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# USING TRADE MICRODATA TO IMPROVE TRADE IN VALUE ADDED MEASURES: PROOF OF CONCEPT USING TURKISH DATA

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*This paper is for agenda item 7.2 and presents analyses that investigates the value-added contribution of firms in Turkey differentiated by import and export intensity and ownership, and by industrial sector. The paper illustrates that sufficient heterogeneity exists within the production functions and sourcing of goods and services of firms within given 2 digit industrial sectors, suggesting considerable scope to improve the quality of input-output based estimates of trade in value-added. Delegates are asked to consider the paper and the feasibility of producing similar results in their country as an addition to the OECD-Eurostat TEC database.*

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# USING TRADE MICRODATA TO IMPROVE TRADE IN VALUE ADDED MEASURES: PROOF OF CONCEPT USING TURKISH DATA[1]

## Executive Summary

1. Existing measures which assess the domestic and foreign value-added content of a country's exports are typically compiled within an input-output framework. This approach necessarily provides estimates of embodied value-added in exports that are particularly sensitive to the level of industry detail provided in the input-output (I-O) tables, and, therefore, implicitly assumes that all firms produce products using the same factors of production and that all consumers purchase the same mix of products from a given sector. But the reality is rarely this simple. In practice, within sectors there is considerable heterogeneity amongst firms in the types of inputs used in producing products and the import content of those inputs.

2. Likewise, the same output product can also entail significant differences in their input foreign content according to the destination of production while the sourcing of imported intermediates can also differ along firm characteristics such as size and ownership. This within sector difference can introduce a bias in the aggregate sector measures as firms contribute differently to sector values in terms of inputs they use, where these are sourced from, output values and the product mix. Exporting firms may well exhibit structural differences in the types of products produced, or in the way in which products are produced, compared to firms that produce only for domestic markets.

3. Against this background, there is a non-negligible risk that the estimates of value-added embodied in trade using I-O tables will be structurally biased. These within sector differences are likely to be greater the higher the level of aggregation. Additionally, the increasing dynamics in global production networks and goods sent abroad for processing makes these biases a likely possibility.

4. As a response to the limitations of aggregate measures, this paper develops a conceptual framework that proposes linking input-output data with additional firm-level information that identifies imports and exports at the firm level. The proposed framework is then tested using Turkish trade micro-data. Specifically, the objectives of this work are twofold.

5. Firstly, to provide a more accurate measure of the value-added content (and imports) embodied in exports by improving I-O coefficients.

6. Secondly, to deepen the understanding of the type of firms responsible for value-added creation through exports, which ultimately feeds in countries' GDP, and the relative use of imported inputs during the production process.

7. The exploratory work using Turkish trade micro-data revealed that:

- It is not possible to decompose the intermediate inputs import content of production according to the destination of production (domestic *vs* foreign markets). Import data are obtained through trade registers and the identification of imports of intermediate goods is made either by applying the

[1] The Secretariat is grateful to Turkstat, Turkey's National Statistical Institute for granting access to micro data that allowed for testing the methodology outlined in this paper and to Drs. Alessia Lo Turco and Daniela Maggioni, for their excellent research assistance.

BEC classification or by matching imports with production codes at the product level. This information is available at the enterprise level but not at the product level or at least disaggregated by the destination of production. Differences in the share of intermediate imports used in goods produced for domestic markets and those produced for export are more likely in countries and sectors where firms (domestic or foreign) are highly engaged in global value chains (GVCs);

- Decomposing intermediate imports ratios by sector and firm ownership status proved feasible;
- Export shares and unit value-added are easily broken down by firm-size and ownership status;
- The increase of the granularity of the data allowed by trade micro-data reveals considerable heterogeneity in the activity indicators and shows that indicator values computed directly at the industry level (as opposed to the firm level) may not provide an accurate picture of the underlying structure of value-added created by domestic firms.

## 1. Introduction

8. The dynamics of globalisation poses new challenges for economic and policy analysis. The liberalisation of trade policies and capital controls, coupled with the reduction in transport, communication and information costs led to an important reduction of trade costs and allowed a reorientation or firms' production strategies in recent decades. As a result, production processes are increasingly fragmented and each production stage is assigned to the most cost-effective location, while 'service links' (transportation and communication services) ensure the co-ordination among the several stages of internationally integrated production process, a phenomena which has became known as international fragmentation of production (Jones and Kierzkowski, 2001).[2]

9. 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 outside companies located overseas and repatriate production to its headquarters or to its regional distributions centres.

10. The vertical fragmentation of production processes, either within the boundaries of the firm or at arm's length has changed trade patterns in a significant way.

11. 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. Accordingly Yi (2003) noted that 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.

12. Secondly, it gives rise to vertical specialisation, by which countries specialise into very specific stages of the production process. As firms located in different countries contribute to the production of a single final product, the usefulness of the concept 'country of origin' becomes questionable. Indeed, there are a number of case studies demonstrating that inputs produced in many different countries enter in the composition of a final product which carries a label "Made in". For instance, a study of the production process of the Boeing 787 Dreamliner calculates that its production involves 43 suppliers spread over 135 sites around the world and that about 70% of its components are produced outside the U.S.[3]

13. Vertical fragmentation challenges the conventional way of compiling international trade statistics. Trade statistics record the full value of the good each time it crosses borders, including embodied

[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 paper uses these different terms interchangeably.

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

intermediate goods and services. This leads to multiple counting which will be larger the more production processes are sliced into individual stages and with each stage occurring in a different country.

14. Imported inputs used in the production of exported goods reduce the share of value-added generated by domestic producers. However, an economy which produces the final stage of the good will register in its exports the whole value of the good sold abroad - and is perceived as generating the entire value of the good – when in fact it has maybe only contributed marginally to its value, by, for instance, only engaging in the good's final assembly.

15. An often-cited case study is that of the Apple iPod, undertaken by Linden *et al.* (2008), 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, and much of the rest coming from the US and Korea. Yet the export figures for China recorded 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 ICT equipment.

16. The multiple counting masks the understanding of the value-added contribution of a country's enterprises to the value of its exports as well as the identification of the products it truly has a comparative advantage in international trade. Bilateral trade in gross terms is also elusive in depicting the underlying trade structure as they incorporate and unknown percentage of third-countries value-added in each product being traded. Indeed, this acknowledgment led to coining statistics on gross trade flows as "what you see is not what you get" (Maurer and Degain, 2010).

17. In order to capture this emergent feature of international trade structure and to gauge each country's real contribution to the goods and services it exports, there is an increasing recognition that measures of trade in the underlying value-added embodied in a product are needed to better reflect the actual contribution trade makes to an economy, in terms of GDP, employment, etc.[4]

18. The development of these statistics is vital for many other policy dimensions. Trade in value-added (TVA) measures can contribute to settling trade disputes as it is very difficult to sustain protectionist measures when countries' production structures are deeply interconnected. Indeed, import duties can really be hurting a country's exports. More generally, it is hard to conduct 'us' versus 'them' type of policies. TVA measures will also contribute to the analysis of the link between trade and employment. Standard trade statistics that rely on gross values cannot capture the new international division of labour arising with GVCs. Measuring trade in value-added will shed light on the countries and sectors where jobs are being created and reveal the factor content of trade. It will allow designing policies aiming at capturing value and increase countries' positions in GVCs. For instance, TVA measures can deepen the understanding of GVCs' role in innovation production and productivity increase as well as the impact of GVCs on the relocation of worldwide pollution in order to implement green growth strategies, both topics of current interest for policy makers.

19. The use of I-O tables to determine the foreign content of exports at the industry level is now widespread and has the great advantage of providing a comprehensive estimate, as both direct and indirect imports (embedded in domestic inputs) are included in the calculation of value-added. However, thus far, I-O tables possess four main limitations which can bias these estimates. They all stem from the aggregate nature of I-O data, which displays data for aggregate economic sectors and the necessary assumptions used to construct input-output tables; which are partly explicable by the lack of data on actual international flows of inputs and outputs across industries as well as the aggregated nature of IO tables.

20. Firm-level (micro) data can overcome some of the limitations of industry level analyses by providing a finer level of detail of the sectoral aggregation in input-output tables, particularly (in the

[4] Using input-output tables for Sweden, Isakson and Wajnblom (2011) show that the contribution of Swedish exports to GDP in 2005 dropped from 49% to 31% if the imported content was eliminated from exports.

context of the analysis of trade in value-added) if the finer level focuses on creating new levels of 'homogeneity' centred around the export and import intensity of firms.

21. This paper provides methodological guidelines on how to compute import coefficients and the value-added embodied in exports at the level of the firm and shows how trade micro-data, i.e., the matching of trade and business activity information at the level of the firm can refine the aggregate nature of the indicators in I-O tables, by increasing their granularity, which are in turn crucial to compute estimates of economy-wide and sector trade in value-added (TVA). Furthermore, the paper critically assesses the results of the implementation of the proposed methodology using Turkish firm-level data, kindly made available by Turkstat, the Turkish National Statistical Institute. The final part of the paper shows how the trade micro-data indicators can be used to disaggregate input-output industries into sub-groups of industries categorised by their import and export intensity.

22. Ultimately, using firm-level data to gauge the direct import content of exports and the value-added embodied in the products a firm exports will permit the identification of products with high value-added content and highlight the characteristics of those firms that export such products. This rich data will allow a closer inspection of how economic actors within countries and sectors position themselves in GVCs and it can improve policy makers understanding of the policies that could be implemented to improve a country's position and capture value in a world of internationally fragmented production chains; and also to understand GVCs impact on job creation and skill composition.

23. This project constitutes the first step towards improving the level of detail in I-O tables and is part of the OECD Programme of Work on Measuring Trade in Value-Added[5] When discussing this document, delegates are asked to comment on the following issues:

- Overall interest of this project, in terms of the recognition that:
  - data aggregation in I-O tables precludes an accurate measurement of trade in value-added;
  - micro-data can prove helpful in mitigating some of these limitations;
- The project outcomes and possible extensions;
- The proposed methodology;
- The feasibility of the project given the state of official trade micro-data statistics;
- The level of disaggregation that is possible given a country's specific confidentiality rules.

24. The document is structured as follows: Section 2 describes how Input-Output Tables have been used to measure the value-added contribution of a country's production to the good and services it exports, what is now termed in the field as trade in value-added (TVA). Using some illustrative examples, Section 3 lists the problems associated with the existing measures and describes how improvements could be made using firm-level data. Section 4 sets out the research agenda by describing a methodology to compile trade micro-data indicators that can feed into input-output 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 micro-data. Section 5 presents the main results using linked micro-data from Turkstat, Turkey's NSO, detailing across and within sector differences found in the indicators compiled and how these differences relate to key enterprise level characteristics. Section 6 comments on the main findings and investigates the thresholds needed to determine a disaggregation of Turkey's IO tables into more homogeneous sub-groupings based on trade characteristics.

5 The OECD Programme of work on Trade in Value Added, to be conducted jointly with the Committee for Industry, Innovation and Entrepreneurship (CIIE) and the Trade Committee was presented to CSTAT Members last June, at the time of the 8th session. More information on this horizontal work can be found in the background document presented to CSTAT: STD/CSTAT (2011)5.

## 2. Trade in Value-Added: concept overview

25. A number of studies have attempted to determine the level of foreign inputs embodied in exports. These studies build up on the pioneering work of Hummels *et al.* (2001)'s concept of vertical trade, which measures the foreign content of exports. They have proposed a methodology based on information contained in input-out tables to separate the value of imported intermediate goods and services from the domestic value-added content of exports.

26. Vertical trade, or the vertical specialisation nature of international trade, is a direct consequence of the fragmentation of production. Hummels *et al.* (2001) established that three conditions need to be met for it to occur: (1) the production of a good or service can be divided in two or more sequential stages, (2) two or more countries add value during the production process and (3) at least one country uses imported inputs in the production process and some of the resulting is exported.

27. Trade in value-added is a closely related but broader concept compared to measuring the foreign content of exports at the individual country level. The two concepts share however two common features: (1) the need to disentangle foreign and domestic value-added in gross export values and (2) the methodology to undertake this distinction relies on the use of input-output tables, more specifically on coefficients from import and domestic matrices.

28. At the theoretical level, the trade in value-added concept requires decomposing every single product in a value-added chain that was able to identify where the value-added originated by tracing the value-added throughout the production chain.

29. Conceptually (ignoring taxes and subsidies for simplicity) it is possible to decompose any particular product with value $V^p$ into the value-added (VA) generated in country *i* such that the total value of

$$V^p = \sum_i VA_i^p \qquad \text{(I)}$$

30. 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 example below.

31. 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 re-imported into country *i* for use in the production of *b*. Let's 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's 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. Let's also assume that apart from the intermediate imports referred to above all the value-added in *b* is also generated in country *i* only.

32. Following (I) above, 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. We know that total gross exports in the economy were equal to 600, which to some extent overstates the contribution of overall trade to the economy, but simply summing the value-added contribution at the product level (the value-added generated by *a* and the 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 or product *a*, whose value-added is separately shown under the production of *a.*

33. In this context it's important to note that the level of detail through which information is presented makes a difference; a point we develop below.

34. In practice of course we will never have the level of detail needed to conduct a value-added decomposition for all individual products in the way theorised above and, so, in practice, it will be necessary to use aggregated data. A pragmatic approach to doing this is by exploiting Input-Output tables, which are readily available in many (notably OECD) economies.[6]

35. 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 (e.g. 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'.

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

$$g = A*g + y \qquad \text{where:}$$

*g*: is an n*1 vector of the output of n industries within an economy.

*A*: is an n*n matrix describing the interrelationships between industries; where $a_{ij}$ is the ratio of inputs from domestic industry *i* used in the output of industry *j*.

*y*: is an n*1 vector of final demand for domestically produced goods and services, including exports.

37. 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:

$$\text{Embodied imports} = m*(1-A)^{-1}*e, \qquad \text{where:}$$

*m*: is a 1*n vector with components $m_j$ (the ratio of imports to output in industry *j*)

*e*: is a n*1 vector of exports by industry.

38. 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:

$$v*(I-A)^{-1}*e \qquad \text{(II)}$$

39. 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, policy makers 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 tradable goods (agriculture, manufacture) allows one 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

[6] Annex 1 provides more information on OECD Input-Output Tables.

indirectly from services sectors. This break-down 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.

40. An additional level of complexity arises because imports may often themselves embody some domestic value-added (re-imports). This amount may be significant when economies are closely integrated 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).

41. Let Z be a global input-output table with dimensions *(n*c) * (n*c)*, where *c* is the number of countries and *n* is, as before, the number of industries. Further let the table be structured so that rows 1 to *n* reflect the industries of country 1, and rows *n*+1 to 2*n* the industries of country 2 and so on, and $v^k_i$ 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:

$$\sum v^k_i * L_{(kn+i)(kn+j)} \quad \text{(III)}$$

where: $L_{ij}$ is the *ij*th element of the global Leontief inverse $(I-Z)^{-1}$.

42. Similarly,

$$\sum v^k_i * L_{(hn+i)(hn+j)} \quad \text{(IV)}$$

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

$$v^k_i * L_{(hn+i)(hn+j)} \quad \text{(V)}$$

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

43. 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)

44. As such a global input-output table will allow users and policy makers 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 |

45. The ability to generate output such as this is, in itself, beneficial to policy makers 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. Estimating overall trade balances however will necessarily need to be made at a higher (including all international economy linkages) level 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 reported in a recent WTO report according to which the US-China trade balance in 2008 could be about 40% lower if calculated in value-added terms (Maurer and Degain, 2010).

## 3. Trade in Value-Added: Aggregation problems

46. As the previous section shows, although conceptually neat, measuring trade in value-added terms is not so straightforward in practice. When working on bilateral balances in value-added terms, foreign value-added needs to be fully decomposed according to the ultimate source country which is particularly challenging in the context of highly fragmented production networks where "circular" trade takes place: inputs are shipped abroad and then come back as more processed products.[7] A more general complication is that "domestic value-added' can be found indirectly in imports of foreign inputs. When these are exported to other countries, "domestic value-added" can also be indirectly found in other countries' exports.

47. As traditional National Accounts do not provide a measure of domestic and foreign value-added in trade flows, researchers often 'harmonize' Input-Output (I-O) tables from different countries and link them with bilateral trade data in order to estimate the share of domestic value-added both in exported and imported goods and services. This work requires a full set of inter-country I-O tables, where all bilateral exchanges of intermediate goods and services are accounted for as imported inputs can embody domestic value-added.

48. A number of efforts have been undertaken in recent years to estimate the value-added content of trade, including in the OECD, using linked input-output tables.[8] However creating the international links between national input-output tables necessarily requires some assumptions about the nature of international trade flows between industries and users; whether those flows relate to intermediate goods or services or indeed final goods and services.

49. In their current stance, I-O tables have two simplistic assumptions that can hamper trade in value-added computations.

50. Firstly, by their very own nature, I-O tables report industry level aggregates, which display 'average' estimates that, to all extent and purposes, assume homogeneity of production processes of sub-level industries and products. Such aggregation can create biases if the firms which export within a particular group of industries use different production processes or produce different products relative to non-exporting firms (e.g. foreign affiliates in a global production chain). This aggregation bias, as it is termed in the literature, has been confirmed for the US by Bernard *et al.* (2007). Using matched plant-level import and export data for the period 1992 to 2000, they find that U.S. plants that tend to import more also tend to export more. In this case, computing the foreign content of exports using I-O tables coefficients will most likely overestimate the true domestic value-added content.[9]

51. Secondly, when constructing country I-O tables, statisticians often make a proportionality assumption and allocate input import values across sectors by assuming that every sector imports each input (material product or service) in the same proportion as its economy-wide use of that input. For instance, if an industry such as motor vehicles uses steel in its production processes and 10 percent of all steel is imported, it is assumed that 10 percent of the steel used by the motor vehicle industry is imported. The import proportionality assumption is limiting since some industries like aircraft might use only domestically-produced steel while others might rely totally on imports.

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7 Circular trade is particularly important in North America (especially between Mexico and the USA) and in Eastern Asia.

8 There are four different recent initiatives to develop global or international input-output tables: 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.* (2009), Johnson and Noguera (2010) and Koopman *et al*. (2011).

9 In this study, Bernard *et al*. (2007) use the Linked-Longitudinal Firm Trade Transaction Database, which is based on data collected by the U.S. Census Bureau and the U.S. Customs Bureau and captures all U.S. international trade transactions.

52. In the absence of a direct measure many studies have relied on the proportionality assumption embedded in countries' I-O tables to compute the foreign content of domestic exports.[10]

53. To reduce the limitations associated with this assumption, the proportions should be calculated at the most disaggregated level possible. Nevertheless, the level of detail used for this calculation varies widely between countries from over 2 000 different commodities for Germany and Denmark, to slightly over 500 for the United States and Japan, to less than 200 for the United Kingdom. Methodological work calculating the aggregation bias associated with the use of this assumption suggests that the application of this assumption on fewer sectors (536 versus 6800 for example) can result in underestimating by 6 per cent the amount of imports that are classified as being intermediate inputs. For some sectors such as petroleum refining, which rely heavily on imported inputs, the downward bias associated with the assumption can be as much as one-third.

54. Recently, the proportionality assumption which results in a proxy measure on sectoral allocation of imported inputs has been compared to more direct approaches using microdata. Using German input-output data which differentiates between domestically purchased and imported inputs, Winkler and Milberg (2009) find that the proxy measure reflecting the proportionality assumption fails to accurately capture the variation in the intensity of imported inputs used across sectors, highlighting a need to improve the granularity of IO tables for TVA analysis, at least when the proportionality assumption is used to allocate imports.

55. The most well documented case of how the proportionality assumption can lead to bias in the estimation of the domestic value content of exports is China. Policy preferences in China for processing exports lead to significant differences in the intensity of imported intermediate inputs in the production for processing exports relative to domestic final sales and normal exports. Since processing exports have accounted for more than half of total Chinese exports between 1996 and 2006 (Koopman *et al.*, 2008), the use of the aggregate industry coefficients available in the input-output tables largely underestimates the share of foreign inputs embodied in Chinese exports.

56. In the absence of real data, there have been quite a few attempts to develop methods accounting for the pervasive role of export processing in China. Dean *et al.* (2007) propose a method that combines China's processing import statistics with UN's Broad Economic Categories (BEC) classification. The BEC Classification divides international trade flows of goods into 19 different product groups, which are then categorised into their main end use: capital goods, intermediate goods or consumption goods, which are the three basic classes of goods in the System of National Accounts. Eight of these categories are identified as being intermediate goods. This classification has the drawback of being based on expert judgment and not accurately reflecting the end use given to traded goods, as the same good can be simultaneously used in the production of another good and destined for final consumption (for instance, oranges, milk and flour can all be a final consumption good for households as well as used as an intermediate input). Moreover, the BEC classification leaves without categorisation three of these 19 product groups (e.g., cars) and also does not classify trade in services.[11]

57. Koopman *et al.* (2008) take a different route and combine disaggregated trade statistics to determine the relative proportion of processing and normal exports within a sector, and data from I-O tables to determine the sector level of total imports and exports. They then develop a method to separate the input content of domestic sales, normal exports and export processing. However, in the absence of real data on domestic value added shares for processing and normal exports, any kind of method based on I-O tables needs to make some kind of simplifying assumption.

58. Data for China suggests that measurement errors due to oversimplifying assumptions are non-negligible and that firm level data can significantly contribute to improve the understanding of value-added

[10] Work on this field which has used this assumption includes Feenstra and Hanson (1996, 1999), Hummels *et al.* (2001), Amiti and Wei (2005, 2006), Chen *et al*. (2005), Grossman and Rosi-Hansberg (2006) and Isakson and Wajnblom (2011).

[11] The BEC classification is currently being revised. For more information, see UN (2007).

creation within an economy. Table 1 discriminates the final use of intermediate imports between regular exports and processing exports and by type of firm in China.[12] It shows that processing trade is highly related to Chinese inward FDI, with the bulk of processing exports being carried out by FIEs. The type of goods exported ('normal' *versus* processing exports), which is correlated with the ownership of the firm, entails very different shares of value-added generated within a country's borders. Unfortunately, the table does not give any information on the intensity of the use of imported intermediate inputs *versus* domestic inputs across firms of different ownership and by the type of goods exported, as only trade information is available at the firm level.[13]

59. In conclusion, the industry aggregation bias and the proportionality assumption embedded in conventional I-O tables present the following difficulties:

*60. 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 exporting firms use very different production processses (inputs and sources) than those firms producing for domestic markets. 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 which uses mainly domestic inputs, the foreign content of (aggregate) exports is going to be higher than what it is in reality using aggregated IO tables. This problem is exacerbated when one also considers the fact that foreign-owned firms often display these characteristics, as the data for China shows.

*61. Imported input coefficients by partner country are the same.* This is a strong assumption that will largely not hold, especially in sectors characterised by firms involved in global value chains where inputs are primarily sourced from a small group of countries, and this group of countries may differ depending on the ownership of any firm.

12 Foreign-invested firms (FIE) can either be foreign-owned firms or Sino-foreign joint ventures.

13 Koopman *et al.* (2008) provide some estimations of the domestic content of exports by different types of ownership. However, the authors do not possess real data on separate input-output coefficients, and again have to make some simplifying assumptions. Hence, the variation in the share of domestic content stems from different compositions of exports.

**Table 1. Use of Imported Intermediates and Output Breakdown by Firm Type**

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

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

62. Against this background, it is clear that the use of aggregated input-output tables to analyse TVA can benefit considerably through more detailed disaggregations of sectors through the use of microdata. The next section outlines how firm-level information can be incorporated into I-O tables, refine the industry level indicator values, and hence provide an idea of their accuracy by analysing within sector heterogeneity.

## 4. Improving Trade in Value Added Measures Using Trade Micro-data

### *4.1. Objectives and a First Assessment of Research Possibilities*

63. In order to improve the quality of I-O data and mitigate the necessary assumptions used in I-O tables, this paper explores the feasibility of using firm-level data to disaggregate IO industries into sub-categories, according to three key firm level characteristics:

- Export intensity, defined by the distribution of export shares
- Import intensity, defined by the distribution of intermediate imports ratio
- Ownership status (foreign-owned *vs* indigenous firms)

64. This disaggregation will then be used to improve the allocation of total imports across sectors and create stronger links between imports used in exports and imports used in domestic demand.

65. Another objective of this research is to gauge the aggregation bias incurred when calculating 2 digit sector values by investigating the distribution of export and import share within sectors and by comparing the aggregate sector values with key points of the underlying within industry (firm level) distribution. The level of industry level heterogeneity is investigated for the following indicators:

- Export and import shares (to output ratio): overall within sector distribution and firm-size classes and firm ownership status breakdown;
- Intermediates import ratio
- Value-Added to output ratio

66. This analysis allows a more detailed understanding of the firm-level value added content of exports and the characteristics of the firms engaged in international trade.

67. In what regards the specific caveats of I-O tables listed in section 3 of the paper, the scope of aggregation bias can be assessed by looking into the distribution of these indicators and how it differs along firm characteristics. Another route is to further disaggregate these indicators at the four digit industry level. This possibility is currently being explored by the OECD.

68. The assumption of homogeneity of input sourcing between indigenous and foreign-owned enterprises, this is explicitly checked by disaggregating import shares at the sector level along firms' ownership status and comparing different points of the distribution.

69. Investigating differences in the intensity of the use of foreign inputs according to the destination of output (domestic *vs* foreign markets) proved not to be a feasible undertaking given that business surveys typically do not allocate specific inputs and their origin to specific output products. They also do not contain information on the markets of destination by product.

70. The disaggregation of export, import and value-added shares of output is motivated by the finding that (as demonstrated by indicators in the TEC database), the bulk of exports are sales of OECD economies' largest companies, with small companies serving primarily the domestic market (Araújo and Gonnard, 2010). It is conceivable that large firms are able to source their inputs from global markets, searching for the best quality-price input mix for their products, while the scale of operations of smaller firms in the economy would dictate sourcing primarily from domestic suppliers. Likewise, differences in firm size typically lead to value-added differentials, driven by differences in economies of scale, technology, and also in the types of products produced (recalling that aggregation presupposes homogeneity).

71. Before proceeding, it needs to be made clear that the measure of value-added content of exports presented in section 2 is related but not the same as the concept of value-added which results from the economic activities carried out at the enterprise level, as the firm-level measure necessarily only captures

the value-added produced by the firm and not the value-added produced by other firms that is embodied in its output.

### *4.2. Methodology and Concepts*

72. At the firm level, measuring trade in value-added terms means calculating the contribution of a firm's activities to the value of the goods and services it produces (and exports), *i.e.*, netting out from the overall output any intermediate consumption. Value-added is thus defined as the value of the firm's output minus intermediate consumption. Following the National Accounts terminology and definitions, value-added in gross terms at current prices is defined as gross output (at basic prices) *minus* intermediate consumption (at purchasers' prices) which is equal to sales *minus* purchases plus total inventory changes (finished products, work in progress and materials).[14]

73. The value of output used in this study is proxied by firm turnover, adjusted for changes in stocks. It reflects all activity incomes plus subsides, fiscal aids and other incomes but excludes other ordinary and extraordinary revenues and profits such as interest, dividends from affiliates and subsidiaries, etc.

74. Intermediate Consumption comprises all types of expenditures used to produce goods and services. Hence it does not include financial expenditures (such as short and long-term debts, interest, exchange rate and credit commissions), extraordinary expenses, including non-operating part expenses and costs and previous years' expenditures, plus advertisement, marketing, insurance, accounting, juristic acts expenditures, etc. To the obtained value of activity expenditures deductions are needed for the yearly variation of (i) the stock value of raw and auxiliary materials, operating and packing goods and (ii) the stock value of trading goods.

75. Based on this information, the following indicators can be computed at the enterprise level:

- Export/Import share: the value of exports/imports over output;
- Intermediate Import ratio: the value of imports of inputs to be used up in production over intermediate consumption;
- Value-added share: value-added over output.

76. Calculating these indicator requires matching trade register with business surveys data at the level of the enterprise.

77. One caveat in the measurement of imported intermediates is that the firm can buy locally (*i.e.* in the domestic market) inputs that are themselves entirely or at least partially produced abroad. As table 2 shows, the percentage of merchandise imports by countries' wholesalers and retailers is quite high. However, unless more detailed information is provided in business surveys, allowing linking the inputs brought domestically to the firms that use them during the production process, the computation of the share of imported inputs in intermediate consumption needs to be restricted to the information stemming from trade registers.

78. Similarly, in the absence of data on exports at the enterprise group level, it is not possible to link exports by wholesalers to the manufacturing part of the group.[15]

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[14] Ideally, net value-added should be computed, i.e., the value of output less the values of intermediate consumption and consumption of fixed capital. However, the methods used for calculating obsolescence, wear and tear on machinery and other capital assets used up in production are complex and tend to vary across countries, creating doubts about the internationally comparability of the obtained figures. Hence, the value-added embodied in a firm's final output shall be presented in gross terms.

[15] For a revision of the literature on the role of wholesalers in international trade, see Crozet *et al.* (2010).

**Table 2. Merchandise Trade by Large Economic Sectors[16]**

% of total trade (2007 or latest available year)

| % of Total exports | Agriculture | Industry | Trade | Total |
|---|---|---|---|---|
| Canada | 1.0% | 59.2% | 8.7% | 100.0% |
| Israel | 1.0% | 74.6% | 19.7% | 100.0% |
| United States | 0.7% | 65.0% | 22.0% | 100.0% |
| EU average | 0.4% | 71.6% | 17.3% | 100.0% |
| **% of Total imports** | Agriculture | Industry | Trade | Total |
| Canada | 0.3% | 42.8% | 35.6% | 100.0% |
| Israel | 0.3% | 43.8% | 47.0% | 100.0% |
| United States | - | - | - | - |
| EU average | 0.2% | 46.2% | 40.8% | 100.0% |

Source: OECD-Eurostat Trade by Enterprise Characteristics (TEC) Database.

79. Enterprises are classified according to their main activity sector and into the following four size classes, where size is defined by the number of employees: 0-9, 10-49, 50-249 and more than 249 employees.

80. Enterprises' ownership status follows the concept of control: an enterprise is considered to be foreign-owned if total stakes of foreign capital are greater than 50%.

### *4.3. Data*

81. The methodology outlined above was implemented using Turkish trade micro-data, obtained by matching several databases managed by Turkstat, Turkey's National Statistical Office, which collaborated with the OECD Secretariat in this project by facilitating access to the data.

82. The data used in this paper comes from the Annual Industry and Service Statistics database (Structural Business Statistics, SBS), the Turkish trade register and the Annual Industrial Products Statistics database.

83. SBS collects information on firm incomes, input costs, employment and investment activity, at the primary 4 digit NACE (rev 1.1) sector of activity and the region of location. The survey covers the whole population of firms operating in Turkey with more than 20 employees and a representative sample of firms with less than 20 employees and whose activity lies in NACE sections C to K, and from M to N.[17] All the indicators presented were computed using weights equal to the number of firms in each segment.

84. The second database used is the trade register which is sourced from customs declarations and contains information on merchandise trade only. As such, exports do not cover services and imported intermediates comprise goods but not services. Import and export flows are collected at 12-digit GTIP[18] classification: the first 8 digits correspond to Combined Nomenclature (CN) classification, and the last 4 digits are national. Information of the origin/destination countries of trade flows is also available.

16 The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli Settlements in the West Bank under the terms of international law.

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

18 Turkish Customs Tariff and Tariff Classification of Goods.

85. 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.[19] 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.

86. This database 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 (*i.e.*, the products that the firm imports and that also correspond to products produced by the firm) as it is highly likely that these are imported goods are sold without further processing. Merging foreign trade data and production data at the product level was done by establishing a correspondence between the GTIP and PROTR classifications provided by Turkstat.

87. The databases were matched using a single identifier of each enterprise created by Turkstat. In order to present comparable data between firm level and aggregate industry level I-O tables, the paper used Turkish enterprise level data for the year of 2006. In fact, firm level data is much timelier than I-O data, which is typically produced with a 3 to 5 year delay.

88. Results are presented at the two digit level of the NACE classification.[20] Even though micro-data based values at the two digit level are highly aggregated they still collide with confidentiality laws. As a consequence, some results had to be suppressed whenever the underlying data of a particular data cell fell into at least one of the following criteria:

- A cell contains only 1 or 2 firms,
- One firm has a share exceeding 80% of the cell,
- Two firms have a combined share exceeding 90% of the cell.

89. Confidentiality is more likely to be breached when two digit sector values are further decomposed into firm size intervals, ownership status or both.

90. Matching the trade register with the Production Survey revealed that firms export many products which do not have a matching code to the products manufactured by the firm. This is not a surprising result and is in line with similar findings from other countries' micro-databases.[21]

91. Given this, a second measure of exports was calculated which restricts exports to the value of foreign sales of those products with a matching code in the firms' production database.

92. As for imports, the analysis starts by assuming that all import flows are intermediate inputs used up in production. A second measure restricts imported intermediate inputs only to the products which are classified as primarily used as intermediate consumption by the BEC classification (see Annex 3). Similarly to exports, a third measure considers only as imported inputs the purchases of foreign goods which are different from the goods produced by the firm, according to the Production Survey.

93. However, using the Production Survey to improve the quality of the measurement of exports of goods effectively produced by the firm and to identify the imports which are likely to constitute imports restricts the analysis to manufacturing firms with more than 20 employees. Annex 4 provides information on the contribution of these firms to two-digit manufacturing sectors exports, imports, output and value-added.

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

20 Annex 2 presents a description of NACE two digit sectors.

21 See Bernard *et al.* (2011) for a review and possible explanations.

## 5. Analysis of Firm-Level Heterogeneity

94. 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 compared the values of these indicators at specific point of the distribution with averages computed at the sector level.

### *5.1. Export Shares*

95. Table 3 shows the distribution of sector export shares (calculated as total exports over total output) for the Turkish economy in 2006. Sectors with suppressed cells due to confidentiality are not displayed in the table. Column two reports values for export intensity calculated directly at the sector level (i.e. by summation of total export and total output values at the two digit sector and then taking the ratio between the two) while column three presents average sector values of export intensity calculated at the firm level. The next columns display values for the middle and upper part of the distribution, more specifically the $50^{th}$, $75^{th}$, $90^{th}$ and $95^{th}$ percentile.

96. It is clear from the table that there is a high discrepancy between the export share at the sector level reported in column two and the average firm level share displayed in the following 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 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).

97. In the specific case of the Turkish economy, except for 'manufacture of tobacco products' (sector 16), and to a much lesser extent of 'mining of metal ores' (sector 13), the economy is characterised by the fact that almost 75% of the firms in a sector only sell to the domestic market. Not only the export base is small, but also only a few firms within sectors have very high export intensities. Focusing on the manufacturing sector, 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 95 percentile.

98. Export shares computed at the sector level convey a different picture: export intensity calculated at the sector level (is typically higher than the average export intensity calculated at the firm level and higher than the $75^{th}$ percentile value. The only exception is the case of the tobacco industry where 50 percent of the firms exports around or more than 40% of their total output, while the sector average is about half this figure. On the contrary, aggregate export intensity is among the highest for motor vehicles, trailers and semi-trailers and other transport equipment (sectors 34 and 35, respectively), while the firm level ratio shows that at least 95 percent of the firms operating in these sectors export less than 20 percent of their output.

99. Excluding from total exports the exports of those products which do not have a matching code to the products each firm declared producing 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 by matching customs and product data at a higher level of aggregation at the CPA six digit level instead of at the PRODCOM 10 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 size of the reduction of export shares within sectors.

### *5.2. Intermediate Imports Ratio*

100. As discussed above for the purpose of the 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 as well as at the firm level. As a consequence, Table 4 displays intermediate import ratios according to only two criteria: the first six columns after the NACE identification takes all imports

made by firms as imports of intermediate goods used up in the production process while the last six columns identify as intermediates only those products which are so identified by the BEC classification. As with export shares, Table 4 only reports non-confidential cells.

101. Table 4 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, regarding the definition of intermediate imports used. Across sectors, imports tend to be more important in manufacturing sectors (corresponding to NACE codes 15 to 37).

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

### *5.3. Firm Size, Ownership and Value-added*

103. The study further explored within sector heterogeneity by looking at the distribution of export shares, intermediate imports ratio and value-added to output ratio by firm size and ownership status of the firm.

104. 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 5 reports a summary of the results instead.

105. Of the disaggregated analysis, it is worth highlighting:

- 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);
- Foreign wholesalers are much more import intensive than domestic wholesalers, which is consistent to the fact that the former are heavily engaged in intra-firm trade.
- Export share increases with firm size with small firms displaying almost zero export values and large firms displaying very high export shares.
- The intermediate import ratio also increases with firm size and so do import to output shares.
- For the few sectors for which 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.
- Differences in import to output shares are larger than for export shares, which suggest that foreign firms source a higher share of their inputs from abroad, as compared to 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 value-added to output ratio of 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, n.e.c.) and 34 (motor vehicles) domestic and foreign-owned firms exhibit a similar performance.
- Value-added increases with firm size. However, in NACE sectors 17(manufacture of textile) and 18 (manufacture of wearing apparel), where smaller firms (less than 50 employees) have a higher value-added per unit of output than medium and large firms (more than 50 employees).

## 6. Identifying thresholds for disaggregating Turley's Input-Output Tables

106. This section of the paper reports the findings obtained when firm-level information is used to improve the intermediate imports ratios and also attempts to classify sectors according to their import and export intensity by proposing different cut off points along the underlying distributions.

### *6.1. Export Intensive Sectors*

107. Table 6 identifies export intensive sectors according to five criteria:

- The aggregate sector level export share is above the median sector export share: 6.2 percent (column two);[22]
- The aggregate sector level export share is above the 75$^{th}$ percentile of the export share distribution: 15.7 percent (column three);
- The average export share across firms is above its median value distribution across sectors: 0.82 (column four);
- The average export share across firms is above the 75$^{th}$ percentile of the firm level distribution across sectors: 2.2 (column five);
- The 90$^{th}$ percentile of the distribution of export share across firms (and within sector) is greater than zero (column six).

108. The latter criterion seems intuitive given the low firm-level export shares. However, it is more based on the extensive margin of exports rather than on the intensive margin, which is the right concept to define export intensity.

109. The definitions based on the median export share are on the other hand too broad since they include almost the totality of manufacturing even if, as shown in Table 3 some of these sectors display a very low share of exports both at the sector and the firm level. As an example, sector 26 (manufacturing of other non-metallic mineral products) displays a total sector export share of 6.12 percent and an average across firms of 1.17 %, but less than 10% of the firms in the sector export.

110. The two definitions based on the last quartile of the export share do not always hint at the same direction. As an example, sector 18 (wearing apparel) is considered export intensive when the sector aggregate export share is taken but not on the basis of the average firm level sector share distribution, while the converse is true in sector 24 (chemicals).

111. The differences between sector and firm level definitions stem from the highly skewed distribution of exports among firms and also by differences in firm size. For instance, sector 18 (wearing apparel) is one of Turkey's largest manufacturing sectors even but 95% of the firms in the sector display an export share below 0.32%. Still, some thousand of them sell abroad very high shares of their turnover (the maximum export share recorded in the sector is among the highest of manufacturing). The export share of this very small group of firms is enough to raise aggregate export share to more than 16% of the sector output. In contrast, sector 24 (chemicals) is rather small in terms of number of firms and even if a larger share of firms display a non zero value of exports, these only amount to 10% of the sector's output.

112. In what regards the possible mismatch between the definition of export intensive sectors when the transaction values for the products not produced by the firm are taken out of total exports, only sector 18 (wearing apparel) exhibits a high discrepancy among sectors identified as export intensive: the sector level export to output ratio is scaled down by 30% while the firm level average increases more dramatically from 1.35% to 8.91%.

[22] These values are obtained using all information, including the one that has been later made confidential.

### *6.2. Import Intensive Sectors*

113. To be consistent with the definition of export intensive sectors, import intensive sectors are considered those for which import share lies in the upper quartile of import intensity. In order to check for possible differences in the measure of import intensity, this is defined in terms of its weight to output and intermediate consumption. Two measures of imports are considered, as before: all imports are assumed to be imported inputs, and then a restricted definition of imports is taken, according to the BEC classification. As with export intensity, sector aggregate measures are compared with firm level averages.

114. Table 7 shows that the classification of import intensive sectors does not change much according to the different criteria adopted with the sole exception that taking firm level averages instead of sector aggregate measures leads to considering sector 51 (wholesale trade) as import intensive. Import intensive sectors all lay within manufacturing, except sectors 13 (mining of metal ores), 40 (collection, purification and distribution of water) and 51 (wholesale trade). Sectors 13 and 40 are only classified as import intensive when the inputs imports to intermediate consumption ratio is considered as the criterion.

**Table 3. Distribution of Export Shares (percent)**

| NACE Rev 1.1 | Total Sector | Average across firms | 50th perc. | 75th perc. | 90th perc. | 95 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 | 5.5 |
| 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 | 9.2 |
| 22 | 1.82 | 0.21 | 0 | 0 | 0 | 0 |
| 24 | 10.25 | 2.64 | 0 | 0 | 5.29 | 14.77 |
| 25 | 15.6 | 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 | 2.2 | 0 | 0 | 0.76 | 13.58 |
| 31 | 22.43 | 2.52 | 0 | 0 | 0 | 16.13 |
| 33 | 9.63 | 2.52 | 0 | 0 | 2.5 | 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 | 0.1 | 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 | 0.1 | 0 | 0 | 0 | 0 |
| 55 | 1.13 | 0.02 | 0 | 0 | 0 | 0 |
| 60 | 0.2 | 0.02 | 0 | 0 | 0 | 0 |
| 61 | 3.2 | 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 | 0.1 | 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 | 0.1 | 0.28 | 0 | 0 | 0 | 0 |
| 92 | 0.09 | 0.03 | 0 | 0 | 0 | 0 |

Source: Turkstat

**Table 4. Distribution of Intermediate Import Ratios (percent)**

| NACE Rev 1.1 | All Imports | | | | | | Only Intermediate Imports According to the BEC Classification | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Sector | Average across firms | 50th perc. | 75th perc. | 90th perc. | 95 perc. | Total Sector | Average across firms | 50th perc. | 75th perc. | 90th perc. | 95 perc. |
| 10 | 5.68 | 1.37 | 0 | 0 | 0 | 0.77 | 5.23 | 1.07 | 0 | 0 | 0 | 0 |
| 13 | 15.83 | 2.42 | 0 | 0 | 5.29 | 13.42 | 13.71 | 1.54 | 0 | 0 | 2.47 | 7.02 |
| 14 | 5.29 | 0.78 | 0 | 0 | 0 | 0.35 | 3.68 | 0.32 | 0 | 0 | 0 | 0 |
| 15 | 8.85 | 0.26 | 0 | 0 | 0 | 0 | 5.78 | 0.16 | 0 | 0 | 0 | 0 |
| 16 | 38.4 | 15.65 | 0.59 | 20.49 | 65.27 | 70.92 | 32.2 | 13.91 | 0.59 | 13.94 | 61.68 | 65.26 |
| 17 | 22.78 | 1.72 | 0 | 0 | 0 | 6.62 | 19.66 | 1.36 | 0 | 0 | 0 | 3.8 |
| 18 | 11.48 | 0.54 | 0 | 0 | 0 | 0 | 9.63 | 0.47 | 0 | 0 | 0 | 0 |
| 19 | 17.49 | 0.99 | 0 | 0 | 0 | 2.03 | 14.4 | 0.77 | 0 | 0 | 0 | 0.39 |
| 20 | 24.07 | 0.18 | 0 | 0 | 0 | 0 | 21.48 | 0.16 | 0 | 0 | 0 | 0 |
| 21 | 36.07 | 4.31 | 0 | 0 | 11.6 | 34.27 | 30.96 | 3.73 | 0 | 0 | 11.48 | 33.68 |
| 22 | 9.11 | 0.5 | 0 | 0 | 0 | 0 | 5.01 | 0.12 | 0 | 0 | 0 | 0 |
| 24 | 55.09 | 9.88 | 0 | 0.77 | 47.79 | 66.42 | 42.82 | 7.89 | 0 | 0 | 35.19 | 54.9 |
| 25 | 36.21 | 2.09 | 0 | 0 | 0 | 9.7 | 32.72 | 1.69 | 0 | 0 | 0 | 2.97 |
| 26 | 14.41 | 0.92 | 0 | 0 | 0 | 0.11 | 11.51 | 0.65 | 0 | 0 | 0 | 0 |
| 27 | 51.91 | 4.52 | 0 | 0 | 10.66 | 35.09 | 50.59 | 3.97 | 0 | 0 | 6.73 | 29.02 |
| 28 | 16.08 | 0.5 | 0 | 0 | 0 | 0 | 13.57 | 0.36 | 0 | 0 | 0 | 0 |
| 29 | 27.48 | 1.83 | 0 | 0 | 0 | 11.25 | 15.32 | 1.2 | 0 | 0 | 0 | 3.21 |
| 31 | 38.25 | 1.91 | 0 | 0 | 0 | 9.14 | 29.15 | 1.5 | 0 | 0 | 0 | 5.24 |
| 32 | 79.18 | 7.9 | 0 | 3.49 | 31.64 | 49.01 | 37.95 | 5.83 | 0 | 1.92 | 18 | 37.38 |
| 33 | 34.02 | 3.88 | 0 | 0 | 7.59 | 29.77 | 19.61 | 2.3 | 0 | 0 | 2.73 | 12.24 |
| 34 | 58.66 | 5.94 | 0 | 0 | 37.48 | 44.09 | 42.98 | 2.18 | 0 | 0 | 2.17 | 11.25 |
| 35 | 31.15 | 2.16 | 0 | 0 | 0.57 | 15.07 | 19.61 | 1.46 | 0 | 0 | 0.57 | 10.04 |
| 36 | 9.57 | 0.34 | 0 | 0 | 0 | 0 | 6.31 | 0.23 | 0 | 0 | 0 | 0 |
| 40 | 1.95 | 3.29 | 0 | 1.15 | 5.3 | 15.72 | 1.61 | 2.42 | 0 | 0.75 | 4.01 | 8.81 |
| 45 | 1.45 | 0.18 | 0 | 0 | 0 | 0 | 0.81 | 0.14 | 0 | 0 | 0 | 0 |
| 50 | 7.14 | 0.21 | 0 | 0 | 0 | 0 | 1.22 | 0.08 | 0 | 0 | 0 | 0 |
| 51 | 10.72 | 2.91 | 0 | 0 | 0 | 8.9 | 7.4 | 1.89 | 0 | 0 | 0 | 1.24 |
| 52 | 1.8 | 0.25 | 0 | 0 | 0 | 0 | 0.33 | 0.1 | 0 | 0 | 0 | 0 |
| 55 | 1.03 | 0.04 | 0 | 0 | 0 | 0 | 0.22 | 0 | 0 | 0 | 0 | 0 |
| 60 | 1.67 | 0.01 | 0 | 0 | 0 | 0 | 0.52 | 0 | 0 | 0 | 0 | 0 |
| 61 | 2.26 | 0.32 | 0 | 0 | 0 | 0 | 0.67 | 0.14 | 0 | 0 | 0 | 0 |
| 63 | 1.55 | 0.11 | 0 | 0 | 0 | 0 | 0.89 | 0.04 | 0 | 0 | 0 | 0 |
| 64 | 2.32 | 0.21 | 0 | 0 | 0 | 0 | 0.47 | 0.05 | 0 | 0 | 0 | 0 |
| 70 | 0.11 | 0 | 0 | 0 | 0 | 0 | 0.03 | 0 | 0 | 0 | 0 | 0 |
| 71 | 0.17 | 0.14 | 0 | 0 | 0 | 0 | 0.05 | 0.12 | 0 | 0 | 0 | 0 |
| 72 | 5.84 | 1.25 | 0 | 0 | 0 | 0.37 | 1.48 | 0.29 | 0 | 0 | 0 | 0 |
| 74 | 1.07 | 0.1 | 0 | 0 | 0 | 0 | 0.76 | 0.09 | 0 | 0 | 0 | 0 |
| 80 | 1.05 | 0.07 | 0 | 0 | 0 | 0 | 0.17 | 0.01 | 0 | 0 | 0 | 0 |
| 85 | 4.05 | 0.06 | 0 | 0 | 0 | 0 | 0.37 | 0.01 | 0 | 0 | 0 | 0 |
| 90 | 2.15 | 21.31 | 0 | 8.34 | 96.86 | 96.86 | 0.92 | 8.79 | 0 | 4.05 | 40.7 | 40.7 |
| 92 | 1.15 | 0.03 | 0 | 0 | 0 | 0 | 0.6 | 0.01 | 0 | 0 | 0 | 0 |
| 93 | 0.48 | 0.02 | 0 | 0 | 0 | 0 | 0.08 | 0 | 0 | 0 | 0 | 0 |

Source: Turkstat.

**Table 5. Summary of Results**

| | | By: Ownership | | Size | | | |
|---|---|---|---|---|---|---|---|
| **Variable** | **Aggregation** | **Domestic** | **Foreign** | **0-9** | **9 to 49** | **50-249** | **>=250** |
| | At Sector Level | 0.2 | 0.3 | 0.2 | 0.2 | 0.2 | 0.3 |
| **va/output** | Average across firms | 0.3 | 0.4 | 0.3 | 0.3 | 0.4 | 0.5 |
| | At Sector Level | 6.6 | 13.0 | 1.2 | 7.6 | 8.6 | 11.6 |
| **Export Share *(%)*** | Average across firms | 0.3 | 12.1 | 0.2 | 3.0 | 5.8 | 9.0 |
| | At Sector Level | 9.5 | 26.2 | 1.8 | 6.0 | 11.9 | 22.7 |
| ***imp_all/output(%)*** | Average across firms | 0.3 | 19.8 | 0.3 | 2.2 | 5.8 | 10.2 |
| | At Sector Level | 7.3 | 16.3 | 1.5 | 4.3 | 7.7 | 17.3 |
| ***imp_bec/output(%)*** | Average across firms | 0.2 | 12.6 | 0.2 | 1.5 | 4.1 | 7.5 |
| | At Sector Level | 12.1 | 36.8 | 2.2 | 7.5 | 15.6 | 31.7 |
| ***imp_all/intermediates(%)*** | Average across firms | 0.5 | 30.5 | 0.3 | 3.2 | 8.6 | 15.9 |
| | At Sector Level | 9.3 | 22.8 | 1.8 | 5.3 | 10.1 | 24.2 |
| ***imp_bec/intermediates(%)*** | Average across firms | 0.3 | 19.2 | 0.2 | 2.1 | 6.0 | 11.3 |

Source: Turkstat

**Table 6. Classification of Export Intensive Sectors**

Alternative Criteria

| NACE Rev 1.1 | Sector Export Share>=p50 | *Sector Export Share>=p75* | Average Firm Level Export Share>=p50 | Average Firm Level Export Share>=p75 | p90 Firm Level Export Share>0 |
|---|---|---|---|---|---|
| 10 | | | | | |
| 11 | | | | | |
| 13 | X | X | X | X | X |
| 14 | X | X | X | X | X |
| 15 | X | | | | |
| 16 | X | X | X | X | X |
| 17 | X | | X | | |
| 18 | X | X | X | | |
| 19 | X | | X | | |
| 20 | | | | | |
| 21 | X | | X | | X |
| 22 | | | | | |
| 23 | | | | | |
| 24 | X | | X | X | X |
| 25 | X | X | X | | |
| 26 | | | X | | |
| 27 | X | X | X | X | X |
| 28 | X | | | | |
| 29 | X | X | X | X | X |
| 30 | | | | | |
| 31 | X | X | X | X | |
| 32 | | | | | |
| 33 | X | | X | X | X |
| 34 | X | X | X | X | X |
| 35 | X | X | X | X | X |
| 36 | X | | X | | |
| 37 | | | | | |
| 40 | | | X | | X |
| 41 | | | | | |
| 45 | | | | | |
| 50 | | | | | |
| 51 | X | | X | | |
| 52 | | | | | |
| 55 | | | | | |
| 60 | | | | | |
| 61 | | | | | |
| 62 | | | | | |
| 63 | | | | | |
| 64 | | | | | |
| 70 | | | | | |
| 71 | | | | | |

**Table 7. Classification of Import Intensive Sectors**

Alternative Criteria

| | Imports/Output Ratio | | | | Imports/intermediate Consumption Ratio | | | |
|---|---|---|---|---|---|---|---|---|
| | All Imports | | Imports According to the BEC Classification | | All Imports | | Imports According to the BEC Classification | |
| NACE Rev 1.1 | *Sector Export Share>=p75* | Average Firm Level Export Share>=p75 | *Sector Export Share>=p75* | Average Firm Level Export Share>=p75 | *Sector Export Share>=p75* | Average Firm Level Export Share>=p75 | *Sector Export Share>=p75* | Average Firm Level Export Share>=p75 |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 13 | | | | | | X | | |
| 14 | | | | | | | | |
| 15 | | | | | | | | |
| *16* | X | X | X | X | X | X | X | X |
| 17 | | | X | | | | X | |
| 18 | | | | | | | | |
| 19 | | | | | | | | |
| 20 | | | X | | | | X | |
| *21* | X | X | X | X | X | X | X | X |
| 22 | | | | | | | | |
| 23 | | | | | | | | |
| *24* | X | X | X | X | X | X | X | X |
| 25 | X | X | X | X | X | | X | X |
| 26 | | | | | | | | |
| 27 | X | X | X | X | X | X | X | X |
| 28 | | | | | | | | |
| 29 | X | | | | X | | | |
| 30 | | | | | | | | |
| 31 | X | | X | X | X | | X | |
| 32 | | | | | X | X | X | X |
| 33 | X | X | X | X | X | X | | X |
| *34* | X | X | X | X | X | X | X | X |
| 35 | X | X | | | X | | X | |
| 36 | | | | | | | | |
| 37 | | | | | | | | |
| 40 | | | | | | X | | X |
| 41 | | | | | | | | |
| 45 | | | | | | | | |
| 50 | | | | | | | | |
| 51 | | X | | X | | X | | X |
| 52 | | | | | | | | |
| 55 | | | | | | | | |
| 60 | | | | | | | | |
| 61 | | | | | | | | |
| 62 | | | | | | | | |
| 63 | | | | | | | | |
| 64 | | | | | | | | |
| 70 | | | | | | | | |
| 71 | | | | | | | | |
| 72 | | | | | | | | |
| 73 | | | | | | | | |
| 74 | | | | | | | | |
| 80 | | | | | | | | |
| 85 | | | | | | | | |
| 90 | | X | | X | | X | | X |
| 92 | | | | | | | | |
| 93 | | | | | | | | |

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## ANNEX 1: INPUT-OUTPUT TABLES

OECD's Science Technology and Industry Directorate has been updating and maintaining harmonised I-O tables, splitting intermediate flows into tables of domestic origin and imports, since the mid-1990s - usually following the rhythm of national releases of benchmark I-O tables. The process of compiling OECD's I-O 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 I-O analysis has benefited from renewed attention in recent years is the improved availability and quality of I-O tables and related statistics from national sources.

The first edition of the OECD I-O Database dates back to 1995 and covered 10 OECD countries with I-O tables spanning the period from early 1970 to early 1990. The first updated edition of this database, released in 2002, increased the country coverage to 18 OECD countries, 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[23] (33 OECD and 13 non-OECD countries) with tables for the mid-2000s (mainly 2005) now available for most of them (Table A2).

***Table A1. Country coverage of OECD Input-Output 2009 edition (As of May 2011)***

| OECD | mid-90s | early-00s | mid-00s | OECD | mid-90s | early-00s | mid-00s | Non-OECD | mid-90s | early-00s | mid-00s |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | 1994/95 | 1998/99 | 2004/05 | Japan | 1995 | 2000 | 2005 | Argentina | 1997 | - | - |
| Austria | 1995 | 2000 | 2005 | Korea | 1995 | 2000 | 2005 | Brazil | 1995 | 2000 | 2005 |
| Belgium | 1995 | 2000 | 2005 | Luxembourg | 1995 | 2000 | 2005 | China | 1995 | 2000 | 2005 |
| Canada | 1995 | 2000 | 2005 | Mexico | - | - | 2003 | Chinese Taipei | 1996 | 2001 | 2006 |
| Chile | 1996 | - | 2003 | Netherlands | 1995 | 2000 | 2005 | India | 1993/94 | 1998/99 | 2006/07 |
| Czech Republic | 1995 | 2000 | 2005 | New Zealand | 1995/96 | 2002/03 | - | Indonesia | 1995 | 2000 | 2005 |
| Denmark | 1995 | 2000 | 2005 | Norway | 1995 | 2000 | 2005 | Romania | - | 2000 | 2005 |
| Estonia | 1997 | 2000 | 2005 | Poland | 1995 | 2000 | 2005 | Russia | 1995 | 2000 | - |
| Finland | 1995 | 2000 | 2005 | Portugal | 1995 | 2000 | 2005 | South Africa | 1993 | 2000 | 2002 |
| France | 1995 | 2000 | 2005 | Slovak Republic | 1995 | 2000 | 2005 | Thailand | - | - | 2005 |
| Germany | 1995 | 2000 | 2005 | Slovenia | - | 2000 | 2005 | Viet Nam | - | 2000 | - |
| Greece | 1995 | 2000 | 2005 | Spain | 1995 | 2000 | 2005 | | | | |
| Hungary | 1998 | 2000 | 2005 | Sweden | 1995 | 2000 | 2005 | | | | |
| Iceland | - | - | - | Switzerland | - | 2001 | - | | | | |
| Ireland | 1998 | 2000 | 2005 | Turkey | 1996 | 1998 | 2002 | *not published - internal use only* | | | |
| Israel | 1995 | - | 2004 | United Kingdom | 1995 | 2000 | 2005 | *Malaysia* | | *2000* | |
| Italy | 1995 | 2000 | 2005 | United States | 1995 | 2000 | 2005 | *Singapore* | *1995* | *2000* | *2005* |

Available year, -: not available

The input-output tables show transactions between domestic industries but as a complement to these tables are supplementary tables which break down total imports by user (industry and category of final demand). Some countries provide these import tables in conjunction with their input-output tables but in some cases they are derived by the OECD Secretariat in producing input-output tables directly from

[23] For more details, see also www.oecd.org/sti/inputoutput.

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 input-output 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 I-O database is based on ISIC Rev.3 (Table A3), meaning that it is compatible with the other OECD industry-based analytical data sets such as the Structural Analysis database (STAN), based on SNA by activity, and bilateral trade in goods by industry (derived from merchandise trade statistics via standard Harmonised System to ISIC conversion keys. The system by necessity (*i.e.* to maximise cross country comparability) is relatively aggregated.

**Table A2. OECD Input-Output Industry Classification**

| ISIC Rev.3 code | | Description |
|---|---|---|
| 1+2+5 | 1 | Agriculture, hunting, forestry and fishing |
| 10+11+12 | 2 | Mining and quarrying (energy) |
| 13+14 | 3 | Mining and quarrying (non-energy) |
| 15+16 | 4 | Food products, beverages and tobacco |
| 17+18+19 | 5 | Textiles, textile products, leather and footwear |
| 20 | 6 | Wood and products of wood and cork |
| 21+22 | 7 | Pulp, paper, paper products, printing and publishing |
| 23 | 8 | Coke, refined petroleum products and nuclear fuel |
| 24ex2423 | 9 | Chemicals exluding pharmaceuticals |
| 2423 | 10 | Pharmaceuticals |
| 25 | 11 | Rubber and plastics products |
| 26 | 12 | Other non-metallic mineral products |
| 271+2731 | 13 | Iron & steel |
| 272+2732 | 14 | Non-ferrous metals |
| 28 | 15 | Fabricated metal products, except machinery and equipment |
| 29 | 16 | Machinery and equipment, nec |
| 30 | 17 | Office, accounting and computing machinery |
| 31 | 18 | Electrical machinery and apparatus, nec |
| 32 | 19 | Radio, television and communication equipment |
| 33 | 20 | Medical, precision and optical instruments |
| 34 | 21 | Motor vehicles, trailers and semi-trailers |
| 351 | 22 | Building & repairing of ships and boats |
| 353 | 23 | Aircraft and spacecraft |
| 352+359 | 24 | Railroad equipment and transport equipment n.e.c. |
| 36+37 | 25 | Manufacturing nec; recycling (include Furniture) |
| 401 | 26 | Production, collection and distribution of electricity |
| 402 | 27 | Manufacture of gas; distribution of gaseous fuels through mains |
| 403 | 28 | Steam and hot water supply |
| 41 | 29 | Collection, purification and distribution of water |
| 45 | 30 | Construction |
| 50+51+52 | 31 | Wholesale and retail trade; repairs |
| 55 | 32 | Hotels and restaurants |
| 60 | 33 | Land transport; transport via pipelines |
| 61 | 34 | Water transport |
| 62 | 35 | Air transport |
| 63 | 36 | Supporting & auxiliary transport activities; activities of travel agencies |
| 64 | 37 | Post and telecommunications |
| 65+66+67 | 38 | Finance and insurance |
| 70 | 39 | Real estate activities |
| 71 | 40 | Renting of machinery and equipment |
| 72 | 41 | Computer and related activities |
| 73 | 42 | Research and development |
| 74 | 43 | Other Business Activities |
| 75 | 44 | Public administration and defence; compulsory social security |
| 80 | 45 | Education |
| 85 | 46 | Health and social work |
| 90-93 | 47 | Other community, social and personal services |
| 95+99 | 48 | Private households and extra-territorial organisations |

## ANNEX 2: NACE CLASSIFICATION – REV. 1.1

| NACE | Description |
|---|---|
| A | Agriculture, hunting and forestry |
| 01 | Agriculture, hunting and related service activities |
| 02 | Forestry, logging and related service activites |
| B | Fishing |
| 05 | Fishing, fish farming and related service activities |
| C | Mining and quarrying |
| 10 | Mining of coal and lignite; extraction of peat |
| 11 | Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying |
| 12 | Mining of uranium and thorium ores |
| 13 | Mining of metal ores |
| 14 | Other mining and quarrying |
| D | Manufacturing |
| 15 | Manufacture of food products and beverages |
| 16 | Manufacture of tobacco products |
| 17 | Manufacture of textiles |
| 18 | Manufacture of wearing apparel; dressing and dyeing of fur |
| 19 | Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear |
| 20 | Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials |
| 21 | Manufacture of pulp, paper and paper products |
| 22 | Publishing, printing and reproduction of recorded media |
| 23 | Manufacture of coke, refined petroleum products and nuclear fuel |
| 24 | Manufacture of chemicals and chemical products |
| 25 | Manufacture of rubber and plastic products |
| 26 | Manufacture of other non-metallic mineral products |
| 27 | Manufacture of basic metals |
| 28 | Manufacture of fabricated metal products, except machinery and equipment |
| 29 | Manufacture of machinery and equipment n.e.c. |
| 30 | Manufacture of office machinery and computers |
| 31 | Manufacture of electrical machinery and apparatus n.e.c. |
| 32 | Manufacture of radio, television and communication equipment and apparatus |
| 33 | Manufacture of medical, precision and optical instruments, watches and clocks |
| 34 | Manufacture of motor vehicles, trailers and semi-trailers |
| 35 | Manufacture of other transport equipment |
| 36 | Manufacture of furniture; manufacturing n.e.c. |
| 37 | Recycling |
| E | Electricity, gas and water supply |
| 40 | Electricity, gas, steam and hot water supply |
| 41 | Collection, purification and distribution of water |

| NACE | Description |
|---|---|
| F | Construction |
| 45 | Construction |
| G | Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods |
| 50 | Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel |
| 51 | Wholesale trade and commission trade, except of motor vehicles and motorcycles |
| 52 | Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods |
| H | Hotels and restaurants |
| 55 | Hotels and restaurants |
| I | Transport, storage and communication |
| 60 | Land transport; transport via pipelines |
| 61 | Water transport |
| 62 | Air transport |
| 63 | Supporting and auxiliary transport activities; activities of travel agencies |
| 64 | Post and telecommunications |
| J | Financial intermediation |
| 65 | Financial intermediation, except insurance and pension funding |
| 66 | Insurance and pension funding, except compulsory social security |
| 67 | Activities auxiliary to financial intermediation |
| K | Real estate, renting and business activities |
| 70 | Real estate activities |
| 71 | Renting of machinery and equipment without operator and of personal and household goods |
| 72 | Computer and related activities |
| 73 | Research and development |
| 74 | Other business activities |
| L | Public administration and defence; compulsory social security |
| 75 | Public administration and defence; compulsory social security |
| M | Education |
| 80 | Education |
| N | Health and social work |
| 85 | Health and social work |
| O | Other community, social and personal service activities |
| 90 | Sewage and refuse disposal, sanitation and similar activities |
| 91 | Activities of membership organizations n.e.c. |
| 92 | Recreational, cultural and sporting activities |
| 93 | Other service activities |
| P | Activities of households |
| 95 | Activities of households as employers of domestic staff |
| 96 | Undifferentiated goods producing activities of private households for own use |
| 97 | Undifferentiated services producing activities of private households for own use |
| Q | Extra-territorial organizations and bodies |
| 99 | Extra-territorial organizations and bodies |

## ANNEX 3: THE BEC CLASSIFICATION

The United Nations Broad Economic Categories (BEC) classification groups commodities according to their main end use into capital goods, intermediate goods and consumption goods, which are the three basic classes of goods in the System of National Accounts (SNA). Commodities are defined in terms of the Standard International Trade Classification, Revision 3 (SITC Rev.3). Hence, BEC assigns SITC Rev.3 commodities to 19 basic categories of goods, eight of which are categories of intermediate goods. Table A1 below shows the correspondence between the BEC Classification and SNA basic classes of goods.

**Table A3. Current Broad Economic Categories Classification of Goods According to Main Use**

| Classification by Broad Economic Categories | SNA: Use class |
|---|---|
| 1 Food and beverages | |
| **11 Primary** | |
| **111** *Mainly* **for industry** | Intermediate |
| **112** *Mainly* **for household consumption** | Final Consumption |
| **12 Processed** | |
| **121** *Mainly* **for industry** | Intermediate |
| **122** *Mainly* **for household consumption** | Final Consumption |
| 2 Industrial supplies not elsewhere specified | |
| **21 Primary** | Intermediate |
| **22 Processed** | Intermediate |
| 3 Fuels and lubricants | |
| **31 Primary** | Intermediate |
| **32 Processed** | |
| **321 Motor spirit** | ***Intermediate/Final Consumption*** |
| **322 Other** | Intermediate |
| 4 Capital goods (except transport equipment), and parts and accessories thereof | |
| **41 Capital goods (except transport equipment)** | Capital |
| **42 Parts and accessories** | Intermediate |
| 5 Transport equipment and parts and accessories thereof | |
| **51 Passenger motor cars** | ***Capital/Final Consumption*** |
| **52 Other** | |
| **521 Industrial** | Capital |
| **522 Non-industrial** | Consumption |
| **53 Parts and accessories** | Intermediate |
| 6 Consumer goods not elsewhere specified | |
| **61 Durable** | Consumption |
| **62 Semi-durable** | Consumption |
| **63 Non-durable** | Consumption |
| 7 Goods not elsewhere specified | ***Not classified*** |

Source: UNSD, ESA/STAT/AC.124/8, New York, April 2007.

## ANNEX 4: SHARE OF FIRMS WITH MORE THAN 20 EMPLOYEES IN THE MANUFACTURING SECTOR

| NACE Rev. 1.1 | EXPORT | OUTPUT | IMPORT | IMPORT BEC | VA |
|---|---|---|---|---|---|
| 15 | 82.0 | 72.5 | 86.8 | 85.0 | 79.5 |
| 16 | 99.6 | 99.3 | 100.0 | 100.0 | 99.5 |
| 17 | 86.1 | 73.1 | 91.2 | 91.7 | 77.7 |
| 18 | 75.9 | 65.0 | 85.8 | 86.2 | 64.9 |
| 19 | 51.4 | 41.5 | 64.6 | 63.3 | 46.8 |
| 20 | 76.0 | 58.2 | 87.7 | 87.3 | 61.6 |
| 21 | 75.6 | 70.2 | 89.7 | 89.2 | 75.8 |
| 22 | 60.7 | 48.5 | 73.0 | 75.4 | 58.1 |
| 23 | 99.7 | 98.0 | 99.5 | 99.5 | 96.4 |
| 24 | 85.1 | 79.1 | 82.6 | 79.6 | 83.7 |
| 25 | 86.2 | 64.7 | 89.7 | 90.7 | 69.5 |
| 26 | 87.4 | 82.1 | 92.4 | 92.6 | 87.4 |
| 27 | 96.0 | 88.5 | 96.4 | 96.5 | 89.8 |
| 28 | 81.9 | 52.8 | 82.5 | 84.2 | 59.1 |
| 29 | 86.1 | 74.5 | 92.0 | 91.0 | 74.4 |
| 30 | 30.3 | 62.2 | 96.1 | 90.5 | 81.0 |
| 31 | 91.8 | 79.2 | 95.9 | 96.2 | 82.4 |
| 32 | 98.0 | 96.5 | 99.4 | 99.1 | 94.9 |
| 33 | 60.6 | 45.5 | 66.8 | 74.5 | 48.7 |
| 34 | 98.6 | 93.4 | 99.0 | 98.9 | 91.9 |
| 35 | 74.7 | 70.9 | 85.9 | 86.6 | 73.2 |
| 36 | 58.7 | 61.8 | 80.6 | 83.8 | 61.8 |
| 37 | 96.9 | 90.9 | 23.3 | 23.2 | 60.3 |