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The Similarities and Differences among Three Major Inter-Country Input-Output Databases and their Implications for Trade in Value-Added Estimates

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Abstract

This paper compares three inter-country input-output (ICIO) databases with official statistics as well as their respective results for trade in value added (TiVA) indicators. The three ICIO databases under review have been constructed by the Global Trade Analysis Project (GTAP), the Organization for Economic Cooperation and Development (OECD), and the World Input Output Database (WIOD) project. First, the three ICIO tables are harmonized into the same country and sector classification, and their consistencies with each country's GDP (based on expenditure accounts) and balance of payments figures are checked. Then, the differences between the three databases in major economic variables, including gross output, value-added, domestic and imported intermediate inputs, as well as final demand are presented. Next, major TiVA indicators based upon the three ICIO tables are estimated, and each country's gross exports are decomposed into various value-added and double counted components, using the method proposed by Koopman, Wang and Wei (2014). The similarities and differences of the estimates among the three databases are discussed. The paper concludes with suggestions on the directions of how the construction of ICIO databases could be improved.

Note: the ICIO data used for this paper include the latest revisions made by GTAP, the OECD and the WIOD team at the completion of the paper. All trade data used in the study include both goods and services.

I. Introduction

There has been a growing recognition in the official statistics community that the increasing global production fragmentation requires a new approach of measuring trade, particularly in terms of trade in value-added.[1] Noting that "measuring trade in value-added is very important to understand the supply side, and also the demand side, of international trade and identify the respective sources of competitiveness",[2] the OECD and WTO launched a joint Trade in Value-Added (TiVA) initiative and database in January 2013,[3] which is designed to mainstream the production of trade in value-added statistics and make it a permanent part of the statistical landscape.

An accurate assessment of trade in value-added has to go beyond a single country's effort, as it requires information on cross-border input-output relationships. There is a consensus among international statistical agencies that direct measurement of trade in value-added is extremely difficult, primarily because the information is not available in business record-keeping systems. For example, as pointed by Yuskavage (2013), U.S. business firms do not maintain information in their accounting systems that would allow them to readily identify whether their material inputs are from domestic or foreign sources. Firms typically obtain their material inputs from wholesale suppliers and distributors, and are less concerned about the country of origin for these materials. Without such information, the most feasible and promising approach to develop comprehensive and consistent measure for trade in value-added that goes beyond case studies of individual products (such as the iPhone[4]) has to involve the use of inter-country input-output (ICIO) tables that link production processes within and across countries.

Therefore, a global input-output table[5] is the underpinning of measuring trade in value-added. However, due to the tremendous amount of data required and the differences in statistical classifications across countries, constructing such database is a non-trivial task. Most existing global I-O databases are a simple collection of individual country I-O tables, such as various versions of OECD Structural Analysis (STAN) Input-Output (I-O) database.[6] One available international I-O table, the Asian international I-O table (AIO), compiled by the Institute of Development Economies (IDE) in Japan, covers a selected set of nine Asian economies plus the United States, and treats the rest of the world (including the European Union, EU) as exogenous blocks. In addition, its publication suffers a significant time delay, the most recent table currently available being 2005.

Nonetheless, with a growing recognition of the need to have a comprehensive and timely global I-O table in order to measure trade in value-added properly and timely, three ICIO databases have been developed.[7] Currently, they are the most widely known and used, and two of them (GTAP and WIOD) are already publicly available to users.

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[1] "International Trade Information Systems in 2020" Global Forum on Trade Statistics, Geneva, 2-4 February 2011, Background note by UNSD, Eurostat and WTO.

[2] "Trade in Value-Added: Concept, Methodologies and Challenges", joint OECD-WTO Note, 2012.

[3] "Measuring trade in value-added": accessible through http://www.oecd.org/industry/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm and http://www.wto.org/miwi.

[4] See Xing, Detert (2010).

[5] So-called "global" or "inter-country" input-output tables include a set of individual countries, for which national supply-use or input-output tables are available, plus a "rest of the world" aggregate that estimates input-output flows for all other countries. An "international" input-output table may only cover a certain number of countries, without an endogenous estimate for the "rest of the world", thus not representing the whole world economy. The three ICIO tables under review in this paper are global ones.

[6] It provides a bulk of the required data and is regularly compiled for about 60 countries across the globe, but integrating them with bilateral trade statistics to get the OECD ICIO tables still remains a challenge.

[7] Lenzen *et al*. (2012) documented another effort to build a global Multi Regional Input-Output (MRIO) database (Eora). It proposes a method to estimate the standard error for each cell in the global I-O table to assess their reliability and uncertainty using constraint violation and discrepancy indicators between balanced I-O tables and unbalanced initial estimates. The EORA database is available at http://worldmrio.com/.
UNCTAD has recently used the Eora database to produce its own set of "trade in Value Added indicators" that covers all developing countries. It provides an alternative to the OECD-WTO TiVA indicators.

- *The World Input-Output Database (WIOD)* is developed by a consortium of eleven European research institutions, and funded by the European Commission. The WIOD contains time series of inter-country input-output tables from 1995 to 2011. It uses supply-use tables (SUT) from individual country's national accounts as the starting point to integrate with bilateral trade statistics and derive the final symmetric world I-O table (WIOT), covering 27 EU members and 13 other major economies (Timmer *et al.*, 2012). Intuitively, this approach makes sense as it links trade statistics (which are product-based) with product statistics in the supply-use table on one hand, and value-added/employment data, which are industry-based, with industry statistics in the supply-use tables on the other hand. It also avoids errors inherent in the assumptions imposed when transferring SUTs to symmetric I-O tables before the reconciliation process even starts. It has become publicly accessible since April 2012.[8] The WIOD data used in this study rely on the November 2013 release of WIOT.

- *Global Trade Analysis Project database (GTAP)* is developed and maintained by the Center of Global Trade Analysis at Purdue University. With 57 sectors, 114 individual countries and 20 composite regions in its most recent version (version 8), GTAP has a broader country and sector coverage than both the Asian I-O table and the WIOD table. GTAP is benchmarked on the reconciled official trade statistics that are based on data reliability (see Gehlhar, 1996). For example, re-exports through Hong Kong are systematically adjusted to their origin and destination countries. However, since GTAP is only benchmarked to adjusted trade statistics, sector level supply and demand data for individual countries may suffer large discrepancies with corresponding national accounts statistics.[9] And because there is no consistency imposed for different versions of the database, it is difficult to use the data to make historical comparisons. In addition, since the international I-O table underlying the GTAP database is based on the so called Multi-Region Input-Output (MRIO) table in the literature, no distinction is made between intermediate and final goods and services trade flows in the data. Therefore, transformation has to be made in order to construct the ICIO tables from GTAP data (Tsigas, Wang and Gelhar, 2012). GTAP data used in this study based on version 8 of the GTAP database.

- *The OECD ICIO database*, represents a similar effort as for WIOD. Building on the OECD harmonized individual country input-output tables, it currently covers 57 countries and 37 industries and serves as the major data source for the first OECD-WTO public database on "Trade in value-added" (TiVA). The database provides TiVA indicators for years 1995, 2000, 2005, 2008 and 2009 for 57 individual countries and a "Rest of the world" aggregate, with a selection of 18 industrial aggregates. The OECD has engaged a set of activities with the view to develop the coverage and quality of ICIO tables as well as to produce annual tables in the near future. The OECD ICIO tables used in the study are based on the April 2013 update.

Because trade in value-added is not readily observable, it is difficult to assess the accuracy of measures estimated from different ICIO tables with different country/sectorial coverage and construction methodologies. No attempt has been made so far to compare these three global ICIO databases with official macro-economic statistics and also among themselves to evaluate their accuracy.[10] This paper tries to fill in this void by comparing the three databases. First, we check how closely the three databases benchmark to the official national accounts and balance-of-payments (BOP) trade statistics, such as each country's GDP, total final domestic demand and total trade in

[8] See WIOD (2012). Despite many advantages, such as improved allocation of imports by end use category, the close link with EU KLEMS and World KLEMS and better and detailed capital types and labour skill levels breakdown, there are some shortcomings in the WIOD data set that need further improvement, such as exports to the rest of the world which are derived as a residual and might potentially become negative for some products. Also, no reconciliation procedure based on data reliability and constrained optimization has been used. In addition, while the coverage of the 27 EU member countries is detailed, less than 10 developing countries are included. Processing trade is also not considered.

[9] For instance, the imports' use by sector in the reference year does not correspond to the benchmark year of import matrix information published by the National Statistical Institutes.

[10] However, some studies have been carried out to compare individual ICIO tables with official statistics. This is the case for Aguiar A. (2013) that compares GTAP GDP data with those from World Bank and UN sources.

goods and services. Then, we measure the differences among the three databases in basic economic variables, such as gross output, value-added, and domestic/imported intermediates and final goods and services. Finally, we compare various trade in value-added indicators estimated from the three databases and highlight the main differences among these estimates which might lead to inconsistent analysis of trade in value added, depending on the data source used. Note that the decomposition of gross exports into their value added components is based on the method proposed by Koopman, Wang and Wei (2014). The paper ends with some suggested directions to improve the accuracy of these global ICIO databases.

II. Discrepancies between the Three ICIO Databases and Official Statistics

The comparison of different ICIO tables is a challenge as it requires harmonizing these tables under review. The three databases under review are based on different country coverage and sector classifications. To enable the comparison, we first mapped the sectors in the three databases to the International Standard Industrial Classification (ISIC) Rev. 3 codes and aggregated them into 25 industries that have the common ISIC codes. Then, we aligned OECD and GTAP data to the 41 countries available in the WIOD database. As shown in Table 1 below, this resulted in a set of 10 harmonized ICIO tables from the 3 databases which are used as the data sources in this comparison exercise.

Table 1. The 10 harmonized ICIO tables, by year and data source

Year	GTAP	OECD	WIOD
2004	√		√
2005		√	√
2007	√		√
2008		√	√
2009		√	√

2.1 Differences with UN National Accounts Statistics

Figures 1 to 5 graph the differences between the official UN national accounts(UNNA) statistics, considered as the benchmark[11], and WIOD, OECD and GTAP figures in GDP, domestic final demand, total exports and imports of goods and services for the five years with comparable data.

In principle, to derive GDP at market prices from the WIOD table (WIOT) by adding up industry value-added, the net taxes on products should be included but the international trade margins should be excluded. However, none of the three databases under review here treat international transportation as an endogenous industry. Hence, to maintain the balance of ICIO table rows and columns and obtain consistent trade in value-assed estimates from the three global databases, the international trade margin has been treated in this paper as a part of the destination country's domestic value-added.

Figures 1(a) to 5(a) show that, except for the "rest of the world" aggregate, GDPs computed from OECD are consistent with what is reported by UNNA while, conversely, GDPs computed from GTAP are consistently lower than what is reported by UNNA, by 5% to 10% for most countries, with the exception of Slovakia that presents a positive difference in 2007. GDPs based on the WIOD source fluctuate around the UNNA benchmark values by small margins (the differences are around or

[11] The UNNA database has been updated in Dec.2013.For the WIOD is arranged according to the 2012ed UNNA database, this paper uses the last version UNNA as the benchmark, even though there are differences in the two versions on the specific countries.

less than +/-1% for 70% of the covered economies). It is possible to outline some countries for which WIOD figures regularly deviate either negatively (under the 100% line in the graphs) or positively (above the 100% line) from the UNNA benchmark. The recurrence of these deviations calls for further examination to highlight the reasons behind (see point 5.3 in the Conclusion). For example, WIOD GDP figures for Bulgaria, Czech Republic, Lithuania, Russia, and Cyprus tend to be lower, whereas WIOD GDP figures for Germany, the United Kingdom, and the United States tend to be higher than the UNNA references across the five years observed.

There are several potential reasons for such discrepancies.

First, as previously mentioned, GTAP database is benchmarked to adjusted trade statistics instead of national accounts statistics, so discrepancies for GDPs may be expected.

Second, there are different vintages of official national accounts statistics since National Statistical Institutes (NSI) constantly make revisions based on newly available data and improved estimation methods. There are differences between the UN national accounts data available today, which we used in this comparison exercise, with the national accounts data that were used by WIOD or GTAP project teams when they constructed their databases. The latest constructed OECD ICIO tables seem to match the recent UNNA GDP data better.

Finally, both WIOD and GTAP databases chose not to apply constraint optimization techniques in the final stage of their data reconciliation process, which may also raise the likelihood for GDPs computed from these databases to deviate from the UNNA reference.

It is important to mention that in order to correctly compute GDP from ICIO tables, special attention needs to be paid to "residents purchase abroad" and "non-residents purchase at domestic market" recorded in the cross section of the value-added and the final demand blocks, as such terms usually do not appear in an industry-by-industry symmetric I-O table. Both OECD and GTAP ICIO tables don’t include these terms, but WIOD WIOTs do. The treatment of "residents purchase abroad" and "non-residents purchase at domestic market" requires adjustment for each country’s domestic and foreign final demand and thus for GDP and total trade. Without taking into account these economic activities, a country’s GDP could be under- or over-estimated. Because there is no statistical information regarding to the sector and country distribution for such activities, the WIOD team chose not to allocate them into final demand by countries and sectors. However, by leaving them in an ICIO table, the issue of internal inconsistency may arise. For example, multiplying the Leontief inverse matrix and final demand without an adjustment may not give the correct estimates of each country’s gross output and total value-added. Therefore, efforts have to be made to properly integrate such economic activities into ICIO tables, similar to what Dixon and Rimmer (2002) did to the U.S. I-O statistics for the USAGE model.

The discrepancies observed for final demand between UNNA and the three ICIO tables follow the same patterns as the ones noticed for GDP. Apart for few economies, WIOD final demand values match closely to UNNA ones, with smaller differences than that for GDP. As for the GDP, the OECD final demand values and UN figures are highly consistent. GTAP final demand values are usually lower than UN ones. However, some significant discrepancies between the two sources, with more than 15% difference in absolute terms, appear for few countries. While GTAP values for Australia and Ireland final demand are lower than UNNA's by around 19% in 2007, Slovakia presents a high and positive difference with UNNA value of 15% in 2004. Conversely, big GTAP-UNNA differences are also noticeable for Ireland and Malta for 2004, GTAP figures being lower respectively by 19% and 23%.

In general, the differences between the UNNA and ICIO tables for trade values are much higher, and fluctuate much more than the differences for GDP or final demand.

Figure 1(d) to 5(d) reveal that total imports computed from the WIOD WIOTs are constantly lower than the official statistics recorded by UNNA. A similar remark can be made for total exports, for which more than half of the sample countries have WIOD values lower than their UNNA counterparts. The Czech Republic is the only country for which WIOD exports and imports are higher than UNNA data for the five years.

Based on the communication with the WIOD team, two main reasons may explain such differences.

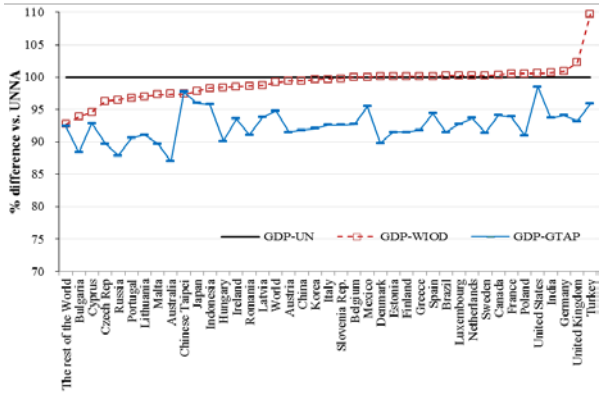
First, re-exports have been subtracted from each country's trade statistics in WIOD tables, while trade statistics recorded in the national accounts usually include re-exports. For some countries like the Netherlands and Belgium, re-exports may constitute a significant portion of their total trade. For example, the Netherlands' exports from WIOD are systematically lower than the UNNA figures, and the difference fluctuates around -20% across the years under review. Re-exports data are available for download from the international Use tables which are also part of the WIOD database. Adding the re-exports from the international Use tables enables to get total export and import figures consistent with national accounts.

Second, in principle, there should not be net taxes on exports but only on domestic use. However, to apply the RAS procedure used by the WIOD team to update the national SUTs to converge, net taxes on exports were also calculated for some countries, such as Bulgaria, Cyprus, Greece, Hungary, Lithuania, Latvia, Malta, Romania, and Russia. For some countries, such as Cyprus and Russia, these net taxes can be sizable for over 10% of their total exports.

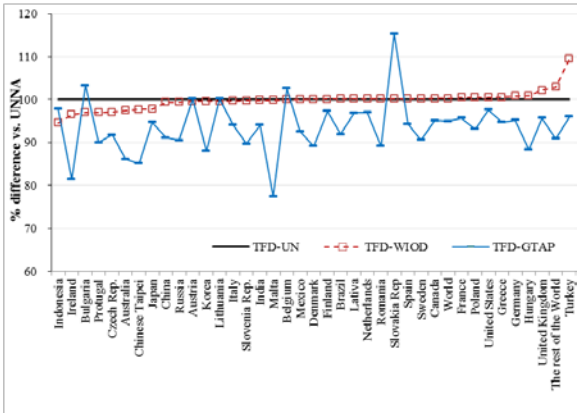
Overall, the OECD trade data either match or are significantly lower than the UNNA. Interestingly, the comparison of the two sources for total exports and imports reveals two marked patterns. Indeed, for a majority of non-EU economies, OECD ICIO trade figures present a negligible or small negative difference vis-à-vis UNNA benchmark data. Conversely, the biggest differences between the two sources can be largely attributed to EU member countries. GTAP trade data fluctuate significantly (positively and negatively) around the UNNA benchmark line in the graphs.

Figure 1. Differences between WIOD/GTAP databases and UNNA, 2004

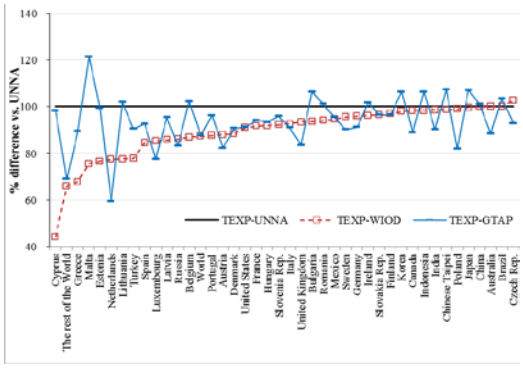
(a) GDP



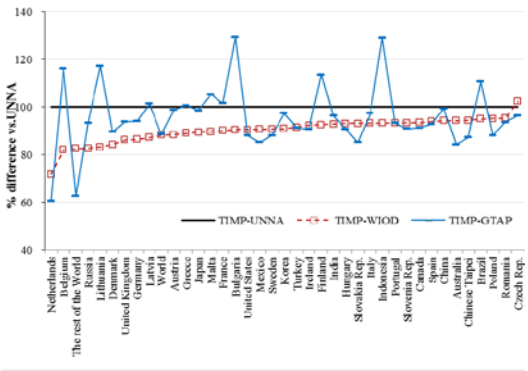
(b) Domestic Final Demand



(c) Total Exports of goods and services



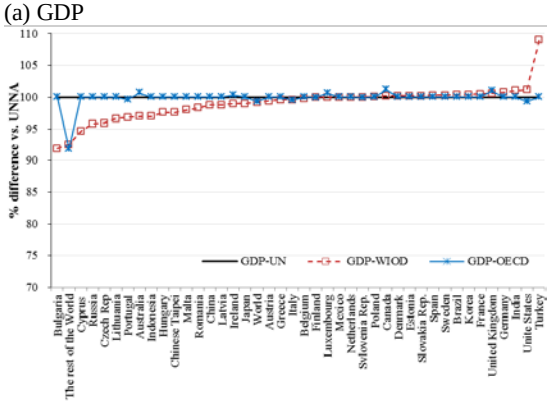
(d) Total Imports of goods and services



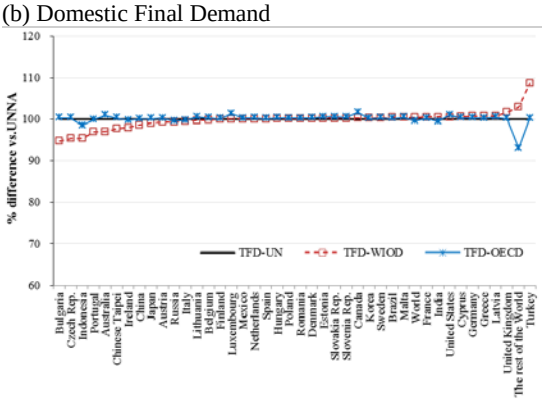
Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

Figure 2. Differences between WIOD/OECD databases and UNNA, 2005

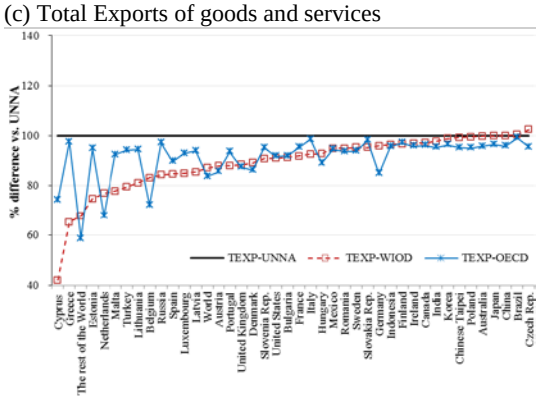
(a) GDP



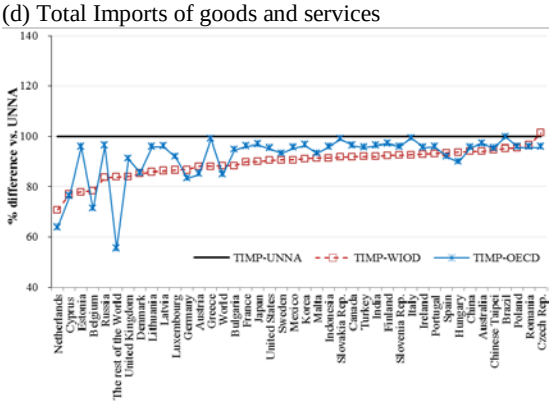
(b) Domestic Final Demand



(c) Total Exports of goods and services



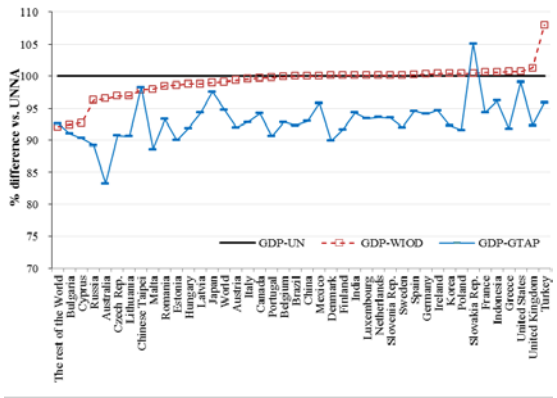
(d) Total Imports of goods and services



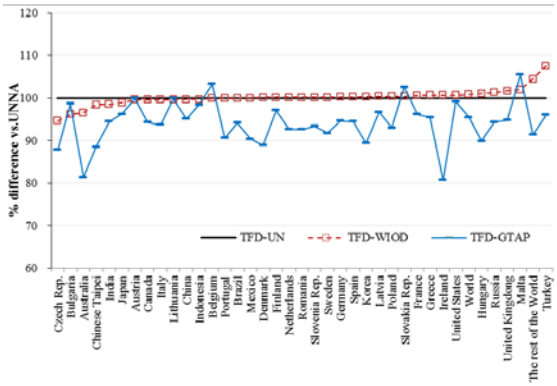
Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

Figure 3. Differences between WIOD/GTAP databases and UNNA, 2007

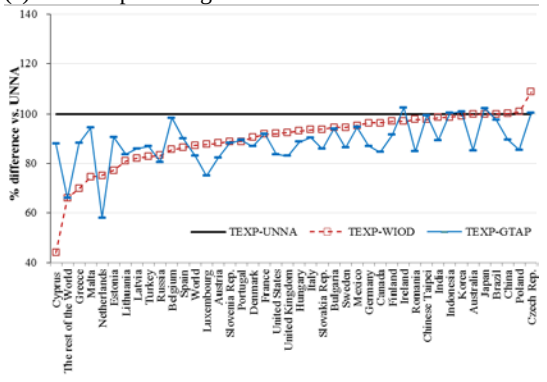
(a) GDP



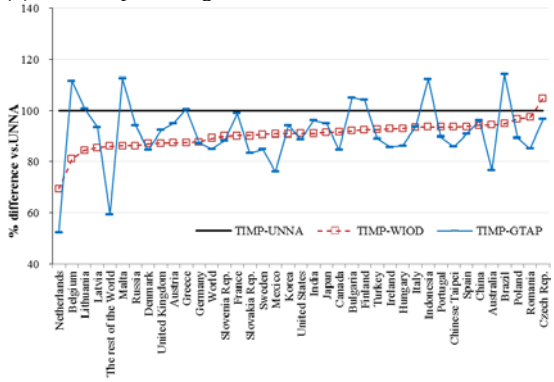
(b) Domestic Final Demand



(c) Total Exports of goods and services



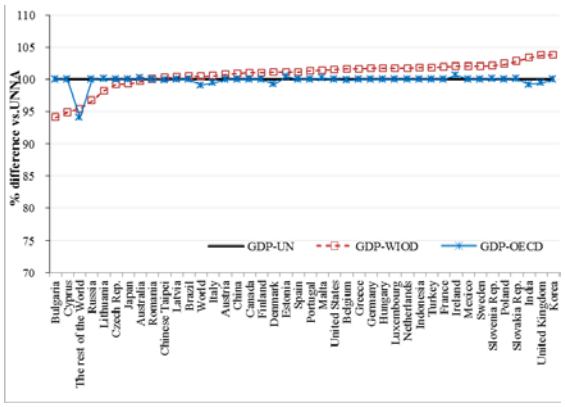
(d) Total Imports of goods and services



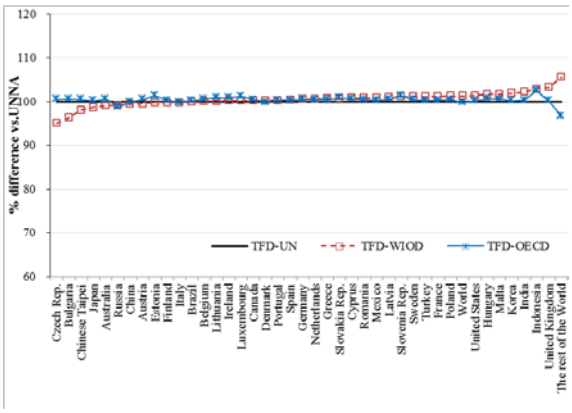
Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

Figure 4. Differences between WIOD/OECD databases and UNNA, 2008

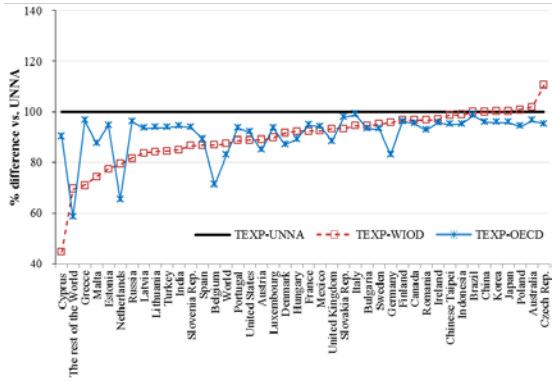
(a) GDP



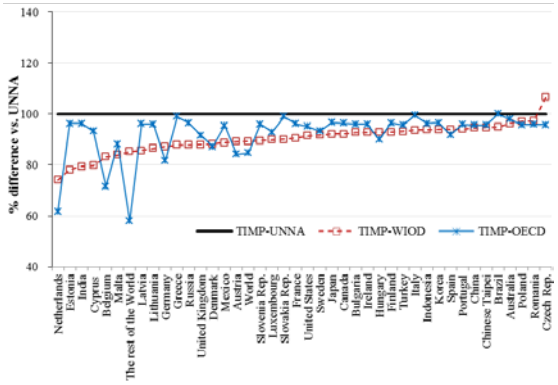
(b) Domestic Final Demand



(c) Total Exports of goods and services



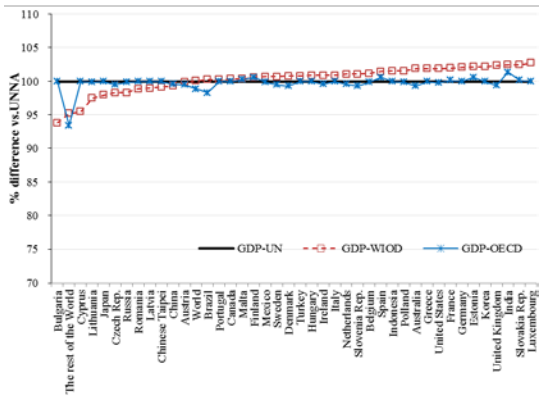
(d) Total Imports of goods and services



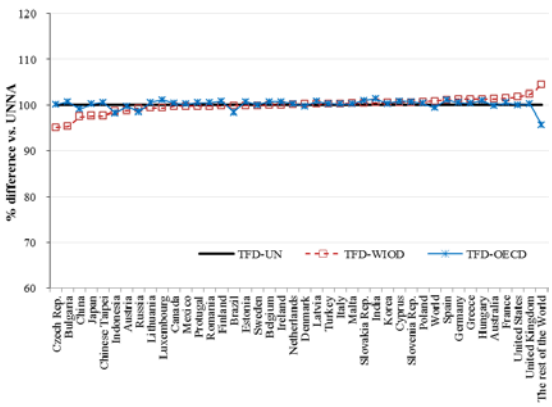
Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

Figure 5. Differences between WIOD/OECD databases and UNNA, 2009

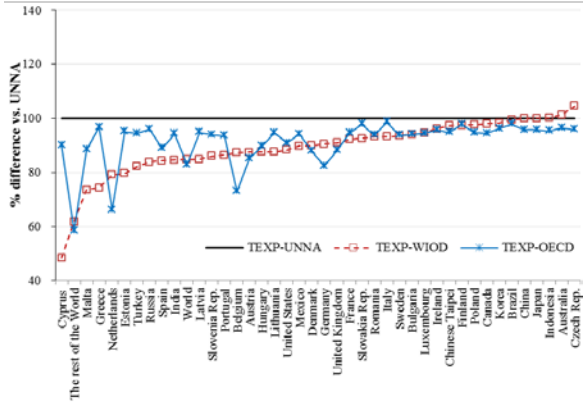
(a) GDP



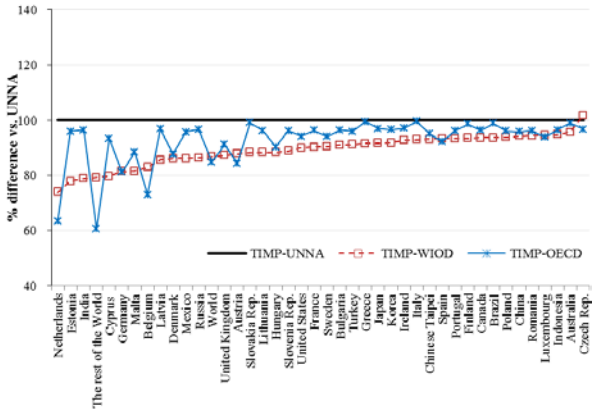
(b) Domestic Final Demand



(c) Total Exports of goods and services



(d) Total Imports of goods and services



Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

2.2 Differences with Balance of Payment Statistics

The comparison of gross trade figures from ICIO tables and Balance of Payments (BOP) data is relevant since BOP data are commonly used by economists and policy makers to analyze international trade flows in goods and services. Theoretically, trade data derived from ICIO tables should be similar to those from the BOP system; if not, they should be accompanied with meaningful metadata to explain the potential differences in concept, coverage or compilation method between the two sources.

The following graphs compare total exports and imports in goods and services between the three ICIO tables under review and equivalent figures from the balance of payments.

Figures 6 and 8 compare WIOD/GTAP trade data with BOP[12] exports and imports in goods and services for year 2004 and 2007. Figure 7， 9 and 10 compare WIOD/OECD and BOP exports and imports in goods and services for year 2005, 2008 and 2009 respectively.

Overall, the WIOD/OECD/GTAP sources present numerous differences between each other. Except for very few exceptions, WIOD figures are largely lower than those derived from BOP.

At the world level, BOP total exports in goods and services exceed WIOD figures by 15.2% for 2009. The highest differences concern primarily EU member countries. This might be attributed to a different treatment of transit trade and re-exports made for EU. For example, the deviations observed across the years for the Netherlands stand at a high level, and BOP values remain between 18% to 24% above WIOD ones. WIOD trade data do not incorporate the re-export and transit activities taking place in the Netherlands, notably through its port operations like in Rotterdam, while BOP figures cover such activities.

Chinese trade data in the WIOD table include trade from the Special Administrative Regions (SAR) of China, Hong Kong and Macao.[13] Theoretically, such a specific geographical entity might represent a source of divergence with Chinese BOP data. However, this seems not to really affect China's exports figures that match closely between the two sources and for all benchmark years.

BOP figures for U.S. are greater by around 8% to 11% than WIOD's, which might be partly explained by the non-inclusion of US re-exports in the later source.

The level of WIOD-BOP discrepancy for various countries is relatively stable along the years. This suggests that structural and coverage issues that last over time might have attributed to the differences between the two sources. Basically, the construction of international trade data in the WIOD table is based on national accounts, , the concepts behind it is slightly differ from the ones prevailing in the BOP.

Similar remarks as for the WIOD-BOP comparison can be made to the OECD-BOP evaluation. OECD data are generally lower than the ones sourced from the BOP system. In addition, the biggest deviations between the two sources mainly concern EU member countries; like for the WIOD data, a plausible explanation is that the OECD table excludes the re-exports and transit trade taking place within the EU. In general, the BOP deviations noted with OECD figures tend to be lower than the ones observed with WIOD data.

The comparison of total gross exports between GTAP and BOP sources (see Figures 6 and 8) perpetuates the big deviations noted for EU member countries in the previous graphs. Here again, BOP figures exceed largely those based on the GTAP source. Moreover, it is worth noting that the differences increase hugely for most countries in 2007. Such a generalized evolution may reflect a

[12] The BOP data used in this report are sourced from Eurostat, IMF, OECD and complemented with national data for some countries.
[13] See WIOD (2012).

drastic change in the way 2007 GTAP trade data were compiled, compared to the 2004 table; GTAP 2007 values may presumably rely more on estimates than on official data.

Generally speaking, the variances highlighted for total imports in goods and services between the three ICIO tables and BOP data lead to similar conclusions as the ones mentioned earlier for exports.

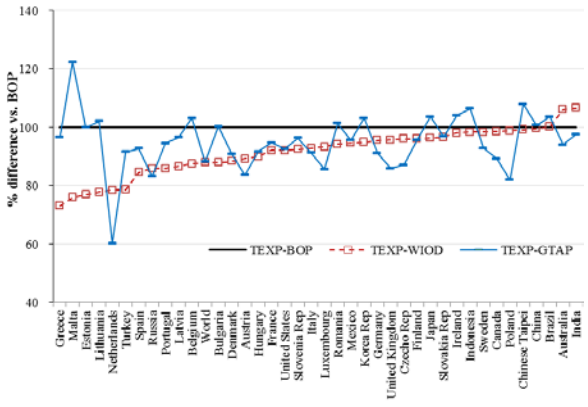
When comparing WIOD and BOP total import figures, similar findings as for exports can be noticed. WIOD figures are generally much lower than BOP ones, with a discrepancy for the world total fluctuating from -11% to -13% for the five years. Also, for most countries, the WIOD-BOP imports' differences present a relative stability in their magnitude across years.

Like for WIOD, OECD imports' figures are generally lower than BOP ones, but with less magnitude. EU member countries still undergo the largest discrepancies. The biggest positive differences with BOP data, for both OECD and WIOD, are shown for Greece.

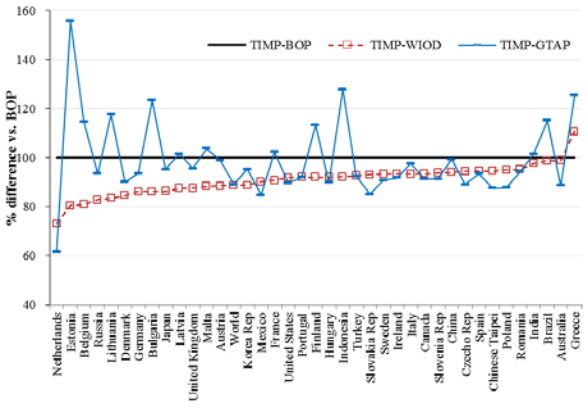
To GTAP gross imports, two main patterns can be outlined in relation to the remarks made for exports. First, GTAP import data are bigger than BOP ones for more countries than for exports. Second, the difference is much smaller for imports compare to that noticed for exports in the sane year. Additionally, Luxembourg imports in GTAP, not shown on the graph present an aberrant magnitude for 2004 and 2007, which are more than three times higher than BOP and even WIOD or OECD figures.

Figure 6. Differences between WIOD/GTAP databases and BOP, 2004

(a) Total exports of goods and services



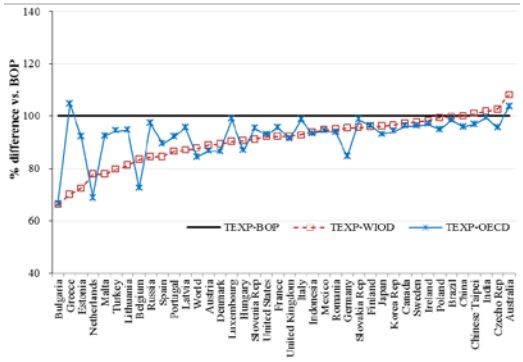
(b) Total imports of goods and services



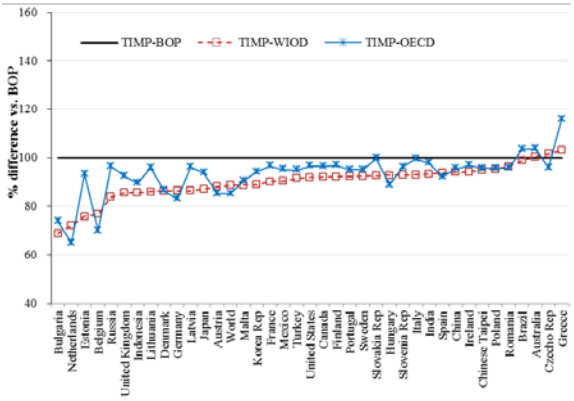
Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

Figure 7. Differences between WIOD/OECD databases and BOP, 2005

(a) Total exports of goods and services



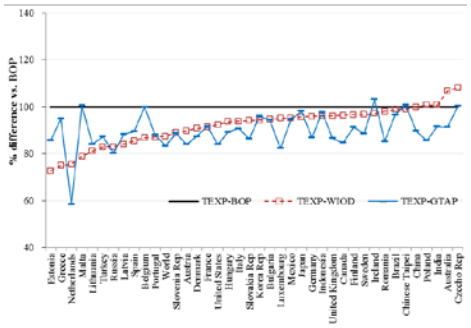
(b) Total imports of goods and services



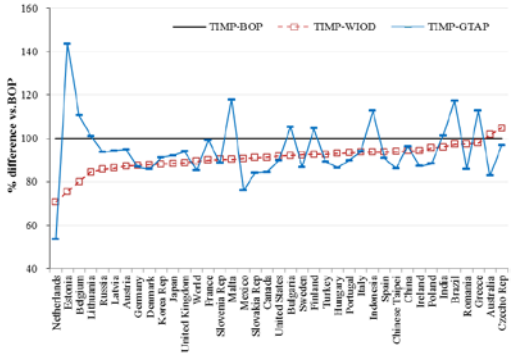
Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

Figure 8. Differences between WIOD/GTAP databases and BOP, 2007

(a) Total exports of goods and services



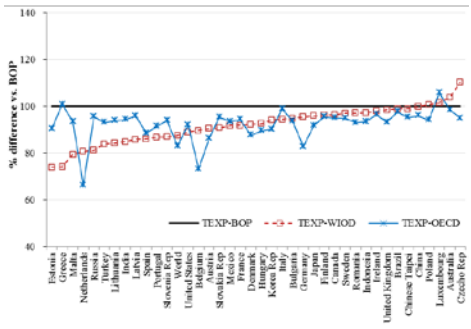
(b) Total imports of goods and services



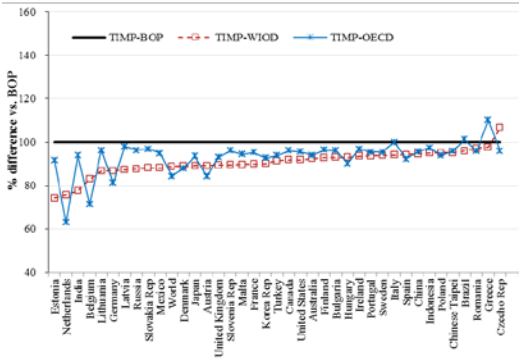
Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

Figure 9. Differences between WIOD/OECD databases and BOP, 2008

(a) Total exports of goods and services



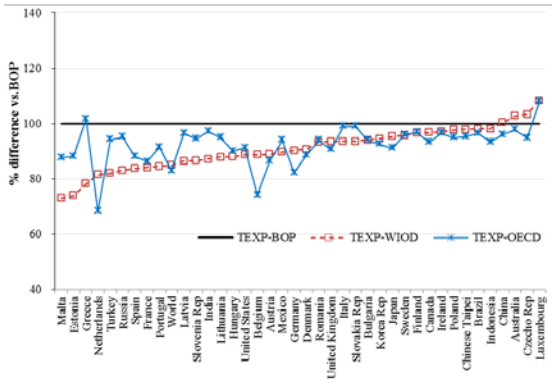
(b) Total imports of goods and services



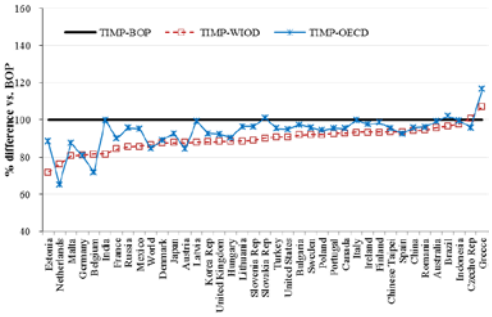
Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

Figure 10. Differences between WIOD/OECD databases and BOP, 2009

(a) Total exports of goods and services



(b) Total imports of goods and services



Note: Countries are sorted according to WIOD's differences with UNNA figures. Country coverage may slightly differ from one graph to another.

III. Differences in the Basic Economic Variables among the Three Databases

3.1 Mean Absolute Percentage Difference of Basic Variables

Since there are many dimensions in an ICIO table, it is meaningful to compare several measures in order to outline the discrepancies among the three databases. Generally speaking, it is the proportionate deviation and not the absolute deviation that matters. Therefore, we compute the "Mean Absolute Percentage difference" for each country among the three databases. Specifically, we consider the following aggregate index discrepancy measure for gross output, value-added, domestic and imported intermediate inputs, and domestic and imported final demands.

Gross output:

$$MAPAG^r = \frac{100 \bullet \sum_{j=1}^{N} | X^W_{jr} - X^l_{jr} |}{\sum_{j=1}^{N} X^W_{jr}} \quad l = G, O \tag{1}$$

Value-added:

$$MAPAV^r = \frac{100 \bullet \sum_{j=1}^{N} | V^W_{jr} - V^l_{jr} |}{\sum_{j=1}^{N} V^W_{jr}} \quad l = G, O \tag{2}$$

Domestic intermediate inputs:

$$MAPADI^r = \frac{100 \bullet \sum_{j=1}^{N} \sum_{i=1}^{N} | z^W_{irjr} - z^l_{irjr} |}{\sum_{j=1}^{N} \sum_{i=1}^{N} z^W_{irjr}} \quad l = G, O \tag{3}$$

Imported intermediate inputs:

$$MAPAII^r = \frac{100 \bullet \sum_{j=1}^{N}\sum_{i=1}^{N}\left|\sum_{s\neq r}^{G} z_{isjr}^{W} - z_{isjr}^{l}\right|}{\sum_{j=1}^{N}\sum_{i=1}^{N}\sum_{s\neq r}^{G} z_{isjr}^{W}} \qquad l = G, O \tag{4}$$

Domestic final demand:

$$MAPADF^r = \frac{100 \bullet \sum_{i=1}^{N}\left| f_{irr}^{W} - f_{irr}^{l}\right|}{\sum_{i=1}^{N} f_{irr}^{W}} \qquad l = G, O \tag{5}$$

Imported final demand:

$$MAPAIF^r = \frac{100 \bullet \sum_{i=1}^{N}\left|\sum_{s\neq r}^{G} f_{isr}^{W} - f_{isr}^{l}\right|}{\sum_{i=1}^{N}\sum_{s\neq r}^{G} f_{isr}^{W}} \qquad l = G, O \tag{6}$$

Where:

W, G, O stand for WIOD, GTAP and OECD respectively; i represents the goods, j the sector, and s, r represent the countries.

X_{jr} : The gross output of sector j in country r;

V_{jr} : The value-added of sector j in country r;

z_{irjr} : Goods i produced in country r used as intermediate input in sector j of country r;

z_{isjr} : Goods i imported from country s used as intermediate input in sector j of country r;

f_{irr} : Goods i produced in country r used as domestic final demand in country r;

f_{isr} : Goods i imported from country s used as final demand in country r.

3.2 Observed Numerical Differences in Basic Variables

The numerical results for the six discrepancy measures defined above are reported in tables 2 and 3 (WIOD and GTAP sources for 2004 and 2007), and tables 4, 5 and 6 (WIOD and OECD sources for 2005 and 2008-09).

We focus on the differences for country total discrepancies to illustrate some key characteristics of the variances of major economic variables among the three databases. Three features are observed:

First, generally speaking, the differences of gross output at sectoral level are relatively less significant than the differences of intermediate inputs between WIOD and GTAP/OECD databases, followed by sector level value-added. The discrepancies between WIOD and OECD are smaller than those between WIOD and GTAP, reflecting the fact that both WIOD and OECD are trying to

benchmark their sector level gross output and value-added to be consistent with the official national account statistics, while GTAP benchmark their data to adjusted official trade statistics.

Second, the discrepancies between domestic transactions are often less than those of imported transactions for both intermediate inputs and final demand for all available years. This may reflect that the differences on how and where imported goods were sourced in the three databases are larger than the differences on how and where domestic products were used. It is not surprising given that the basic input-output statistics in the three databases largely rely on similar sources.

Finally, the discrepancies between domestic purchased intermediate inputs are much larger than the discrepancies for domestic final demand, and it is opposite for the discrepancies in imports used for intermediate and final demand, although in a much smaller extent. Looking into the variances at sectoral level, the sectors that have large portion of their products can be used as both intermediate and final goods are often associated with large discrepancies, reflecting different practices to allocate these dual-use products among the three databases. Computing the discrepancy measures similar to equations (1) and (6) by product group and final demand category could help identify where the large discrepancies come from, providing a mean to identify and solve potential issues in the data.

Table 2. Mean Absolute Percentage differences between WIOD and GTAP ICIO tables, 2004

Country	Domestic intermediate inputs	Imported intermediate inputs	Domestic final demand	Imported final demand	Gross output	Value added
Australia	28.6	87.8	0.8	82.4	25.1	37.5
Austria	60.8	78.3	0.4	110.6	41.1	53.7
Belgium	63.7	118.3	0.6	98.4	50.1	67.6
Brazil	53.9	85.1	1.1	273.2	33	45.2
Bulgaria	96.6	107.6	0	244.1	49.9	61.7
Canada	65.3	85	1.6	74.7	34.4	40.4
China	45.4	61.3	2.3	129.9	31.4	37.8
Cyprus	98.5	178.2	0	331.5	64.2	74.2
Czech Rep	63.3	71.5	0.2	97.3	36.3	48.6
Denmark	66.9	95.7	0.4	99.6	55.6	70.2
Estonia	74.9	118.2	0	294.1	45	56.2
Finland	71.9	94.4	0.3	164.5	40	53.2
France	57.6	75.5	3.1	115.5	45.1	56.6
Germany	61.8	83.9	3.4	107.7	34.4	38.5
Greece	83.2	140.7	0.4	94.5	46.4	67.9
Hungary	73.9	75.3	0.1	107.1	38.1	60
India	44.6	87.2	0.8	195.5	26	38.9
Indonesia	89.8	105	0.3	356.1	27.4	29.9
Ireland	69.9	83.2	0.3	140.4	43.4	50.4
Italy	55	73.2	2.5	101.6	40.6	52.4
Japan	57.3	93.5	6.6	111.7	30.4	44.3
Korea Rep	57.4	76.3	0.9	152.7	30.7	45.6
Latvia	68.5	106.2	0	87	56.9	87.2
Lithuania	107.9	109.5	0	167.2	51.9	61.3
Luxembourg	98.5	103.4	0.1	1496.6	60	80.3
Malta	87.1	115.8	0	130.9	69.9	104.3
Mexico	41.9	69.8	0.6	64.7	26.1	30.5
Netherlands	85.6	80.8	1	86.6	52	68.2
Poland	71.4	72.6	0.4	99.1	43.8	67.9
Portugal	65.1	75.6	0.3	76.6	46.4	62.8
Romania	77.6	86	0.1	100.8	38.2	52
Russia	79.3	112.3	0.8	108.2	42.2	46.7
Slovakia Rep	140.4	80.4	0.1	115.7	73.7	80.6
Slovenia Rep	76.6	86.9	0	75.3	40.9	49.6
Spain	45.5	75.9	1.1	80.7	26	29.6
Sweden	75.2	79.6	0.6	105.9	49	62.7
Chinese Taipei	61	63.9	0.4	104.6	28.4	44.2
Turkey	63.8	72.8	0.5	111.4	36.9	45.5
United Kingdom	64.2	94.2	3.2	94.3	40.2	43.1
United States	67.6	93.6	24.2	77.3	50.6	63.8
The rest of the World	81.6	82.5	6.7	107.6	32.5	37.4
World	62.3	83.7	66.3	104.8	39.3	50

Table 3. Mean Absolute Percentage differences between WIOD and GTAP ICIO tables, 2007

Country	Domestic intermediate inputs	Imported intermediate inputs	Domestic final demand	Imported final demand	Gross output	Value added
Australia	32.9	86.1	0.9	77.1	27.9	39.9
Austria	64.1	79.2	0.4	105.6	42.6	53.7
Belgium	69	119	0.6	99.3	50.9	68.4
Brazil	55.7	86.5	1.8	255.7	37.6	45.5
Bulgaria	83.9	101.4	0	178.2	41.6	59
Canada	68.8	85.4	1.7	71.2	37	43
China	38.7	61.3	3.1	135.9	30.4	35.2
Cyprus	94.4	190.5	0	288.1	57.5	71.7
Czech Rep	63.3	74.1	0.2	96.7	34.1	48.4
Denmark	67.9	98.9	0.4	91.7	54.5	71.9
Estonia	66.4	113.2	0	281.5	44.9	54.3
Finland	72.6	94.4	0.2	146.6	38.6	53.4
France	56.5	81.9	3	106.4	42	57
Germany	61.2	82.1	3	99.2	33.6	39.4
Greece	99.3	137.2	0.4	102	50.8	75.9
Hungary	84.1	76.5	0.1	100.1	37.7	56.4
India	49.7	90.4	1.1	179.6	25.3	36.9
Indonesia	89.1	96.5	0.3	257	29.6	28.8
Ireland	64.1	95.3	0.3	105	43.5	52.4
Italy	57.1	72.6	2.4	94.9	40.6	51.6
Japan	56.1	81.5	5	118.3	31.7	44.9
Korea Rep	54.9	72.2	1.1	147.3	32.4	49.8
Latvia	70.9	107.2	0	72.1	59.2	86.5
Lithuania	105.6	116.2	0	128.4	48.7	59.8
Luxembourg	101.6	107.1	0.1	1677	64.4	85.6
Malta	89.1	138.9	0	166.2	45.1	74
Mexico	44.9	71.1	0.7	60.3	27.8	33.5
Netherlands	79.7	81	1	82.3	48.3	64.1
Poland	68.5	75.1	0.5	97.3	41.9	66.5
Portugal	64.3	79.6	0.3	75.6	45.2	62.7
Romania	83.5	84.7	0.2	82.7	43	58.6
Russia	80.3	113.7	1.3	92.5	45	53.4
Slovakia Rep	117.5	89.7	0.1	125.3	57.3	64.8
Slovenia Rep	73.5	90.6	0	77	39.2	48.9
Spain	50.2	77.1	1.3	84.7	27.6	32.6
Sweden	72.7	76.2	0.6	90.8	46.9	61.3
Chinese Taipei	68.7	59.8	0.3	112.2	26.7	42.3
Turkey	68.3	71.4	0.7	120	40.9	51.1
United Kingdom	67.8	95.7	3.2	89	43.5	44.3
United States	67.2	89.1	22.1	76.5	50.6	65.1
The rest of the World	88.8	83.1	7.7	94	32.1	35.6
World	62.1	82.8	66.1	100.5	39	49.6

Table 4. Mean Absolute Percentage differences between WIOD and OECD ICIO tables, 2005

Country	Domestic intermediate inputs	Imported intermediate inputs	Domestic final demand	Imported final demand	Gross output	Value added
Australia	65.3	89.7	0.7	64.4	39.4	52.5
Austria	64.1	66.4	0.2	47.5	27.8	38.4
Belgium	57.1	68	0.4	56.1	25.6	40.3
Brazil	50.1	89.3	0.9	78.2	33.8	48.6
Bulgaria	51.1	97.1	0	55.1	33.3	57.4
Canada	65.5	83.4	1.1	53.5	33.5	45.6
China	33.5	64.8	1.2	66.4	21.1	29.3
Cyprus	92.9	112.9	0	87.3	40.4	56
Czech Rep	50.8	62.6	0.1	58.3	25.2	34.1
Denmark	65.7	101.9	0.2	81.7	32.9	42.9
Estonia	63.9	97.5	0	78.9	31	46.7
Finland	56.5	84.7	0.2	65.4	24.6	41.3
France	52.1	67.1	1.9	48.1	31.3	44.2
Germany	60.1	76	2.6	52.9	31.3	40.8
Greece	50.9	88.9	0.2	56.2	31.4	44.8
Hungary	56.9	73.2	0.1	61.8	22.7	39.4
India	24.4	114.3	0.4	92.8	15.6	24.4
Indonesia	67.8	87.4	0.2	108.1	30	33.2
Ireland	70.5	106.5	0.1	80.1	42.3	48
Italy	45.6	96.2	1.4	68.2	25.3	43.4
Japan	63.3	74.2	5.1	73.2	42.7	53.1
Korea Rep.	54.7	74.4	0.8	61.7	35	54.8
Latvia	78.9	102.2	0	88.2	32.8	41.2
Lithuania	57.7	84.5	0	82	21.8	36.7
Luxembourg	143.5	160.3	0	81.6	106.6	82.8
Malta	77.9	103.9	0	70	35.5	41.8
Mexico	40	44.1	0.6	55.8	25.5	33.3
Netherlands	67	87.4	0.6	87	30.3	42.1
Poland	42.3	67.2	0.3	49.5	21.6	32.9
Portugal	42.8	61.1	0.1	51.2	31.4	44
Romania	53.6	75.8	0.1	56.3	21.5	33.5
Russia	39.7	99.9	0.4	67.4	14.6	30
Slovakia Rep	40.8	68	0	69.3	17.4	30.2
Slovenia Rep	47.2	64.4	0	82.2	24.2	35.6
Spain	43.9	74.6	0.9	45	22.8	39.9
Sweden	59.7	76.3	0.3	52.7	28.8	39.3
Chinese Taipei	83	68.9	0.3	73	39.5	50.4
Turkey	24.9	76.8	0.3	51.2	21.8	35.6
United Kingdom	66.3	89.7	2.1	65.4	36.6	46.4
United States	67.6	75.7	14.1	57	46	55
The rest of the World	82.5	81.4	4.2	56	39.9	42.8
World	59.1	78.6	42.6	59.9	35.8	46.3

Table 5. Mean Absolute Percentage differences between WIOD and OECD ICIO tables, 2008

Country	Domestic intermediate inputs	Imported intermediate inputs	Domestic final demand	Imported final demand	Gross output	Value added
Australia	64.9	76.6	0.7	66.4	44.2	55.5
Austria	73.4	75.6	0.2	44.6	30.6	36.2
Belgium	55.1	66.1	0.3	55.4	25.3	36.7
Brazil	43.7	76.5	1.1	70	31.9	47.9
Bulgaria	62.7	82.5	0	62.1	38.7	61.4
Canada	50.4	65.8	1	46.7	34.5	41.1
China	33.2	68.7	1.9	57.6	21	30.1
Cyprus	89.9	126.5	0	119.9	44.9	57.8
Czech Rep	44.1	52.3	0.1	46.4	21.1	31
Denmark	61.3	102.1	0.2	65.4	37.5	41.6
Estonia	55.2	90.9	0	92.9	30.7	42.6
Finland	48.6	88.6	0.2	66.3	24.2	40.1
France	57.9	68.3	2.1	50.9	36.5	43.9
Germany	66.7	74.4	2.5	51	32.8	45.2
Greece	85	101.7	0.2	73.5	39.6	47
Hungary	48.9	55.7	0.1	59.9	22.6	35.1
India	25.3	90.1	0.5	88.2	16.3	26.1
Indonesia	35.6	65.8	0.1	73.4	18.1	22.5
Ireland	71	122.5	0.2	106.7	44	54.7
Italy	49.8	69.3	1.3	60.4	32.8	45.3
Japan	59.3	69.5	4.1	62.7	41	52.8
Korea Rep	42	68.7	0.5	67.2	24	38.5
Latvia	83	106.7	0	92.2	39.5	45.7
Lithuania	57.9	81.1	0	97.4	20.6	33.3
Luxembourg	136.2	163	0	96.2	113.4	90.3
Malta	61.2	99.4	0	94.5	24.8	33.2
Mexico	42.4	48.4	0.6	61.2	24.9	32.3
Netherlands	62.1	81.4	0.6	79.9	28.4	39
Poland	37.9	59.7	0.3	45	24.3	33
Portugal	59	71.4	0.2	47.9	35.6	44.8
Romania	35.9	66.1	0.1	49.7	20.7	29.2
Russia	40.2	98.8	0.7	64	16.8	30.8
Slovakia Rep	30.7	66.4	0	68.4	15	23
Slovenia Rep	41.3	66.4	0	71.5	24.3	35
Spain	35.4	66	0.8	47.9	23.3	35.5
Sweden	56.1	80.2	0.3	57.6	27.8	35.1
Chinese Taipei	75.3	72.9	0.3	83.8	34	48.4
Turkey	38.6	132.7	0.5	95	24.6	39.2
United Kingdom	57.4	77.4	1.7	59.7	38.1	43.4
United States	62.6	68.7	11.6	61.5	43.2	52.2
The rest of the World	76.9	83.7	5.4	58.6	38.3	38.2
World	54.3	75.8	40.9	60.3	34	43.3

Table 6. Mean Absolute Percentage differences between WIOD and OECD ICIO tables, 2009

Country	Domestic intermediate inputs	Imported intermediate inputs	Domestic final demand	Imported final demand	Gross output	Value added
Australia	61.2	77.8	0.7	67.7	41.6	52.2
Austria	70.2	81.5	0.2	49.6	31.2	36.4
Belgium	51.3	70	0.3	56.5	27.6	39
Brazil	48.8	81.4	1.2	70.7	38	49.6
Bulgaria	58.7	83.5	0	60.6	39.4	60.8
Canada	52.5	71.3	1.1	56.6	37	43.3
China	32.7	68.4	2.3	60.7	20.9	32.1
Cyprus	87	132.3	0	107.8	44	57.6
Czech Rep	54.8	68.6	0.1	57.2	28.9	37.3
Denmark	61.7	106.3	0.2	61.2	39.2	45
Estonia	54.5	92.5	0	92.6	28.9	41.5
Finland	53.4	95.2	0.2	67.8	28.3	45.1
France	63.3	72.7	2.2	55.1	40.8	45.8
Germany	69	84	2.5	52.6	35.7	47
Greece	101.1	107.6	0.2	61	43.5	47.2
Hungary	58.8	61.9	0.1	62.4	29	46.5
India	28.5	97.1	0.6	92.6	18.3	27.4
Indonesia	33.2	66.4	0.1	75.2	17.4	22
Ireland	81.2	129.6	0.1	127.4	45.8	54
Italy	53.5	68.1	1.3	61.4	34.3	46.2
Japan	62.4	72.4	4.6	65.6	43.3	54.3
Korea Rep	43.8	75.5	0.5	73.3	26.3	39.5
Latvia	92.9	113.8	0	101.6	45.5	52.1
Lithuania	58	86	0	93.3	20.4	33.2
Luxembourg	145.5	164.2	0	92.6	115.3	90.4
Malta	63.1	109.8	0	101	27.5	36.8
Mexico	41.6	49	0.5	66.7	27.6	35.2
Netherlands	66.6	90.2	0.6	79.8	32	40.3
Poland	36.6	61.3	0.3	47.9	23.2	31.2
Portugal	59.1	78.7	0.2	50.3	36.8	45.3
Romania	36	66.8	0.1	55.5	20.8	29.7
Russia	39.1	113.8	0.6	58.8	22.1	34.2
Slovakia Rep	33.3	76.2	0	78.7	17.3	26.2
Slovenia Rep	44.1	70.1	0	72.1	26.7	37.7
Spain	37.9	69.5	0.7	49.1	25.2	36.3
Sweden	59.4	89.6	0.3	60.8	31	37.8
Chinese Taipei	75	70.9	0.3	83.5	34.6	48.6
Turkey	40.3	139.6	0.5	95.3	29.1	43.9
United Kingdom	58.8	79.1	1.5	59.5	38.7	44.8
United States	70.2	70.7	12.4	63.5	47.8	54
The rest of the World	72.7	88.1	5.6	61.3	39.2	39.7
World	55.9	79.9	42.3	62.6	36.2	45

IV. Differences in Major Trade in Value-added Indicators

4.1 Value-added to Gross Export Ratio (VAX) and Bilateral Balance of Trade

Two major trade in value-added indicators are estimated and compared among the three ICIO databases and graphed in figures 11 to 15: the ratio of total value-added exports to gross exports (VAX), and the ratio of bilateral value-added balance of trade to gross balance of trade (BOT). VAX indicators are compared in three ways: at country and aggregate sector level, as well as by major trading partners. The ratio of value-added and gross BOT is compared by major trading partners.

On average, GTAP and OECD-WTO's TiVA estimates are higher than WIOD on VAX ratios for most countries, though the level of the differences varies from one year to another. Out of 41 countries, GTAP-based estimates present a higher VAX ratio than WIOD for 30 countries in 2004 and for 31 countries in 2007. For 2005, 2008, and 2009, OECD-based estimates have higher VAX ratios than WIOD for 19, 39, and 24 countries, respectively.

The differences of VAX ratio estimates for the eight aggregated sectors among the three databases are comparatively small. The differences between the estimates for two sectors are more noticeable: "Electricity, gas, and water supply", the GTAP estimates and the OECD estimates are both higher than the WIOD; for "Construction", the GTAP estimates are lower than the WIOD estimates, while the OECD estimates are higher than the WIOD estimates.

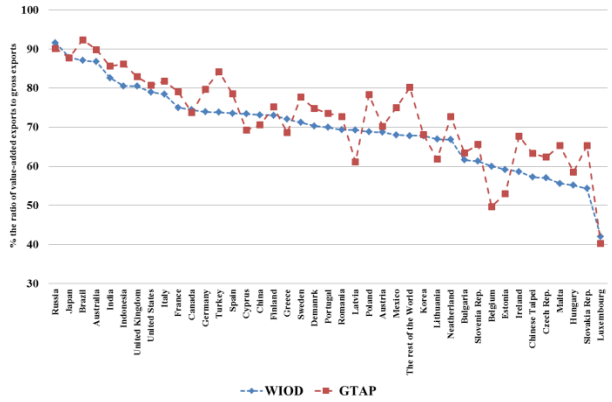
Overall, the estimates of VAX ratio for major trading partners among the three databases are close. The main difference, although of small magnitude, relates to US-EU12.[14]

The three databases report consistent value-added to gross BOT ratios for U.S.-Canada, China-U.S., China-EU15, and China-EU12. However, there are large discrepancies for the estimates of U.S.-EU15 and even more for U.S.-EU12. In addition, the differences in the estimates for China-Japan are quite unpredictable: the differences between the WIOD and GTAP for 2007 and the WIOD and OECD for 2008 are very small, while the differences in the estimates for 2004, 2005, and 2009 are big. As for 2009, China-Japan gross trade balance figures differ significantly, not only in terms of magnitude but also in direction, between WIOD and OECD. This is due to the fact that WIOD data show a positive, and questionable, trade balance of China vis-à-vis Japan for that year. The above remarks confirm the necessity of comparing and validating ICIO raw data with official macro statistics to ensure their reliability. Indeed, without such a validation step based on official statistics, the review of bilateral trade balances through the VA approach might not be reliable since results and related interpretations may differ widely depending on which ICIO data used. However, at the moment, scarce BOP bilateral trade data for both goods and services are available, resulting in a lack of relevant statistics to be used for validating ICIO-based trade balances.

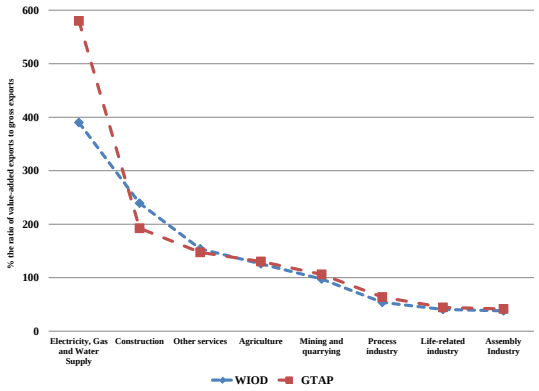
[14] "EU15" stands for "Western EU" aggregate and includes the following 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. The "New EU countries" aggregate, or "EU12", includes the 12 countries having joined the EU as from 2004: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.

Figure 11. Differences between WIOD and GTAP in VAX ratio estimates, 2004

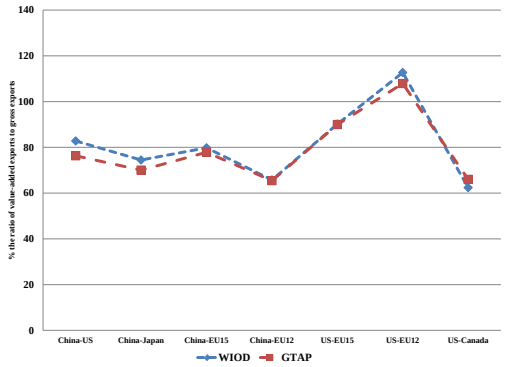
(a) VAX by Country



(b) VAX by Major Sector



(c) VAX by Major Trading Partner



(d) Ratio of value-added to Gross BOT by Major Trading Partner

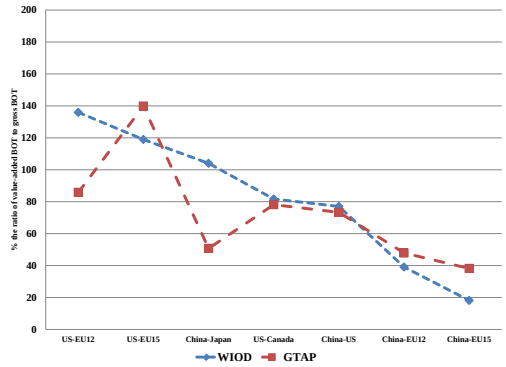
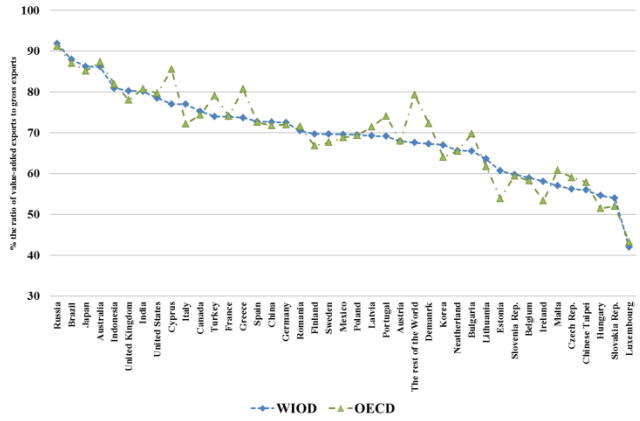
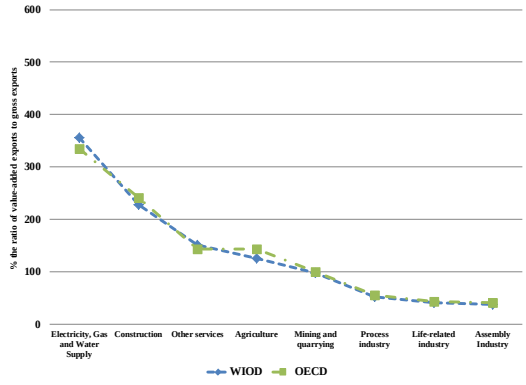


Figure 12. Differences between WIOD and TiVA in VAX ratio estimates, 2005

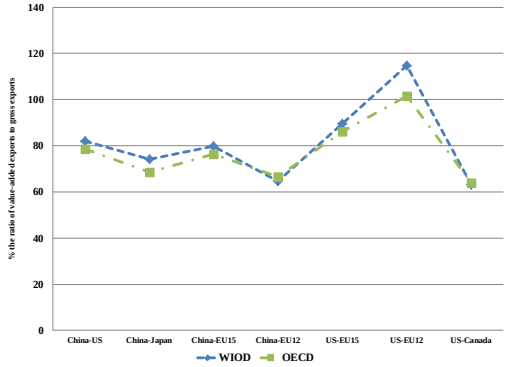
(a) VAX by Country



(b) VAX by Major Sector



(c) VAX by Major Trading Partner



(d) Ratio of value-added to Gross BOT by Major Trading Partner

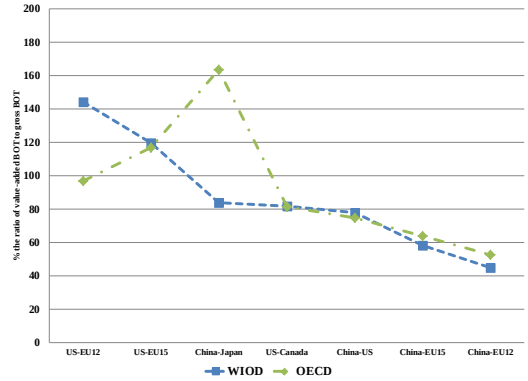
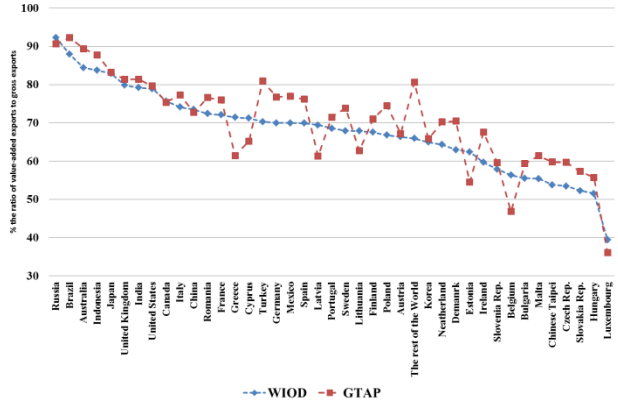
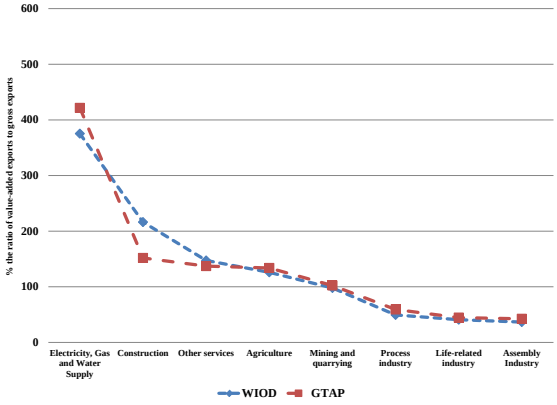


Figure 13. Differences between WIOD and GTAP in VAX ratio estimates, 2007

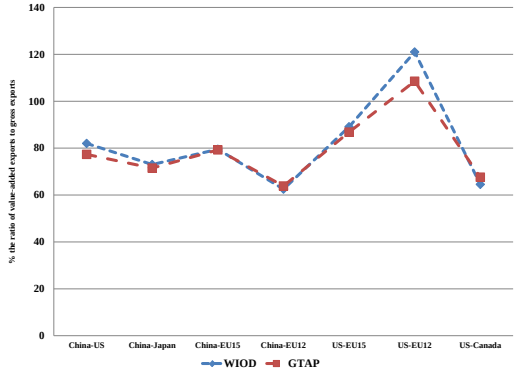
(a) VAX by Country



(b) VAX by Major Sector



(c) VAX by Major Trading Partner



(d) Ratio of value-added to Gross BOT by Major Trading Partner

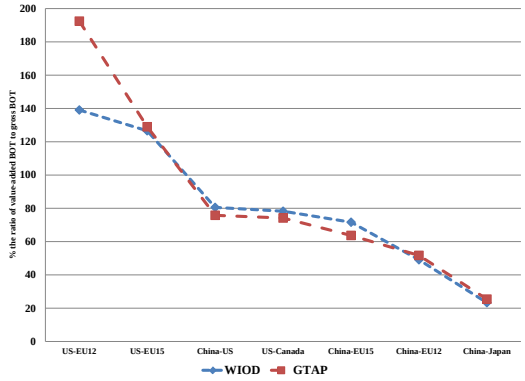
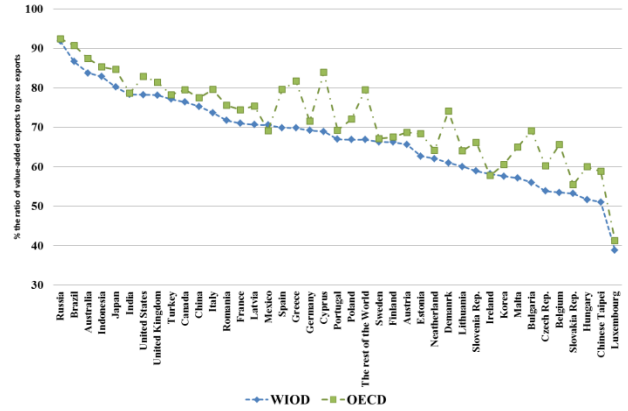
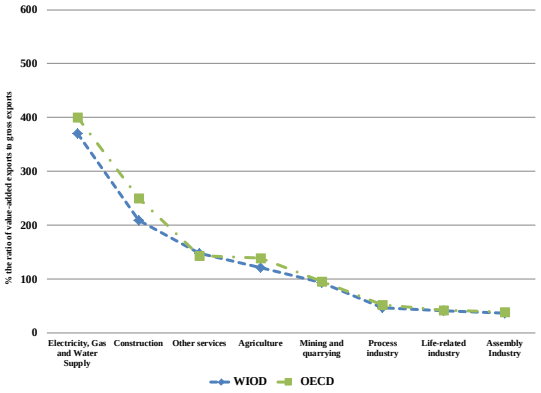


Figure 14. Differences between WIOD and TiVA in VAX ratio estimates, 2008

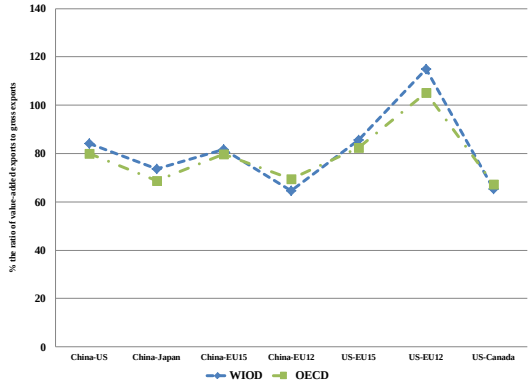
(a) VAX by Country



(b) VAX by Major Sector



(c) VAX by Major Trading Partner



(d) Ratio of value-added to Gross BOT by Major Trading Partner

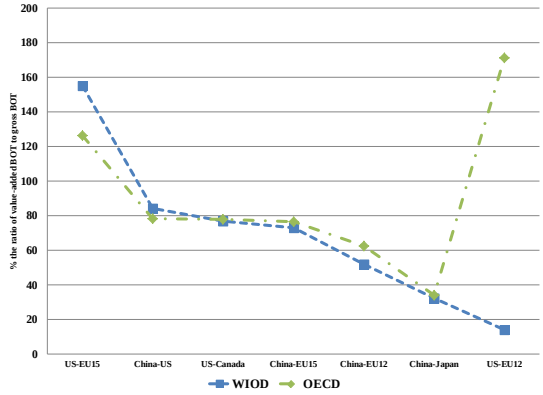
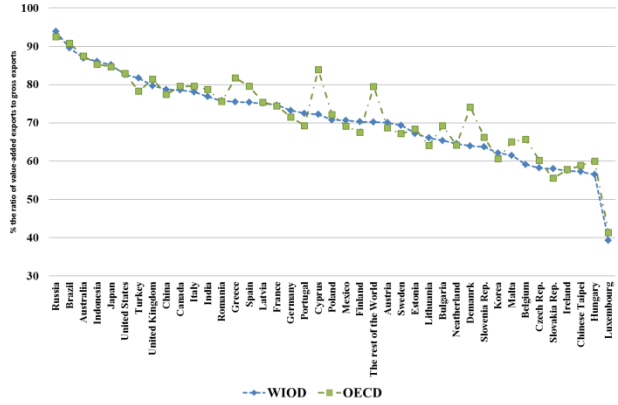
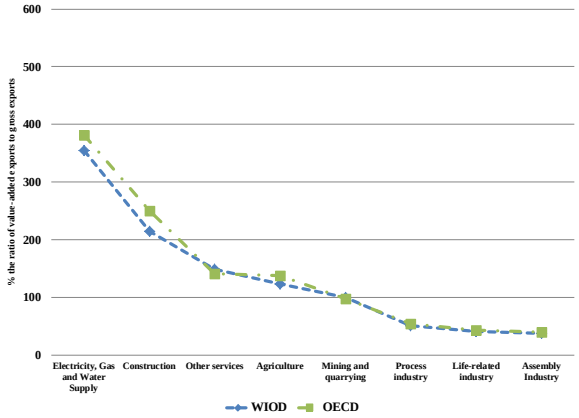


Figure 15. Differences between WIOD and TiVA in VAX ratio estimates, 2009

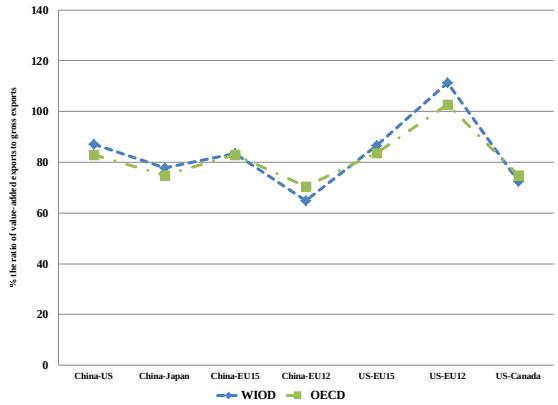
(a) VAX by Country



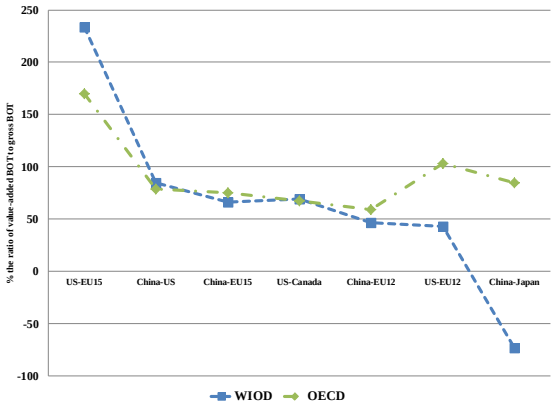
(b) VAX by Major Sector



(c) VAX by Major Trading Partner



(d) Ratio of value-added to Gross BOT by Major Trading Partner



4.2 Major Value-added and Double Counted Components in Gross Exports of Goods and Services

4.2.1 Comparison of Major Value-added Components in Gross Exports – OECD-WTO TiVA vs WIOD

Tables 7, 8 and 9 present the full decomposition of countries' gross exports of goods and services into their value-added components based on both OECD and WIOD ICIO tables, for 2005, 2008 and 2009. The calculations are based on the method proposed by Koopman, Wang and Wei (2014). Some country aggregates have been compiled for EU members. Since the components are computed using the same computer programs, the differences noticed in this evaluation are only due to the divergences between the two data sets.

At a first glance, the major differences noticed in the three tables between OECD-WTO TiVA and WIOD are the rest of the world (RoW) aggregate. However, the comparison of this RoW aggregate is hazardous and even not relevant, for several reasons. First, the RoW aggregate often serves as a balancing item within the production of ICIO tables and does not contain as many details as the individual countries covered in the tables. In addition, to enable the comparison exercise, the three ICIO tables have been aggregated and harmonized to the same country and sector coverage, as mentioned earlier. While the resulting RoW aggregate suppose to cover the same countries (all countries less 40 countries) in the three harmonized tables, the level of detail in RoW data differs from one table to another. As for the WIOD table, the RoW estimate in the harmonized table is the same as in the original table. However, in the OECD table, which originally contains 57 countries and a RoW aggregate, the RoW estimate present in the harmonized table includes not only the original OECD RoW data but also the detailed data compiled for the additional 17 individual countries not retained within the comparison exercise. Thus the OECD harmonized table includes more precision in the RoW aggregate than its WIOD equivalent, which makes difficult

to outline potential reasons for discrepancies between the two sources. Inevitably, the same reasons apply to the comparison between the GTAP and the WIOD tables.

The two EU aggregates, that is "Western EU" (EU15) and "New EU countries" (EU12), do not show major discrepancies for the value-added shares between the two sources. It is worth noting that more deviations appear between OECD-WTO TiVA and WIOD value-added estimates for 2008 and 2009, especially for the "New EU countries" (EU12) aggregate. In 2008, OECD-WTO TiVA-based domestic value-added content of exports for EU12 surpasses that obtained through WIOD data by 2.7 %. The reason for such a variation might be due to different levels of revisions for EU data between the two tables.

As shown in column 10 in the three tables, the sum of all the individual value-added components of exports matches perfectly the gross exports figures. In short, gross exports = domestic value-added of exports + foreign value-added of exports. Hence, the OECD-WTO/WIOD difference observed for one of the two value-added contents (domestic or foreign) is inversely proportional to that shown for the second component. For example, the share of domestic content in Australian exports for 2005 is 1.0% higher when estimated from OECD data than from WIOD's (see column 6), whereas the OECD-WTO TiVA estimate for the foreign content (see column 9) is lower than WIOD's by the same percentage.

Within individual countries, Turkey presents the most significant differences in value-added shares between the two sources. The OECD-WTO TiVA share of the domestic value-added in Turkish exports is 5.1% higher in 2005 than that estimated from WIOD figures. Such a big deviation between the two sources persists for 2008 and 2009 and stands at more than 3.5%.

The main OECD-WTO/WIOD differences often appear for value-added exports of final goods and services and intermediates absorbed by direct importers (see columns 1 and 2). This may arise from discrepancies at the level of the intermediate demand matrix in the two ICIO tables, which calls for further examination of the intermediate flows reported in the OECD and WIOD data sets. This also presupposes that the two sources may apply different rules to determine the end-use category (intermediate or final consumption) of goods and services exchanged among countries. The countries most affected by such differences are China, India, Indonesia, and Mexico, with slight disparity in the evolution across years. Whereas the importance of the discrepancy increases sharply between 2005 and 2009 for India and Indonesia, it tends to decrease across years for China. The OECD-WTO/WIOD discrepancy observed for Mexico remains at a significant level in the three years, with a much higher OECD-WTO share of "Direct valued added in final goods and services" (column 1).

As for China, the treatment of processing trade, which usually has a higher share of foreign inputs than non-processing trade, is a core issue for the value-added estimate. The reason for the discrepancy between the two sources can be due to different data sources and compilation methods applied to include the production and trade activities taking place within Chinese export processing zones. The OECD data set incorporates detailed data on processing trade from the Chinese Academy of Sciences which were not available at the time the WIOD tables were compiled.

Less significant differences appear for the shares of indirect value-added exports, sent to third countries, (see column 3) or those of the domestic value-added returned back home (see columns 4 and 5). The main exception is Russia for which the OECD-WTO TiVA share is systematically lower by around 5% to 7% than the one estimated from WIOD tables.

Overall, the divergences among the shares estimated from OECD and WIOD data may reflect different version of the raw national data may be used as the tables were not compiled during the same period. Indeed, the OECD ICIO tables, compiled one or two years after the WIOD tables, could benefit from better data availability and incorporate more recent revisions. Also, as mentioned above,

different compilation rules might be applied for the construction of the global I-O tables with various repercussions on value added trade estimates.

Beyond the differences noticed at country level, it is worth noting that OECD-WTO and WIOD estimates tend to converge at an aggregated level, which can be observed for the world and the "Western EU" estimates.

Table 7. The value-added components of gross exports - Comparison between OECD-WTO TiVA and WIOD, 2005 (% of total gross exports)

		Domestic VA content of exports						Foreign VA content of exports				Additional indicators	
		Direct VA exports of final Goods and Services (G/S)	Direct VA exports of intermedia te G/S	Indirect VA exports of G/S to third countries	Returned domestic VA in final G/S	Returned Domestic VA in intermedia te G/S	Total (= 1 to 5)	Foreign VA in final G/S	Foreign VA in intermedia te G/S	Total (= 7+8)	Total of all VA componen ts (= 6+9)	Total multiple counting (= 4+5+7+8)	Value added exports (= 1+2+3)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Australia	OECD-WTO	19.9	58.6	8.8	0.2	0.3	87.8	2.7	9.5	12.2	100.0	12.7	87.3
	WIOD	17.5	58.2	10.5	0.3	0.3	86.8	2.9	10.3	13.2	100.0	13.8	86.2
	% difference (OECD-WTO VS WIOD)	**2.5**	**0.4**	**-1.7**	**-0.1**	**0.0**	**1.0**	**-0.2**	**-0.8**	**-1.0**		**-1.1**	**1.1**
Brazil	OECD-WTO	24.0	53.0	10.1	0.1	0.2	87.3	3.6	9.1	12.7	100.0	12.9	87.1
	WIOD	27.8	49.0	11.2	0.1	0.2	88.3	4.1	7.6	11.7	100.0	12.0	88.0
	% difference (OECD-WTO VS WIOD)	**-3.8**	**3.9**	**-1.1**	**0.0**	**0.0**	**-0.9**	**-0.5**	**1.4**	**0.9**		**0.9**	**-0.9**
Canada	OECD-WTO-WTO	26.2	44.5	3.6	0.4	0.6	75.4	11.8	12.8	24.6	100.0	25.6	74.4
	WIOD	23.3	47.3	4.7	0.5	0.7	76.4	10.7	12.9	23.6	100.0	24.8	75.2
	% difference (OECD-WTO-WTO VS WIOD)	**2.9**	**-2.7**	**-1.0**	**-0.1**	**0.0**	**-1.0**	**1.1**	**-0.1**	**1.0**		**0.9**	**-0.9**
China	OECD-WTO	42.6	24.2	5.1	0.3	1.4	73.5	15.1	11.4	26.5	100.0	28.2	71.8
	WIOD	34.8	30.5	7.3	0.4	1.6	74.6	12.3	13.0	25.4	100.0	27.3	72.7
	% difference (OECD-WTO VS WIOD)	**7.7**	**-6.3**	**-2.3**	**-0.1**	**-0.1**	**-1.1**	**2.7**	**-1.6**	**1.1**		**0.9**	**-0.9**
India	OECD-WTO	30.0	43.2	7.6	0.1	0.3	81.2	8.3	10.5	18.8	100.0	19.2	80.8
	WIOD	31.4	40.5	8.2	0.1	0.4	80.6	9.5	9.9	19.4	100.0	19.9	80.1
	% difference (OECD-WTO VS WIOD)	**-1.4**	**2.7**	**-0.6**	**0.0**	**-0.1**	**0.5**	**-1.2**	**0.7**	**-0.5**		**-0.7**	**0.7**
Indonesia	OECD-WTO	19.7	53.4	8.9	0.1	0.3	82.3	5.7	12.0	17.7	100.0	18.0	82.0
	WIOD	17.5	52.7	10.7	0.1	0.3	81.3	5.4	13.4	18.7	100.0	19.1	80.9
	% difference (OECD-WTO VS WIOD)	**2.2**	**0.7**	**-1.8**	**0.0**	**0.0**	**1.0**	**0.3**	**-1.4**	**-1.0**		**-1.1**	**1.1**
Japan	OECD-WTO	36.3	39.1	9.8	0.6	0.9	86.7	5.4	7.9	13.3	100.0	14.8	85.2
	WIOD	32.1	43.2	11.0	0.8	1.1	88.2	4.1	7.7	11.8	100.0	13.8	86.2
	% difference (OECD-WTO VS WIOD)	**4.2**	**-4.1**	**-1.2**	**-0.3**	**-0.2**	**-1.5**	**1.4**	**0.1**	**1.5**		**1.0**	**-1.0**
Korea Rep	OECD-WTO	20.0	34.2	9.8	0.2	0.6	64.7	8.3	27.0	35.3	100.0	36.0	64.0
	WIOD	23.5	33.8	9.7	0.2	0.6	67.8	9.9	22.3	32.2	100.0	33.0	67.0
	% difference (OECD-WTO VS WIOD)	**-3.5**	**0.3**	**0.1**	**0.0**	**0.0**	**-3.1**	**-1.7**	**4.7**	**3.1**		**3.0**	**-3.0**
Mexico	OECD-WTO	34.2	31.4	3.3	0.2	0.4	69.4	20.4	10.2	30.6	100.0	31.1	68.9
	WIOD	22.3	41.2	6.1	0.2	0.5	70.4	13.3	16.3	29.6	100.0	30.4	69.6
	% difference (OECD-WTO VS WIOD)	**11.8**	**-9.8**	**-2.8**	**-0.1**	**-0.2**	**-1.0**	**7.1**	**-6.1**	**1.0**		**0.8**	**-0.8**
Russia	**OECD-WTO**	8.6	70.8	11.9	0.4	0.3	91.9	1.2	6.9	8.1	100.0	8.8	91.2
	WIOD	9.5	65.6	16.8	0.3	0.4	92.5	1.0	6.5	7.5	100.0	8.2	91.8
	% difference (OECD-WTO VS WIOD)	**-0.9**	**5.2**	**-4.9**	**0.1**	**-0.1**	**-0.6**	**0.2**	**0.4**	**0.6**		**0.6**	**-0.6**
Chinese Taipei	OECD-WTO	19.8	28.3	9.8	0.1	0.5	58.5	12.4	29.0	41.5	100.0	42.1	57.9
	WIOD	14.5	30.8	10.6	0.2	0.5	56.7	10.0	33.3	43.3	100.0	44.0	56.0
	% difference (OECD-WTO VS WIOD)	**5.3**	**-2.6**	**-0.8**	**-0.1**	**0.0**	**1.9**	**2.4**	**-4.3**	**-1.9**		**-1.9**	**1.9**
Turkey	OECD-WTO	46.0	27.3	5.8	0.1	0.2	79.4	12.0	8.6	20.6	100.0	20.9	79.1
	WIOD	40.7	25.7	7.6	0.1	0.2	74.3	12.5	13.2	25.7	100.0	26.0	74.0
	% difference (OECD-WTO VS WIOD)	**5.4**	**1.6**	**-1.8**	**0.0**	**-0.1**	**5.1**	**-0.5**	**-4.5**	**-5.1**		**-5.1**	**5.1**
United States	OECD-WTO	30.4	42.5	6.8	5.2	4.3	89.2	3.9	6.9	10.8	100.0	20.3	79.7
	WIOD	26.2	44.8	7.5	4.5	4.5	87.6	4.5	8.0	12.4	100.0	21.5	78.5
	% difference (OECD-WTO VS WIOD)	**4.1**	**-2.2**	**-0.7**	**0.6**	**-0.2**	**1.6**	**-0.6**	**-1.0**	**-1.6**		**-1.2**	**1.2**
Western EU	OECD-WTO	**27.1**	**35.5**	**8.0**	**0.6**	**1.0**	72.3	**10.3**	**17.5**	27.7	100.0	29.4	70.6
	WIOD	**28.3**	**34.5**	**8.6**	**0.7**	**1.0**	73.2	**11.0**	**15.8**	26.8	100.0	28.6	71.4
	% difference (OECD-WTO VS WIOD)	**-1.2**	**0.9**	**-0.6**	**-0.1**	**0.0**	**-0.9**	**-0.7**	**1.6**	**0.9**		**0.8**	**-0.8**
New EU countries	OECD-WTO	**22.3**	**30.8**	**8.8**	**0.1**	**0.2**	62.3	**13.6**	**24.1**	37.7	100.0	38.1	61.9
	WIOD	**23.2**	**29.3**	**9.3**	**0.1**	**0.2**	62.2	**14.7**	**23.2**	37.8	100.0	38.2	61.8
	% difference (OECD-WTO VS WIOD)	**-0.9**	**1.5**	**-0.5**	**0.0**	**0.0**	**0.1**	**-1.0**	**0.9**	**-0.1**		**-0.1**	**0.1**
Rest of the World	OECD-WTO	20.2	51.7	7.4	1.2	3.0	83.6	5.1	11.3	16.4	100.0	20.6	79.4
	WIOD	16.4	44.6	6.6	1.4	3.8	72.8	9.6	17.6	27.2	100.0	32.4	67.6
	% difference (OECD-WTO VS WIOD)	**3.8**	**7.1**	**0.9**	**-0.2**	**-0.7**	**10.9**	**-4.5**	**-6.4**	**-10.9**		**-11.8**	**11.8**
World	OECD-WTO	27.2	39.7	7.6	1.1	1.6	77.2	8.7	14.1	22.8	100.0	25.5	74.5
	WIOD	25.3	39.2	8.3	1.1	1.8	75.7	9.4	14.9	24.3	100.0	27.2	72.8
	% difference (OECD-WTO VS WIOD)	**1.9**	**0.5**	**-0.7**	**0.0**	**-0.2**	**1.5**	**-0.7**	**-0.8**	**-1.5**		**-1.7**	**1.7**

Table 8. The value-added components of gross exports - Comparison between OECD-WTO TiVA and WIOD, 2008 (% of total gross exports)

		Domestic VA content of exports						Foreign VA content of exports			Additional indicators		
		Direct VA exports of final Goods and Services (G/S) (1)	Direct VA exports of intermediate G/S (2)	Indirect VA exports of G/S to third countries (3)	Returned domestic VA in final G/S (4)	Returned Domestic VA in intermediate G/S (5)	Total (= 1 to 5) (6)	Foreign VA in final G/S (7)	Foreign VA in intermediate G/S (8)	Total (= 7+8) (9)	Total of all VA components (= 6+9) (10)	Total multiple counting (= 4+5+7+8) (11)	Value added exports (= 1+2+3) (12)
Australia	OECD-WTO	17.6	59.3	9.1	0.2	0.4	86.6	2.6	10.8	13.4	100.0	14.0	86.0
	WIOD	12.3	59.7	11.7	0.3	0.4	84.4	2.3	13.3	15.6	100.0	16.3	83.7
	% difference (OECD-WTO VS WIOD)	**5.3**	**-0.4**	**-2.7**	**-0.1**	**0.0**	**2.2**	**0.3**	**-2.5**	**-2.2**		**-2.3**	**2.3**
Brazil	OECD-WTO	26.0	52.1	10.2	0.2	0.3	88.6	3.4	7.9	11.4	100.0	11.8	88.2
	WIOD	23.0	51.3	12.3	0.2	0.3	87.1	3.9	9.0	12.9	100.0	13.4	86.6
	% difference (OECD-WTO VS WIOD)	**3.0**	**0.8**	**-2.1**	**0.0**	**-0.1**	**1.5**	**-0.4**	**-1.1**	**-1.5**		**-1.6**	**1.6**
Canada	OECD-WTO	25.4	47.5	4.5	0.6	0.8	78.8	9.4	11.8	21.2	100.0	22.6	77.4
	WIOD	19.1	50.9	6.3	0.5	0.7	77.6	8.4	13.9	22.4	100.0	23.6	76.4
	% difference (OECD-WTO VS WIOD)	**6.3**	**-3.4**	**-1.8**	**0.0**	**0.1**	**1.2**	**1.0**	**-2.1**	**-1.2**		**-1.0**	**1.0**
China	OECD-WTO	41.5	26.8	6.0	0.4	1.8	76.6	12.1	11.3	23.4	100.0	25.6	74.4
	WIOD	36.0	31.6	7.7	0.4	1.8	77.5	10.5	12.0	22.5	100.0	24.7	75.3
	% difference (OECD-WTO VS WIOD)	**5.6**	**-4.8**	**-1.7**	**-0.1**	**0.0**	**-0.9**	**1.6**	**-0.7**	**0.9**		**0.9**	**-0.9**
India	OECD-WTO	25.7	43.8	7.4	0.1	0.3	77.4	8.3	14.4	22.6	100.0	23.1	76.9
	WIOD	32.1	38.1	8.0	0.1	0.4	78.8	10.1	11.1	21.2	100.0	21.7	78.3
	% difference (OECD-WTO VS WIOD)	**-6.4**	**5.7**	**-0.6**	**0.0**	**0.0**	**-1.4**	**-1.8**	**3.3**	**1.4**		**1.4**	**-1.4**
Indonesia	OECD-WTO	21.1	52.4	8.7	0.1	0.3	82.6	6.6	10.7	17.4	100.0	17.8	82.2
	WIOD	15.7	56.0	11.2	0.1	0.3	83.3	5.0	11.7	16.7	100.0	17.1	82.9
	% difference (OECD-WTO VS WIOD)	**5.4**	**-3.5**	**-2.5**	**0.0**	**0.0**	**-0.7**	**1.6**	**-0.9**	**0.7**		**0.6**	**-0.6**
Japan	OECD-WTO	30.5	39.3	10.2	0.4	0.9	81.4	6.1	12.5	18.6	100.0	19.9	80.1
	WIOD	28.0	41.6	10.5	0.6	1.1	81.8	5.7	12.5	18.2	100.0	19.8	80.2
	% difference (OECD-WTO VS WIOD)	**2.5**	**-2.3**	**-0.3**	**-0.1**	**-0.2**	**-0.4**	**0.4**	**0.0**	**0.4**		**0.1**	**-0.1**
Korea Rep	OECD-WTO	18.3	30.9	8.9	0.2	0.6	58.8	9.3	31.9	41.2	100.0	41.9	58.1
	WIOD	19.2	30.3	8.1	0.1	0.5	58.2	11.4	30.3	41.8	100.0	42.4	57.6
	% difference (OECD-WTO VS WIOD)	**-0.9**	**0.6**	**0.8**	**0.0**	**0.0**	**0.6**	**-2.1**	**1.5**	**-0.6**		**-0.5**	**0.5**
Mexico	OECD-WTO	28.1	36.1	4.5	0.2	0.6	69.5	17.7	12.8	30.5	100.0	31.3	68.7
	WIOD	22.2	41.5	6.8	0.3	0.6	71.4	13.2	15.4	28.6	100.0	29.5	70.5
	% difference (OECD-WTO VS WIOD)	**5.8**	**-5.4**	**-2.3**	**-0.1**	**0.0**	**-1.9**	**4.5**	**-2.6**	**1.9**		**1.9**	**-1.9**
Russia	**OECD-WTO**	6.6	72.9	12.2	0.6	0.4	92.7	0.9	6.4	7.3	100.0	8.3	91.7
	WIOD	8.8	64.1	18.9	0.5	0.6	92.9	0.8	6.3	7.1	100.0	8.2	91.8
	% difference (OECD-WTO VS WIOD)	**-2.1**	**8.8**	**-6.8**	**0.1**	**-0.1**	**-0.2**	**0.1**	**0.1**	**0.2**		**0.1**	**-0.1**
Chinese Taipei	OECD-WTO	15.1	27.4	10.0	0.1	0.5	53.1	10.7	36.3	46.9	100.0	47.5	52.5
	WIOD	11.9	29.1	10.1	0.1	0.4	51.5	9.5	38.9	48.5	100.0	49.0	51.0
	% difference (OECD-WTO VS WIOD)	**3.2**	**-1.6**	**-0.1**	**0.0**	**0.1**	**1.5**	**1.1**	**-2.7**	**-1.5**		**-1.5**	**1.5**
Turkey	OECD-WTO	40.7	26.7	6.2	0.1	0.2	73.9	12.9	13.3	26.1	100.0	26.4	73.6
	WIOD	32.6	35.4	9.2	0.2	0.3	77.6	9.9	12.4	22.4	100.0	22.9	77.1
	% difference (OECD-WTO VS WIOD)	**8.2**	**-8.8**	**-2.9**	**-0.1**	**-0.1**	**-3.8**	**2.9**	**0.8**	**3.8**		**3.5**	**-3.5**
United States	OECD-WTO	29.4	42.1	7.3	3.4	3.4	85.6	4.8	9.6	14.4	100.0	21.1	78.9
	WIOD	25.1	45.2	8.0	3.2	3.6	85.0	5.3	9.6	15.0	100.0	21.8	78.2
	% difference (OECD-WTO VS WIOD)	**4.4**	**-3.1**	**-0.7**	**0.2**	**-0.2**	**0.6**	**-0.5**	**-0.1**	**-0.6**		**-0.6**	**0.6**
Western EU	OECD-WTO	28.5	33.7	7.8	0.6	0.9	71.6	10.7	17.6	28.4	100.0	29.9	70.1
	WIOD	26.1	33.4	8.6	0.7	1.1	69.8	11.8	18.4	30.2	100.0	32.0	68.0
	% difference (OECD-WTO VS WIOD)	**2.5**	**0.3**	**-0.7**	**-0.1**	**-0.2**	**1.9**	**-1.1**	**-0.8**	**-1.9**		**-2.1**	**2.1**
New EU countries	OECD-WTO	27.1	27.2	8.2	0.1	0.2	62.8	16.4	20.7	37.2	100.0	37.6	62.4
	WIOD	21.9	28.6	9.2	0.1	0.3	60.1	15.4	24.5	39.9	100.0	40.3	59.7
	% difference (OECD-WTO VS WIOD)	**5.2**	**-1.4**	**-1.0**	**0.0**	**-0.1**	**2.7**	**1.0**	**-3.7**	**-2.7**		**-2.8**	**2.8**
Rest of the World	OECD-WTO	17.8	54.3	7.5	1.7	4.1	85.3	4.8	9.9	14.7	100.0	20.5	79.5
	WIOD	15.0	45.1	6.8	2.1	5.4	74.3	8.5	17.2	25.7	100.0	33.1	66.9
	% difference (OECD-WTO VS WIOD)	**2.8**	**9.2**	**0.7**	**-0.4**	**-1.3**	**11.0**	**-3.7**	**-7.3**	**-11.0**		**-12.7**	**12.7**
World	OECD-WTO	26.6	39.8	7.8	1.0	1.7	76.8	8.7	14.5	23.2	100.0	25.9	74.1
	WIOD	23.4	38.9	8.5	1.1	2.1	73.9	9.6	16.5	26.1	100.0	29.2	70.8
	% difference (OECD-WTO VS WIOD)	**3.2**	**0.9**	**-0.7**	**-0.1**	**-0.4**	**2.8**	**-0.8**	**-2.0**	**-2.8**		**-3.3**	**3.3**

Table 9. The value-added components of gross exports - Comparison between OECD-WTO TiVA and WIOD, 2009 (% of total gross exports)

		Domestic VA content of exports						Foreign VA content of exports				Additional indicators	
		Direct VA exports of final Goods and Services (G/S) (1)	Direct VA exports of intermediate G/S (2)	Indirect VA exports of G/S to third countries (3)	Returned domestic VA in final G/S (4)	Returned Domestic VA in intermediate G/S (5)	Total (= 1 to 5) (6)	Foreign VA in final G/S (7)	Foreign VA in intermediate G/S (8)	Total (= 7+8) (9)	Total of all VA components (= 6+9) (10)	Total multiple counting (= 4+5+7+8) (11)	Value added exports (= 1+2+3) (12)
Australia	OECD-WTO	17.0	62.3	8.1	0.2	0.4	88.0	2.4	9.7	12.0	100.0	12.6	87.4
	WIOD	14.4	62.2	10.3	0.3	0.4	87.5	2.3	10.1	12.5	100.0	13.1	86.9
	% difference (OECD-WTO VS WIOD)	**2.6**	**0.1**	**-2.2**	**-0.1**	**0.0**	**0.4**	**0.0**	**-0.4**	**-0.4**		**-0.5**	**0.5**
Brazil	OECD-WTO	24.2	57.1	9.5	0.1	0.2	91.1	2.5	6.4	8.9	100.0	9.3	90.7
	WIOD	24.4	53.5	11.6	0.2	0.2	89.9	3.0	7.1	10.1	100.0	10.5	89.5
	% difference (OECD-WTO VS WIOD)	**-0.2**	**3.6**	**-2.2**	**0.0**	**0.0**	**1.2**	**-0.4**	**-0.7**	**-1.2**		**-1.2**	**1.2**
Canada	OECD-WTO	28.9	46.4	4.3	0.4	0.6	80.5	9.3	10.2	19.5	100.0	20.5	79.5
	WIOD	22.3	50.4	5.8	0.5	0.6	79.6	8.2	12.3	20.4	100.0	21.5	78.5
	% difference (OECD-WTO VS WIOD)	**6.6**	**-4.1**	**-1.6**	**0.0**	**0.0**	**0.9**	**1.2**	**-2.1**	**-0.9**		**-1.0**	**1.0**
China	OECD-WTO	43.9	27.8	5.8	0.4	1.8	79.7	10.6	9.7	20.3	100.0	22.6	77.4
	WIOD	39.6	31.7	7.4	0.6	1.8	81.0	9.3	9.6	19.0	100.0	21.3	78.7
	% difference (OECD-WTO VS WIOD)	**4.3**	**-3.9**	**-1.7**	**-0.2**	**0.1**	**-1.4**	**1.3**	**0.1**	**1.4**		**1.3**	**-1.3**
India	OECD-WTO	25.6	46.4	6.7	0.2	0.3	79.1	8.3	12.6	20.9	100.0	21.4	78.6
	WIOD	37.6	33.0	6.2	0.1	0.3	77.2	14.1	8.7	22.8	100.0	23.2	76.8
	% difference (OECD-WTO VS WIOD)	**-12.0**	**13.4**	**0.4**	**0.1**	**0.0**	**1.9**	**-5.8**	**3.9**	**-1.9**		**-1.8**	**1.8**
Indonesia	OECD-WTO	23.6	53.8	7.9	0.1	0.3	85.6	6.2	8.1	14.4	100.0	14.7	85.3
	WIOD	16.9	58.5	10.6	0.1	0.3	86.4	4.4	9.1	13.6	100.0	13.9	86.1
	% difference (OECD-WTO VS WIOD)	**6.7**	**-4.8**	**-2.7**	**0.0**	**0.0**	**-0.8**	**1.8**	**-1.0**	**0.8**		**0.8**	**-0.8**
Japan	OECD-WTO	29.2	45.1	10.3	0.5	0.8	85.9	4.3	9.8	14.1	100.0	15.4	84.6
	WIOD	28.2	46.5	10.5	0.6	0.9	86.6	4.0	9.3	13.4	100.0	14.9	85.1
	% difference (OECD-WTO VS WIOD)	**1.1**	**-1.4**	**-0.2**	**-0.1**	**0.0**	**-0.7**	**0.3**	**0.4**	**0.7**		**0.5**	**-0.5**
Korea Rep	OECD-WTO	18.3	34.0	8.3	0.1	0.5	61.2	8.9	29.9	38.8	100.0	39.5	60.5
	WIOD	21.4	33.1	7.6	0.1	0.5	62.7	11.0	26.3	37.3	100.0	37.9	62.1
	% difference (OECD-WTO VS WIOD)	**-3.1**	**0.9**	**0.7**	**0.0**	**0.0**	**-1.6**	**-2.1**	**3.7**	**1.6**		**1.6**	**-1.6**
Mexico	OECD-WTO	33.4	31.9	3.8	0.2	0.4	69.8	18.9	11.3	30.2	100.0	30.9	69.1
	WIOD	26.3	38.6	5.8	0.3	0.4	71.3	14.2	14.4	28.7	100.0	29.4	70.6
	% difference (OECD-WTO VS WIOD)	**7.1**	**-6.6**	**-2.0**	**-0.1**	**0.0**	**-1.6**	**4.7**	**-3.1**	**1.6**		**1.5**	**-1.5**
Russia	**OECD-WTO**	8.6	73.1	10.8	0.4	0.4	93.2	0.9	5.9	6.8	100.0	7.6	92.4
	WIOD	9.5	68.1	16.3	0.4	0.4	94.7	0.7	4.6	5.3	100.0	6.2	93.8
	% difference (OECD-WTO VS WIOD)	**-1.0**	**5.0**	**-5.4**	**0.0**	**0.0**	**-1.5**	**0.2**	**1.3**	**1.5**		**1.4**	**-1.4**
Chinese Taipei	OECD-WTO	17.0	32.2	9.6	0.1	0.4	59.4	9.7	30.9	40.6	100.0	41.2	58.8
	WIOD	13.1	33.9	10.2	0.1	0.4	57.7	8.3	34.0	42.3	100.0	42.8	57.2
	% difference (OECD-WTO VS WIOD)	**3.9**	**-1.7**	**-0.6**	**0.0**	**0.1**	**1.6**	**1.4**	**-3.1**	**-1.6**		**-1.6**	**1.6**
Turkey	OECD-WTO	43.5	28.6	6.1	0.1	0.1	78.5	11.7	9.9	21.5	100.0	21.8	78.2
	WIOD	35.0	37.6	9.0	0.2	0.2	82.0	8.4	9.6	18.0	100.0	18.4	81.6
	% difference (OECD-WTO VS WIOD)	**8.5**	**-9.0**	**-2.9**	**-0.1**	**0.0**	**-3.6**	**3.3**	**0.3**	**3.6**		**3.4**	**-3.4**
United States	OECD-WTO	29.7	46.1	7.2	3.2	2.7	88.8	3.7	7.5	11.2	100.0	17.1	82.9
	WIOD	26.7	48.3	7.6	3.0	3.0	88.7	4.2	7.1	11.3	100.0	17.4	82.6
	% difference (OECD-WTO VS WIOD)	**3.0**	**-2.2**	**-0.5**	**0.1**	**-0.3**	**0.1**	**-0.5**	**0.4**	**-0.1**		**-0.3**	**0.3**
Western EU	OECD-WTO	29.4	35.3	7.5	0.6	0.8	73.7	10.3	16.0	26.3	100.0	27.7	72.3
	WIOD	28.1	35.2	8.0	0.7	0.9	72.9	10.9	16.1	27.1	100.0	28.6	71.4
	% difference (OECD-WTO VS WIOD)	**1.3**	**0.1**	**-0.5**	**-0.1**	**-0.1**	**0.8**	**-0.6**	**-0.2**	**-0.8**		**-0.9**	**0.9**
New EU countries	OECD-WTO	29.4	28.5	7.9	0.1	0.2	66.2	15.6	18.2	33.8	100.0	34.1	65.9
	WIOD	24.9	30.4	9.0	0.1	0.3	64.7	14.7	20.6	35.3	100.0	35.7	64.3
	% difference (OECD-WTO VS WIOD)	**4.5**	**-1.9**	**-1.1**	**0.0**	**0.0**	**1.5**	**0.9**	**-2.4**	**-1.5**		**-1.5**	**1.5**
Rest of the World	OECD-WTO	19.8	52.8	6.8	1.6	3.9	84.9	5.2	9.9	15.1	100.0	20.6	79.4
	WIOD	18.9	44.8	6.5	1.8	4.2	76.2	8.8	15.0	23.8	100.0	29.8	70.2
	% difference (OECD-WTO VS WIOD)	**0.9**	**8.0**	**0.4**	**-0.2**	**-0.3**	**8.8**	**-3.7**	**-5.1**	**-8.8**		**-9.2**	**9.2**
World	OECD-WTO	28.0	41.0	7.3	0.9	1.5	78.7	8.3	13.0	21.3	100.0	23.7	76.3
	WIOD	26.2	40.2	8.0	1.0	1.7	77.0	9.0	14.0	23.0	100.0	25.7	74.3
	% difference (OECD-WTO VS WIOD)	**1.8**	**0.8**	**-0.7**	**-0.1**	**-0.1**	**1.7**	**-0.7**	**-1.0**	**-1.7**		**-1.9**	**1.9**

4.2.2 Comparison of Major Value-added Components in Gross Exports – GTAP vs WIOD

The results of the comparison of the value-added components of gross exports between the GTAP and the WIOD data sets are reported in tables 10 and 11. These estimates are computed using the same methodology by Koopman *et al.* (2014), and the results are presented the same way as for the OECD-WTO/WIOD comparison, for two years, 2004 and 2007. Generally speaking, GTAP-WIOD differences are much more significant than those noted between the OECD-WTO and WIOD.

The main noticeable differences in the results obtained from the two sources pertain to the value-added components of exports in both final and intermediate goods and services that are absorbed by direct importers. This can be observed identically for the two years under review (see columns 1 and 2 in the two tables). While the shares of value-added exports of final goods and services in gross exports (see column 1) are much bigger in GTAP results than in WIOD's, for all countries except Turkey, the opposite trend is observed for intermediates (see column 2).

GTAP 2004 and 2007 estimates of value-added exports of final goods and services absorbed by direct importers exceed those based on WIOD data by more than 10% for most countries. The difference with WIOD estimates stand at 11.8% at world level for 2004 and reaches 24.9% for Indonesia and even 34.9% for Russia, the highest differential noticed from the two tables. On the contrary, GTAP estimates of value-added in intermediates' gross exports absorbed by direct importers are much lower than WIOD's. For few countries, including Australia, Canada and Japan, the range of the deviation shown for intermediates is almost the same as for final goods and services. For example, the GTAP-WIOD difference for Canada value-added exports absorbed by direct importers in 2007 stands at 16.7 % for final goods and services (see column 1 in table 11) and -16.7% for intermediates (see column 2 in table 11). Such a balanced deviation between the two types of goods suggests that the two sources might use different HS (Harmonized System trade classification) to end-use concordance to allocate aggregate bilateral trade flows to intermediate and final goods.

Turkey presents the highest GTAP-WIOD deviations for the domestic and foreign value-added of exports, of about +/- 10% (see columns 6 and 9 in Tables 10 and 11). Surprisingly, this was also the case with the OECD-WTO/WIOD comparison where the difference is around +/- 5% for 2005. That presupposes a difference in the processing of Turkish data between WIOD and the two other ICIO tables. This discrepancy may also be related to the numerous deviations observed with official statistics for this country in the previous sections.

Similarly to the OECD-WTO/WIOD comparison, the differences noticed for the shares of indirect value-added exports (see column 3) or those of the domestic value-added returned back home (see columns 4 and 5) are generally minor. The major differences for the share of indirect value-added exports in gross exports are noticed for Russia and Turkey.

Table 10. The value-added components of gross exports - Comparison between GTAP and WIOD results, 2004 (% of total gross exports)

		Domestic VA content of exports						Foreign VA content of exports				Additional indicators	
		Direct VA exports of final Goods and Services (G/S) (1)	Direct VA exports of intermediate G/S (2)	Indirect VA exports of G/S to third countries (3)	Returned domestic VA in final G/S (4)	Returned Domestic VA in intermediate G/S (5)	Total (= 1 to 5) (6)	Foreign VA in final G/S (7)	Foreign VA in intermediate G/S (8)	Total (= 7+8) (9)	Total of all VA components (= 6+9) (10)	Total multiple counting (= 4+5+7+8) (11)	Value added exports (= 1+2+3) (12)
Australia	GTAP	34.6	44.6	10.7	0.2	0.1	90.2	4.1	5.8	9.8	100.0	10.2	89.8
	WIOD	19.6	57.2	9.9	0.2	0.3	87.2	3.1	9.7	12.8	100.0	13.3	86.7
	% difference (GTAP VS WIOD)	**14.9**	**-12.6**	**0.8**	**0.0**	**-0.1**	**3.0**	**1.0**	**-4.0**	**-3.0**		**-3.1**	**3.1**
Brazil	GTAP	47.4	35.6	9.3	0.2	0.0	92.6	3.9	3.5	7.4	100.0	7.7	92.3
	WIOD	27.8	48.5	10.8	0.1	0.2	87.3	4.6	8.1	12.7	100.0	12.9	87.1
	% difference (GTAP VS WIOD)	**19.7**	**-12.9**	**-1.5**	**0.1**	**-0.1**	**5.3**	**-0.7**	**-4.6**	**-5.3**		**-5.3**	**5.3**
Canada	GTAP	41.3	28.0	4.4	0.5	0.4	74.5	17.0	8.5	25.5	100.0	26.3	73.7
	WIOD	24.3	45.7	4.4	0.5	0.6	75.6	11.2	13.2	24.4	100.0	25.6	74.4
	% difference (GTAP VS WIOD)	**17.0**	**-17.7**	**0.0**	**0.0**	**-0.2**	**-1.0**	**5.7**	**-4.7**	**1.0**		**0.8**	**-0.8**
China	GTAP	31.5	30.0	9.1	0.3	1.5	72.4	14.0	13.6	27.6	100.0	29.4	70.6
	WIOD	34.0	31.5	7.5	0.4	1.5	75.0	11.9	13.1	25.0	100.0	26.9	73.1
	% difference (GTAP VS WIOD)	**-2.5**	**-1.6**	**1.5**	**-0.1**	**0.0**	**-2.6**	**2.2**	**0.5**	**2.6**		**2.6**	**-2.6**
India	GTAP	38.3	37.6	9.7	0.2	0.1	85.9	6.7	7.3	14.1	100.0	14.4	85.6
	WIOD	31.6	42.4	8.7	0.1	0.3	83.0	7.7	9.3	17.0	100.0	17.4	82.6
	% difference (GTAP VS WIOD)	**6.8**	**-4.7**	**1.0**	**0.1**	**-0.2**	**2.9**	**-1.0**	**-1.9**	**-2.9**		**-3.0**	**3.0**
Indonesia	GTAP	42.9	33.0	10.2	0.2	0.1	86.4	6.2	7.4	13.6	100.0	13.8	86.2
	WIOD	18.0	52.1	10.4	0.1	0.2	80.8	5.3	13.8	19.2	100.0	19.5	80.5
	% difference (GTAP VS WIOD)	**24.9**	**-19.1**	**-0.2**	**0.1**	**-0.2**	**5.6**	**0.9**	**-6.5**	**-5.6**		**-5.6**	**5.6**
Japan	GTAP	50.5	25.5	11.8	1.1	0.6	89.5	6.0	4.5	10.5	100.0	12.3	87.7
	WIOD	33.2	43.7	10.9	0.9	1.1	89.8	3.7	6.6	10.2	100.0	12.2	87.8
	% difference (GTAP VS WIOD)	**17.3**	**-18.2**	**0.8**	**0.3**	**-0.5**	**-0.3**	**2.3**	**-2.0**	**0.3**		**0.1**	**-0.1**
Korea Rep	GTAP	36.8	22.2	9.1	0.2	0.4	68.7	17.5	13.8	31.3	100.0	31.9	68.1
	WIOD	26.2	32.7	8.9	0.2	0.5	68.5	10.8	20.7	31.5	100.0	32.2	67.8
	% difference (GTAP VS WIOD)	**10.6**	**-10.5**	**0.2**	**0.0**	**-0.2**	**0.2**	**6.7**	**-6.9**	**-0.2**		**-0.3**	**0.3**
Mexico	GTAP	36.9	31.5	6.6	0.2	0.5	75.7	14.3	10.0	24.3	100.0	25.1	74.9
	WIOD	24.5	37.9	5.6	0.2	0.5	68.8	15.1	16.2	31.2	100.0	32.0	68.0
	% difference (GTAP VS WIOD)	**12.4**	**-6.4**	**0.9**	**0.0**	**0.0**	**6.9**	**-0.8**	**-6.1**	**-6.9**		**-6.9**	**6.9**
Russia	**GTAP**	44.9	32.8	12.4	0.2	0.2	90.5	5.4	4.2	9.5	100.0	9.9	90.1
	WIOD	10.0	66.1	15.5	0.3	0.3	92.1	1.1	6.8	7.9	100.0	8.4	91.6
	% difference (GTAP VS WIOD)	**34.9**	**-33.2**	**-3.1**	**-0.1**	**-0.1**	**-1.7**	**4.3**	**-2.6**	**1.7**		**1.4**	**-1.4**
Chinese Taipei	GTAP	31.7	22.8	8.8	0.1	0.3	63.6	18.4	18.0	36.4	100.0	36.8	63.2
	WIOD	16.2	31.1	10.0	0.2	0.5	57.9	10.8	31.3	42.1	100.0	42.8	57.2
	% difference (GTAP VS WIOD)	**15.5**	**-8.4**	**-1.2**	**-0.1**	**-0.2**	**5.7**	**7.6**	**-13.3**	**-5.7**		**-6.0**	**6.0**
Turkey	GTAP	35.5	36.6	12.1	0.2	0.1	84.5	6.0	9.5	15.5	100.0	15.8	84.2
	WIOD	40.1	25.8	7.9	0.1	0.2	74.1	12.7	13.2	25.9	100.0	26.2	73.8
	% difference (GTAP VS WIOD)	**-4.6**	**10.8**	**4.2**	**0.1**	**-0.1**	**10.4**	**-6.7**	**-3.7**	**-10.4**		**-10.3**	**10.3**
United States	GTAP	46.9	27.2	6.7	5.0	2.8	88.6	6.4	5.0	11.4	100.0	19.3	80.7
	WIOD	26.5	45.1	7.3	4.8	4.6	88.4	4.2	7.4	11.6	100.0	21.0	79.0
	% difference (GTAP VS WIOD)	**20.4**	**-17.9**	**-0.7**	**0.2**	**-1.8**	**0.2**	**2.3**	**-2.4**	**-0.2**		**-1.7**	**1.7**
Western EU countries	GTAP	38.4	28.4	9.0	0.9	0.7	77.3	11.6	11.1	22.7	100.0	24.2	75.8
	WIOD	29.0	35.0	8.6	0.8	1.0	74.4	10.7	15.0	25.6	100.0	27.4	72.6
	% difference (GTAP VS WIOD)	**9.4**	**-6.6**	**0.4**	**0.1**	**-0.3**	**3.0**	**0.9**	**-3.9**	**-3.0**		**-3.2**	**3.2**
New EU countries	GTAP	33.7	23.7	9.1	0.1	0.2	66.9	17.2	15.9	33.1	100.0	33.4	66.6
	WIOD	23.2	29.2	9.3	0.1	0.2	62.0	14.9	23.1	38.0	100.0	38.4	61.6
	% difference (GTAP VS WIOD)	**10.5**	**-5.4**	**-0.1**	**0.0**	**-0.1**	**4.9**	**2.3**	**-7.2**	**-4.9**		**-5.0**	**5.0**
Rest of the World	GTAP	29.8	40.2	10.2	2.1	2.0	84.2	7.3	8.5	15.8	100.0	19.8	80.2
	WIOD	17.8	43.5	6.5	1.3	3.5	72.6	10.0	17.4	27.4	100.0	32.2	67.8
	% difference (GTAP VS WIOD)	**12.0**	**-3.3**	**3.7**	**0.8**	**-1.5**	**11.7**	**-2.7**	**-8.9**	**-11.7**		**-12.3**	**12.3**
World	GTAP	38.1	30.3	9.1	1.4	1.1	79.9	10.4	9.7	20.1	100.0	22.6	77.4
	WIOD	26.3	39.0	8.2	1.2	1.7	76.3	9.4	14.3	23.7	100.0	26.5	73.5
	% difference (GTAP VS WIOD)	**11.8**	**-8.7**	**0.9**	**0.2**	**-0.6**	**3.6**	**1.1**	**-4.6**	**-3.6**		**-4.0**	**4.0**

Table 11. The value-added components of gross exports - Comparison between GTAP and WIOD results, 2007 (% of total gross exports)

		Domestic VA content of exports						Foreign VA content of exports				Additional indicators	
		Direct VA exports of final Goods and Services (G/S)	Direct VA exports of intermediate G/S	Indirect VA exports of G/S to third countries	Returned domestic VA in final G/S	Returned Domestic VA in intermediate G/S	Total (= 1 to 5)	Foreign VA in final G/S	Foreign VA in intermediate G/S	Total (= 7+8)	Total of all VA components (= 6+9)	Total multiple counting (= 4+5+7+8)	Value added exports (= 1+2+3)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Australia	GTAP	26.0	49.6	13.7	0.3	0.2	89.8	3.6	6.5	10.2	100.0	10.6	89.4
	WIOD	14.2	58.9	11.2	0.3	0.4	85.0	2.5	12.5	15.0	100.0	15.6	84.4
	% difference (GTAP VS WIOD)	**11.8**	**-9.3**	**2.4**	**0.0**	**-0.2**	**4.8**	**1.2**	**-6.0**	**-4.8**		**-5.0**	**5.0**
Brazil	GTAP	40.8	40.7	10.8	0.4	0.1	92.7	3.4	3.8	7.3	100.0	7.7	92.3
	WIOD	26.4	49.5	12.0	0.1	0.2	88.3	3.8	7.9	11.7	100.0	12.1	87.9
	% difference (GTAP VS WIOD)	**14.4**	**-8.8**	**-1.2**	**0.2**	**-0.2**	**4.5**	**-0.4**	**-4.1**	**-4.5**		**-4.4**	**4.4**
Canada	GTAP	39.0	30.9	5.4	0.5	0.5	76.3	14.9	8.8	23.7	100.0	24.7	75.3
	WIOD	22.4	47.6	5.7	0.5	0.7	76.9	9.8	13.3	23.1	100.0	24.3	75.7
	% difference (GTAP VS WIOD)	**16.7**	**-16.7**	**-0.3**	**0.0**	**-0.2**	**-0.5**	**5.1**	**-4.6**	**0.5**		**0.3**	**-0.3**
China	GTAP	33.9	30.5	8.3	0.4	1.6	74.7	13.3	12.0	25.3	100.0	27.3	72.7
	WIOD	35.8	30.4	7.4	0.4	1.8	75.7	11.6	12.7	24.3	100.0	26.5	73.5
	% difference (GTAP VS WIOD)	**-1.9**	**0.1**	**1.0**	**0.0**	**-0.2**	**-1.0**	**1.7**	**-0.7**	**1.0**		**0.7**	**-0.7**
India	GTAP	31.8	39.9	9.7	0.3	0.2	81.8	8.2	9.9	18.2	100.0	18.6	81.4
	WIOD	31.9	39.2	8.0	0.1	0.4	79.7	9.9	10.4	20.3	100.0	20.8	79.2
	% difference (GTAP VS WIOD)	**-0.2**	**0.7**	**1.6**	**0.1**	**-0.2**	**2.1**	**-1.7**	**-0.5**	**-2.1**		**-2.2**	**2.2**
Indonesia	GTAP	39.5	37.9	10.3	0.2	0.1	88.0	5.6	6.4	12.0	100.0	12.2	87.8
	WIOD	17.0	55.3	11.3	0.1	0.3	84.0	4.3	11.6	16.0	100.0	16.3	83.7
	% difference (GTAP VS WIOD)	**22.5**	**-17.4**	**-1.0**	**0.1**	**-0.2**	**4.0**	**1.3**	**-5.2**	**-4.0**		**-4.1**	**4.1**
Japan	GTAP	47.7	25.2	10.2	0.7	0.5	84.4	8.6	7.0	15.6	100.0	16.8	83.2
	WIOD	29.6	42.2	11.1	0.6	1.1	84.6	5.0	10.4	15.4	100.0	17.1	82.9
	% difference (GTAP VS WIOD)	**18.1**	**-16.9**	**-0.9**	**0.1**	**-0.6**	**-0.2**	**3.5**	**-3.4**	**0.2**		**-0.3**	**0.3**
Korea Rep	GTAP	35.4	21.5	8.9	0.2	0.4	66.4	18.3	15.3	33.6	100.0	34.2	65.8
	WIOD	21.2	34.2	9.6	0.2	0.6	65.7	9.5	24.7	34.3	100.0	35.1	64.9
	% difference (GTAP VS WIOD)	**14.2**	**-12.7**	**-0.7**	**0.0**	**-0.2**	**0.7**	**8.8**	**-9.4**	**-0.7**		**-0.9**	**0.9**
Mexico	GTAP	35.3	34.1	7.5	0.2	0.5	77.6	12.2	10.1	22.4	100.0	23.1	76.9
	WIOD	22.3	41.0	6.6	0.3	0.6	70.8	13.4	15.8	29.2	100.0	30.1	69.9
	% difference (GTAP VS WIOD)	**13.0**	**-6.9**	**0.9**	**0.0**	**-0.1**	**6.9**	**-1.2**	**-5.7**	**-6.9**		**-7.0**	**7.0**
Russia	GTAP	41.5	36.3	12.7	0.3	0.3	91.2	4.6	4.3	8.8	100.0	9.4	90.6
	WIOD	9.2	65.4	17.7	0.4	0.4	93.1	0.8	6.1	6.9	100.0	7.7	92.3
	% difference (GTAP VS WIOD)	**32.3**	**-29.0**	**-5.0**	**-0.1**	**-0.2**	**-2.0**	**3.8**	**-1.8**	**2.0**		**1.7**	**-1.7**
Chinese Taipei	GTAP	26.8	23.1	9.8	0.1	0.3	60.1	17.8	22.1	39.9	100.0	40.3	59.7
	WIOD	12.4	30.4	11.0	0.1	0.5	54.4	9.3	36.3	45.6	100.0	46.2	53.8
	% difference (GTAP VS WIOD)	**14.5**	**-7.2**	**-1.2**	**0.0**	**-0.2**	**5.7**	**8.5**	**-14.2**	**-5.7**		**-6.0**	**6.0**
Turkey	GTAP	33.0	36.5	11.4	0.2	0.2	81.3	7.1	11.6	18.7	100.0	19.1	80.9
	WIOD	36.1	26.2	8.0	0.1	0.3	70.6	13.3	16.0	29.4	100.0	29.7	70.3
	% difference (GTAP VS WIOD)	**-3.1**	**10.3**	**3.4**	**0.1**	**-0.1**	**10.7**	**-6.2**	**-4.4**	**-10.7**		**-10.6**	**10.6**
United States	GTAP	43.5	29.0	7.1	3.8	2.6	86.0	7.6	6.4	14.0	100.0	20.4	79.6
	WIOD	25.4	45.7	7.8	3.8	4.0	86.8	4.7	8.5	13.2	100.0	21.1	78.9
	% difference (GTAP VS WIOD)	**18.1**	**-16.7**	**-0.7**	**0.0**	**-1.4**	**-0.7**	**2.8**	**-2.1**	**0.7**		**-0.7**	**0.7**
Western EU countries	GTAP	34.8	29.1	8.9	0.8	0.8	74.4	12.4	13.2	25.6	100.0	27.2	72.8
	WIOD	26.7	34.0	8.7	0.7	1.1	71.2	11.4	17.5	28.8	100.0	30.6	69.4
	% difference (GTAP VS WIOD)	**8.1**	**-4.9**	**0.2**	**0.1**	**-0.3**	**3.2**	**1.0**	**-4.3**	**-3.2**		**-3.5**	**3.5**
New EU countries	GTAP	28.9	25.4	9.5	0.1	0.3	64.3	17.0	18.7	35.7	100.0	36.1	63.9
	WIOD	21.8	28.5	9.2	0.1	0.3	59.9	15.5	24.6	40.1	100.0	40.5	59.5
	% difference (GTAP VS WIOD)	**7.2**	**-3.1**	**0.3**	**0.0**	**0.0**	**4.4**	**1.4**	**-5.8**	**-4.4**		**-4.4**	**4.4**
Rest of the World	GTAP	26.0	43.6	11.1	2.8	2.5	85.9	5.9	8.2	14.1	100.0	19.4	80.6
	WIOD	15.3	43.9	6.7	1.8	4.5	72.2	9.2	18.5	27.8	100.0	34.1	65.9
	% difference (GTAP VS WIOD)	**10.7**	**-0.3**	**4.4**	**1.0**	**-2.0**	**13.6**	**-3.3**	**-10.3**	**-13.6**		**-14.7**	**14.7**
World	GTAP	34.5	32.1	9.3	1.3	1.2	78.5	10.6	11.0	21.5	100.0	24.1	75.9
	WIOD	24.2	38.7	8.5	1.1	1.9	74.4	9.6	16.1	25.6	100.0	28.6	71.4
	% difference (GTAP VS WIOD)	**10.3**	**-6.5**	**0.8**	**0.2**	**-0.7**	**4.1**	**1.0**	**-5.1**	**-4.1**		**-4.6**	**4.6**

V. Directions to Further Develop ICIO Tables

5.1 Core Reasons for Discrepancies between ICIO Tables

The construction of ICIO tables is complex and usually requires the application of specific compilation methods and assumptions to reconcile data from different sources and cope with data availability or reliability issues. Therefore, the concepts applied to build the tables can justify for the differences observed with official statistics. For example, GTAP is mainly benchmarked to trade statistics, not sector level supply and demand data for individual countries, which may lead to the differences noticed between GTAP GDP or final demand data and UNNA ones. Additionally, as indicated within the TiVA indicators' comparison, the way goods and services are broken down by end use category in the ICIO table necessarily affects the results obtained for TiVA indicators and explains some of the discrepancies between the three sources.

Data coverage differences between ICIO tables may also be at the origin of some differences observed with official statistics. For instance, the inclusion, or not, of re-exports, or processing trade in the data may justify for differences observed, especially for economies involved in such activities like China, the Netherlands or Mexico.

An ICIO table always reflects the level of data update and availability at the time of its construction. The three ICIO tables under review were compiled at differenttime and may not be necessarily revised in the same way or frequency, especially as the revision of ICIO tables is an intensive task. Thus, comparing an ICIO table with another one more recently updated or revised inevitably could lead to differences, and also impact on their TiVA estimates.

5.2 Highlighting and Documenting the Differences between ICIO Tables and Standard Statistical Frameworks

Trade analysts and policy makers are used to scrutinizing official statistics, like GDP, final demand or trade in goods and services, based on standard statistical systems like the System of National Accounts (SNA), the Balance of Payments (BOP) or customs-based statistics. Since the same economic variables are found in the ICIO tables, it is relevant to compare ICIO values with those from standard statistical systems, like what was done for this study. The objective is to flag and document the observed discrepancies.

Discussing the reasons for these deviations is challenging since they may originate from various aspects: issues with raw data sources, compilation or reconciliation method, and so on. However, ICIO/TiVA users should be able to access quality metadata that describe the differences found in ICIO tables so that they may better interpret and use ICIO tables and derived TiVA indicators.

5.3 Suggestions for future improvement

These data used for the construction of ICIO tables originate from various statistical sources, such as national Input-Output tables, Supply-Use tables, national accounts (output, value-added,..), merchandise trade statistics based on the Broad Economic Categories (BEC) classification or the Harmonized System (HS), trade in services statistics based on the balance of payments, and so on.

In order to improve the reliability of ICIO tables, it is important to address the numerous issues in international trade statistics that affect both goods and services data. Some of the problems to be tackled are: coverage issues, the inconsistency of so-called "mirror" statistics, confidentiality issues, without

omitting the crucial lack of data in some domains, e.g. services bilateral trade statistics. In addition, specific trade patterns such as intra-firm trade, transit-trade, processing trade or re-exports require the development and use of complementary data sources without which ICIO tables will not be able to reflect the reality of international production and trade. Further work is also needed to identify data sources for re-exports and estimate the mark-up margins for major re-exporting countries in the world in order to treat them as country's indirect service exports in future efforts. Moreover, to make GDP and final demand decomposition internally consistent, international shipping services should be treated as an additional industry in the ICIO table, not just simply added to direct value-added in the destination country like in our comparison exercise; the treatment of transactions such as "residents purchase abroad" and "non-residents purchase at domestic market" (see II 2.1) and their inclusion in ICIO tables would also help to better estimate GDP.

International organizations and experts are continuously looking for improving the construction and reliability of ICIO tables. For example, the OECD is currently undertaking a set of activities to improve the production of its ICIO tables. Activities are carried out to improve trade statistics for their use in ICIO tables, including inter alia ways to reduce bilateral trade asymmetries for goods and services or improving the estimation of CIF/FOB margins. Work on the improvement of bilateral trade in services statistics is performed in co-operation with WTO. Conceptual matters like the heterogeneity of firms are also addressed as ways to improve the accuracy of ICIO tables. As to WIOT, the WIOD project has recently revised the preliminary estimates for 2008 and 2009 and updated the WIOT by adding years 2010 and 2011.

In addition to the three databases tackled in this study, there have been a number of attempts to compile ICIO tables in recent years, including Lenzen et al. (2012), Wang (2011), Wang et al. (2012) and Johnson and Noguera (2012). Together, these efforts have led to important improvements in the quality of the estimated ICIO tables. A wide-spread consensus has emerged that global ICIO tables should be benchmarked to official national accounts estimates of output and final consumption, and share structures rather than values per se should be focused on in official bilateral trade statistics. Also, moving away from the traditional crude "proportionality" assumption and capturing firm heterogeneities in imports from different sources should be the direction to pursue.

Besides these common features, each of these recent efforts provides additional useful experience in constructing global ICIO tables, particularly in terms of global balancing. A number of different approaches have thus been adopted to estimate the balanced global tables. For example, Wang (2011) introduced estimates of initial data reliability to guide the balancing process, while Lenzen et al. (2012) proposed a method to estimate the standard error for each cell in the global IO tables to assess their reliability and uncertainty using data of constraint violation and discrepancies between balanced ICIO table and unbalanced initial estimates.[15] Streicher and Stehrer (2012) proposed a method to construct a trade matrix of cif/fob margins together with supply and use tables for the "rest of the world." This results in a consistent global SUT system with international transportation services that is also balanced at the global level. Wang et al (2012) suggest building on these recent efforts by developing a mathematical programming model to integrate individual country SUTs with detailed bilateral trade statistics using a three-stage reconciliation procedure to produce a consistent annual global SUT. Wang *et al.*'s procedure solves the inconsistencies in trade statistics and data from different sources using a system of simultaneous equations that minimize a quadratic penalty function that only allow minimum deviation from both official SUTs and bilateral trade statistics.

In conclusion, we believe that central to these efforts is the identification of basic data sources that will create better indicators of data reliability throughout the ICIO production system, and further

[15] See also Lenzen et al (2012) for details.

improve the methods of identifying and allocating imported intermediate inputs. For instance, current end use classifications, such as the UN BEC, need to be extended to cover dual used products and services. Methods also need to be developed to properly distribute imports to domestic users either based on cross country statistical surveys or based on firm level and Customs transaction-level trade data. Another important element is introducing firm heterogeneity information into traditional SUTs based on firm level data that helps capture the differences between exporters and non-exporters, as well as other important firm characteristics, such as size and ownership, to reduce the aggregation bias in traditional ICIO tables.

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Appendices

Table A1: Countries included in the harmonized database

WIOD code	Description	WIOD code	Description
AUS	Australia	ITA	Italy
AUT	Austria	JPN	Japan
BEL	Belgium	KOR	Korea Rep
BGR	Bulgaria	LTU	Lithuania
BRA	Brazil	LUX	Luxembourg
CAN	Canada	LVA	Latvia
CHN	China	MEX	Mexico
CYP	Cyprus	MLT	Malta
CZE	Czech Rep	NLD	Netherlands
DEU	Germany	POL	Poland
DNK	Denmark	PRT	Portugal
ESP	Spain	ROU	Romania
EST	Estonia	RUS	Russia
FIN	Finland	SVK	Slovakia Rep
FRA	France	SVN	Slovenia Rep
GBR	United Kingdom	SWE	Sweden
GRC	Greece	TUR	Turkey
HUN	Hungary	TWN	Chinese Taipei
IDN	Indonesia	USA	United States
IND	India	WLD	World
IRL	Ireland	ROW	The rest of the World

Table A2: The concordance between WIOD, GTAP, OECD and ISIC rev.3.1 codes

Harmonized sector	ISIC Rev.3.1	WIOD sector	OECD sector	GTAP sector
1	01-05	C1	AGR	prd, wht, gro, v_f, osd, c_b, pfb, ocr, prc, ctl, oap, rmk, wol, fsh, frs
2	10-14	C2	MIN	coa, oil, gas, omn
3	15-16	C3	FOD	cmt, omt, mil, sgr, ofd, vol, b_t
4	17-19	C4-C5	TEX	tex, wap, lea
5	20	C6	WOD	lum
6	21-22	C7	PAP	ppp
7	23	C8	PET	p_c
8	24-25	C9-C10	CHM, RBP	crp
9	26	C11	NMM	nmm
10	27-28	C12	MET, FBM	i_s, nfm, fmp
11	29	C13	MEQ	otn
12	30-33	C14	ITQ, ELQ, CMQ, SCQ	ele, ome
13	34-35	C15	MTR, TRQ	mvh
14	36-37	C16	OTM	omf
15	40-41	C17	EGW	ely, gdt, wtr
16	45	C18	CON	cns
17	50-55	C19-C22	WRT, HTR	trd
18	60, 63	C23, C26	TRN	otp
19	61	C24		wtp
20	62	C25		atp
21	64	C27	PTL	cmn
22	65-66	C28	FIN	ofi, isr
23	70-74	C29-C30	REA, RMQ, ITS, RDS, BZS	obs
24	75, 80, 85	C31-C33	GOV, EDU, HTH	osg
25	90-95	C34-C35	OTS, PVH	ros

Note: GTAP Sector 57 "DWE" is not part of the ISIC classification.