Trade in Value Added

Developing New Measures of Cross-Border Trade

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edited by
Aaditya Mattoo, Zhi Wang and Shang-Jin Wei

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1 INTRODUCTION

The dynamics of globalisation pose new challenges for economic and policy analysis. The liberalisation of trade policies and capital controls, coupled with reductions in transport, communication and information costs, has led to a significant reduction in trade costs and facilitated a reorientation of firms' production strategies in recent decades towards increasingly fragmented processes, with each production stage assigned to the most cost-effective location: a phenomenon which has became known as international fragmentation of production (Jones and Kierzkowski 2001).[2]

Vertical fragmentation of production can occur within the firm, as the firm internalises countries' and regions' comparative advantages and establishes subsidiaries abroad. Another option is for the firm to outsource certain parts of the production process to non-affiliated companies located overseas. Whether within the boundaries of the firm or at arm's length, the vertical fragmentation of production has changed trade patterns in a significant way. Firstly, intermediate goods and services cross borders several times as they incorporate subsequent stages of production. Miroudot *et al* (2009) estimate that in 2006 trade in intermediate inputs represented 56% and 73% of overall trade flows in goods and services, respectively, and Yi (2003) noted that

[1] The authors are grateful to TurkStat, Turkey's National Statistical Institute, for granting access to their micro databases which allowed testing the methodology outlined in this chapter.

[2] Several terms have been used to coin the international fragmentation of production: global value chains, international supply chains, internationally sliced up value-added chain, segmentation of production across national borders, vertical fragmentation, *etc.* This chapter uses these different terms interchangeably.

the increase in trade in intermediates is the single most important factor explaining why world trade has grown much faster than global GDP in the past three decades. Secondly, it gives rise to vertical specialisation, by which countries specialise in very specific stages of the production process. Indeed, as firms or production units located in different countries increasingly collectively contribute to the production of a single final product, the usefulness of the concept 'country of origin' has also become increasingly questionable.

This phenomenon has also led many to question the meaning that can be attributed to conventional estimates of trade statistics, which record the full value of a good or service each time it crosses a border as it passes along the production chain. In other words, this is a form of multiple counting that risks exaggerating the economic importance of trade to an economy. An often cited case study is that of the Apple iPod, undertaken by Linden *et al* (2009), which concludes that only 10% of the price of an assembled iPod at the Chinese factory-gate is Chinese value added. The bulk of the components (around 70% of the iPod's value at the factory-gate) are imported from Japan, with much of the rest coming from the USA and Korea. Yet the export figures for China record the full value of the final good. This is not an isolated example and applies to a wide range of goods coming from many countries, as reported by Koopman *et al* (2008), who estimated that, on average, foreign countries contribute 80% or more of the value added embodied in recorded Chinese exports of information and communications technology equipment.[3]

It is clear that the multiple counting masks the contribution that exports make to domestic value added as well as the identification of the products a country truly has a comparative advantage in. These increasingly international production processes call for the development of measures of trade in the underlying value added embodied in a product.[4]

Indeed, there are a number of areas where measuring trade in value added can bring a new perspective and is likely to impact on policy choices.

Global imbalances. Accounting for trade in intermediate parts and components, and taking into account 'trade in tasks', does not change the overall trade balance of a country with the rest of the world: it redistributes the surpluses and deficits across partner countries. When bilateral trade balances are measured in gross terms, the deficit with final goods producers (or the surplus of exporters of final products) is exaggerated because it incorporates

[3] Similar studies include Apple's iPhone (Xing and Detert 2010), the Boeing 787 Dreamliner (Newhouse 2007), Mattel's Barbie doll (Tempest 1996) and Nokia's N95 Smartphone (Ali-Yrkkö *et al* 2011).

[4] Using input–output tables for Sweden, Isakson and Wajnblom (2011) show that the share of national value-added exports in GDP is 18 percentage points lower than the share of gross exports in GDP, which includes the value of intermediate imports (31% versus 40%, respectively).

the value of foreign inputs.[5] The true imbalance is therefore also with the countries who have supplied inputs to the final producer. As pressure for rebalancing increases in the context of persistent deficits, there is a risk of protectionist responses that target countries at the end of global value chains on the basis of an inaccurate perception of the origin of trade imbalances.

Market access and trade disputes. Measuring trade in value added sheds new light on today's trade reality, where competition is not between nations, but between firms. Competitiveness in a world of global value chains means access to competitive inputs and technology. Outsourcing and offshoring of elaborate parts and components can only take place in situations where the regulatory frameworks are non-discriminatory and intellectual property is respected. The optimum tariff structure in such a situation is flat (little or no escalation) and reliable (contractual arrangements within supply chains, especially between affiliated establishments, tend to be long term). WTO's World Trade Report 2011 on preferential trade agreements (PTA) reveals that more and more PTAs are going beyond preferential tariffs, with numerous non-tariff areas of a regulatory nature being included in the agreements. According to the report, global production networks may be prompting the emergence of these 'deep' PTAs, as good governance on a range of regulatory areas is far more important to these networks than further reductions in already low tariffs (WTO 2011).

Moreover, in the context of the fragmentation of production and global value chains, mercantilist-styled 'beggar thy neighbour' strategies can turn out to be 'beggar thyself' miscalculations. As mentioned earlier, domestic value added is found not only in exports but also in imports: some goods and services are intermediates, shipped abroad, whose value is returned to the domestic economy embodied in imports. As a consequence, tariffs, non-tariff barriers and trade measures, such as anti-dumping rights, are likely to impact domestic producers in addition to foreign producers. For example, a study of the Swedish National Board of Trade on the European shoe industry highlights that shoes 'manufactured in Asia' incorporate between 50% and 80% of European Union value added. In 2006, anti-dumping rights were introduced by the European Commission on shoes imported from China and Vietnam. An analysis in value-added terms would have revealed that EU value added was in fact subject to the anti-dumping rights (National Board of Trade 2007).

The impact of macroeconomic shocks. The 2008–9 financial crisis was characterised by a synchronised trade collapse in all economies. Various authors have discussed the role of global supply chains in the transmission of what was initially a shock on demand in markets affected by a credit shortage. In

[5] See Maurer and Degain (2010). Koopman *et al* (2008) find that the domestic value added of Chinese exports is on average 60%.

particular, the literature has emphasised the 'bullwhip effect' of global value chains.[6] When there is a sudden drop in demand, firms delay orders and run down inventories with the consequence that the fall in demand is amplified along the supply chain and can translate into a standstill for companies located upstream. A better understanding of value-added trade flows would provide tools for policymakers to anticipate the impact of macroeconomic shocks and adopt the right policy responses. Any analysis of the impact of trade on short-term demand is likely to be biased when looking only at gross trade flows. This was recently demonstrated in the aftermath of the natural disaster that hit Japan in March 2011.[7]

Trade and employment. Several studies on the impact of trade liberalisation on labour markets try to estimate the 'job content' of trade. Such analysis is only relevant if one looks at the value added of trade. What the value-added figures can tell us is where exactly jobs are created. Decomposing the value of imports into the contribution of each economy (including the domestic one) can give an idea of who benefits from trade. The EU shoe industry example given above can be interpreted in terms of jobs. Traditional thinking in gross terms would regard imports of shoes manufactured in China and Vietnam by EU shoe retailers as EU jobs lost and transferred to these countries. But in value-added terms, one would have to account for the EU value added, and while workers may have indeed lost their job in the EU at the assembly stage, value added based measures would have highlighted the important contribution made by those working in the research, development, design and marketing activities that exist because of trade (and the fact that this fragmented production process keeps costs low and EU companies competitive). When comparative advantages apply to 'tasks' rather than to 'final products', the skill composition of labour embedded in the domestic content of exports reflects the relative development level of participating countries. Industrialised countries tend to specialise in high-skill tasks, which are better paid and capture a larger share of the total value added. A WTO and IDE-JETRO study on global value chains in East Asia shows that China specialises in low-skill types of jobs. Japan, on the contrary, has been focusing in export activities intensive in medium and high-skill labour, while importing goods produced by low-skilled workers. The study also shows that the Republic of Korea was adopting a middle-of-the ground position (in 2006), but was also moving closer to the pattern found in Japan (WTO and IDE-JETRO 2011).

Trade and the environment. Another area where the measurement of trade flows in value-added terms would support policymaking is in the assessment of the environmental impact of trade. For example, concerns over greenhouse

[6] See Escaith *et al* (2011) and Lee *et al* (1997).

[7] For an application of international IO in this case see Escaith *et al* (2011).

gas emissions and their role in climate change have triggered research on how trade openness affects CO_2 emissions. The unbundling of production and consumption and the international fragmentation of production require a value-added view of trade to understand where imported goods are produced (and hence where CO_2 is produced as a consequence of trade). Various Organisation for Economic Co-operation and Development (OECD) studies note that the relocation of industrial activities can have a significant impact on differences in consumption-based and production-based measures of CO_2 emissions (Ahmad and Wyckoff 2003; Nakano *et al* 2009).

Trade, growth and competitiveness. Likewise, indicators of competitiveness such as 'revealed comparative advantage' are affected by the measurement of trade in gross terms. Going back to the iPhone example, traditional trade statistics suggest that China has a comparative advantage in producing iPhones, but with value-added measures its comparative advantage is in assembly work. Having in mind growth strategies and the concerns of policymakers in identifying export sectors and promoting industrial policies, the analysis of the export competitiveness of industries cannot ignore the fragmentation of production and the role of trade in intermediates.

The use of input–output (IO) tables to determine the domestic content of exports in value-added terms at the industry level is now widespread and has the great advantage of providing comprehensive estimates, as both direct and indirect imports (embedded in domestic inputs) are included in the calculation of value added. However, IO tables have historically been and are typically constructed by national statistics offices as tools to determine interactions within industries of an economy, with the underlying assumption, when used as an analytical tool, that the production processes of firms within a given sector are homogeneous. However, the advent of global production processes raises questions about this assumption, especially in the context of studies that try to estimate the domestic value added embodied in exports, if the firms producing goods or services for export markets use different production processes from those firms producing the 'same' goods or services for domestic markets. Arguably, therefore, what is needed is an approach that motivates the development of more detailed input–output tables that adequately reflect, by design, this heterogeneity.

Motivating such a development will take some time, however, particularly at a time of stretched resources within statistical offices. But other approaches that capitalise on the availability of microdata could provide the basis for simpler solutions.

This chapter describes such an approach using Turkish firm-level microdata. It provides methodological guidelines on how to compute import coefficients at the level of the firm and shows how trade microdata, *ie* the matching of trade and business activity information at the level of the firm can refine the aggregate nature of the indicators in IO tables, by increasing their granularity.

Furthermore, the chapter critically assess the results of the implementation of the proposed methodology using Turkish firm-level data, kindly made available by TurkStat, the Turkish National Statistical Institute.

This chapter is structured as follows: Section 2 describes the concept of trade in value added (TVA) and how IO tables have been used to measure the contribution a country's exports make to overall domestic value added. Section 3 explains the limitations of existing aggregate IO tables and the bias which can be introduced when computing trade in value-added measures. Section 4 proposes a methodology to compile trade microdata indicators that can be produced by statistical offices as standard outputs in their own right but that are also able to be plugged into IO tables. It also presents the data used in the study to test the outlined methodology and documents the main limitations found which are directly related with the information available from trade microdata. Section 5 comments on the main findings stemming from the integration of firm-level indicators into Turkey's IO table, and Section 6 concludes, by proposing a research agenda.

2 TRADE IN VALUE ADDED: CONCEPT OVERVIEW

In a perfect world with perfect information it would be possible to decompose each product into a value-added chain that was able to identify where the value added originated by tracing it throughout the production chain.

Conceptually (ignoring taxes and subsidies for simplicity), it is possible to decompose any particular product with value V^p into the value added VA^p generated in country i for the production product p (directly and indirectly), such that the total value of

$$V^p = \sum_i \mathrm{VA}_i^p. \tag{8.1}$$

This is relatively clear and simple. However, complications can arise when aggregating up for a whole industry group or for a whole economy, as shown in the following example.

Consider an economy i that produces only two products a and b for export, with product a exported to country j for further processing before being reimported into country i for use in the production of b. Let us assume that 100 units of a, with value 200, are produced and exported and then used in the production of 100 units of product c, with value 300, that are in turn used in the production of 100 units of b with value 400. Let us further assume, for simplicity, that each unit of a is produced entirely in country i; in other words, no intermediate inputs are directly or indirectly sourced from abroad. We also assume that, apart from the intermediate imports referred to above, all the value added in b is also generated in country i only.

If we consider the global production chain, it is at least, in theory, possible to show that the 100 units of a generated 200 units of domestic value

added, and the 100 units of b generated 300 units of domestic value added (100 directly after processing the 100 units of product c, but 200 indirectly, reflecting the fact that each unit of c reflects two units of value added generated in producing a, an intermediate input into c). We know that total gross exports in economy i were equal to 600, which overstates the contribution of overall trade to the economy, but simply summing the value-added contribution at the product level (the direct and indirect value added generated by a and the direct and indirect value added generated by b) will also overestimate the significance of trade in this context, as the overall value added generated in the economy through the sale of both a and b is only 300; reflecting the fact that of the 300 units of value added generated through the production of b, 200 units reflect the embodiment of product a, whose value added is separately shown under the production of a.

Input–output tables are designed to measure the interrelationships between the producers of goods and services (including imports) within an economy and the users of these same goods and services (including exports). In this context they can be used to estimate the contribution that imports make in the production of any good (or service) for export. For example, if a motor car manufacturer imports certain components (*eg* the chassis), the direct import contribution will be the ratio of the value of the chassis to the total value of the car. And if the car manufacturer purchases other components from domestic manufacturers, who in turn use imports in their production process, those imports must be included in the car's value. These indirect imports should be included in any statistic that attempts to measure the contribution of imports to the production of motor cars for export. The total direct and indirect imports are known as 'embodied imports'.

In an input–output framework the relationship between producers and consumers can be simply described as follows:

$$g = A \cdot g + y, \tag{8.2}$$

where g is an $n \times 1$ vector of the output of n industries within an economy. A is an $n \times n$ matrix describing the interrelationships between industries (known as the Leontief matrix), where a_{ij} is the ratio of inputs from domestic industry i used in the output of industry j. y is an $n \times 1$ vector of final demand for domestically produced goods and services, including exports.

Assuming that all goods produced by any particular industry are homogenous, total imports embodied directly and indirectly within exports and the additional domestic activity induced by this additional production can be calculated thus:

$$\text{embodied imports} = m(1 - A)^{-1} \times e, \tag{8.3}$$

where m is a $1 \times n$ vector with components m_j (the ratio of imports to output in industry j) and e is an $n \times 1$ vector of exports by industry.

In the same way, one can estimate the total indirect and direct contribution of exports to value added by replacing the import vector m above with an

equivalent vector that shows the ratio of value added to output (v). So, the contribution of exports to total economy value added is equal to

$$v(I - A)^{-1} \times e. \tag{8.4}$$

At the whole-economy level this works fine, both for imports, if we accept the fact that they are measured gross, and, importantly, for value added. Returning to the example above, the approach would accurately record the 300 contribution exports made to value added. In addition, policymakers are equally interested in understanding the contribution that specific sectors make to the domestic content of exports, both directly and indirectly. In advanced industrialised economies, a large share of global GDP (and employment) accrues to services, while international trade remains largely dominated by goods. Yet, identifying backwards linkages from those export-oriented sectors producing tradeable goods (agriculture, manufacture) allows us to map where the domestic value added was created. The break-up of domestic content by direct and indirect sectoral value added reveals that a large chunk of the value originates indirectly from service sectors. This breakdown is particularly important when identifying the sources of national competitiveness, which may rest in up-stream sectors which are not considered as exporters by traditional statistics, or measuring the employment impact of export production.

An additional level of complexity arises because imports may often themselves embody some domestic value added (reimports). This amount may be significant when economies are closely inserted in global value chains. In order to trace this value, a global input–output table is needed: a table that in effect reallocates imports and exports to intermediate consumption or final domestic demand (such as household and government final consumption and capital formation).

Let G be a global input–output table with dimensions $(nc) \times (nc)$, where c is the number of countries and n is, as before, the number of industries. Furthermore, let the table be structured so that rows 1 to n reflect the industries of country 1, and rows $n + 1$ to $2n$ reflect the industries of country 2 and so on, and v_i^k is the direct value added produced by industry i in country k, as a share of its total output. It can be shown that the total direct and indirect domestic value added produced by industry j in country k is equal to

$$\sum v_i^k L_{(kn+i)(kn+j)}, \tag{8.5}$$

where L_{ij} is the ijth element of the global Leontief inverse $(I - G)^{-1}$.

Similarly,

$$\sum v_i^k L_{(hn+i)(hn+j)} \tag{8.6}$$

reflects the total value added generated in country k for unit output of industry j in country h, and

$$v_i^k L_{(hn+i)(hn+j)} \tag{8.7}$$

reflects value added generated by industry i in country k for unit output of industry j in h, providing a mechanism that shows the contributions made across different sectors of the economy.

Therefore, for any given export therefore by an industry, it should be possible to decompose the entire value into

(i) the domestic value added generated in its production, both directly from the main producing industry and indirectly via transactions between domestic industries and via transactions between domestic and foreign industries, and
(ii) the imported value added generated in producing the imports used in production (not including any part of the import value that reflects domestic value added).

A global input–output table will thus allow users and policymakers to decompose the entire value of any good in the following way:

- direct domestic value added from the final producer;
- indirect domestic value added by producing industry;
- indirect imported value added by produced country and industry.

The ability to generate output such as this is, in itself, beneficial to policymakers interested in the real contribution that industries make to economic growth, and indeed employment (as the flows above can be reformulated to show employment contributions), since they can be used to assess the domestic content of both imports and exports. Overall trade balances, however, will necessarily need to be estimated at a higher level (including all international economy linkages) to remove the double counting that occurs as goods and services criss-cross national boundaries during the production process. But the approach described above will allow more meaningful measures of overall bilateral trade balances, such as the one in a recent WTO report, according to which the US–China trade balance in 2008 would have been about 40% lower if calculated in value-added terms (Maurer and Degain 2010).

3 IMPROVING TRADE IN VALUE-ADDED MEASURES USING TRADE MICRODATA FOR EXPORTING FIRMS

A number of efforts have been undertaken in recent years to estimate the value added content of trade, including in the OECD, using linked IO tables.[8] However, improved estimates using microdata could be attained.

[8]There are four different recent initiatives to develop global or international IO tables: the Global Trade Analysis Project (GTAP), Asian International Input–Output Tables, OECD Input–Output Database and the World Input–Output Database (WIOD); see Ahmad *et al* (2011) for an overview. The first studies to estimate the value-added content of international trade under an explicit international input–output framework all rely on the GTAP database (Daudin *et al* 2011; Johnson and Noguera 2010; Koopman *et al* 2011).

In this context it is important to highlight some of the restrictive assumptions inherent in the use of IO tables when used to estimate trade in value added.

- **Domestic sales are assumed to have the same foreign value-added content as exports**. This limitation is also a direct consequence of aggregating information at the industry level, which can lead to biases in the estimation of the domestic value-added content of exports. If, for instance, the bulk of imported inputs are used in a sub-sector where most of the final production is destined to the domestic market and most of that industry's exports come from another sub-sector that uses mainly domestic inputs, the foreign content of (aggregate) exports is going to be higher than it is in reality.
- **Indigenous firms are assumed to source inputs in a similar way as foreign-owned enterprises**. As data for China show (Table 8.1), it is likely that foreign-owned firms' are more engaged in global value chains inputs produced abroad by other parts of the foreign business group of which they are part, which will in turn result in different intensity of imported inputs in intermediate consumption between indigenous and foreign-owned firms.

Against this background, it is clear that the use of IO tables that do not adequately differentiate between exporting firms and firms producing goods and services for domestic markets may provide an imperfect picture of the domestic value added embodied in a country's exports. Although it is impractical to estimate the domestic value-added content as outlined in Section 2 at a very detailed product level, identifying three simple statistics of exporting firms and those that produce goods for domestic markets only can, as shown below, provide not insignificant improvements to the overall results: value-added-to-output ratios; import-to-intermediate-consumption ratios and share of overall output of exporting firms.

4 DATA

The microdata used in this analysis are sourced from the Annual Industry and Service Statistics database (Structural Business Statistics, SBS), the Turkish trade register and the Annual Industrial Products Statistics database of TurkStat.

Since 2003 SBS has collected information on firm incomes, input costs, employment and investment activity, at the primary four-digit NACE (Rev 1.1) sector of activity and the region of location since 2003. The survey covers the whole population of firms with more than 20 employees operating in Turkey

Table 8.1: *Use of imported intermediates and output breakdown by firm type in China.*

		Imported intermediates		Export breakdown		
Year	Firm type	Share of intermediates for processing exports	Share of intermediates for normal use	Share of normal exports	Share of processing exports	Other
2002	Wholly foreign	66.0	10.4	11.9	87.9	0.3
2002	Joint venture	45.3	34.2	27.8	71.0	0.8
2002	State owned	18.2	57.5	64.7	31.8	2.6
2002	Collective	27.1	54.0	70.7	28.1	2.7
2002	Private	8.1	63.2	88.4	8.7	7.6
2002	All	38.3	38.5	42.2	55.9	1.7
2003	Wholly foreign	62.4	12.4	11.8	87.9	0.4
2003	Joint Venture	40.0	38.7	29.4	69.9	1.1
2003	State owned	14.0	62.9	67.2	28.8	2.2
2003	Collective	24.0	56.4	71.2	26.4	1.8
2003	Private	14.3	59.4	78.9	15.9	6.0
2003	All	35.4	41.2	41.9	56.0	1.6
2004	Wholly foreign	60.9	13.2	12.4	87.5	0.4
2004	Joint venture	39.5	37.1	30.1	69.1	1.2
2004	State owned	12.7	68.1	66.7	29.0	1.8
2004	Collective	22.7	61.2	71.8	25.1	2.1
2004	Private	14.9	61.3	81.1	13.8	5.6
2004	All	35.1	42.3	41.6	56.3	1.5
2005	Wholly foreign	63.3	13.3	13.4	86.5	0.7
2005	Joint venture	41.0	38.6	32.0	67.0	1.0
2005	State owned	11.7	70.8	66.5	28.1	1.7
2005	Collective	21.6	64.5	70.4	26.2	1.7
2005	Private	15.4	61.1	82.1	12.0	5.8
2005	All	36.6	42.9	41.9	55.6	1.5
2006	Wholly foreign	61.9	14.9	14.6	85.3	1.1
2006	Joint venture	38.8	40.8	35.2	63.1	1.1
2006	State owned	11.0	71.4	65.8	27.1	1.5
2006	Collective	20.3	67.5	71.8	24.7	1.6
2006	Private	13.8	61.6	84.1	10.3	5.8
2006	All	35.7	43.5	43.5	53.6	1.7

Source: China's Customs (cited in Wang (2008) and adapted by the authors).

and a representative sample of firms with less than 20 employees and whose activity lies in NACE Sections C–K and M–N.[9]

The second database used is the trade register which is sourced from

[9]The survey excludes firms operating in the following sectors: agriculture and related activities, hunting and forestry, public administration and defence and activities of households and of extra-territorial bodies.

customs declarations and contains information on merchandise trade only. Hence, exports do not cover services and imported intermediates cover goods only. Also excluded from imports and exports are border and coastal trade, transit, temporary trade and monetary gold transactions under US$100. Import and export flows are collected at 12-digit GTIP[10] classification. Information on the origin/destination countries of trade flows is also available.

The third database used is the Annual Industrial Products Statistics database which contains information on the type and number of produced goods, their volume and value of production together with the total quantity and value of total sales from products produced within the reference year or preceding years. Product data are collected at 10-digit PRODTR level.[11] Production data are available for firms with more than 20 persons employed and which primary or secondary activity lays either in the C (Mining & Quarrying) or D (Manufacturing) sections of NACE Rev 1.1.

This database, available for the period 2005–9, is used to identify the export flows of goods that the firm effectively produces (by matching the codes of the exported products to those of the products produced by the firm) and to exclude from import flows those goods which belong to its product scope (*ie*, the products that the firm import and that also correspond to products produced by the firm) on the assumption that these are imported goods that are sold without further processing. Merging foreign trade data and production data at the product level was achieved by establishing a correspondence between the GTIP and PROTR classifications provided by TurkStat.

The databases were matched using a single identifier of each enterprise created by TurkStat. The analysis used Turkish enterprise level data for the year of 2006.

The IO table for Turkey uses the latest table for 2002 sourced from the OECD's IO database (see Appendix A on page 204).

It is useful at this stage to say a few words on the computation of the indicators mentioned above.

- Export intensity: this is the value of the export to output ratio.
- Intermediate imports ratio: this is the value of intermediate imports divided by intermediate consumption
- Exporting firms' share of total output: share of sector or total economy production undertaken by exporting firms.

The value of output is proxied by firm turnover, available in enterprise surveys. It equals all activity incomes plus subsides, fiscal aids and other incomes but excludes other ordinary and extraordinary revenues and profits such as

[10] Turkish Customs Tariff and Tariff Classification of Goods.

[11] This is national product classification with the first eight digits corresponding to Eurostat's Prodcom classification of 2006.

interest and dividends from affiliates and subsidiaries. Also included is the annual change in the stock value of semi-finished and finished products:

$$\begin{aligned}\text{output} = {} & \text{income from sales of goods and services} \\ & + \text{subsidies, fiscal aids and other incomes} \\ & + \Delta\text{stock value of semi-finished products} \\ & + \Delta\text{stock value of finished products.}\end{aligned} \tag{8.8}$$

Intermediate consumption comprises all types of expenditures necessary to undertake the economic activity of the enterprise. Hence, it excludes from financing charges (interest) and extraordinary expenses, including non-operating expenses and costs and previous years' expenditures.[12] From the obtained value of activity expenditures is deducted the annual variation of both changes in the stock value of raw and auxiliary materials, operating and packing goods and changes in the stock value of trading goods:[13]

$$\begin{aligned}&\text{intermediate consumption} \\ &= \text{total value of equipment, raw and auxiliary materials, operating} \\ &\quad \text{and packing good purchased to he used in production of goods and} \\ &\quad \text{services in the reference period} \\ &\quad + \text{value of goods to be sold without further processing} \\ &\quad + \text{purchase of electricity} \\ &\quad + \text{purchase of other fuels} \\ &\quad + \text{payments made to employment agencies and similar organisations} \\ &\quad + \text{expenditures on auxiliary activities provided by other enterprises} \\ &\quad + \text{payments made for production subcontracted to third parties} \\ &\quad + \text{rental expenses} \\ &\quad - \Delta\text{stock value of raw, auxiliary materials, operating and} \\ &\quad \text{packing goods} \\ &\quad - \Delta\text{stock value of goods purchased to be sold without} \\ &\quad \text{further processing.}\end{aligned} \tag{8.9}$$

Measuring imported intermediates at the firm level has some important caveats, which are worth discussing. Firstly, only direct imports can be captured in customs data. Imported inputs can embody themselves domestic value added which cannot be disentangled from the total import value. Secondly, a firm can buy locally (*ie* via a wholesaler in the domestic market) inputs

[12] Also excluded from the analysis here were advertising, accounting and marketing costs, although these should in theory be included.

[13] In theory these should also be adjusted for any stock revaluations (*ie* holding gains/losses).

Table 8.2: *Merchandise trade by large economic sectors (as a percentage of total trade in 2009 or latest available year).*

	Total exports (%)					
	Agriculture	Industry	Trade	Services	Unspecified	Total
Canada	1.6	71.6	10.5	16.4	—	100.0
Turkey	0.1	59.9	34.5	5.5	—	100.0
USA	0.4	63.0	25.1	11.5	—	100.0
EU average	0.4	56.8	19.3	11.0	12.5	100.0
	Total imports (%)					
	Agriculture	Industry	Trade	Services	Unspecified	Total
Canada	0.5	48.5	40.8	10.3	—	100.0
Turkey	0.0	54.6	31.5	13.9	—	100.0
USA	0.1	47.0	41.6	11.3	—	100.0
EU average	0.2	37.5	38.3	12.8	11.1	100.0

Source: OECD-Eurostat Trade by Enterprise Characteristics (TEC) Database. Rounded figures, which may not sum exactly to 100.

that are produced abroad. According to the OECD-Eurostat TEC database, the percentage of wholesalers and retailers in many countries is not insignificant: they account, for example, for 19% of Germany's extra-EU exporters and 36% of exporting enterprises in the USA, where they are almost 50% of all importing enterprises as well. As shown in Table 8.2, wholesalers and retailers undertake a sizeable share of merchandise trade, which in the case of imports is above 30% of total imports, on average, for the countries covered by the database.[14]

Future plans, of both the Eurostat-OECD Trade by Enterprise Characteristics expert group and the OECD group working on the measurement of trade in value added, will focus on allocating these imports to using these goods as inputs by separately identifying and treating imports purchased by the wholesaling industry. Research will also focus on creating links between enterprises and any affiliate enterprises they set up as separate wholesale/retail arms.

In this study the microdata were based on 2006 results, whereas the IO coefficients and the export values were retrieved from the 2002 IO table, meaning that a full reconciliation of data was not possible. But there are other reasons why a complete reconciliation between the two sources would in any case be non-trivial. One of the reasons reflects the fact that the IO tables will, by design, include a number of corrections and adjustments to reflect reporting errors, such as incorrect reporting information from enterprises, and national accounts adjustments to reflect the non-observed (informal, grey, shadow) economy among others. But another equally important reason reflects the

[14]For a review of the literature on the role of wholesalers in international trade and its determinants see Crozet *et al* (2010) and Bernard *et al* (2011).

allocation of businesses to different industry sectors. The assumption used in the analysis here is that enterprises in the firm-level data are also the basis for constructing the IO tables. In theory, statistical offices are encouraged to construct IO tables using establishments. For most businesses the enterprise and the establishment is one and the same, but this is not always the case, particularly for larger enterprises. Further work will be needed to ensure a reconciliation of allocation methods used in the IO tables with those used in this additional analysis.

That said, these caveats are not expected to have a significant impact on the overall results. Firms engaged in the informal sector, for example, are typically small and unlikely to be involved in international trade. And, as noted, most establishments are also enterprises. In any case, to minimise the possibility of these differences having a major impact on the overall results, the approach used here is based on ratios.

In other words, in creating a split of any industrial sector into an exporting component and a non-exporting component, the approach has been to split total output in the sector in accordance with the split prevailing in the firm level data (assuming the ratios for 2006 are suitable for 2002). The next step is to create the estimates for each sector using information on the ratio of value added to output and the ratio of import to intermediate consumption for the population of exporting firms in every industry.

5 SUMMARY OF RESULTS

Table 8.3 presents the key results by two-digit ISIC industry. The table compares the share of imported inputs in total industrial output for exporting firms only (column 3) against the aggregate industry shares (across all firms in each sector) obtained via the aggregate two-digit IO tables (column 5). It shows that estimated imports embodied in exports were, on average, 125% higher combining IO information with firm level information about import shares from exporters compared with the results based on the aggregated IO coefficients. The table also shows that, in every industrial sector where some disaggregation was attempted, the amount of imports embodied in exports was higher and the difference was significant. The only exception was post and telecommunications (IO 64), where the difference was negligible. However, the latter result may be related to the low degree of tradability of that activity.

6 CONCLUSIONS AND RESEARCH AGENDA

The experimental results shown above demonstrate that more detailed IO tables which have a greater focus on the structure of exporting firms than

Table 8.3: *Comparison of results, 2002.*

		Import shares from exporting firms		Results based on aggregated IO table		
ISIC	Exports	A	B	A	B	C
1	2,244,050	0.13	299,932	0.06	145,611	106
2	10,896	0.06	662	0.03	311	113
5	65,569	0.14	9,440	0.07	4,585	106
10	1,655	0.26	438	0.12	200	118
11	1,708	0.14	240	0.08	133	81
13	114,967	0.36	40,909	0.16	18,845	117
14	251,485	0.26	64,926	0.13	32,242	101
15	2,457,225	0.29	700,829	0.12	287,108	144
16	122,341	0.56	68,994	0.23	27,552	150
17	7,018,726	0.61	4,260,200	0.27	1,872,164	128
18	8,242,291	0.54	4,447,960	0.24	1,992,294	123
19	287,732	0.63	182,681	0.37	105,676	73
20	146,946	0.70	102,729	0.28	41,604	147
21	344,823	0.63	217,567	0.30	101,801	114
22	46,795	0.44	20,644	0.23	10,562	95
23	606,703	1.11	676,060	0.57	343,648	97
24	1,545,378	0.68	1,045,659	0.28	438,663	138
25	1,327,502	0.82	1,085,012	0.33	444,134	144
26	1,819,875	0.40	729,259	0.18	325,196	124
27	3,700,493	0.79	2,932,985	0.37	1,354,991	116
28	1,116,763	0.64	718,554	0.30	333,180	116
29	2,299,397	0.59	1,348,560	0.28	636,981	112
30	10,242	0.49	5,049	0.27	2,803	80
31	1,239,762	0.73	903,317	0.31	388,618	132

'ISIC' denotes ISIC Rev. 3.1 industry. Export values are given in billion TL. A, direct and indirect imports as share of output. B, value of imports embodied in exports. C, difference in imported input contents, in percent.

has hitherto been the case should be pursued and developed by statistical offices. As noted above, this is unlikely to happen soon, but much can be done to motivate this development by exploiting existing microdata to produce indicators that can be integrated into existing IO tables. Moreover, as demonstrated in Appendix B on page 206, the development of these indicators is justifiable, as they provide stand-alone inputs for many other forms of analysis.

Certainly there remain a number of challenges, some of which have already been mentioned above, such as

- the alignment of enterprise and establishment based data,
- the inclusion of exporters of services in the exporting sector and imports of services in the calculation of total imports by the non-exporting and exporting sectors,

Table 8.3: *Continued.*

		Import shares from exporting firms		Results based on aggregated IO table		
ISIC	Exports	A	B	A	B	C
32	1,889,535	0.95	1,794,366	0.47	890,595	101
33	50,983	0.65	33,033	0.36	18,567	78
34	4,329,850	0.89	3,846,233	0.34	1,459,386	164
35	457,860	0.57	260,670	0.22	100,917	158
36	1,147,834	0.64	739,668	0.41	470,319	57
40	23,590	0.47	11,159	0.24	5,571	100
45	1,258,809	0.43	546,747	0.33	411,653	33
50	1,288,810	0.49	625,801	0.07	95,017	559
51	2,674,465	0.46	1,237,896	0.17	457,308	171
52	3,533,579	0.32	1,138,621	0.15	521,427	118
60	3,949,926	0.22	879,132	0.10	404,293	117
61	1,581,180	0.18	276,993	0.09	138,304	100
62	860,967	0.19	159,600	0.09	75,480	111
63	1,675,591	0.23	393,472	0.11	175,954	124
64	155,113	0.15	23,933	0.15	22,725	5
65	1,481,153	0.30	439,548	0.14	209,600	110
66	225,731	0.18	40,885	0.09	19,296	112
72	23,033	0.28	6,424	0.10	2,263	184
74	153,218	0.15	23,163	0.05	7,854	195
75	226,844	0.11	25,500	0.05	11,942	114
90	90	0.18	16	0.09	8	87
92	97,915	0.12	11,556	0.05	5,193	123
93	102	0.35	36	0.09	10	277
Total	62,109,502	0.52	32,377,056	0.23	14,412,585	125

'ISIC' denotes ISIC Rev. 3.1 industry. Export values are given in billion TL. A, direct and indirect imports as share of output. B, value of imports embodied in exports. C, difference in imported input contents, in percent.

- the treatment of imports purchased via non-affiliated or affiliated wholesalers.

Perhaps the most pressing area where further work is necessary, however, concerns the further disaggregation of sectors into importing intensity groups and ownership (foreign or domestic) and indeed the possibility of deriving sub-sectors of these groupings (including exporters) based on intensities or other breakdowns, for example, by breaking down exporters' quartiles based on the proportion of output they export, by size class or more detailed industrial classification. But all of these considerations need to be set against confidentiality constraints. Appendix B on page 206 provides further information on what is possible here.

One other important area of work concerns the nature of importers. Input–output tables in some countries often use limiting assumptions to allocate

imports to using sectors. Often this is based on a straightforward proportionality assumption that allocates imports on the basis of their share within total supply. Some countries tackle this allocation using dedicated surveys, but these are not always conducted systematically. Capitalising on the use of existing microdata, in particular that relating to firms recognised as importers in trade registers, could lead to improvements in this allocation, particularly if this microdata is linked to information regarding the nature of the import (*ie* whether it is an intermediate good or one destined for final demand; see Appendix B on page 206). This activity forms part of the research agenda that takes this work forward.

Ultimately the intention is for the OECD to systematically integrate these new statistics into national IO tables, in conjunction with a number of other initiatives, for example, the creation of a Broad Economic Categories (BEC) data set (Zhu *et al* 2011).

7 APPENDIX A. IO TABLES

OECD's Science Technology and Industry Directorate has been updating and maintaining harmonised IO tables, splitting intermediate flows into tables of domestic origin and imports, since the mid-1990s, usually following the rhythm of national releases of benchmark IO tables. The process of compiling OECD's IO database greatly depends on cooperation with national statistical institutes. Ideally, national authorities would provide the latest supply–use tables and benchmark symmetric input–output tables (SIOTs) at the most detailed level of economic activity possible, with a basic price valuation, and, preferably, separating domestically produced and imported intermediate goods and services. However, few countries can meet such requirements. Therefore, in order to maximise country coverage, all relevant *partial* data is used. It should be noted that one of the main reasons that IO analysis has benefited from renewed attention in recent years is the improved availability and quality of IO tables and related statistics from national sources.

The first edition of the OECD IO Database dates back to 1995 and covers 10 OECD countries, with IO tables spanning the period from early 1970 to early 1990. The first updated edition of this database, released in 2002, increased the coverage to 18 OECD countries, plus China and Brazil, and introduced harmonised tables for the mid-1990s. Since 2006, this tradition of growth has continued so that there are now tables available for 46 countries (33 OECD and 13 non-OECD countries) with tables for the mid-2000s (mainly 2005) now available for most of them (Table 8.4).

The IO tables show the transactions between domestic industries. The tables break down total imports by user (industry and category of final demand). Some countries provide the latter import tables in conjunction with their IO tables, but in some cases they are derived by the OECD Secretariat

Table 8.4: *Country coverage of OECD Input–Output 2009 edition (as of May 2011).*

OECD	Mid-1990s	Early 2000s	Mid-2000s
Australia	1994/95	1998/99	2004/05
Austria	1995	2000	2005
Belgium	1995	2000	2005
Canada	1995	2000	2005
Chile	1996	—	2003
Czech Republic	1995	2000	2005
Denmark	1995	2000	2005
Estonia	1997	2000	2005
Finland	1995	2000	2005
France	1995	2000	2005
Germany	1995	2000	2005
Greece	1995	2000	2005
Hungary	1998	2000	2005
Iceland	—	—	—
Ireland	1998	2000	2005
Israel	1995	—	2004
Italy	1995	2000	2005
Japan	1995	2000	2005
Korea	1995	2000	2005
Luxembourg	1995	2000	2005
Mexico	—	—	2003
Netherlands	1995	2000	2005
New Zealand	1995/96	2002/03	—
Norway	1995	2000	2005
Poland	1995	2000	2005
Portugal	1995	2000	2005
Slovak Republic	1995	2000	2005
Slovenia	—	2000	2005
Spain	1995	2000	2005
Sweden	1995	2000	2005
Switzerland	—	2001	—
Turkey	1996	1998	2002
United Kingdom	1995	2000	2005
USA	1995	2000	2005

in producing IO tables directly from supply–use tables, which requires the use of assumptions that will have a significant impact on the results of trade in value-added analysis, particularly at the industry level. The main assumption used is the 'proportionality' assumption, which assumes that the share of imports in any product consumed directly as intermediate consumption or final demand (except exports) is the same for all users. Indeed, this is also an assumption that is widely used by national statistics offices in constructing IO tables. Improving the way that imports are allocated to users will form a central part of the work-plan going forward. But an important part of the work plan will be the attempt to gain an improved understanding of how countries estimate their import-flow matrices and indeed an attempt to motivate better methods of allocation, at the national level, where possible.

The industry classification used in the current version of the IO database

Table 8.4: *Continued.*

Non-OECD	Mid-1990s	Early 2000s	Mid-2000s
Argentina	1997	—	—
Brazil	1995	2000	2005
China	1995	2000	2005
Chinese Taipei	1996	2001	2006
India	1993/94	1998/99	2006/07
Indonesia	1995	2000	2005
Romania	—	2000	2005
Russia	1995	2000	—
South Africa	1993	2000	2002
Thailand	—	—	2005
Vietnam	—	2000	—
Malaysia*		2000	
Singapore*	1995	2000	2005

A dash means that the available year data is not available. *Not published (internal use only).

is based on ISIC Rev. 3 (Table 8.6), meaning that it is compatible with the other OECD industry-based analytical data sets such as the Structural Analysis (STAN) database, based on System of National Accounts by activity, and bilateral trade in goods by industry (derived from merchandise trade statistics via standard Harmonized System to ISIC conversion keys). By necessity (*ie* to maximise inter-country comparability), the system is relatively aggregated.

8 APPENDIX B: ANALYSIS OF FIRM-LEVEL HETEROGENEITY

8.1 Firm-Level Heterogeneity

This section shows the results of the exploratory work and aims at detailing the level of within-sector heterogeneity found in the key indicators identified above and comparing the values of these indicators at specific points of the distribution with averages computed at the sector level. The analysis is primarily centred on establishing a level of detail that could be provided within IO tables without compromising confidentiality constraints, but very clearly the results themselves are useful in understanding firm dynamics, and even without their integration into IO tables they can prove to be powerful policy tools.

Table 8.5 depicts correlations between the main variables of interest. It shows that there is a positive and highly significant correlation between the share of output exported by firms and the intermediate import ratio. Also, there is a positive correlation between the share of a firm's exports in total sector exports (calculated at the two-digit level) and the intermediate import ratio, except for wholesalers and retailers, which raises concerns about aggregation bias in TVA measures. The same information is depicted in Figure 8.1, which plots the distribution of the intermediate import ratios and the share

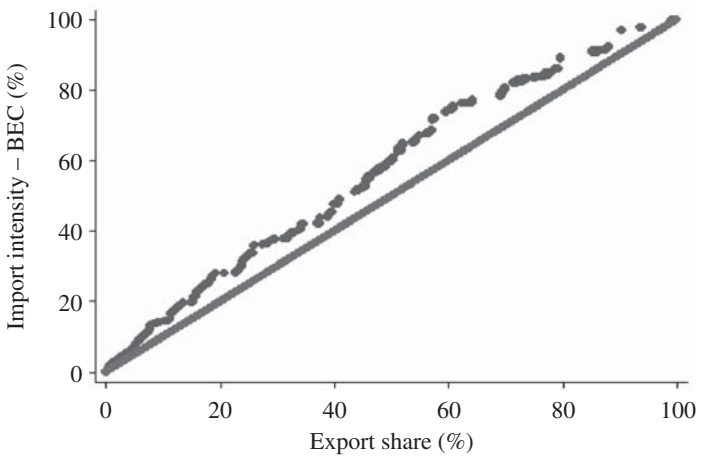

Figure 8.1: *Q–Q plot of intermediate import ratio against export share.*
Source: authors' calculations using TurkStat's databases.

Table 8.5: *Correlation table between selected indicators.*

Correlations between:	Whole economy	Manufacturing	Wholesalers & retailers
Export intensity and…			
· intermediate import ratio (BEC class.)	0.09	0.24	0.02
· value added per unit of output	−0.03	−0.03	−0.02
· value added	0.13	0.27	0.11
· foreign ownership	0.06	0.12	0.02
· firm size	0.15	0.30	0.11
Sector export share and…			
· intermediate import ratio (BEC class.)	0.04	0.11	**0.00**
· value added per unit of output	**0.00**	**−0.01**	**0.00**
· value added	0.03	0.07	0.03
· foreign ownership	0.07	0.10	0.02
· firm size	0.05	0.09	0.04
Intermediate import ratio (BEC classif.) and…			
· value added per unit of output	−0.02	−0.02	−0.01
· foreign ownership	0.10	0.22	0.07
· firm size	0.14	0.33	0.10

Source: authors' calculations using TurkStat's databases. All coefficients are significant at 1% unless indicated in bold.

of exported output at the firm level. From the figure it emerges that higher export shares correspond to more than proportional increases in the import

Table 8.6: *OECD IO industry classification. NACE Classification – Rev. 1.1.*

NACE	Description
01,02&05	Agriculture, hunting and related service industries
10–12	Mining and quarrying (energy)
13&14	Mining and quarrying (non-energy)
15&16	Food products, beverages and tobacco
17–19	Textiles, textile products, leather and footwear
20	Wood and products of wood and cork
21&22	Pulp, paper, paper products, printing and publishing
23	Coke, refined petroleum products and nuclear fuel
24ex2423	Chemicals excluding pharmaceuticals
2423	Pharmaceuticals
25	Rubber & plastics products
26	Other non-metallic mineral products
271&2731	Iron & steel
272&2732	Non-ferrous metals
28	Fabricated metal products, except machinery & equipment
29	Machinery & equipment, nec
30	Office, accounting & computing machinery
31	Electrical machinery & apparatus, nec
32	Radio, television & communication equipment
33	Medical, precision & optical instruments
34	Motor vehicles, trailers & semi-trailers
351	Building and repairing of ships & boats
352–359	Railroad equipment and transport equipment nec
36&37	Manufacturing nec; recycling (including furniture)

intensity measured as the share of BEC intermediates over intermediate consumption.

8.2 Export Shares

Table 8.7 shows the distribution of sector export shares (calculated as total exports over total output) for the Turkish economy in 2006. Sectors with cells suppressed due to confidentiality are not displayed in the table. The second column reports values for export intensity calculated directly at the sector level (*ie* by summation of total export and total output values at the two-digit sector and then taking the ratio between the two), while the third column presents average sector values of export intensity calculated at the firm level. The next columns display values for selected the middle and upper part of the distribution, more specifically the 50th, 75th, 90th and 95th percentiles.

It is clear from the table that there is a large discrepancy between the export share at the sector level reported in the second column and the average firm-level share displayed in the third column. This is easily explained by the large percentage of firms which do not export. Indeed, the initial idea was to display also values for the lower part of the distribution, but results showed what

Table 8.6: *Continued.*

NACE	Description
401	Production, collection and distribution of electricity
402	Manufacture of gas; distribution of gaseous fuels through mains
403	Steam and hot water supply
41	Collection, purification & distribution of water
45	Construction
50–52	Wholesale & retail trade; repairs
55	Hotels & restaurants
60	Land transport; transport via pipelines
61	Water transport
62	Air transport
63	Supporting & auxiliary transport activities; activities of travel agencies
64	Post & telecommunications
65–67	Finance & insurance
70	Real estate activities
71	Renting of machinery & equipment
72	Computer & related activities
73	Research & Development
74	Other business activities
75	Public admin. & defence; compulsory social security
80	Education
85	Health & social work
90–93	Other community, social & personal services
95–99	Private households and extraterritorial organisations

is already a stylised fact about export performance: only very few firms in the economy export (Araújo and Gonnard 2011; Ottaviano and Mayer 2008). As such, the values for the lower part of the indicators' distributions are not displayed, as they are mostly equal to zero, except for sector 16 (manufacture of tobacco products).

In the specific case of the Turkish economy, except for 'manufacture of tobacco products' (sector 16), and to a much lesser extent 'mining of metal ores' (sector 13), all the economy is characterised by the fact that almost 75% of the firms in a sector sell only to the domestic market. Not only is the export base is small, but also only a few firms within sectors have very high export intensities. Focusing on the manufacturing sector, and with the exception of the tobacco industry, the ratio of exports to output is higher than 25% only in sector 27 (manufacture of basic metals) at the 95th percentile.

Export shares computed at the sector level convey a different picture: export intensity calculated at this level is typically higher than the average export intensity calculated at the firm level and higher than the 75th percentile value. The only exception is the case of the tobacco industry, where 50% of the firms export around 40% or more of their total output, while the sector average is about half this figure. Conversely, aggregate export intensity is among the highest for motor vehicles, trailers and semi-trailers and other transport

Table 8.7: *Distribution of export shares (%).*

NACE Rev. 1.1	Total sector	Average across firms	50th perc.	75th perc.	90th perc.	95th perc.
13	25.76	13.55	0	0.43	71.25	84.59
14	21.48	5.84	0	0	30.49	47.61
15	10.08	0.68	0	0	0	0
16	23.09	40.62	39.79	78.57	85.63	93.75
17	13.89	1.43	0	0	0	5.50
18	16.66	1.35	0	0	0	0.32
19	9.22	1.86	0	0	0	5.51
20	5.47	0.18	0	0	0	0
21	6.31	1.41	0	0	2.86	9.20
22	1.82	0.21	0	0	0	0
24	10.25	2.64	0	0	5.29	14.77
25	15.60	1.57	0	0	0	8.64
26	6.12	1.17	0	0	0	1.82
27	20.03	3.48	0	0	8.13	28.15
28	11.07	0.61	0	0	0	0
29	17.92	2.20	0	0	0.76	13.58
31	22.43	2.52	0	0	0	16.13
33	9.63	2.52	0	0	2.50	19.96
34	43.98	2.82	0	0	4.97	18.24
35	26.73	2.65	0	0	6.89	15.42
36	10.14	0.97	0	0	0	0
40	0.68	1.27	0	0	0.61	3.14
45	1.41	0.10	0	0	0	0
50	0.66	0.12	0	0	0	0
51	7.49	1.99	0	0	0	2.02
52	0.44	0.10	0	0	0	0
55	1.13	0.02	0	0	0	0
60	0.20	0.02	0	0	0	0
61	3.20	0.17	0	0	0	0
63	0.59	0.03	0	0	0	0
64	0.08	0.03	0	0	0	0
71	0.01	0	0	0	0	0
72	1.75	0.10	0	0	0	0
74	0.42	0.02	0	0	0	0
80	0.01	0.01	0	0	0	0
85	0.05	0.01	0	0	0	0
90	0.10	0.28	0	0	0	0
92	0.09	0.03	0	0	0	0

Source: Source: authors' calculations using TurkStat's databases. Data have been made confidential for missing two-digit NACE sectors.

equipment (sectors 34 and 35, respectively), while the firm-level ratio shows that at least 95% of the firms operating in these sectors export less than 20% of their output.

Excluding from total exports the exports of those products that do not have a code matching the products that each firm have declared they produced

Table 8.8: *Distribution of intermediate import ratios (%).*

NACE Rev. 1.1	Total sector	Average across firms	50th perc.	75th perc.	90th perc.	95th perc.
			(a) All imports			
10	5.68	1.37	0	0	0	0.77
13	15.83	2.42	0	0	5.29	13.42
14	5.29	0.78	0	0	0	0.35
15	8.85	0.26	0	0	0	0
16	38.4	15.65	0.59	20.49	65.27	70.92
17	22.78	1.72	0	0	0	6.62
18	11.48	0.54	0	0	0	0
19	17.49	0.99	0	0	0	2.03
20	24.07	0.18	0	0	0	0
21	36.07	4.31	0	0	11.6	34.27
22	9.11	0.5	0	0	0	0
24	55.09	9.88	0	0.77	47.79	66.42
25	36.21	2.09	0	0	0	9.7
26	14.41	0.92	0	0	0	0.11
27	51.91	4.52	0	0	10.66	35.09
28	16.08	0.5	0	0	0	0
29	27.48	1.83	0	0	0	11.25
31	38.25	1.91	0	0	0	9.14
32	79.18	7.9	0	3.49	31.64	49.01
33	34.02	3.88	0	0	7.59	29.77
34	58.66	5.94	0	0	37.48	44.09
35	31.15	2.16	0	0	0.57	15.07
36	9.57	0.34	0	0	0	0
40	1.95	3.29	0	1.15	5.3	15.72
45	1.45	0.18	0	0	0	0
50	7.14	0.21	0	0	0	0
51	10.72	2.91	0	0	0	8.9
52	1.8	0.25	0	0	0	0
55	1.03	0.04	0	0	0	0
60	1.67	0.01	0	0	0	0
61	2.26	0.32	0	0	0	0
63	1.55	0.11	0	0	0	0
64	2.32	0.21	0	0	0	0
70	0.11	0	0	0	0	0
71	0.17	0.14	0	0	0	0
72	5.84	1.25	0	0	0	0.37
74	1.07	0.1	0	0	0	0
80	1.05	0.07	0	0	0	0
85	4.05	0.06	0	0	0	0
90	2.15	21.31	0	8.34	96.86	96.86
92	1.15	0.03	0	0	0	0
93	0.48	0.02	0	0	0	0

Source: authors' calculations using TurkStat's databases. Data have been made confidential for missing two-digit NACE sectors.

according to the Industrial Production Survey scales down export to output shares by 60% (not shown). One possibility which is advanced in the literature for this disparity is misreporting. The misreporting hypothesis was checked

Table 8.8: *Continued.*

NACE Rev. 1.1	Total sector	Average across firms	50th perc.	75th perc.	90th perc.	95th perc.
(b) Only intermediate imports according to the BEC classification						
10	5.23	1.07	0	0	0	0
13	13.71	1.54	0	0	2.47	7.02
14	3.68	0.32	0	0	0	0
15	5.78	0.16	0	0	0	0
16	32.2	13.91	0.59	13.94	61.68	65.26
17	19.66	1.36	0	0	0	3.8
18	9.63	0.47	0	0	0	0
19	14.4	0.77	0	0	0	0.39
20	21.48	0.16	0	0	0	0
21	30.96	3.73	0	0	11.48	33.68
22	5.01	0.12	0	0	0	0
24	42.82	7.89	0	0	35.19	54.9
25	32.72	1.69	0	0	0	2.97
26	11.51	0.65	0	0	0	0
27	50.59	3.97	0	0	6.73	29.02
28	13.57	0.36	0	0	0	0
29	15.32	1.2	0	0	0	3.21
31	29.15	1.5	0	0	0	5.24
32	37.95	5.83	0	1.92	18.00	37.38
33	19.61	2.3	0	0	2.73	12.24
34	42.98	2.18	0	0	2.17	11.25
35	19.61	1.46	0	0	0.57	10.04
36	6.31	0.23	0	0	0	0
40	1.61	2.42	0	0.75	4.01	8.81
45	0.81	0.14	0	0	0	0
50	1.22	0.08	0	0	0	0
51	7.4	1.89	0	0	0	1.24
52	0.33	0.1	0	0	0	0
55	0.22	0	0	0	0	0
60	0.52	0	0	0	0	0
61	0.67	0.14	0	0	0	0
63	0.89	0.04	0	0	0	0
64	0.47	0.05	0	0	0	0
70	0.03	0	0	0	0	0
71	0.05	0.12	0	0	0	0
72	1.48	0.29	0	0	0	0
74	0.76	0.09	0	0	0	0
80	0.17	0.01	0	0	0	0
85	0.37	0.01	0	0	0	0
90	0.92	8.79	0	4.05	40.7	40.7
92	0.6	0.01	0	0	0	0
93	0.08	0	0	0	0	0

Source: authors' calculations using TurkStat's databases. Data have been made confidential for missing two-digit NACE sectors.

by matching customs and product data at a higher level of aggregation at the CPA six-digit level instead of at the PRODCOM ten-digit level. Export shares are scaled down by a smaller amount (40% on average), but there are significant

differences across sectors. However, there are substantial discrepancies in the relative sizes of the reduction of export shares within sectors.

8.3 Intermediate Imports Ratio

As discussed above, for the purpose of analysis of the use of imports of intermediate goods, three measures of imports were constructed. However, matching the codes of imported products with those of the products produced by each firm did not reveal significant discrepancies between import shares, both at the sector level and at the firm level. Table 8.8 consequently displays intermediate import ratios according to only two criteria: the first part of the table takes all imports made by firms as imports of intermediate goods used up in the production process, while second part of the table identifies as intermediates only those products which are so identified by the BEC classification. As with export shares, Table 8.8 only reports non-confidential cells.

Table 8.8 shows that, as for exports, the import activity of firms within sectors is strongly heterogeneous, with a small share of firms reporting non-zero imports, regardless of the definition of intermediate imports used. Across sectors, imports tend to be more important in manufacturing sectors (corresponding to NACE codes 15–37).

As for the specific definitions used, as expected, considering all imports as intermediate inputs yields higher intermediate import coefficients, both at the aggregate sector level and in terms of firm-level averages. These discrepancies are, however, higher in terms of total sector averages, particularly in sector 32 (radio, television and communication equipment apparatus), and with the exception of sector 90 (sewage and refuse disposal), where the average across firms is higher than the aggregate sector value.

8.4 Firm Size, Ownership and Value Added

We have further explored within-sector heterogeneity by looking at the distribution of export shares, the intermediate imports ratio and the ratio of value added to output by firm size and ownership status of the firm.[15]

Although disaggregated tables with within-sector decompositions were also produced, the small number of foreign firms and their important role in the Turkish economy made it impossible to disclose cells for a number of sectors. Table 8.9 reports a summary of the results instead.

Of the disaggregated analysis, it is worth highlighting the following.

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[15] The figures in this section refer to import shares calculated only on products classified as intermediates by the BEC classification. However, intermediate imports ratios do not change significantly if all imports are considered. Regarding firm size, values reported refer to employment levels calculated in terms of head counts. Results do not change substantially if head counts are replaced by full-time equivalents.

Table 8.9: *Summary of results.*

Variable	Ownership	
	Domestic	Foreign
Export share (%)	0.34	12.13
imp_all/intermediates (%)	0.45	30.50
imp_bec/intermediates (%)	0.28	19.24

Variable	Firm size			
	0–9	9–49	50–249	250+
Export share (%)	0.22	2.96	5.79	8.96
imp_all/intermediates (%)	0.32	3.19	8.64	15.9
imp_bec/intermediates (%)	0.19	2.08	5.95	11.28

Variable	Export intensity	
	Export intensive	Non-export intensive
Export share (%)	1.77	0.28
imp_all/intermediates (%)	1.53	0.42
imp_bec/intermediates (%)	1.11	0.25

Source: authors' calculations using TurkStat's databases.

- The export share of foreign-owned enterprises is much larger than the export share of purely domestic ones, except in sectors 28 and 29 (fabricated metal products, machinery and equipment); on average, foreign-owned firms account for about 18% of total exports in the economy, but the sector-specific weight of foreign companies is particularly high in the automotive industry, where they account for more than half of exports. A significant share of wholesalers' exports is also made by foreign firms (about 40%).
- Foreign wholesalers are much more import intensive than indigenous wholesalers, which is consistent with the fact that the former are heavily engaged in intra-firm trade.[16]
- Export share increases with firm size, with small firms displaying export values of almost zero and large firms displaying very high export shares.
- The intermediate import ratio also increases with firm size.
- For the few sectors for which it is possible to disaggregate export and import shares simultaneously by size and ownership, foreign firms have higher import and export shares for firms with more than 49 employees.

[16]Indigenous firms are those which are controlled by entities resident in Turkey.

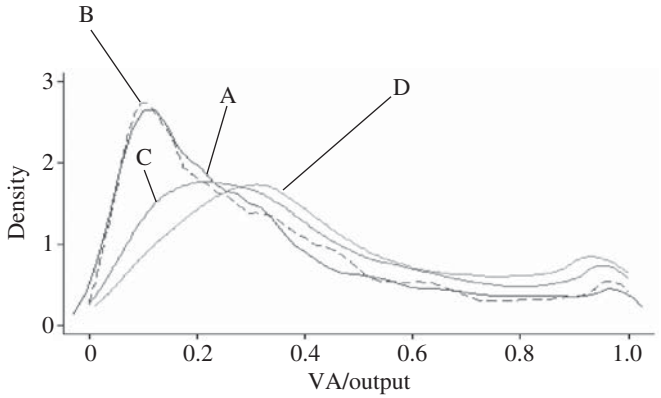

Figure 8.2: *Distribution of value added per unit of output by firm size.*

Source: authors' calculations using TurkStat's databases. Kernel = Epanechnikow. Bandwidth = 0.277. A, 1–9; B, 10–49; C, 50–249; D, 249+.

- Differences in 'import to output' shares are larger than 'for export' shares, which suggests that foreign firms source a higher share of their inputs from abroad, compared with domestic firms. However, the difference is less pronounced for the groups of firms having between 50 and 249 employees.
- Domestic firms exhibit, on average, a ratio of value added to output which is about 90% that of foreign-owned firms. However, there are sectors where the average firm-level value added per unit of output is higher than that of foreign-owned enterprises by a significant amount: 21% in NACE sector 33 (manufacture of medical, precision and optical instruments, watches and clocks), 22% in NACE sector 17 (manufacture of textiles) and 41% in NACE sector 18 (manufacture of wearing apparel). In sectors NACE sectors 29 (manufacture of machinery and equipment, nec) and 34 (motor vehicles) domestic and foreign-owned firms exhibit a similar performance.
- Value added increases with firm size. Figure 8.2 shows the distribution of the value added per unit of output for firms in different size segments. It shows that a randomly drawn medium-sized or large firm (with more than 49 employees) is likely to generate a higher value added per unit of output than micro and small firms (those with up to 49 employees).

The breakdown of the distribution of value added per unit of output between indigenous and foreign firms (Figure 8.3) shows that foreign-owned firms exhibit a higher share along most of the distribution and are more likely than indigenous firms to display a value-added share of output above 80%. It is quite interesting that the distribution for indigenous firms resembles the

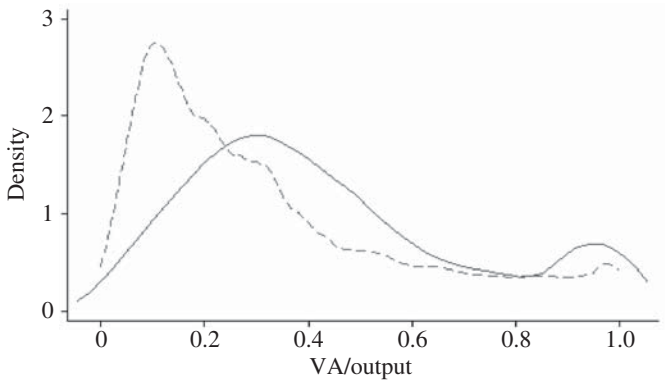

Figure 8.3: *Distribution of value added per unit of output by firm ownership.*

Source: authors' calculations using TurkStat's databases. Kernel = Epanechnikow. Bandwidth = 0.0545. ————, foreign firms; – – – –, domestic firms.

distribution for smaller firms in Figure 8.2, while the foreign firms' distribution mimics that of larger firms.

There are differences at the sector level, however. In NACE sectors 17 (manufacture of textile) and 18 (manufacture of wearing apparel), smaller firms (those with less than 50 employees) have a higher value added per unit of output than medium and large firms (those with 50 or more employees).[17] Within-sector differences in value added per unit of output between foreign and indigenous firms are not as striking as the differences in intermediate import ratios. Indigenous firms account for the majority of value added over sector output in manufacturing, while foreign firms' value added represents an important share of value added in some service sectors, such as in NACE sectors 64 (post and telecommunications), 71 (renting of machinery and equipment) and 72 (computer and related activities).

Disaggregating the ratio of imported inputs over intermediate consumption by firm ownership and firm size reveals that resourcing to foreign inputs dramatically increases with firm size. Table 8.1 shows that there is a positive and highly significant correlation between the ratio of intermediate imports to intermediate consumption and firm size.

When firms are split according to their ownership status and firm export share is plot against its input import intensity (Figure 8.4), the general relationship found in Figure 8.1 is not verified. It is clear from Figure 8.4 that higher export shares in foreign firms correspond to lower import ratios, regardless of the overall higher import and export orientation of foreign firms.

[17] Sector disaggregation is not shown to save space, but it can be provided upon request, within the limits of confidentiality.

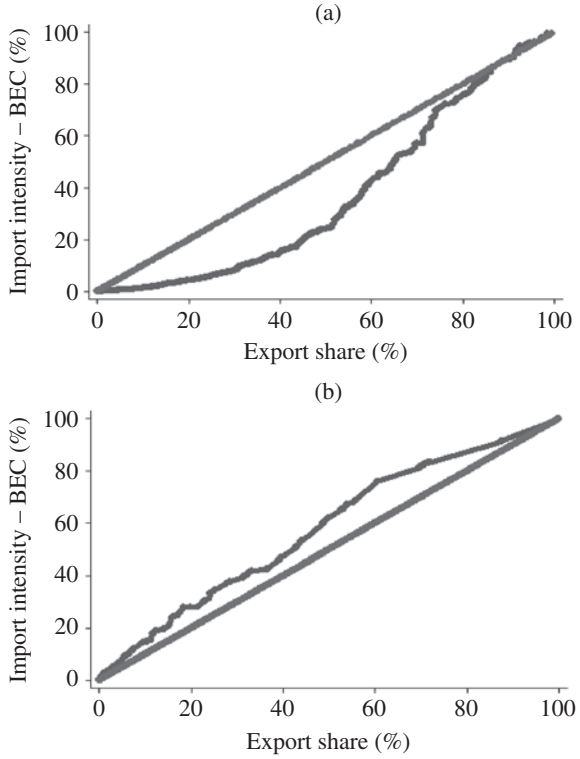

Figure 8.4: *Q–Q plot of intermediate import ratio against export share by firm ownership.*

Source: authors' calculations using TurkStat's databases. (a) Foreign controlled firms; (b) domestic firms.

Finally, Table 8.10 highlights differences in the mean of intermediate import ratios between exporters and non-exporters along firm size class and ownership status: it confirms that the difference in the means of the import ratios between exporters and non exporters are significantly positive and large regardless of the size class or ownership status considered.

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Table 8.10: *Differences in intermediate import ratios between exporters and non-exporters.*

(a) Total

	Mean	Std. Err.
Exporters	8.10	0.10
Non-exporters	0.18	0.00

(b) By firm size

	0–9		0–49		50–249		249+	
	Mean	Std. err.	Mean	Std. err.	Mean	Std. err.	Mean	Std. err.
Exporters	5.23	0.12	8.61	0.17	14.41	0.32	20.75	0.65
Non-exporters	0.15	0.00	0.95	0.03	1.46	0.09	1.58	0.21

(c) By ownership

	Domestic		Foreign owned	
	Mean	Std. err.	Mean	Std. err.
Exporters	7.65	0.10	28.92	1.08
Non-exporters	0.18	0.00	3.68	0.64

Source: authors' calculations using TurkStat's databases.

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