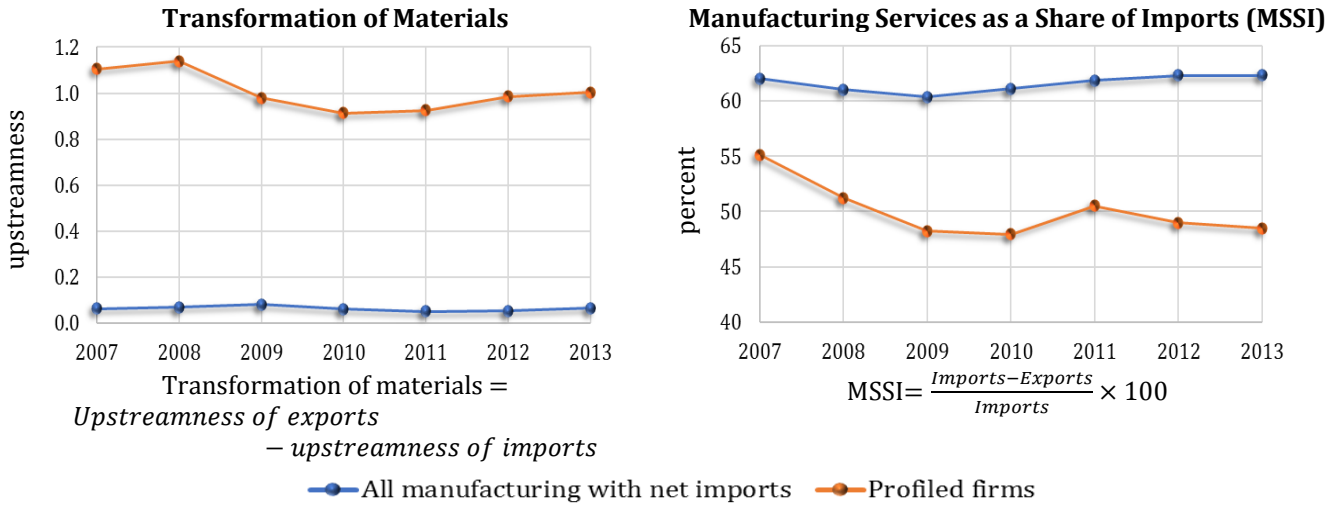


Panel B: Y-Axis Range [$0-10 billion]



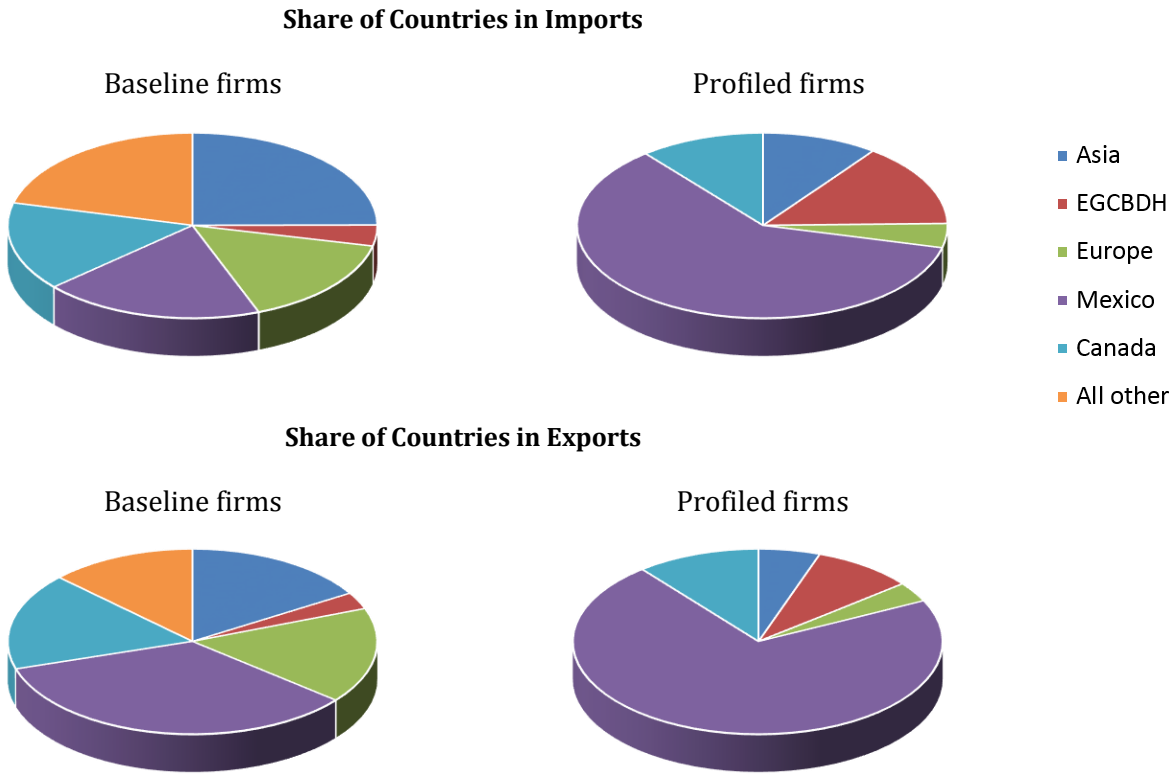
Notes: (a) Source: IMF - Balance of Payments Standard Presentation by Indicator: Current Account, Goods and Services, Services (Data extracted from IMF Data Warehouse 5/15/2018 5:55:32 PM). (b) As defined in BPM6. (c) Lack of statistical data that can be reported or calculated is indicated by (...). (d) Sources for individual country estimates as reported to IMF: Australia - administrative records, Belgium - surveys, China (Mainland) - customs records, Czech Republic - surveys, France - combination of sources, Germany - combination of sources, South Korea – international transactions reporting system (ITRS), Italy - combination of sources, Japan - combination of sources, Netherlands - surveys, Sweden - surveys, UK - no information prior to 2013.

Figure 4: Aggregates by Year – Comparison of Profiled Firms and All Manufacturing with Net Imports



Notes: (a) For 'all manufacturing with net imports' MSSI is simply (imports-exports), not necessarily an 'estimate' of manufacturing services.

Figure 5: Aggregates by Country – Profiled Firms versus Baseline Firms



Note: EGCBDH = El Salvador, Guatemala, Colombia, Brazil, Dominican Republic, Haiti. Europe = UK, Germany, Italy, Belgium, Turkey, Austria, Switzerland, Belarus, Finland, France. Asia = China, Israel, South Korea, Japan, Taiwan, Vietnam, Pakistan, Saudi Arabia.