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# Reconciling the GTAP Data Base: Where are the Big Changes?

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**Impact**ECON

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The ImpactECON working paper series focuses on adapting, testing and transitioning academic work for practical, real world use. The end goal is to improve CGE modeling with emphasis on policy and investment analysis through improvements to data and modeling constructs.

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# Abstract

Inaccuracies in the collection and compiling of data mean that data supplied by one country is rarely consistent with data supplied by another. Even within the same country, the same data collected from two alternative sources could vary due to differences in how the data is being collected, interpreted, classified, and valued, notwithstanding the differences caused by simple errors and omissions.

Global economic analysis however, requires consistent and reconciled global data, and this reconciliation process is laden with judgments about the quality of the alternative data sets being reconciled. In the case of the GTAP Data Base (Narayanan, Aguiar et al. 2012) the externally collected trade, macro, protection and energy data supplied by international sources are considered superior to individual country data because it has typically gone through a standardization and balancing process. The extent to which this reconciliation process alters the country data however has not been examined.

In this paper, we hope to shed some light on the extent to which the country data changes as a result of the GTAP construction process. In particular, we are interested in identifying where the largest changes occur as a result of this reconciliation process. Do changes mostly occur in particular countries where the data are poor; or do changes mostly occur in particular data across all countries. The answers to these questions can be used to help ascertain where resources might best be utilized to further improve the quality of global data. We find that there is some evidence that data from developing countries with weaker IO tables and less sectors do undergo more changes than those with more robust IO tables, the largest differences however occur in the sales shares due to differences between the trade data in the IO tables and the balanced trade dataset used in the GTAP database. Further examination of one of the worst tables – Cyprus – revealed issues with the trade data in the original contributed IO tables, although there was also evidence that re-exports also played a role in raising trade by more than expected.

# 1 Introduction

Data collected by one country is rarely consistent with data collected by another due to inaccuracies in the collection and compiling of data. An example of this is in the trade data, where the amount or value of exports one country claims to sell to another rarely matches what the other country claims to import or buy from them, even after transportation and other costs are taken into account. Even within the same country, the same data collected from two alternative sources may differ due to differences in how the data is being collected, interpreted, classified, and valued, notwithstanding the differences caused by errors and omissions. For example, GDP collected from the expenditure side never equals GDP collected from the production side, there is always a statistical discrepancy.

Global economic analysis however, requires consistent and reconciled global data. The reconciliation of global datasets is laden with judgments about the quality of the alternative data sets being reconciled. In the case of the GTAP Data Base (Narayanan, Aguiar et al. 2012) the externally collected trade (Gehlhar, Wang et al. 2008), macroeconomic (World Development Indicators, World Bank), protection (Boumellassa, Laborde et al. 2009) and energy data (Organisation for Economic Cooperation and Development and International Energy Agency 2003) are contributed based on international sources and are considered superior to the individual country data because they have gone through this standardization and reconciliation process, although little research has been undertaken to compare the sources.

The choice of which international datasets to include and how to rank them has evolved over the last twenty years as new data has become available and new policy issues have become increasingly important to policymakers and their constituents. For instance, the growing concern for climate change has globally raised the importance of modelling energy and greenhouse gas emissions, leading to significant changes in the way the GTAP Data Base dealt with energy data.

More recently concerns have been raised about the decision by the Center to rank the international datasets above the country data. As a result other global datasets, namely WIOD developed by Marcel, Erumban et al. (2012), have been produced that give the country data preference. While country data (particularly supply and use tables) has improved considerably over time, and concerted efforts (European Commission, IMF et al. 2008) continue to bring welcome improvements in quality, country data continues to be a source of concern as the country coverage of GTAP expands – the GTAP 8.1 database contained 134 countries, up from 66 in version 5 (Dimaranan and McDougall, 2002). On the other hand, data sources (e.g., Marcel, Erumban et al. (2012) and Tukker, Poliakov et al. (2009)) that start with the intention of giving preferential treatment to country data must ultimately make decisions about what to do about negative residuals in trade.

The extent to which the GTAP reconciliation process (nicknamed *FIT*) alters the country data has not been widely examined, and there is often a great deal of speculation and debate about the extent and necessity of all or some of these changes, particularly as the country data is believed to have improved over time. In this paper we hope to shed some light on this issue by examining the extent to which the country data changes as a result of the GTAP construction process. In particular, we are interested in:

Which countries change the most? Are poorer countries affected more by the reconciliation process than richer countries, because of the less reliable data collection methods at their disposal? Do the countries which change the most have older data or more missing data?

Are there particular inputs or uses that stand out across all countries? Are these related to particular external data sources?

It is hoped that the answers to these questions can be used to help ascertain where resources might best be utilized to further improve the quality of global data. In section 2 we briefly review the GTAP Data Base construction process; and in section 3, we outline the methods used to compare the pre- and post-*FIT* country data. Section 4 then provides the results from the comparison, by country and by input/use and attempts to gain some insights into the quality of the data based on other information we have about the contributed data, e.g., how old the data is, missing information etc. Section 5, then concludes the paper.

## 2 The GTAP Data Base construction

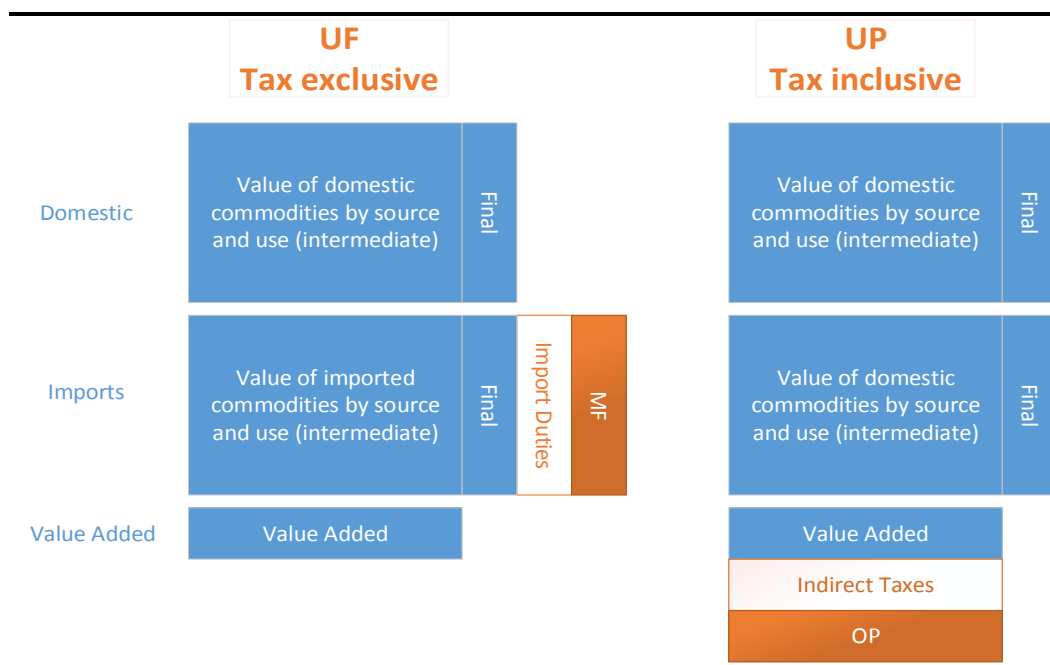
In this section we provide an overview of the data construction process. First we review the IO table contribution process and potential issues with the IO tables faced by contributors and the Center after contribution. Next we examine the GTAP construction process, including any preliminary adjustments made to the IO tables to disaggregate or target production, the reconciliation of the IO tables with international data sources (*FIT*) and the final assembly.

### 21 IO Table Contributions

Economic data for each country including the value of inputs and uses of production is provided as an IO table by a global network of contributors. Full details of what data is required by GTAP is provided in Huff, McDougall et al. (1998). Figure 1 provides a pictorial view of the four arrays (UP, UF, MF and OP) that are needed. The four arrays represent the IO table inclusive and exclusive of sales taxes, import duties and indirect taxes.

The starting point for most contributors is an I-O table, supply and use tables, or social accounting matrix developed by the country's statistical office. Most tables require revisions to be made by the contributor to get the original table into a format ready for GTAP. Below we outline some of the issues that are dealt with by contributors, with assistance from the Center.

**Figure 1: Format for IO table Contributions to the GTAP Data Base**



Source: Huff, McDougall et al. (1998)

*Sectoral Coverage and Concordances:* The GTAP Data Base currently includes 57 sectors ([https://www.gtap.agecon.purdue.edu/databases/v8/v8\\_sectors.asp](https://www.gtap.agecon.purdue.edu/databases/v8/v8_sectors.asp)). Contributed tables must distinguish at least 30 sectors, and these sectors must be mapped directly to the 57 GTAP sectors. Moreover, they must ensure that agriculture and food processing, and energy are separated from other sectors. Unfortunately, not all countries use the standard international classifications and therefore contributors must often determine their own concordance; ambiguity is common. Moreover, any disaggregation performed by the contributor usually involves applying shares equally to the disaggregated sector, unless they have additional data and the skills to apply balancing techniques. Unfortunately, the techniques used here do not capture the extent to which the cost shares are the same across industries only how much they change as a result of the GTAP construction process.

*Sign:* With the exception of changes in stocks, all values must be positive. A common problem in IO tables is that they reflect a given year and it is possible that returns to capital are negative, due to a bad year. The contributor will need to adjust these returns to reflect a more typical return in a normal year.

*Balance:* The table must balance. That is total sales of each sector must equal to total costs. There may be cases where the original IO table does not balance or, more likely, that changes made elsewhere by the contributor cause an imbalance elsewhere that must be rectified.

*Taxes:* Taxes may be missing in the original supply and use or I-O table. Contributors must therefore choose to add or exclude them from the contributed IO table.

*Dwellings:* Dwellings are defined as imputed rents and are calculated based on ownership of dwellings. The main cost of dwelling is usually capital, and it is usually sold directly to households. Despite the fact that dwellings estimates are required under the SNA, many countries do not report dwellings or aggregate them with rent. Adjustments must be made, either by contributors or by the GTAP Center to include or disaggregate them.

*Government:* The government should purchase primarily from the government services sector. IO tables may treat government differently and adjustments must be made, either by contributors or by the GTAP Center.

*Trade and transport margins:* Since domestic margins are not treated separately in GTAP, they must be brought to account as direct purchases of trade and transport services by the consuming sector. Statistical offices often account for these domestic margins separately in the IO or supply and use table. Contributors must therefore make adjustments to include them as direct purchases.

*Re-exports:* Re-exports are not permitted in the GTAP Data Base. If the input-output table includes re-exports then they need to be removed from imports and exports.

*Domestic and imported use matrix:* GTAP requires that the table distinguishes between domestic and imported uses; this data is often not available in the original data obtained from the statistical office and adjustments must be made by the contributor.

*Additional row/column constructs:* I-O tables obtained from the statistical office sometimes contain additional rows/columns to represented imputed items that are not required by GTAP. An example of this is FISIM (financial intermediation) which represents imputed banking services; these need to be removed.

*Value-added:* Contributors are asked to provide data on inputs of land, labor and capital by sector. Land in particular is usually missing and no account is specifically taken of self-employed labor.

## 2.2 The Construction of the GTAP Data Base

The GTAP construction process, described in Figure 2, can be divided into three components: IO tables pre-processing, FIT, and assembly. Each of these is discussed in turn below.<sup>3</sup>

### 2.2.1 PRE-PROCESSING OF CONTRIBUTED IO TABLES

The contributed input-output tables which have already satisfied the guidelines for contributors, then go through a cleaning procedure and are pre-processed to produce consistent 57 sector tables. This pre-processing includes:

*Minor Cleaning:* Any small imbalances or small negatives are removed.

*Disaggregation:* Those I-O tables which do not have full agricultural and/or non-agricultural disaggregation then go through the I-O disaggregation procedure. Agricultural IO tables based on FAO data and contributed by Everett Peterson are used to disaggregate agriculture. This ensures that the cost shares of the disaggregated agricultural commodities look reasonable. Non-agricultural disaggregation is done using the shares obtained from the representative table. Note that disaggregation does not alter the aggregated totals, it merely apportions the cost and use structures while keeping the same totals. With IO tables potentially being disaggregated both by the IO contributor, before being given to GTAP, and then by the Center, the concerns about the quality of the initial IO table and whether it reflects the country it is meant to portray or some proxy, are generally valid.

*Composite Regions:* Input-output tables are constructed for all composite regions – GTAP regions for which there are no contributed tables. This is done by matching each country within the composite region with a country for which we have an IO table. This country's IO table then

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<sup>3</sup> For those looking for a more basic understanding of the GTAP Data Base we refer you to Walmsley, Aguiar and Narayanan (2013), Harslett (2013) and Narayanan, Aguiar and McDougall (2012).



act as a proxy for the missing country. Later all the proxy IO tables for countries in each composite region are aggregated to form the composite regions.

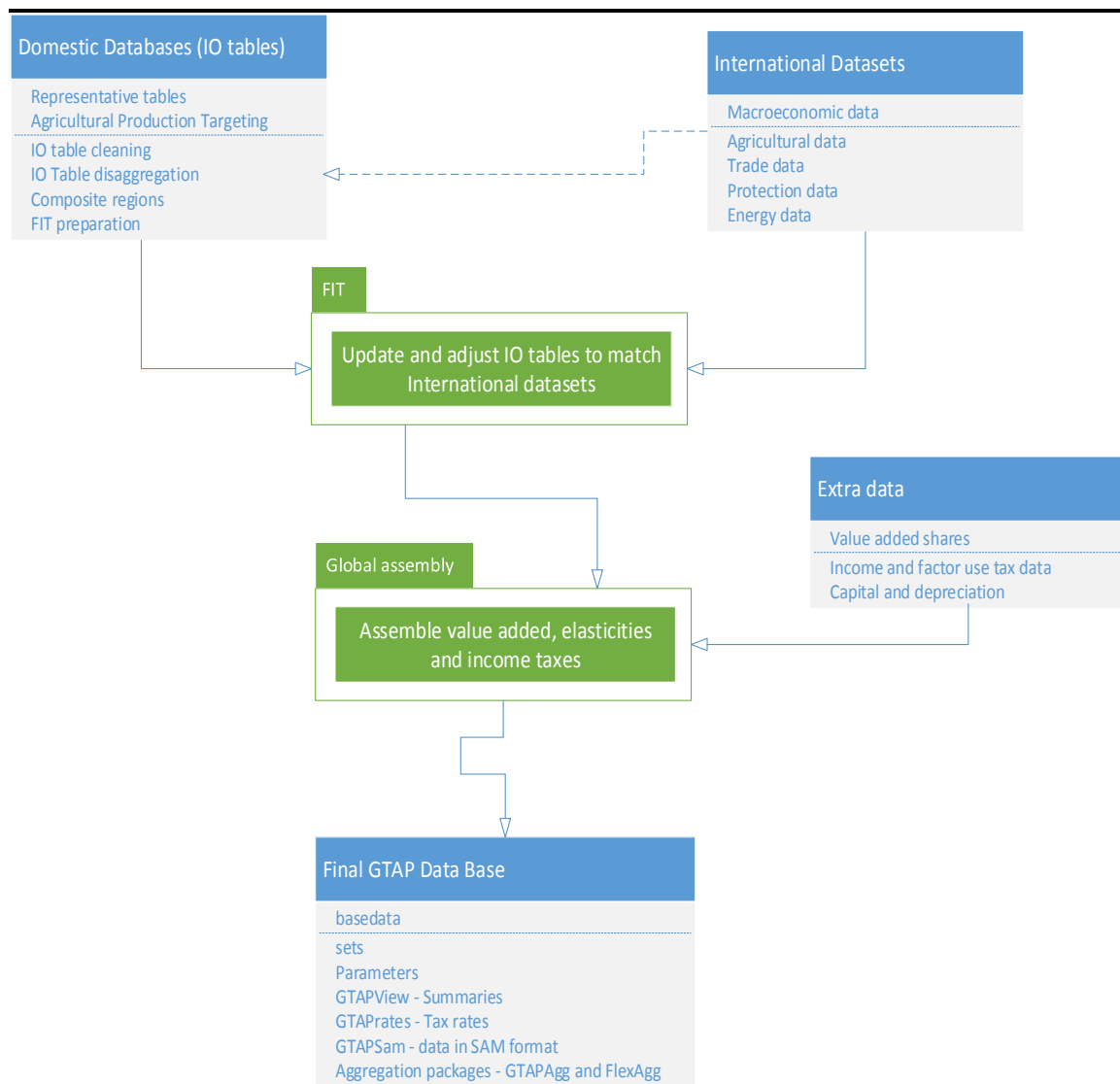
*Agricultural Production Targeting:* Agricultural output in several countries, especially the OECD members, is targeted to match agricultural production statistics by sector.

**In this paper, our initial data is taken from this stage in the construction process. It is the contributed IO table after disaggregation and cleaning, but after agricultural production targeting. By taking the data at this stage we can circumvent aggregating the final data back to the original aggregation, which will differ by country and make country rankings more difficult. The disaggregated initial data we use aggregates back to the original contributed IO table. Appendix III**

# Basic Information on Contributed IO tables

Table A 5 provides summary statistics, including the number of sectors in the initial contributed IO table, thereby giving an indication of which contributed tables needed to be disaggregated by the Center and whether this disaggregation was in agriculture, manufacturing or services.

**Figure 2: GTAP Global Data Base Construction Procedure**



Source: Authors' construction

## 2.2.2 FIT

A single procedure is used to achieve the next three objectives:

- The IO tables are updated to the reference year – Version 8.1, 2007.<sup>4</sup>
- The IO tables are adjusted to match the trade, protection, energy, and macro-economic variables in the global datasets (Table 1).
- Changes in stocks are eliminated.

**Table 1: International Datasets used in GTAP 8.1 Data Base**

| Data Set   | Details                             |
|--|-------------------------------------|
| Reference year   | 2007                                |
| Standard Countries (# of countries international data are collected for) | 244                                 |
| Macroeconomic Data   | World Development Indicators        |
| Govt. Consumption  | International Financial Statistics  |
| Goods Trade Data   | COMTRADE, processed by Mark Gehlhar |
| Services Trade data  | OECD and CPB                        |
| Domestic Support   | OECD and Hans Jensen                |
| Export Subsidies   | David Laborde                       |
| MFA Export Tax Equivalent  | Joe Francois                        |
| Agricultural Tariffs   | MacMAPv3 from ITC/CEPII             |
| Merchandise Tariffs  | MacMAPv3 from ITC/CEPII             |
| Energy Data  | IEA energy price & volumes data     |
| Agricultural Factor Split  | FAO, processed by Peterson          |
| Income & Factor Taxes  | IMF data                            |
| Population Data  | World Bank                          |

*Source: Authors' construction*

We call the adjustment procedure fitting the I-O tables, after the program FIT that implements it. FIT applies entropy-theoretic methods (Theil (1967) and Bacharach (1970)) to adjust an I-O table to various external constraints derived from the international data sets. It was originally developed as part of the SALTER project at the (Australian) Industry Commission (James and McDougall 1993), and has since been extended for GTAP.

We apply the fitting procedure after disaggregating the primary I-O tables and constructing composite tables for each country in a composite region. Thus the inputs into the procedure are a complete set of fully disaggregated regional I-O tables for 244 countries, and a set of international data sets (listed in Table 1) and the outputs are the fitted I-O tables and an adjusted energy volumes data set.

The following targets are applied:

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<sup>4</sup> The reference year of the IO table does not need to be the same reference year in the final GTAP Data Base. Bringing all IO tables, from different base years, to a common reference year is the first adjustment performed to the country data.

- i. from constraints imposed by the GTAP data base structure: zero values for changes in stocks of domestic product and imports, by commodity;
- ii. from the macroeconomic data set: values at purchasers' prices for GDP, aggregate private consumption, government consumption, and investment;
- iii. from the trade data set, modified according to the energy data set: border values of exports and imports, by commodity;
- iv. from the protection data set, modified and supplemented from the energy data set: import duty rates, by commodity; export subsidy rates, by commodity; non-commodity indirect tax rates, by industry; commodity tax rates on intermediate usage, by industry and commodity; and rates of tax on private consumption of energy, by commodity; and
- v. from the energy data set: basic values for intermediate usage of energy, by energy industry and energy commodity; basic values for private consumption of energy, by energy commodity (the energy industries and energy commodities are aggregations of standard GTAP sectors).

The FIT program incorporates an I-O quantity model, an I-O price model, and an entropy-theoretic balancing procedure. Broadly speaking, the I-O quantity model serves to remove changes in stocks and adjust exports, consumption, and investment. It feeds these final demand changes backward through the I-O structure to determine new levels for intermediate usage and primary factor employment. The I-O price model feeds tax rate changes forward through the I-O structure to adjust basic and post-tax prices for intermediate usage and final demands. The entropy procedure adjusts taste and technology variables to meet the import and energy usage targets. The general rule in the fitting procedure is to adjust the regional I-O tables to the international data sets, rather than the other way around, with some exceptions in agricultural domestic support and energy data.

It should be noted that since the international data sets match the data base reference year, adjusting the I-O tables to the international data sets is also the method used to update the year to the base year. This also converts the IO table into the correct units and currency.

### **2.2.3 ASSEMBLY**

The data assembly module is where:

- i. adjustments to value added take place;
- ii. the factor payments data are adjusted to incorporate land- and capital-based payments;
- iii. the various international data sets and domestic data bases are put together and final checks are made;

- iv. additional data such as population, capital stocks, depreciation, and savings are included; and
- v. additional datasets used in the standard GTAP model or its variants (e.g., sets, elasticities, energy volumes) and summary (e.g., time series trade data, tax rates) datasets are produced.

In terms of value added, several adjustments are made. First, labor payment data are disaggregated into skilled and unskilled labor payments using payment shares generated in the estimation procedure. Second, factor employment data for primary agriculture and natural resource-based sectors are adjusted using primary factor shares documented in Narayanan, Aguiar et al. (2012). In agriculture, external estimates of factor earnings shares are used; and for natural resource based sectors a proportion of the earnings of labor and capital is reallocated to natural resources to achieve target supply elasticities.

### 3 Methodology for Comparing Initial and Final IO tables

In order to compare the original contributed IO tables with the final country data in the GTAP Data Base we must first put them both into a comparable format. The format chosen is the four arrays structure (Figure 1) available to contributors (Huff, McDougall et al. 1998). IO table contributions in alternative formats are first converted into this format and then combined into a single file. The GTAP database itself is also converted into this format (see Figure 1 for a schematic of how the GTAP headers match the four array format).

The need for a comparable format also raises the question about which initial data to use, since many of the IO tables were not contributed with the full 57 sectors disaggregated. For this reason, we have decided to take the initial IO tables out of the pre-processing stage after minor cleaning and disaggregation. As noted above, at this stage they still aggregate up to the original tables.

Another issue we need to consider is that the initial data may not be in the correct currency/units and hence comparing the initial and final values would result in large differences simply due to differences in currency and units; we therefore compare shares rather than values. This means that we do not examine how different the contributed table's estimates of GDP is from the World Bank once units and currency are taken into account. We can however examine differences in the shares of final demand to GDP between the initial and final table. We can also look at the absolute differences between initial and final sales shares as well as initial and final cost shares.

Finally, in the interests of being able to diagnose when in the process the changes occur, it would be beneficial to examine some of the intermediate stages in the construction process. Unfortunately, there are not a lot of intermediate inputs available since much of the processing occurs in one step during the FIT module. We must therefore make inferences on this based on the results obtained.

As mentioned above, we examine both sales ( $S_{i,u,r}^I$  or  $S_{i,u,r}^F$ ) and cost shares ( $C_{i,u,r}^I$  or  $C_{i,u,r}^F$ ) in the initial (I) and final (F) data:

$$S_{i,u,r}^I = \frac{UP_{i,u,r}}{\sum_i UP_{i,u,r}} \quad (1)$$

and

$$C_{i,u,r}^I = \frac{UF_{i,u,r}}{\sum_i UF_{i,u,r}} \quad (2)$$

Both the (percentage point) differences ( $D_{i,u,r}$ ) in shares are examined, as well as an entropy measures ( $E_{i,u,r}$ ) of the differences (Walmsley and McDougall 2004).

$$D_{i,u,r} = S_{i,u,r}^F - S_{i,u,r}^I \quad (3)$$

$D_{i,u,r}$  is the percentage point different between the GTAP shares and the share obtained from the initial I-O table of input  $i$  in used in use  $u$ . Note that all differences are percentage point, unless stated otherwise.

$S_{i,u,r}^I$  is the adjusted share of input  $i$  in used in use  $u$  in the initial I-O table, multiplied by 100.

$S_{i,u,r}^F$  is the adjusted share of input  $i$  used in use  $u$  in the comparison/final I-O table, multiplied by 100.

The entropy method calculates the difference between the shares in the I-O table as an equal weighted average of each share multiplied by the natural log of the ratio of that share to the equivalent share in the comparison I-O table. In this case the example is sales shares, although cost shares can be examined in the same way.

$$E_{i,u,r} = 0.5 \left[ S_{i,u,r}^I \left[ \text{LOG}_e(S_{i,u,r}^I / S_{i,u,r}^F) \right] \right] + 0.5 \left[ S_{i,u,r}^F \left[ \text{LOG}_e(S_{i,u,r}^F / S_{i,u,r}^I) \right] \right] \quad (4)$$

where:  $E_{i,u,r}$  is the entropy measure of the difference between  $S_{i,u,r}^I$  and  $S_{i,u,r}^F$ .

The benefit of using percentage point differences or the entropy approach, as opposed to percent changes, is that the same absolute difference between two large shares is considered to be less important than the same absolute difference between two smaller shares, while in the shares and entropy method they are treated equally. The entropy measure itself however, has no meaning and hence we tend to concentrate on the percentage point differences and the standard deviation of those differences in shares across uses, inputs or countries.

## 4 Results from the Comparison

In this section we examine the results of the comparison. In the first sub-section we compare the percentage point differences in the cost shares and in the sales shares by country to examine if these differences are larger in particular countries. We calculate the mean and the standard deviations of the percentage point differences between the initial and final shares (equation 3) and then calculate the 90 percent confidence intervals around these percentage point differences between the initial and final shares. When looking at countries the mean changes are zero, since positive differences between initial and final shares are offset by negative differences in other shares, since the shares must add to 100 (since they are on percentages).

In the second section we calculate the mean and standard deviations of the changes in the IO tables by inputs (costs) and uses (sales) in order to examine if there are particular inputs or uses that change more than others. Here the means may not equal zero, if there are persistent changes in the shares across all countries. For example, land is generally not included in contributed IO tables and hence the share of land in costs usually rises, giving a mean of greater than zero.

Table A 6 provides a list of sectors and Table A 7 provides a list of other codes. Country codes are taken from GTAP and/or the ISO classification.

### 4.1 By Country

Table A 1 in the appendix lists the standard deviation, minimum, maximum and 90% confidence interval of the percentage point differences (Equation 3) in the cost shares by country, as well as the entropy measure (Equation 4). The table orders countries according to the standard deviation, which are correlated (not perfectly) with the entropy measure. We find that the standard deviation in the percentage point difference in the cost shares ranges from 5.5 percentage point differences for Uganda to 1.4 percentage point differences in New Zealand. Likewise, Table A 2 shows the results for the sales shares. In general, the differences between initial and final sales shares are greater than those seen between the cost shares, with the standard deviation ranging from 9.26 percentage points in Malawi to 1.64 percentage points in Argentina.

*The confidence intervals of the 10 worst countries in terms of cost and sales shares are depicted in Figure 3 and This figure shows the 90 percent confidence intervals for the worst 10 countries cost shares - the final GTAP cost shares for Cyprus is within -11 and +11 percentage points of the initial cost shares from the IO tables.*

*Source: Authors' calculations*

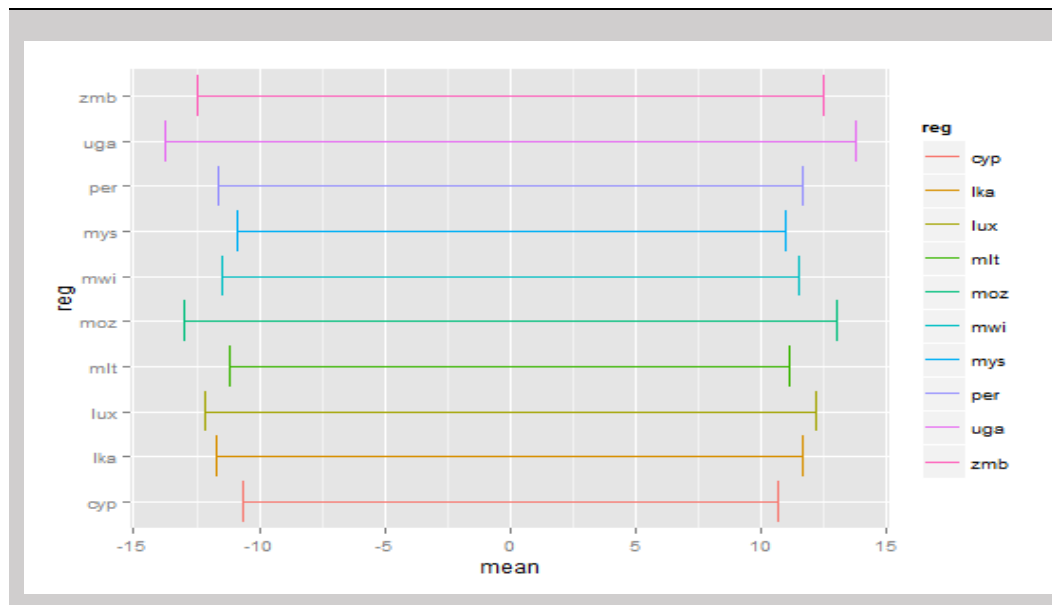
Figure 4, respectively. The numbers in Figure 3 show the 90 confidence intervals for the worst 10 countries around the percentage point differences between the final GTAP cost share and the initial IO cost share. So in the case of the cost shares, the final GTAP costs share will be 10 percentage points higher or lower than the initial cost share from the IO table. If the initial cost



share is 50 percent, then we are 90 percent confident that the final share will be between 40 and 60 percent; if the initial share was 20 percent we would be 90 percent confident that the final share would be between 10 and 30 percent. Figure 4 shows the 90 percent confidence intervals around the sales shares for the worst 10 countries; the final GTAP sales shares are within  $\pm 20$  percentage points of the initial IO table's sales shares, with a mean of zero.

A comparison of these panels therefore reveals that sales shares are more likely to change as a result of the GTAP reconciliation process than cost shares, with the confidence interval of  $\pm 20$  percentage points as opposed to  $\pm 10$  percent percentage. This is not surprising since most of the external macro data imposed on the IO tables relate to total final use. Hence changes to private consumption, government consumption, investment and exports will alter their (sales) shares relative to each other and to intermediates, which are not targeted. The allocation of total final demand across commodities is not targeted and hence (cost) shares, the share of final demand by commodity, remain unchanged. External data imposed on the cost structure, on the other hand, tend to be imposed equally across all uses causing slight changes in the cost structure of all industries and final demand, rather than large changes in some industries. For example, total imports by commodity are targeted and will result in a dampened rise or fall of their (cost) share in all intermediate and final demand categories. Value-added is another example. The allocation of value-added across capital, land and labor types is assumed to change, but the share of total value-added is not altered, thereby limiting changes in value-added relative to intermediate demand.

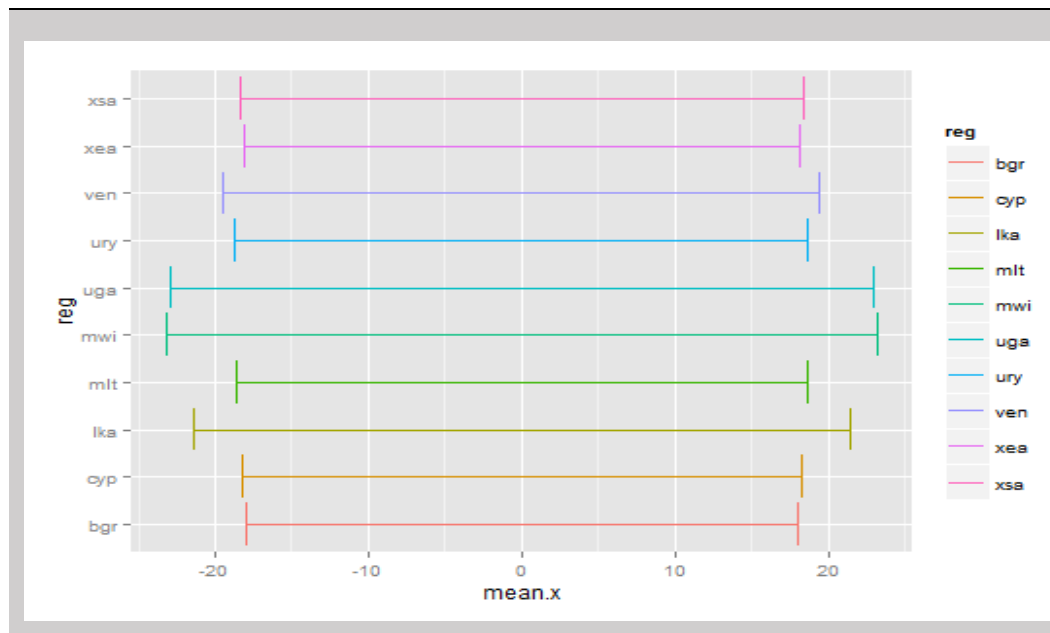
**Figure 3: Top 10 Countries with largest 90% confidence intervals around (percentage point) differences in Cost Shares between initial IO tables and Final GTAP Data Base (across all inputs)**



*This figure shows the 90 percent confidence intervals for the worst 10 countries cost shares - the final GTAP cost shares for Cyprus is within -11 and +11 percentage points of the initial cost shares from the IO tables.*

*Source: Authors' calculations*

**Figure 4: Top 10 Countries with largest 90% confidence intervals around (percentage point) differences in Sales Shares between initial IO tables and Final GTAP Data Base (across all uses)**



*This figure shows the 90 percent confidence intervals for the worst 10 countries sales shares - the final GTAP sales shares for Cyprus is within -18 and +18 percentage points of the initial sales shares from the IO tables.*

*Source: Authors' calculations*

In general, we also find that countries which have the largest cost shares differences also experience the largest sales share differences (98 percent correlation between the two country lists). This is probably not surprising given that ultimately changes in data are likely to affect both sales and cost shares.

We are interested in the extent to which these differences might be related to the 'quality' of the IO tables, broadly defined. To provide a metric for quality we might examine things like the base year, when was the table contributed, how many sectors were contributed etc. The relationship between the changes in the IO table shares and the version number or base year is much weaker than expected; newer tables have slightly lower sales share differences but the correlation is only 0.15. The number of sectors contributed, particularly manufacturing sectors, is a better indicator of differences, with a correlation of almost -0.5 for both sales and cost shares. We might also expect the level of development to indicate quality of the underlying IO table. Again we find only a small correlation between the differences and per capita GDP, although there is a larger correlation between differences and the World Bank development categories (0.36). The larger the economy, measured in terms of GDP or population, the larger the percent differences in both sales and cost shares (-0.3). This suggests that there are other factors involved in explaining these differences.

Finally, Table 2 compares the ranking using standard deviation to those obtained if entropy is used. There is a high correlation between the two measures, 0.88.

**Table 2: Comparison of Entropy v Difference Rankings**

| Cost Shares                                       |   |                                      | Sales Shares                                      |   |                                      |
|---|---|--------------------------------------|---|---|--------------------------------------|
| I   | II  | III                                  | IV  | V   | VI                                   |
| Top ten Countries (ordered by standard deviation) | Ranking of countries in column I if entropy used to order | Top 10 Countries ordered by Entropy) | Top ten Countries (ordered by standard deviation) | Ranking of countries in column I if entropy used to order | Top 10 Countries ordered by Entropy) |
| 1 Uganda  | 4   | 1 Mozambique                         | 1 Malawi  | 2   | 1 Uganda                             |
| 2 Mozambique                                      | 1   | 2 Singapore                          | 2 Uganda  | 1   | 2 Malawi                             |
| 3 Zambia  | 9   | 3 Sri Lanka                          | 3 Sri Lanka                                       | 4   | 3 Venezuela                          |
| 4 Luxembourg                                      | 20  | 4 Uganda                             | 4 Venezuela                                       | 3   | 4 Sri Lanka                          |
| 5 Sri Lanka                                       | 3   | 5 Venezuela                          | 5 Uruguay   | 5   | 5 Uruguay                            |
| 6 Peru  | 13  | 6 Malawi                             | 6 Malta   | 17  | 6 Peru                               |
| 7 Malawi  | 6   | 7 Tanzania                           | 7 Rest of South Asia                              | 7   | 6 Rest of South Asia                 |
| 8 Malta   | 17  | 8 Madagascar                         | 8 Cyprus  | 12  | 7 Chile                              |
| 9 Malaysia  | 36  | 9 Zambia                             | 9 Rest of East Asia                               | 18  | 8 Rest of Former Soviet Union        |
| 10 Cyprus   | 12  | 10 Bangladesh                        | 10 Bulgaria                                       | 19  | 9 Malaysia                           |

Source: Authors' calculations

## 4.2 By Use and Input

*In this section we examine differences with respect to the inputs (cost shares) and uses (output shares) across all countries to determine if there are particular inputs or uses that are causing most of the differences across countries. The results for cost shares are shown in Figure 5 and Table A 3; and those for the sales shares are found in This figure shows the 90 percent confidence intervals for the worst 10 inputs - the final GTAP cost shares for land (prim\_land) by all countries is within -20 and +40 percentage points of the initial cost shares from the country IO tables.*

Source: Authors' calculations

The differences in the sales shares depicted in **Error! Not a valid bookmark self-reference.** and Table A 4 are of greater concern. As expected from the analysis of the country data the differences in the sales shares were on average much larger than the cost shares, and hence the differences here are also much higher. The share of private consumption (fin\_ch) in total sales rises by 1.23 percent and exports by 2.62 percent relative to the initial shares in the contributed IO tables, with standard deviations of more than 20 percent. Investment (fin\_if) and government (fin\_cg) also have large standard deviations (9.4 and 7.4 respectively). The entropy results (A lot of these differences in sales shares within private and government consumption and investment occur in their demand for imports and are therefore most likely due to the matching of imports to the trade data. Likewise exports also adjust due to matching to trade data. With trade and final private consumption (and to a lesser extent government) rising as a result of the construction process, there are large movements in both domestic and imported sales across the uses as both imports by commodity and total final demand (total C, I, and G, and X by commodity) are targeted. The large differences between exports and imports reported

by individual countries and the imports and exports resulting from the global reconciliation process is well known, however according to these comparisons a significant portion of the changes to the structure of the IO tables between the contributed table and the final GTAP database, stem from the trade data.

The most heavily impacted sectors again include a couple of energy sectors, although the sectors most affected are those that rely on imported inputs in a lot of countries, e.g., the other food sector (*ofd\_i*) and trade (*trd\_i*). Paddy rice (*pdr\_i*) and raw milk (*rmk\_i*) are also high on the list. This is most likely due to concordance issues in the underlying contributed IO table, since these raw agricultural materials are rarely traded, while their counterparts processed rice (*prc*) and milk (*mlk*) are.

Table 3), which adjust for the size of the initial share, also place final demand in exports, private consumption, government and investment in the top four positions as the shares that have moved the most as a result of the GTAP construction process.

Figure 6 and Table A 4.

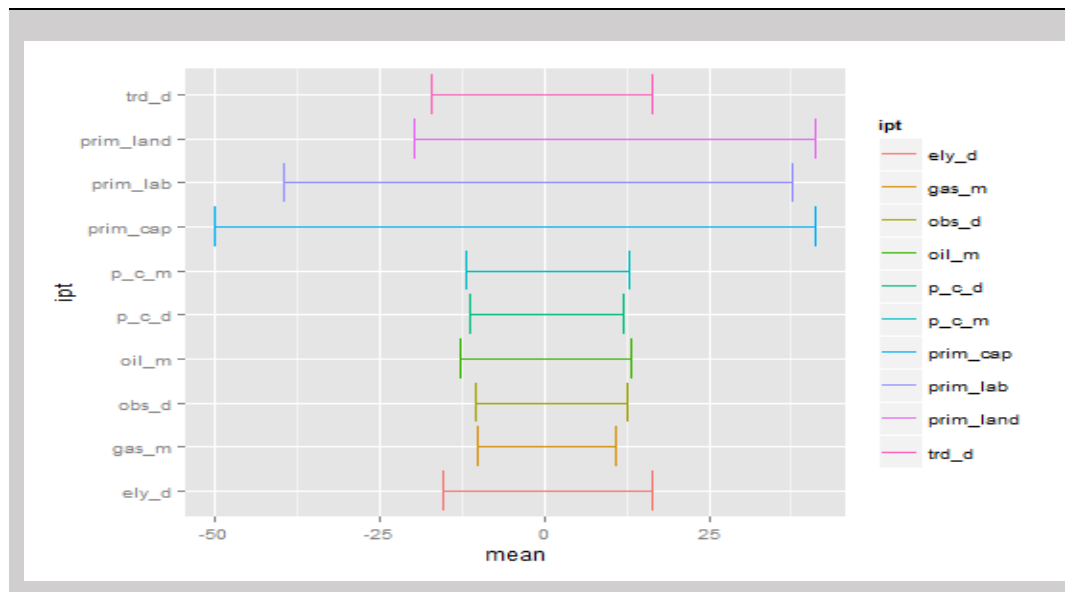
In the case of cost shares the largest differences can be found in two areas, value-added (capital (*prim\_cap*), land (*prim\_land*) and labor (*prim\_lab*)) and energy (domestic electricity (*ely\_d*), imported oil (*oil\_m*), imported petroleum (*p\_c\_m*), domestic petroleum (*p\_c\_d*) and imported gas (*gas\_m*)).<sup>5</sup> The differences in value added are large, with standard deviations between 12 and to 19 percent, however they are not surprising given that most contributed IO tables do not include land and hence this must be estimated and extracted from other components of value-added. As a result, the mean difference in the share of land between the initial and final IO table is positive, while the mean difference in the share of labor and capital is generally negative.

The standard deviation of the difference in the cost shares of domestic and imported intermediates range between 6.67 for domestic trade and 1.67 for domestic cattle meat (*cmt\_d*). Energy commodities account for 5 of the top 10 and are likely the result of the inclusion of additional energy data obtained from the IEA data. In general, the share of energy in production costs rises due to the inclusion of the additional energy data, although the increases are less than 0.6 percent on average (mean). The more surprising results are the inclusion of differences in the cost share of domestic other business services (*obs\_d*) and of trade (*trd\_d*) in the top 10 (Figure 5). Further examination of this suggests these difference come from intermediate use of trade by energy; and intermediate use of other business services by agriculture or services in Europe.

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<sup>5</sup> Not that these tables were obtained after agricultural targeting and hence they underestimate the potential changes that occur to agricultural commodities in cost shares in those countries that undergo agricultural targeting.

**Figure 5: Top 10 largest 90% confidence intervals around (percentage point) differences in Cost Shares between initial IO tables and Final GTAP Data Base (across all countries)**



*This figure shows the 90 percent confidence intervals for the worst 10 inputs - the final GTAP cost shares for land (prim\_land) by all countries is within -20 and +40 percentage points of the initial cost shares from the country IO tables.*

*Source: Authors' calculations*

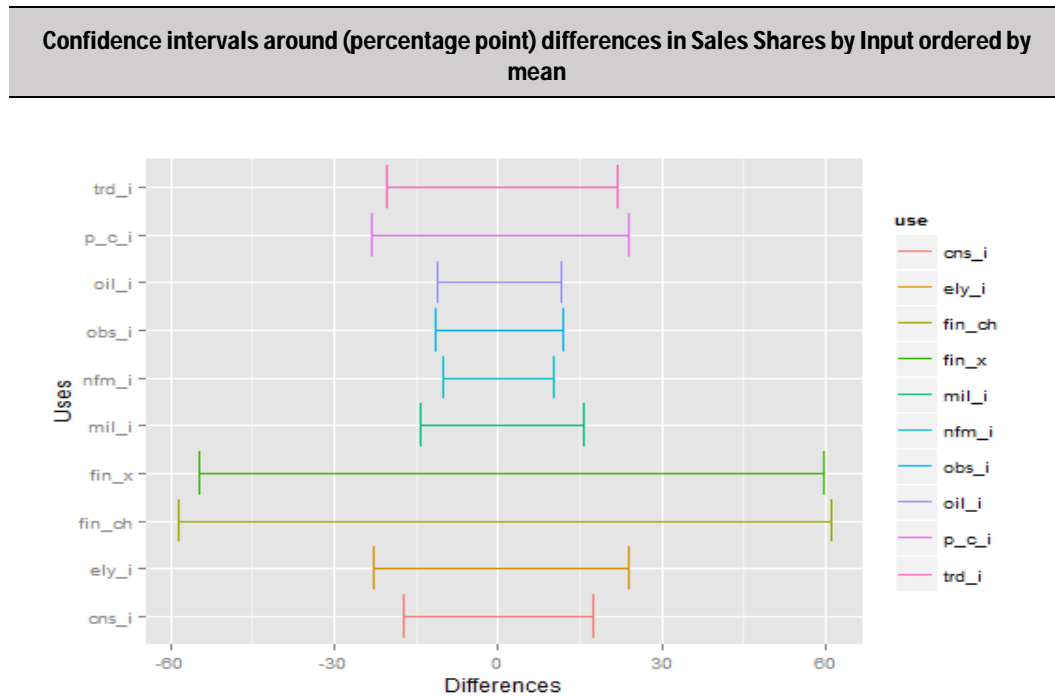
The differences in the sales shares depicted in **Error! Not a valid bookmark self-reference.** and Table A 4 are of greater concern. As expected from the analysis of the country data the differences in the sales shares were on average much larger than the cost shares, and hence the differences here are also much higher. The share of private consumption (fin\_ch) in total sales rises by 1.23 percent and exports by 2.62 percent relative to the initial shares in the contributed IO tables, with standard deviations of more than 20 percent. Investment (fin\_if) and government (fin\_cg) also have large standard deviations (9.4 and 7.4 respectively). The entropy results (A lot of these differences in sales shares within private and government consumption and investment occur in their demand for imports and are therefore most likely due to the matching of imports to the trade data. Likewise exports also adjust due to matching to trade data. With trade and final private consumption (and to a lesser extent government) rising as a result of the construction process, there are large movements in both domestic and imported sales across the uses as both imports by commodity and total final demand (total C, I, and G, and X by commodity) are targeted. The large differences between exports and imports reported by individual countries and the imports and exports resulting from the global reconciliation process is well known, however according to these comparisons a significant portion of the changes to the structure of the IO tables between the contributed table and the final GTAP database, stem from the trade data.

The most heavily impacted sectors again include a couple of energy sectors, although the sectors most affected are those that rely on imported inputs in a lot of countries, e.g., the other food sector (ofd\_i) and trade (trd\_i). Paddy rice (pdr\_i) and raw milk (rmk\_i) are also high on the list. This is most likely due to concordance issues in the underlying contributed IO table,

since these raw agricultural materials are rarely traded, while their counterparts processed rice (prc) and milk (mlk) are.

Table 3), which adjust for the size of the initial share, also place final demand in exports, private consumption, government and investment in the top four positions as the shares that have moved the most as a result of the GTAP construction process.

**Figure 6: Top 10 largest (percentage point) differences in Cost Shares between initial IO tables and Final GTAP Data Base (across all countries)**



*This figure shows the 90 percent confidence intervals for the worst 10 uses - the final GTAP sales shares for exports (fin\_x) across all countries is within -55 and +60 percentage points of the initial sales shares from the IO tables.*

*Source: Authors' calculations*

A lot of these differences in sales shares within private and government consumption and investment occur in their demand for imports and are therefore most likely due to the matching of imports to the trade data. Likewise exports also adjust due to matching to trade data. With trade and final private consumption (and to a lesser extent government) rising as a result of the construction process, there are large movements in both domestic and imported sales across the uses as both imports by commodity and total final demand (total C, I, and G, and X by commodity) are targeted.<sup>6</sup> The large differences between exports and imports reported by individual countries and the imports and exports resulting from the global reconciliation process is well known, however according to these comparisons a significant portion of the

<sup>6</sup> Note that changes also occur due to the removal of change in stocks. These have been removed from the rankings.

changes to the structure of the IO tables between the contributed table and the final GTAP database, stem from the trade data.

The most heavily impacted sectors again include a couple of energy sectors, although the sectors most affected are those that rely on imported inputs in a lot of countries, e.g., the other food sector (ofd\_i) and trade (trd\_i). Paddy rice (pdr\_i) and raw milk (rmk\_i) are also high on the list. This is most likely due to concordance issues in the underlying contributed IO table, since these raw agricultural materials are rarely traded, while their counterparts processed rice (prc) and milk (mlk) are.

**Table 3: Comparison of Entropy v Difference Rankings**

| Cost Shares                                       |  |  | Sales Shares                                      |  |   |
|---|--|--|---|--|---|
| Top ten Countries (ordered by standard deviation) | Ranking of countries in column I if entropy used | Top 10 Countries ordered by Entropy)     | Top ten Countries (ordered by standard deviation) | Ranking of countries in column I if entropy used | Top 10 Countries ordered by Entropy)      |
| 1 Capital (prim_cap)                              | 3  | 1 Land (prim_land)                       | 1 Final Household consumption (fin_ch)            | 3  | 1 Exports (fin_x)                         |
| 2 Labor (prim_lab)                                | 5  | 2 Imported government services (ogs_m)   | 2 Exports (fin_x)                                 | 1  | 2 Final Government consumption (fin_cg)   |
| 3 Land (prim_land)                                | 1  | 3 Capital (prim_cap)                     | 3 Other food products (ofd_i)                     | 10   | 3 Final Household consumption (fin_ch)    |
| 4 Domestic Trade (trd_d)                          | 15   | 4 Imported gas (gas_m)                   | 4 Petroleum (p_c_i)                               | 5  | 4 Investment (fin_if)                     |
| 5 Domestic electricity (ely_d)                    | 14   | 5 Labor (prim_lab)                       | 5 Investment (fin_if)                             | 4  | 5 Petroleum (p_c_i)                       |
| 6 Imported oil (oil_m)                            | 6  | 6 Imported oil (oil_m)                   | 6 Electricity (ely_i)                             | 8  | 6 Oil (oil_i)                             |
| 7 Imported petroleum (p_c_m)                      | 9  | 7 Imported wheat (wht_m)                 | 7 Trade (trd_i)                                   | 7  | 7 Trade (trd_i)                           |
| 8 Domestic petroleum (p_m_d)                      | 28   | 8 Imported paddy rice (pdr_m)            | 8 Final Government consumption (fin_cg)           | 2  | 8 Electricity (ely_i)                     |
| 9 Domestic other business services (obs_d)        | 38   | 9 Imported Petroleum(p_c_m)              | 9 Chemicals, rubbers and plastics (crp_i)         | 9  | 9 Chemicals, rubbers and plastics (crp_i) |
| 10 Imported Gas (gas_m)                           | 4  | 10 Imported vegetables and fruit (v_f_m) | 10 Textiles (tex_i)                               | 14   | 10 Other food products (ofd_i)            |

Source: Authors' calculations

### 4.3 A Closer look at Cyprus

One reason for the significant differences may be the growing importance of re-exports. Re-exports are removed from IO tables as part of contribution process, however adjustments to the trade data are only done for a select group of countries – Hong Kong and the Netherlands. A case in point is Cyprus, which is in the top 10 worst countries for changes to the underlying IO data. Cyprus is often the first port of call into the European Union and hence processes a lot of goods for entry into the European Union that it simply re-exports to other parts of the European Union. Further investigation of the Cyprus<sup>7</sup> IO table (Table 4), however, reveals that the original table had almost no trade, in contrast to the World Bank data that places exports at around 50 percent of GDP, thus raising our concerns about the original IO table contribution. Closer examination of the trade data highlights two key areas where the trade data differ. First, there is a substantial increase in trade was in services, which is not surprising given the importance of tourism and services to the Cyprus economy. On the other hand, there was also a substantial increase in petroleum, chemicals, motor vehicles and some manufactures that could be attributed to re-exports. In this particular case, tracking total exports and imports from the World Bank data may not have been as useful as adjusting for re-exports.

**Table 4: Decomposition of Cyprus GDP according to the original Contribution, GTAP and World Bank data (2007 percent)**

|                               | C     | I     | G     | X     | -M     |
|-------------------------------|-------|-------|-------|-------|--------|
| Initial contributed IO tables | 61.60 | 16.63 | 22.28 | 0.09  | -0.60  |
| Final GTAP IO table           | 71.61 | 22.86 | 21.65 | 54.68 | -70.80 |
| World Bank Data               | 66.41 | 22.43 | 17.41 | 47.94 | -54.19 |

*Sources: Center for Global Trade Analysis, Narayanan, Aguiar et al (2012) and World Bank.*

<sup>7</sup> We chose Cyprus because it is part of the European Union and therefore you would expect the data to be of reasonable quality. We did not chose Luxembourg because this table is known to have been constructed from the Belgium table.



# 5 Conclusions

In this paper, we compared the GTAP IO tables before and after being processed for the GTAP Data Base in order to examine where the largest changes occur in the IO tables as a result of the GTAP construction process. We find that while there is some evidence that data from developing countries with weaker IO tables and less sectors do undergo more changes than those with more robust IO tables, the largest differences occur in the sales shares due to differences in the trade data between the contributed IO tables and the balanced trade dataset used in the GTAP database. We find that the energy sectors, as well as agriculture, other business services and trade also appear to have higher absolute changes in their sales shares than other commodities.

Other large changes result from the re-allocation of value added across land, labor and capital as land, natural resources and self-employment are incorporated, however this is to be expected given that land is not included in most IO tables and hence needs to be incorporated.

The issues associated with the trade data need to be examined more carefully, looking at some of the worst countries individually to ascertain if trade is a problem and if so what adjustments might be needed. For instance, are the issues with re-exports pervasive and/or should total trade be adjusted to match known country-specific totals, with the current methodology used to obtain the bilateral detail or are there issues with the IO tables.

There are a number of areas where further research is required. The data used in this paper were obtained after agricultural production targeting. Ideally it would be useful to see how agricultural production targeting also affects these results. Indeed, it would be beneficial if more comparisons could be made at various stages within the construction process so that we could ascertain the extent to which adjustments matter, for instance the extent to which trade data alters the IO data versus the energy data; and even the extent to which the energy data alters the trade data. The inclusion of these international datasets to replace country data and their implications for the country data should be thoroughly reviewed before being implemented into the database.

# Appendix I Cost and Sales Shares by Country

**Table A 1: Summary Statistics for Percentage Point Differences between Initial and Final Cost Shares by Region (sorted by Standard Deviation)**

| region | Standard Deviation | min    | max   | 90% Confidence Interval |       | Entropy |
|--------|--------------------|--------|-------|-------------------------|-------|---------|
|        |                    |        |       | lower                   | upper |         |
| uga    | 5.50               | -95.41 | 92.68 | -13.75                  | 13.75 | 2.06    |
| moz    | 5.19               | -99.83 | 97.39 | -12.97                  | 12.97 | 2.05    |
| zmb    | 4.99               | -74.98 | 94.17 | -12.46                  | 12.46 | 2.02    |
| lux    | 4.87               | -67.12 | 99.26 | -12.17                  | 12.17 | 1.74    |
| lka    | 4.67               | -81.27 | 97.33 | -11.68                  | 11.68 | 2.17    |
| per    | 4.65               | -70.89 | 71.54 | -11.62                  | 11.62 | 1.40    |
| mwi    | 4.59               | -56.17 | 86.69 | -11.48                  | 11.48 | 3.00    |
| mlt    | 4.46               | -52.36 | 93.00 | -11.14                  | 11.14 | 2.19    |
| mys    | 4.37               | -94.90 | 83.59 | -10.89                  | 10.97 | 1.40    |
| cyp    | 4.26               | -71.37 | 83.93 | -10.66                  | 10.66 | 2.08    |
| tza    | 4.26               | -76.36 | 87.70 | -10.65                  | 10.65 | 2.15    |
| ury    | 4.20               | -63.97 | 99.38 | -10.50                  | 10.50 | 1.58    |
| ven    | 4.19               | -94.69 | 99.53 | -10.48                  | 10.48 | 1.96    |
| bgr    | 4.18               | -49.23 | 89.48 | -10.45                  | 10.45 | 2.16    |
| xea    | 3.95               | -47.52 | 84.94 | -9.88                   | 9.89  | 1.52    |
| mdg    | 3.95               | -62.80 | 89.71 | -9.88                   | 9.88  | 1.67    |
| est    | 3.91               | -79.30 | 81.65 | -9.79                   | 9.79  | 1.31    |
| xsu    | 3.87               | -45.41 | 71.15 | -9.67                   | 9.67  | 2.20    |
| sgp    | 3.84               | -69.04 | 82.63 | -9.61                   | 9.61  | 2.14    |
| phl    | 3.84               | -57.74 | 81.64 | -9.56                   | 9.65  | 1.10    |
| idn    | 3.80               | -96.26 | 83.17 | -9.47                   | 9.53  | 0.87    |
| ltu    | 3.74               | -28.83 | 99.47 | -9.35                   | 9.35  | 1.69    |
| zwe    | 3.70               | -73.31 | 77.37 | -9.26                   | 9.26  | 1.27    |
| grc    | 3.62               | -67.19 | 64.68 | -9.04                   | 9.04  | 1.25    |
| xsa    | 3.57               | -46.63 | 75.62 | -8.92                   | 8.92  | 1.39    |
| xse    | 3.56               | -60.29 | 57.17 | -8.87                   | 8.92  | 0.81    |
| col    | 3.56               | -61.01 | 54.72 | -8.90                   | 8.90  | 1.19    |
| fra    | 3.52               | -74.15 | 85.19 | -8.79                   | 8.79  | 0.90    |
| nld    | 3.48               | -69.92 | 95.33 | -8.70                   | 8.70  | 1.17    |
| vnm    | 3.45               | -52.38 | 66.88 | -8.63                   | 8.63  | 1.19    |
| ita    | 3.44               | -55.45 | 78.08 | -8.60                   | 8.60  | 0.88    |
| bel    | 3.42               | -54.55 | 72.49 | -8.54                   | 8.54  | 1.32    |
| xsm    | 3.37               | -62.55 | 65.24 | -8.42                   | 8.42  | 0.97    |
| irl    | 3.33               | -70.38 | 64.88 | -8.32                   | 8.32  | 1.33    |

| region | Standard Deviation | min    | max   | 90% Confidence Interval |       | Entropy |
|--------|--------------------|--------|-------|-------------------------|-------|---------|
|        |                    |        |       | lower                   | upper |         |
| esp    | 3.31               | -62.38 | 98.92 | -8.27                   | 8.27  | 0.93    |
| pol    | 3.29               | -60.55 | 73.78 | -8.24                   | 8.24  | 0.96    |
| mex    | 3.29               | -74.01 | 42.70 | -8.23                   | 8.23  | 0.85    |
| prt    | 3.28               | -51.15 | 71.80 | -8.21                   | 8.21  | 1.17    |
| deu    | 3.24               | -50.53 | 81.24 | -8.10                   | 8.10  | 1.07    |
| xsc    | 3.22               | -55.58 | 86.82 | -8.06                   | 8.06  | 1.04    |
| xca    | 3.22               | -43.21 | 81.99 | -8.04                   | 8.04  | 1.04    |
| tha    | 3.21               | -62.60 | 48.91 | -7.99                   | 8.05  | 0.71    |
| zaf    | 3.18               | -60.13 | 91.10 | -7.96                   | 7.96  | 0.83    |
| xna    | 3.13               | -51.99 | 81.20 | -7.83                   | 7.83  | 0.76    |
| chl    | 3.13               | -58.87 | 71.41 | -7.82                   | 7.82  | 0.94    |
| lva    | 3.11               | -39.59 | 76.51 | -7.78                   | 7.78  | 0.98    |
| swe    | 3.10               | -57.88 | 72.36 | -7.74                   | 7.74  | 1.02    |
| mar    | 3.09               | -89.32 | 81.91 | -7.72                   | 7.72  | 0.84    |
| rus    | 3.08               | -50.84 | 94.32 | -7.70                   | 7.70  | 0.85    |
| hun    | 3.02               | -35.83 | 74.44 | -7.55                   | 7.55  | 1.13    |
| kor    | 3.00               | -72.25 | 45.54 | -7.50                   | 7.50  | 0.72    |
| svn    | 3.00               | -42.01 | 82.77 | -7.50                   | 7.50  | 1.14    |
| cze    | 2.99               | -61.82 | 70.68 | -7.47                   | 7.47  | 1.22    |
| xfn    | 2.98               | -44.09 | 64.32 | -7.44                   | 7.44  | 1.12    |
| xcb    | 2.91               | -53.52 | 55.99 | -7.27                   | 7.27  | 0.74    |
| xef    | 2.90               | -48.20 | 66.34 | -7.24                   | 7.24  | 0.95    |
| che    | 2.88               | -42.03 | 82.36 | -7.21                   | 7.21  | 1.06    |
| hkg    | 2.87               | -83.49 | 98.05 | -7.16                   | 7.16  | 0.60    |
| fin    | 2.86               | -73.91 | 48.86 | -7.14                   | 7.14  | 0.73    |
| svk    | 2.81               | -33.81 | 82.63 | -7.03                   | 7.03  | 0.97    |
| bgd    | 2.67               | -41.87 | 85.75 | -6.68                   | 6.68  | 1.10    |
| dnk    | 2.66               | -49.53 | 50.66 | -6.64                   | 6.64  | 0.92    |
| gbr    | 2.65               | -43.68 | 97.48 | -6.64                   | 6.64  | 0.84    |
| jpn    | 2.53               | -47.70 | 83.87 | -6.33                   | 6.33  | 0.54    |
| xer    | 2.51               | -59.04 | 45.91 | -6.28                   | 6.28  | 0.50    |
| bra    | 2.46               | -45.16 | 45.31 | -6.16                   | 6.16  | 0.72    |
| twn    | 2.41               | -42.30 | 97.33 | -6.02                   | 6.04  | 0.39    |
| hrv    | 2.39               | -55.75 | 41.25 | -5.98                   | 5.98  | 0.59    |
| tun    | 2.34               | -48.57 | 48.20 | -5.85                   | 5.85  | 0.58    |
| tur    | 2.24               | -52.47 | 40.55 | -5.61                   | 5.61  | 0.57    |
| usa    | 2.23               | -43.90 | 46.36 | -5.57                   | 5.57  | 0.49    |
| can    | 2.18               | -52.22 | 42.84 | -5.45                   | 5.45  | 0.62    |
| ind    | 2.17               | -36.16 | 41.99 | -5.43                   | 5.43  | 0.76    |
| xoc    | 2.15               | -37.63 | 86.10 | -5.38                   | 5.38  | 0.54    |
| chn    | 1.98               | -36.62 | 28.89 | -4.94                   | 4.94  | 0.72    |
| alb    | 1.84               | -42.32 | 59.44 | -4.59                   | 4.59  | 0.22    |

| region | Standard Deviation | min    | max   | 90% Confidence Interval |       | Entropy |
|--------|--------------------|--------|-------|-------------------------|-------|---------|
|        |                    |        |       | lower                   | upper |         |
| aus    | 1.78               | -37.57 | 32.38 | -4.45                   | 4.45  | 0.48    |
| arg    | 1.64               | -30.36 | 26.11 | -4.11                   | 4.11  | 0.34    |
| bwa    | 1.60               | -31.07 | 47.08 | -4.00                   | 4.00  | 0.45    |
| nzl    | 1.41               | -34.70 | 26.22 | -3.53                   | 3.53  | 0.30    |

*Source: Authors' calculations*

**Table A 2: Summary Statistics for Percentage Point Differences between Initial and Final Sales Shares by Region (sorted by standard deviation)**

| region | Standard Deviation | min    | max   | 90% Confidence Interval |       | Entropy |
|--------|--------------------|--------|-------|-------------------------|-------|---------|
|        |                    |        |       | lower                   | upper |         |
| mwi    | 9.26               | -99.07 | 98.91 | -23.16                  | 23.15 | 6.44    |
| uga    | 9.18               | -96.35 | 99.90 | -22.96                  | 22.96 | 5.93    |
| lka    | 8.58               | -96.07 | 99.98 | -21.45                  | 21.46 | 4.83    |
| ven    | 7.78               | -88.28 | 99.88 | -19.45                  | 19.45 | 5.38    |
| ury    | 7.47               | -99.65 | 99.63 | -18.67                  | 18.67 | 3.65    |
| mlt    | 7.46               | -97.19 | 98.23 | -18.66                  | 18.66 | 3.62    |
| xsa    | 7.34               | -99.34 | 93.84 | -18.35                  | 18.35 | 3.57    |
| cyp    | 7.29               | -66.50 | 98.13 | -18.22                  | 18.22 | 3.70    |
| xea    | 7.25               | -99.45 | 97.72 | -18.11                  | 18.14 | 3.20    |
| bgr    | 7.20               | -74.64 | 97.11 | -17.99                  | 17.99 | 4.21    |
| chl    | 7.17               | -95.97 | 99.32 | -17.93                  | 17.93 | 2.93    |
| xsu    | 7.13               | -75.56 | 89.62 | -17.83                  | 17.83 | 4.84    |
| zmb    | 7.08               | -97.92 | 99.69 | -17.69                  | 17.69 | 3.53    |
| mys    | 7.05               | -97.47 | 99.47 | -17.60                  | 17.63 | 3.42    |
| xca    | 6.92               | -99.14 | 98.49 | -17.29                  | 17.29 | 2.56    |
| xsm    | 6.74               | -98.56 | 98.28 | -16.86                  | 16.86 | 2.36    |
| lux    | 6.72               | -95.44 | 91.32 | -16.80                  | 16.80 | 2.56    |
| xsc    | 6.63               | -96.47 | 94.66 | -16.58                  | 16.58 | 2.88    |
| phl    | 6.55               | -99.46 | 96.62 | -16.36                  | 16.39 | 2.63    |
| moz    | 6.48               | -86.62 | 85.02 | -16.20                  | 16.20 | 2.72    |
| grc    | 6.46               | -91.86 | 86.66 | -16.15                  | 16.15 | 2.54    |
| tza    | 6.44               | -61.06 | 94.20 | -16.10                  | 16.10 | 3.20    |
| vnm    | 6.36               | -98.62 | 97.84 | -15.89                  | 15.89 | 2.41    |
| per    | 6.33               | -99.98 | 89.05 | -15.83                  | 15.83 | 2.64    |
| nld    | 6.33               | -99.67 | 95.87 | -15.83                  | 15.83 | 2.41    |
| che    | 6.29               | -94.13 | 95.22 | -15.72                  | 15.72 | 1.93    |
| zwe    | 6.27               | -95.05 | 81.31 | -15.69                  | 15.69 | 2.25    |
| tha    | 6.27               | -89.95 | 96.38 | -15.66                  | 15.69 | 2.33    |
| deu    | 6.25               | -94.28 | 93.22 | -15.62                  | 15.62 | 2.05    |
| xef    | 6.24               | -83.61 | 93.33 | -15.59                  | 15.59 | 2.22    |
| swe    | 6.21               | -96.18 | 92.63 | -15.52                  | 15.52 | 2.19    |
| irl    | 6.19               | -81.83 | 89.71 | -15.49                  | 15.49 | 2.25    |
| sgp    | 6.19               | -77.80 | 98.82 | -15.48                  | 15.48 | 2.51    |
| bra    | 6.16               | -98.77 | 99.28 | -15.40                  | 15.40 | 2.13    |
| est    | 6.11               | -84.21 | 96.96 | -15.27                  | 15.27 | 2.82    |
| xse    | 6.04               | -77.49 | 87.57 | -15.09                  | 15.12 | 1.75    |
| idn    | 6.02               | -94.23 | 92.63 | -15.03                  | 15.05 | 2.32    |
| ltu    | 6.01               | -92.38 | 99.42 | -15.02                  | 15.02 | 2.33    |
| col    | 5.97               | -87.80 | 99.49 | -14.92                  | 14.92 | 2.46    |
| ind    | 5.91               | -97.83 | 92.26 | -14.79                  | 14.79 | 2.03    |

| region | Standard Deviation | min    | max   | 90% Confidence Interval |       | Entropy |
|--------|--------------------|--------|-------|-------------------------|-------|---------|
|        |                    |        |       | lower                   | upper |         |
| bel    | 5.88               | -75.28 | 89.44 | -14.71                  | 14.71 | 2.30    |
| hun    | 5.87               | -94.15 | 95.46 | -14.67                  | 14.67 | 2.27    |
| pol    | 5.77               | -89.84 | 97.83 | -14.43                  | 14.43 | 1.93    |
| hkg    | 5.74               | -69.71 | 95.28 | -14.35                  | 14.35 | 1.33    |
| mdg    | 5.74               | -80.36 | 98.84 | -14.35                  | 14.35 | 2.11    |
| dnk    | 5.70               | -87.12 | 91.13 | -14.25                  | 14.25 | 2.00    |
| xfn    | 5.67               | -98.13 | 75.85 | -14.17                  | 14.17 | 2.02    |
| fin    | 5.63               | -85.36 | 83.20 | -14.08                  | 14.08 | 1.79    |
| svn    | 5.62               | -92.31 | 92.62 | -14.04                  | 14.04 | 2.35    |
| mex    | 5.59               | -81.10 | 88.52 | -13.99                  | 13.99 | 1.81    |
| rus    | 5.55               | -91.87 | 78.75 | -13.89                  | 13.89 | 1.99    |
| ita    | 5.54               | -72.40 | 93.21 | -13.84                  | 13.84 | 2.04    |
| esp    | 5.49               | -97.43 | 98.31 | -13.73                  | 13.73 | 1.74    |
| xcb    | 5.48               | -97.78 | 86.23 | -13.69                  | 13.69 | 1.64    |
| zaf    | 5.42               | -93.60 | 88.10 | -13.55                  | 13.55 | 1.90    |
| prt    | 5.41               | -75.01 | 96.19 | -13.52                  | 13.52 | 2.02    |
| svk    | 5.39               | -63.13 | 88.45 | -13.47                  | 13.47 | 1.93    |
| tur    | 5.32               | -82.99 | 97.21 | -13.30                  | 13.30 | 1.65    |
| mar    | 5.18               | -99.29 | 97.74 | -12.95                  | 12.95 | 1.47    |
| can    | 5.08               | -94.27 | 63.26 | -12.69                  | 12.69 | 1.66    |
| xna    | 4.93               | -62.36 | 62.29 | -12.33                  | 12.33 | 1.36    |
| fra    | 4.91               | -75.46 | 97.97 | -12.27                  | 12.27 | 1.75    |
| cze    | 4.91               | -44.38 | 82.90 | -12.26                  | 12.26 | 2.10    |
| gbr    | 4.80               | -87.40 | 80.69 | -12.00                  | 12.00 | 1.57    |
| lva    | 4.65               | -67.32 | 92.99 | -11.62                  | 11.62 | 1.51    |
| xer    | 4.61               | -67.34 | 71.46 | -11.53                  | 11.53 | 1.13    |
| jpn    | 4.55               | -94.66 | 94.76 | -11.38                  | 11.38 | 1.06    |
| chn    | 4.44               | -95.73 | 93.42 | -11.10                  | 11.10 | 1.36    |
| bgd    | 4.29               | -77.29 | 99.19 | -10.73                  | 10.73 | 1.01    |
| kor    | 4.18               | -98.15 | 84.55 | -10.46                  | 10.46 | 0.94    |
| xoc    | 4.18               | -75.73 | 61.63 | -10.46                  | 10.46 | 0.95    |
| usa    | 3.80               | -60.62 | 86.97 | -9.51                   | 9.51  | 0.95    |
| aus    | 3.80               | -90.48 | 69.25 | -9.50                   | 9.50  | 1.02    |
| arg    | 3.64               | -92.59 | 73.45 | -9.11                   | 9.11  | 0.79    |
| hrv    | 3.40               | -65.71 | 96.81 | -8.51                   | 8.51  | 0.55    |
| bwa    | 3.35               | -87.65 | 93.19 | -8.38                   | 8.38  | 0.46    |
| alb    | 3.30               | -77.33 | 63.69 | -8.26                   | 8.26  | 0.56    |
| tun    | 3.29               | -65.20 | 70.52 | -8.23                   | 8.23  | 0.53    |
| nzl    | 3.26               | -59.92 | 69.62 | -8.16                   | 8.16  | 0.60    |
| twl    | 2.47               | -38.08 | 79.98 | -6.17                   | 6.20  | 0.38    |

Source: Authors' calculations

# Appendix II Cost and Sales Shares by Inputs and Uses

**Table A 3: Summary Statistics for Percentage Point Differences between Initial and Final Cost Shares by Input (sorted by standard deviation)**

| input     | Mean  | Standard Deviation | min    | max   | 90% Confidence Interval |       | Entropy |
|-----------|-------|--------------------|--------|-------|-------------------------|-------|---------|
|           |       |                    |        |       | lower                   | upper |         |
| prim_cap  | -4.36 | 18.26              | -96.26 | 89.48 | -50.01                  | 41.29 | 9.68    |
| prim_lab  | -0.96 | 15.49              | -99.83 | 88.59 | -39.68                  | 37.76 | 7.17    |
| prim_land | 10.57 | 12.20              | -48.97 | 45.40 | -19.93                  | 41.07 | 77.57   |
| trd_d     | -0.42 | 6.67               | -34.23 | 91.49 | -17.08                  | 16.25 | 3.51    |
| ely_d     | 0.51  | 6.39               | -43.68 | 93.00 | -15.46                  | 16.47 | 2.80    |
| oil_m     | 0.23  | 5.16               | -52.47 | 87.70 | -12.66                  | 13.12 | 1.61    |
| p_c_m     | 0.57  | 4.94               | -69.04 | 98.05 | -11.79                  | 12.93 | 2.35    |
| p_c_d     | 0.45  | 4.66               | -61.01 | 68.54 | -11.21                  | 12.11 | 2.40    |
| obs_d     | 1.19  | 4.61               | -64.91 | 65.31 | -10.34                  | 12.71 | 2.83    |
| gas_m     | 0.24  | 4.21               | -37.57 | 99.47 | -10.29                  | 10.78 | 1.58    |
| ofi_d     | -0.37 | 4.16               | -51.15 | 53.03 | -10.77                  | 10.03 | 1.89    |
| oap_d     | -0.11 | 4.06               | -63.97 | 83.87 | -10.25                  | 10.04 | 1.55    |
| oil_d     | 0.08  | 4.04               | -47.16 | 87.46 | -10.01                  | 10.17 | 1.23    |
| ofd_d     | -0.11 | 4.00               | -48.68 | 52.15 | -10.12                  | 9.90  | 1.95    |
| otn_m     | 0.30  | 3.74               | -49.84 | 81.99 | -9.04                   | 9.65  | 1.17    |
| rmk_d     | -0.14 | 3.70               | -67.12 | 66.64 | -9.40                   | 9.12  | 1.57    |
| pdr_m     | 0.10  | 3.64               | -59.04 | 99.26 | -9.01                   | 9.21  | 0.80    |
| ctl_d     | -0.05 | 3.63               | -73.31 | 61.34 | -9.12                   | 9.01  | 1.13    |
| pdr_d     | 0.07  | 3.55               | -71.37 | 99.53 | -8.80                   | 8.94  | 0.63    |
| ofd_m     | 0.34  | 3.51               | -16.30 | 85.76 | -8.42                   | 9.10  | 1.18    |
| c_b_d     | 0.08  | 3.49               | -76.36 | 83.59 | -8.64                   | 8.80  | 0.91    |
| wht_m     | 0.10  | 3.32               | -36.42 | 97.33 | -8.21                   | 8.41  | 0.87    |
| otp_d     | 0.09  | 3.29               | -39.77 | 45.11 | -8.13                   | 8.31  | 1.49    |
| crp_m     | 0.52  | 3.18               | -25.66 | 46.20 | -7.44                   | 8.48  | 1.51    |
| osd_m     | 0.19  | 3.15               | -48.97 | 97.33 | -7.68                   | 8.05  | 0.70    |
| i_s_m     | 0.23  | 3.13               | -57.88 | 61.62 | -7.59                   | 8.05  | 0.99    |
| coa_d     | 0.00  | 3.11               | -46.53 | 86.04 | -7.76                   | 7.77  | 1.19    |
| gas_d     | 0.00  | 3.07               | -56.95 | 71.15 | -7.67                   | 7.68  | 1.35    |
| osg_m     | 0.24  | 3.00               | -4.19  | 92.58 | -7.27                   | 7.74  | 1.65    |
| cns_d     | -0.06 | 2.98               | -40.35 | 63.58 | -7.52                   | 7.40  | 1.22    |
| osg_d     | -0.16 | 2.95               | -77.78 | 49.02 | -7.54                   | 7.21  | 1.38    |
| ocr_d     | 0.03  | 2.87               | -35.45 | 83.17 | -7.16                   | 7.21  | 1.43    |
| ros_d     | -0.40 | 2.67               | -34.75 | 80.96 | -7.08                   | 6.27  | 1.66    |
| crp_d     | -0.42 | 2.64               | -25.66 | 57.71 | -7.01                   | 6.18  | 1.28    |

| input | Mean  | Standard Deviation | min    | max   | 90% Confidence Interval |       | Entropy |
|-------|-------|--------------------|--------|-------|-------------------------|-------|---------|
|       |       |                    |        |       | lower                   | upper |         |
| v_f_d | -0.18 | 2.55               | -70.72 | 43.06 | -6.55                   | 6.19  | 1.23    |
| mvh_m | -0.02 | 2.53               | -65.89 | 69.28 | -6.34                   | 6.29  | 0.84    |
| tex_m | 0.25  | 2.50               | -47.51 | 38.46 | -5.99                   | 6.49  | 0.62    |
| tex_d | -0.26 | 2.49               | -61.17 | 29.60 | -6.48                   | 5.96  | 0.59    |
| gro_d | 0.00  | 2.43               | -41.10 | 86.69 | -6.08                   | 6.08  | 0.78    |
| ome_m | 0.27  | 2.39               | -26.46 | 26.97 | -5.69                   | 6.23  | 1.14    |
| omn_d | -0.07 | 2.32               | -74.98 | 29.33 | -5.86                   | 5.73  | 0.79    |
| ele_m | 0.06  | 2.30               | -43.31 | 46.39 | -5.70                   | 5.81  | 0.72    |
| osd_d | 0.07  | 2.29               | -30.86 | 40.31 | -5.65                   | 5.79  | 0.62    |
| otp_m | 0.07  | 2.15               | -37.86 | 88.62 | -5.30                   | 5.44  | 0.67    |
| frs_d | 0.02  | 2.13               | -26.50 | 56.21 | -5.31                   | 5.35  | 0.63    |
| v_f_m | 0.04  | 2.12               | -51.88 | 82.36 | -5.27                   | 5.34  | 0.76    |
| gdt_d | -0.12 | 2.04               | -37.19 | 50.53 | -5.21                   | 4.97  | 1.36    |
| ofi_m | 0.18  | 2.01               | -7.28  | 73.20 | -4.84                   | 5.20  | 0.69    |
| lum_m | 0.23  | 1.91               | -9.53  | 60.37 | -4.55                   | 5.01  | 0.54    |
| i_s_d | -0.17 | 1.89               | -36.23 | 20.44 | -4.88                   | 4.54  | 0.60    |
| nfm_d | -0.13 | 1.87               | -32.82 | 60.58 | -4.81                   | 4.56  | 0.62    |
| isr_d | -0.03 | 1.87               | -20.16 | 43.08 | -4.70                   | 4.65  | 0.65    |
| vol_m | 0.06  | 1.83               | -18.52 | 84.94 | -4.51                   | 4.62  | 0.48    |
| omt_d | -0.14 | 1.82               | -41.91 | 43.35 | -4.69                   | 4.40  | 0.76    |
| omn_m | 0.02  | 1.77               | -24.54 | 66.74 | -4.40                   | 4.44  | 0.65    |
| ros_m | -0.02 | 1.77               | -49.53 | 55.81 | -4.43                   | 4.40  | 0.99    |
| mil_d | 0.13  | 1.74               | -41.80 | 31.80 | -4.21                   | 4.47  | 0.53    |
| nfm_m | 0.01  | 1.72               | -35.98 | 23.23 | -4.28                   | 4.30  | 0.51    |
| ocr_m | 0.04  | 1.71               | -48.72 | 50.57 | -4.23                   | 4.30  | 0.63    |
| ome_d | -0.13 | 1.70               | -23.60 | 16.28 | -4.37                   | 4.12  | 0.83    |
| cmt_d | -0.13 | 1.67               | -31.20 | 54.14 | -4.32                   | 4.05  | 0.61    |



**Table A 4: Summary Statistics for Percentage Point Differences between Initial and Final Sales Shares by Use (sorted by standard deviation)**

| Use    | Mean  | Standard Deviation | Min    | max   | 90% Confidence Interval |       | Entropy |
|--------|-------|--------------------|--------|-------|-------------------------|-------|---------|
|        |       |                    |        |       | lower                   | upper |         |
| fin_ch | 1.23  | 23.88              | -99.45 | 99.98 | -58.47                  | 60.94 | 16.17   |
| fin_x  | 2.62  | 22.88              | -98.62 | 98.99 | -54.58                  | 59.83 | 15.53   |
| ofd_i  | -0.22 | 10.63              | -95.44 | 95.55 | -26.79                  | 26.36 | 5.70    |
| p_c_i  | 0.25  | 9.42               | -98.59 | 99.69 | -23.29                  | 23.80 | 4.29    |
| fin_if | -0.38 | 9.39               | -99.24 | 90.54 | -23.87                  | 23.10 | 6.14    |
| ely_i  | 0.50  | 9.36               | -96.66 | 98.82 | -22.91                  | 23.91 | 4.19    |
| trd_i  | 0.83  | 8.42               | -94.09 | 96.62 | -20.23                  | 21.88 | 7.01    |
| fin_cg | 0.08  | 7.42               | -99.98 | 98.23 | -18.48                  | 18.64 | 5.40    |
| crp_i  | -0.16 | 7.28               | -86.61 | 99.90 | -18.36                  | 18.05 | 4.41    |
| tex_i  | -0.14 | 6.99               | -98.85 | 96.96 | -17.61                  | 17.33 | 2.59    |
| cns_i  | 0.13  | 6.94               | -77.91 | 99.28 | -17.22                  | 17.47 | 3.46    |
| osg_i  | -0.12 | 6.61               | -96.18 | 99.63 | -16.64                  | 16.39 | 4.19    |
| mil_i  | 0.65  | 6.00               | -71.53 | 99.47 | -14.36                  | 15.66 | 2.68    |
| sgr_i  | -0.06 | 5.85               | -91.86 | 99.88 | -14.70                  | 14.57 | 2.09    |
| cmt_i  | -0.29 | 5.71               | -99.46 | 95.49 | -14.57                  | 14.00 | 2.06    |
| omt_i  | -0.20 | 5.26               | -66.02 | 94.76 | -13.35                  | 12.95 | 2.23    |
| b_t_i  | -0.17 | 5.12               | -95.05 | 98.63 | -12.97                  | 12.64 | 2.60    |
| pcr_i  | -0.06 | 5.00               | -94.13 | 88.22 | -12.57                  | 12.44 | 1.50    |
| ros_i  | -0.40 | 4.95               | -95.73 | 86.97 | -12.77                  | 11.96 | 2.96    |
| vol_i  | -0.16 | 4.77               | -94.65 | 88.82 | -12.07                  | 11.76 | 1.74    |
| otp_i  | 0.04  | 4.74               | -80.43 | 61.20 | -11.80                  | 11.88 | 2.21    |
| obs_i  | 0.25  | 4.64               | -75.02 | 62.88 | -11.36                  | 11.86 | 2.68    |
| ofi_i  | -0.33 | 4.62               | -83.99 | 54.07 | -11.87                  | 11.21 | 1.64    |
| oil_i  | 0.28  | 4.54               | -62.71 | 99.49 | -11.07                  | 11.64 | 3.04    |
| oap_i  | -0.29 | 4.24               | -84.95 | 82.19 | -10.88                  | 10.30 | 1.75    |
| nmn_i  | -0.21 | 4.20               | -75.68 | 99.19 | -10.72                  | 10.30 | 1.72    |
| nfm_i  | 0.16  | 4.08               | -80.51 | 91.33 | -10.05                  | 10.37 | 1.39    |
| lum_i  | -0.05 | 4.06               | -81.26 | 96.93 | -10.20                  | 10.11 | 1.06    |
| lea_i  | -0.15 | 4.06               | -99.67 | 94.67 | -10.30                  | 10.00 | 1.38    |
| wap_i  | 0.00  | 4.04               | -97.43 | 85.73 | -10.11                  | 10.11 | 1.61    |
| cmn_i  | 0.06  | 3.67               | -97.83 | 88.64 | -9.12                   | 9.25  | 0.87    |
| i_s_i  | -0.10 | 3.54               | -72.91 | 79.98 | -8.95                   | 8.75  | 1.38    |
| wtp_i  | 0.08  | 3.52               | -50.09 | 81.56 | -8.71                   | 8.87  | 1.15    |
| omf_i  | -0.15 | 3.38               | -81.99 | 82.37 | -8.59                   | 8.29  | 1.63    |
| gdt_i  | -0.31 | 3.31               | -98.15 | 44.76 | -8.59                   | 7.98  | 1.62    |
| ctl_i  | -0.18 | 3.18               | -71.66 | 90.96 | -8.14                   | 7.78  | 1.30    |
| omn_i  | -0.01 | 3.16               | -62.30 | 97.74 | -7.91                   | 7.89  | 1.39    |
| ele_i  | -0.26 | 3.11               | -58.71 | 69.80 | -8.04                   | 7.51  | 1.25    |
| rmk_i  | -0.11 | 3.09               | -92.57 | 51.18 | -7.84                   | 7.63  | 1.27    |
| isr_i  | -0.03 | 3.02               | -82.48 | 91.80 | -7.57                   | 7.52  | 0.94    |

| Use   | Mean  | Standard Deviation | Min    | max   | 90% Confidence Interval |       | Entropy |
|-------|-------|--------------------|--------|-------|-------------------------|-------|---------|
|       |       |                    |        |       | lower                   | upper |         |
| ppp_i | -0.15 | 3.00               | -64.49 | 86.17 | -7.65                   | 7.34  | 1.13    |
| atp_i | 0.02  | 2.85               | -83.91 | 73.63 | -7.12                   | 7.15  | 0.98    |
| v_f_i | -0.02 | 2.70               | -62.37 | 63.01 | -6.78                   | 6.75  | 1.18    |
| ome_i | -0.04 | 2.62               | -50.32 | 53.70 | -6.60                   | 6.51  | 1.16    |
| ocr_i | -0.11 | 2.48               | -54.39 | 71.18 | -6.31                   | 6.09  | 0.97    |
| mvh_i | -0.10 | 2.28               | -70.02 | 56.60 | -5.79                   | 5.59  | 0.93    |
| c_b_i | -0.12 | 2.16               | -85.69 | 54.66 | -5.51                   | 5.27  | 0.80    |
| fmp_i | -0.18 | 2.11               | -31.75 | 39.80 | -5.47                   | 5.10  | 0.88    |
| fsb_i | -0.06 | 2.10               | -61.02 | 60.31 | -5.31                   | 5.18  | 1.18    |
| gas_i | 0.03  | 2.00               | -31.89 | 61.22 | -4.96                   | 5.02  | 1.04    |
| wol_i | -0.04 | 2.00               | -56.79 | 66.52 | -5.03                   | 4.94  | 0.49    |
| frs_i | -0.07 | 1.99               | -34.12 | 39.77 | -5.05                   | 4.91  | 0.91    |
| pdr_i | -0.02 | 1.86               | -86.17 | 75.60 | -4.66                   | 4.62  | 0.38    |
| dwe_i | -0.09 | 1.71               | -51.07 | 38.87 | -4.37                   | 4.18  | 0.94    |
| gro_i | -0.10 | 1.71               | -84.79 | 24.82 | -4.36                   | 4.17  | 0.56    |
| wtr_i | -0.04 | 1.63               | -59.00 | 71.36 | -4.12                   | 4.03  | 0.50    |
| coa_i | -0.03 | 1.63               | -46.53 | 69.44 | -4.09                   | 4.03  | 0.97    |
| osd_i | -0.03 | 1.56               | -74.34 | 33.21 | -3.93                   | 3.87  | 0.38    |
| otn_i | -0.02 | 1.54               | -33.05 | 45.87 | -3.87                   | 3.82  | 0.53    |
| wht_i | -0.05 | 1.46               | -37.98 | 54.79 | -3.70                   | 3.59  | 0.44    |
| pfb_i | 0.00  | 1.32               | -41.45 | 47.04 | -3.30                   | 3.31  | 0.41    |

*Source: Authors' calculations*

# Appendix III Basic Information on Contributed IO tables

Table A 5: Basic Information about the contributed Table

|     | GTAP Version IO table was contributed | Total No. of sectors in contribution (max 57) | No. of Agricultural sectors (max 12) | No. of Processed food sectors (max 7) | No. of Manufacturing sectors (max 37) |
|-----|---------------------------------------|---|--------------------------------------|---------------------------------------|---------------------------------------|
| AUS | 8                                     | 54  | 11                                   | 6                                     | 37                                    |
| NZL | 9                                     | 41  | 4                                    | 4                                     | 33                                    |
| CHN | 9                                     | 45  | 2                                    | 7                                     | 36                                    |
| HKG | 1                                     | 37  | 6                                    | 5                                     | 26                                    |
| JPN | 8.1                                   | 57  | 12                                   | 8                                     | 37                                    |
| KOR | 8.1                                   | 56  | 12                                   | 7                                     | 37                                    |
| MNG | 8                                     | 34  | 2                                    | 3                                     | 29                                    |
| TWN | 8.1                                   | 57  | 12                                   | 8                                     | 37                                    |
| BRN | 9                                     | 34  | 1                                    | 1                                     | 32                                    |
| KHM | 7                                     | 57  | 12                                   | 8                                     | 37                                    |
| IDN | 7                                     | 53  | 10                                   | 7                                     | 36                                    |
| LAO | 7                                     | 31  | 12                                   | 1                                     | 18                                    |
| MYS | 8                                     | 46  | 6                                    | 5                                     | 35                                    |
| PHL | 8                                     | 50  | 9                                    | 6                                     | 35                                    |
| SGP | 8.1                                   | 43  | 2                                    | 5                                     | 36                                    |
| THA | 8                                     | 51  | 9                                    | 7                                     | 35                                    |
| VNM | 7.1                                   | 47  | 6                                    | 7                                     | 34                                    |
| BGD | 5                                     | 57  | 12                                   | 8                                     | 37                                    |
| IND | 8                                     | 50  | 10                                   | 4                                     | 36                                    |
| NPL | 8                                     | 57  | 12                                   | 8                                     | 37                                    |
| PAK | 9                                     | 32  | 8                                    | 4                                     | 20                                    |
| LKA | 7                                     | 29  | 5                                    | 3                                     | 21                                    |
| CAN | 7                                     | 51  | 8                                    | 8                                     | 35                                    |
| USA | 7                                     | 57  | 12                                   | 8                                     | 37                                    |
| MEX | 8                                     | 37  | 2                                    | 2                                     | 33                                    |
| ARG | 6                                     | 57  | 12                                   | 8                                     | 37                                    |
| BOL | 7.1                                   | 33  | 4                                    | 5                                     | 24                                    |
| BRA | 8.1                                   | 52  | 11                                   | 8                                     | 33                                    |
| CHL | 7                                     | 40  | 3                                    | 5                                     | 32                                    |
| COL | 8.1                                   | 56  | 12                                   | 7                                     | 37                                    |
| ECU | 7                                     | 41  | 5                                    | 5                                     | 31                                    |
| PRY | 9                                     | 36  | 7                                    | 6                                     | 23                                    |
| PER | 7                                     | 50  | 12                                   | 8                                     | 30                                    |
| URY | 7                                     | 50  | 12                                   | 8                                     | 30                                    |

|     | <b>GTAP Version IO<br/>table was<br/>contributed</b> | <b>Total No. of<br/>sectors in<br/>contribution<br/>(max 57)</b> | <b>No. of<br/>Agricultural<br/>sectors (max<br/>12)</b> | <b>No. of<br/>Processed<br/>food sectors<br/>(max 7)</b> | <b>No. of<br/>Manufacturing<br/>sectors<br/>(max 37)</b> |
|-----|--|--|---|--|--|
| VEN | 8  | 46   | 4   | 6  | 36   |
| CRI | 7  | 37   | 9   | 7  | 21   |
| GTM | 7  | 50   | 12  | 7  | 31   |
| HND | 8  | 42   | 7   | 7  | 28   |
| NIC | 7  | 34   | 5   | 5  | 24   |
| PAN | 7  | 27   | 10  | 2  | 15   |
| SLV | 8  | 38   | 7   | 6  | 25   |
| DOM | 9  | 30   | 4   | 4  | 22   |
| JAM | 9  | 35   | 6   | 5  | 24   |
| PRI | 9  | 38   | 1   | 7  | 30   |
| TTO | 9  | 43   | 7   | 7  | 29   |
| AUT | 7.1  | 54   | 12  | 8  | 34   |
| BEL | 7.1  | 54   | 12  | 8  | 34   |
| CYP | 7.1  | 54   | 12  | 8  | 34   |
| CZE | 7.1  | 54   | 12  | 8  | 34   |
| DNK | 7.1  | 54   | 12  | 8  | 34   |
| EST | 7.1  | 54   | 12  | 8  | 34   |
| FIN | 7.1  | 54   | 12  | 8  | 34   |
| FRA | 7.1  | 54   | 12  | 8  | 34   |
| DEU | 7.1  | 54   | 12  | 8  | 34   |
| GRC | 7.1  | 54   | 12  | 8  | 34   |
| HUN | 7.1  | 54   | 12  | 8  | 34   |
| IRL | 7.1  | 54   | 12  | 8  | 34   |
| ITA | 7.1  | 54   | 12  | 8  | 34   |
| LVA | 7.1  | 54   | 12  | 8  | 34   |
| LTU | 7.1  | 54   | 12  | 8  | 34   |
| LUX | 7.1  | 54   | 12  | 8  | 34   |
| MLT | 7.1  | 54   | 12  | 8  | 34   |
| NLD | 7.1  | 54   | 12  | 8  | 34   |
| POL | 7.1  | 54   | 12  | 8  | 34   |
| PRT | 7.1  | 54   | 12  | 8  | 34   |
| SVK | 7.1  | 54   | 12  | 8  | 34   |
| SVN | 7.1  | 54   | 12  | 8  | 34   |
| ESP | 7.1  | 54   | 12  | 8  | 34   |
| SWE | 7.1  | 54   | 12  | 8  | 34   |
| GBR | 7.1  | 54   | 12  | 8  | 34   |
| CHE | 8  | 30   | 3   | 1  | 26   |
| NOR | 8  | 38   | 3   | 1  | 34   |
| ALB | 5.3  | 57   | 12  | 8  | 37   |
| BGR | 7.1  | 54   | 12  | 8  | 34   |

|     | <b>GTAP Version IO table was contributed</b> | <b>Total No. of sectors in contribution (max 57)</b> | <b>No. of Agricultural sectors (max 12)</b> | <b>No. of Processed food sectors (max 7)</b> | <b>No. of Manufacturing sectors (max 37)</b> |
|-----|--|--|---|--|--|
| BLR | 8.1  | 40   | 12  | 8  | 20   |
| HRV | 5.2  | 57   | 12  | 8  | 37   |
| ROU | 7.1  | 54   | 12  | 8  | 34   |
| RUS | 7  | 41   | 4   | 4  | 33   |
| UKR | 7  | 46   | 1   | 8  | 37   |
| KAZ | 7  | 34   | 1   | 1  | 32   |
| KGZ | 7  | 31   | 1   | 1  | 29   |
| ARM | 7  | 30   | 6   | 4  | 20   |
| AZE | 7  | 32   | 1   | 1  | 30   |
| GEO | 7  | 57   | 12  | 8  | 37   |
| BHR | 8  | 37   | 5   | 1  | 31   |
| IRN | 7  | 43   | 6   | 3  | 34   |
| ISR | 8  | 43   | 9   | 5  | 29   |
| JOR | 9  | 45   | 6   | 7  | 32   |
| KWT | 8  | 37   | 5   | 1  | 31   |
| OMN | 8  | 37   | 5   | 1  | 31   |
| QAT | 8  | 37   | 5   | 1  | 31   |
| SAU | 8  | 37   | 5   | 1  | 31   |
| TUR | 9  | 42   | 1   | 6  | 35   |
| ARE | 8  | 37   | 5   | 1  | 31   |
| EGY | 6.2  | 31   | 3   | 4  | 24   |
| MAR | 7  | 46   | 12  | 6  | 28   |
| TUN | 6  | 37   | 3   | 5  | 29   |
| BEN | 8.1  | 29   | 5   | 1  | 23   |
| BFA | 8.1  | 38   | 8   | 6  | 24   |
| CMR | 8  | 57   | 12  | 8  | 37   |
| CIV | 8  | 34   | 4   | 2  | 28   |
| GHA | 8  | 41   | 9   | 4  | 28   |
| GIN | 8.1  | 30   | 9   | 3  | 18   |
| NGA | 8.1  | 38   | 12  | 4  | 22   |
| SEN | 9  | 31   | 2   | 4  | 25   |
| TGO | 8.1  | 30   | 3   | 4  | 23   |
| ETH | 7.1  | 39   | 6   | 5  | 28   |
| KEN | 8  | 33   | 10  | 3  | 20   |
| MDG | 6  | 57   | 12  | 8  | 37   |
| MWI | 8.1  | 36   | 9   | 4  | 23   |
| MUS | 6.1  | 42   | 11  | 5  | 26   |
| MOZ | 8.1  | 37   | 9   | 3  | 25   |
| RWA | 8.1  | 34   | 10  | 4  | 20   |
| TZA | 8.1  | 39   | 11  | 6  | 22   |

|     | <b>GTAP Version IO<br/>table was<br/>contributed</b> | <b>Total No. of<br/>sectors in<br/>contribution<br/>(max 57)</b> | <b>No. of<br/>Agricultural<br/>sectors (max<br/>12)</b> | <b>No. of<br/>Processed<br/>food sectors<br/>(max 7)</b> | <b>No. of<br/>Manufacturing<br/>sectors<br/>(max 37)</b> |
|-----|--|--|---|--|--|
| UGA | 8  | 33   | 3   | 2  | 28   |
| ZMB | 8.1  | 36   | 9   | 4  | 23   |
| ZWE | 5.1  | 57   | 12  | 8  | 37   |
| BWA | 5  | 57   | 12  | 8  | 37   |
| NAM | 8  | 29   | 3   | 2  | 24   |
| ZAF | 7  | 41   | 3   | 6  | 32   |

*Source: Annual Report on the Regional I-O Tables in the GTAP Data Base*

# Appendix IV Notation used

**Table A 6: Sectoral listing**

| Number | Code | Description                            |
|--------|------|--|
| 1      | PDR  | Paddy rice                             |
| 2      | WHT  | Wheat                                  |
| 3      | GRO  | Cereal grains nec                      |
| 4      | V_F  | Vegetables, fruit, nuts                |
| 5      | OSD  | Oil seeds                              |
| 6      | C_B  | Sugar cane, sugar beet                 |
| 7      | PFB  | Plant-based fibers                     |
| 8      | OCR  | Crops nec                              |
| 9      | CTL  | Bovine cattle, sheep and goats, horses |
| 10     | OAP  | Animal products nec                    |
| 11     | RMK  | Raw milk                               |
| 12     | WOL  | Wool, silk-worm cocoons                |
| 13     | FRS  | Forestry                               |
| 14     | FSH  | Fishing                                |
| 15     | COA  | Coal                                   |
| 16     | OIL  | Oil                                    |
| 17     | GAS  | Gas                                    |
| 18     | OMN  | Minerals nec                           |
| 19     | CMT  | Bovine meat products                   |
| 20     | OMT  | Meat products nec                      |
| 21     | VOL  | Vegetable oils and fats                |
| 22     | MIL  | Dairy products                         |
| 23     | PCR  | Processed rice                         |
| 24     | SGR  | Sugar                                  |
| 25     | OFD  | Food products nec                      |
| 26     | B_T  | Beverages and tobacco products         |
| 27     | TEX  | Textiles                               |
| 28     | WAP  | Wearing apparel                        |
| 29     | LEA  | Leather products                       |
| 30     | LUM  | Wood products                          |
| 31     | PPP  | Paper products, publishing             |
| 32     | P_C  | Petroleum, coal products               |
| 33     | CRP  | Chemical, rubber, plastic products     |
| 34     | NMM  | Mineral products nec                   |
| 35     | I_S  | Ferrous metals                         |
| 36     | NFM  | Metals nec                             |
| 37     | FMP  | Metal products                         |
| 38     | MVH  | Motor vehicles and parts               |

| Number | Code | Description                                       |
|--------|------|---|
| 39     | OTN  | Transport equipment nec                           |
| 40     | ELE  | Electronic equipment                              |
| 41     | OME  | Machinery and equipment nec                       |
| 42     | OMF  | Manufactures nec                                  |
| 43     | ELY  | Electricity                                       |
| 44     | GDT  | Gas manufacture, distribution                     |
| 45     | WTR  | Water   |
| 46     | CNS  | Construction                                      |
| 47     | TRD  | Trade   |
| 48     | OTP  | Transport nec                                     |
| 49     | WTP  | Water transport                                   |
| 50     | ATP  | Air transport                                     |
| 51     | CMN  | Communication                                     |
| 52     | OFI  | Financial services nec                            |
| 53     | ISR  | Insurance   |
| 54     | OBS  | Business services nec                             |
| 55     | ROS  | Recreational and other services                   |
| 56     | OSG  | Public Administration, Defense, Education, Health |
| 57     | DWE  | Dwellings   |

**Table A 7: Other codes for assistance**

| Number | Code      | Description                                 |
|--------|-----------|---|
| 1      | _d        | Post-script indicating Domestic variety     |
| 2      | _m        | Post-script indicating Imported variety     |
| 3      | _i        | Post-script indicating Industry or activity |
| 4      | prim_land | Land  |
| 5      | prim_cap  | Capital                                     |
| 6      | prim_lab  | Labor                                       |
| 7      | fin_x     | Exports                                     |
| 8      | fin_cg    | Government consumptions                     |
| 9      | fin_ch    | Private household consumptions              |
| 10     | fin_if    | Investment                                  |



# Bibliography

Bacharach, M. (1970). Biproportional matrices and input-output change, Cambridge.

Boumellassa, H., D. Laborde and C. Mitaritonna (2009). A picture of tariff protection across the World in 2004 : MAcMap-HS6, Version 2. IFPRI Discussion Paper 903. Washington DC, International Food Policy Research Institute (IFPRI).

European Commission, IMF, OECD, United Nations and W. Bank (2008). "System of National Accounts."

Gehlhar, M., Z. Wang and S. Yao (2008). Reconciling Merchandise Trade Data. Global Trade, Assistance, and Production: The GTAP 7 Data Base. B. Narayanan and T. L. Walmsley. West Lafayette, IN, Center for Global Trade Analysis, Purdue University.

Harslett, P., (2013). "The GTAP Data Base Construction Procedure." GTAP Working paper, 76, Center for Global Trade Analysis, Purdue University, West Lafayette, IN, USA

Huff, K. M., R. McDougall and T. L. Walmsley (1998). Contributing IO tables to the GTAP Data Base GTAP Technical Paper Series. C. f. G. T. Analysis. West Lafayette, IN.

James, M. and R. McDougall (1993). FIT: An input-output data update facility for SALTER. SALTER working paper. A. I. Commission.

Marcel, T., A. A. Erumban, G. J. d. Vries, I. Arto, V. A. A. Genty, J. Frederik Neuwahl, M. Rueda-Cantuche, A. Villanueva, J. Francois, O. Pindyuk, J. Pöschl, R. Stehrer and G. Streicher (2012). The World Input-Output Database (WIOD): Contents, Sources and Methods. Working Paper Number.

Narayanan, G. B., A. Aguiar and R. McDougall (2012). Global Trade, Assistance, and Production: The GTAP 8 Data Base. West Lafayette, Indiana, Center for Global Trade Analysis, Purdue University.

Organisation for Economic Cooperation and Development and International Energy Agency (2003). IEA Online Database Services, Organisation for Economic Cooperation and Development and International Energy Agency, Washington D.C.

Theil, H. (1967). Economics and information theory. Amsterdam, North-Holland.

Tukker, A., E. Poliakov, R. Heijungs, T. Hawkins, F. Neuwahl, J. Rueda-Cantuche, S. Giljum, S. Moll, J. Oosterhaven and M. Bouwmeester (2009). "Towards a global multi-regional environmentally extended input-output database." Ecological Economics 68(7): 1929-1937.

Walmsley, T. L. and R. McDougall (2004). Using Entropy to Compare Shares. GTAP Research Memorandum. C. f. G. T. Analysis. West Lafayette, IN, 9.

Walmsley, T. L., A. Aguiar and B. G. Narayanan (2013). "A Global Dataset of Input-Output Tables Linked by International Trade and Policy Data." GTAP Working Paper, 67, Center for Global Trade Analysis, Purdue University, IN, USA