

Chapter 12

Services trade data

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12.1 Introduction

The main objective of this chapter is to explain the procedures adopted in assembling the bilateral trade matrices for trade in nonfactor services, and the vector of margins exports in the GTAP version 4 data base. In assembling the services trade data we closely follow the procedures used in the GTAP version 3 data base (see, Swaminathan, 1997). The structure of the rest of the chapter is as follows. In the next section we present the overall strategy adopted in assembling services trade data for the version 4. The main data sources are summarized in section 3. The procedures adopted in constructing services trade data matrices and vector of margins exports are explained in section 4. Concluding remarks are given in the final section.

12.2 Overall strategy for the construction of the services trade data

There are eight service sectors in the GTAP version 4 data base and they are shown in table 12.1 below.

Table 12.1 Nonfactor services sectors in version 4 data base

Number	GTAP Code	GTAP Sector Description
43	ely	electricity
44	gdt	gas
45	wtr	water
46	cns	construction
47	t_t	trade and transport
48	osp	other services, private
49	osg	other services, government
50	dwe	ownership of dwellings

The overall strategy is described as follows:

- we first treat as non-tradable the sectors “gas”, “water”, and “ownership of dwellings”,
- for “electricity”, we have a bilateral trade data set that uses the GTAP regional classification,
- for “construction”, “trade and transport”, “other services, private”, and “other services, government”, we use a bilateral trade data set that has to be remapped to the GTAP regional and sectoral classifications.
- trade margins obtained from merchandise trade data are used in computing the margins exports.

The detailed procedures for implementing these strategies are discussed in section 12.4.

12.3 Data sources

Table 12.2 summarizes data sources, the type of data contained in each source, and the GTAP data that was created from each data source.

Table 12.2 Data sources for trade in services in version 4 of the GTAP data base

Data Source	Type of Data	GTAP Data
Mark Gehlhar	Bilateral trade matrices for Electricity, gas, and water	Bilateral trade matrices for Electricity, gas, and water
Mark Gehlhar (collected from the World Bank country tables)	Nonfactor services receipts (US\$), by country	Total exports of nonfactor services, by GTAP region
	Nonfactor services payments (US\$), by country	Total imports of nonfactor services, by GTAP region
Michigan Model services trade data base	Bilateral services trade matrices for five sectors for 35 countries/regions	Initial estimates of the matrix elements for the matrix balancing procedures
Regional I/O tables in GTAP version 4 data base	Exports by sector and imports by sector and by usage	Export and import shares of service sectors by GTAP Region
Merchandise trade (<i>fob</i> and <i>cif</i>) in GTAP Version 4 data base	Global exports of margins	Margin exports by GTAP region

12.4 Procedures

In this section, we explain the procedures adopted in constructing the bilateral trade matrices and the margins services vector.

Construction of bilateral trade matrices for GTAP sectors 46 (*cns*), 47 (*t_t*), 48 (*osp*), and 49 (*osg*)

Similar to version 3, we proceed with the construction of the bilateral trade flow matrix by sector. We thus have one array of size 45 by 45 for each service sector since there are 45 regions in version 4. An entry (cell) in this array represents the export of service sector i from source region r (row) to destination region s (column), valued at *fob* prices, and measured in millions of 1995 US dollars. It also represents the value of imports of service sector i by destination region s from source region r , valued at *cif* prices, and measured in the same units.

The essence of this is that there is only *one* array of size 45 by 45 for each service sector (unlike merchandise trade data, where each merchandise sector is associated with *two* trade arrays, one valued at *fob* prices and the other valued at *cif* prices). This implies two important issues

underlying trade in non-factor services: zero margins - services are traded with zero freight costs, and free trade - services trade in the GTAP data base is free from any import or export intervention.

This treatment of non-factor services trade is justifiable considering the fact that the primary source data for global non-factor services trade characterized by *both* sectoral details and bilateral details are unavailable. Each matrix is therefore constructed using a mathematical procedure (RAS - a constrained iterative matrix balancing algorithm). There is no basis for incorporating freight costs or policy interventions. However, the availability of better quality data, in the future, on services trade, and on a global basis, would make it possible, to improve upon the existing procedures.

We illustrate the existing procedures by focusing on the trade matrix for sector 46 (construction). The same method is used for constructing the trade arrays for sector 47 (trade and transport), sector 48 (other services private), and sector 49 (other services government). The regional I/O tables play an important role in this procedure in terms of providing sectoral details. We explain below several steps involved in the existing procedure.

Step 1: Compute services trade shares, by sector

We computed the export (import) share of service sector i in total exports (imports) of all services for each region by using the information given in the regional I/O tables on exports (by sector), and imports, (by sector and usage). We obtained total exports by summing across sectors, 43 to 50, and total imports by summing across the four usage categories (intermediate usage, investment usage, private consumption usage, and government usage) for each sector, and then summing across sectors 43 to 50. We computed the export (import) share of service sector i in total exports (imports) of all services for each region.

Step 2: Compute target totals for services trade

In the second step, we compute targets for services imports and exports, differentiated by region and commodity. To do this, we first calculate the initial targets for services imports and exports, differentiated by region. We then differentiate these regional targets also by commodity. Summing over the regions, we obtain initial the targets for imports and exports differentiated by commodity only. But these initial commodity targets are mutually inconsistent, so we have to adjust them to eliminate any inconsistencies. From the adjusted commodity targets, we calculate a single target for total global services trade. We adjust the regional targets for imports and exports to match with this global target. Finally, we adjust the commodity-by-region targets so as to match with the adjusted commodity targets and the regional targets.

For the initial regional totals, we use the World Bank source data (provided by Mark Gehlhar). These contain the total exports and total imports of non-factor services for 210 countries, measured

in US dollars, for the years 1993 through 1995. We select the trade data for 1995, which is the base year for the version 4 GTAP data base. Missing observations for 1995 are replaced by the most recent non-zero observation. The countries in the source data are mapped into the 45 GTAP regions in the version 4. Using the country mapping, non-factor service export (import) totals are obtained for the 45 GTAP regions, in millions of 1995 US dollars. These form an initial set of targets for services imports and exports by GTAP region.

We obtain the initial commodity-by-region targets for exports (imports) of sector i by source (destination) region r as the product of the share of sector i in total exports (imports) of all services from regional I/O tables and the non-factor service export (import) totals. These derived sectoral export and import totals thus form the targets to be attained by the trade matrix for sector i .

Summing the initial commodity-by-region targets over the regions, we obtain the initial commodity targets, for both imports and exports. In general, the import targets and export targets should be equal, since global exports of each commodity must be equal to global imports. In practice, the initial estimates do not agree. To resolve this inconsistency, we calculate a new set of commodity targets, taking for each commodity, the geometric mean of the initial export target and the initial import target.

The trade and transport sector is a special case. We take here not the geometric mean but the minimum of world exports and imports. By assumption, the source data for exports include trade and transport margin services, while the source data for imports exclude them.

Summing these trade targets over commodities, we obtain a single target value for global services trade. We rescale the regional targets for exports and imports to match with this global total. We then adjust the commodity-by-region targets, using the RAS method, to match the adjusted commodity and region targets. We make this adjustment separately for exports and imports.

For exports and imports of “other government services” for the United States, we encounter a special difficulty. For some reason, the US I/O table shows the United States as having an extraordinarily high share of its services trade in “other government services”. In consequence, in the initial trade totals, exports and imports of trade in “other government services” by the United States dwarf trade by other regions. More precisely, exports of “other government services” from the United States exceed total imports into all other regions; and likewise, imports into the United States exceed total exports from all other regions. Obviously these targets are inconsistent, and cannot be satisfied by any possible bilateral trade matrix. Even if other regions traded exclusively with the United States, their trade would not suffice to meet the US trade targets.

To meet with this special difficulty, we use a special rule to set the initial “other government services” export and import targets for the United States. Specifically, we set them equal to the product of the share of the United States in global services trade, the share of “other government services” in global services trade, and total world services trade itself. Then in adjusting the commodity-by-region targets by the RAS method, we hold these special targets fixed.

Step 3: Construct services trade matrices, by sector (introduce bilateral detail)

We construct the balanced trade matrices by employing the RAS algorithm and using the initial estimates of the matrices' elements to achieve the targets for row totals, column totals, and matrix total.

The initial estimates of the trade matrices' elements are obtained from the Michigan model. The Michigan data base for services trade consists of 5 arrays of size 35 by 35. For each GTAP sector, we extract the bilateral trade matrix from the corresponding Michigan data base, using the sectoral mapping shown in table 12.3 below. For the GTAP sector "trade and transport", we use the sum of the Michigan "wholesale and retail trade" and "transport, storage, and communication" services sectors. For the GTAP sectors "other services, private" and "other services, government", we use the sum of the Michigan sectors "finance, insurance, and real estate" and "community, social, and personal services". We do not apportion this total between the two GTAP sectors because, in the sequel, only the structure, not the scale, of the data in these matrices is relevant.

Table 12.3 Mapping from Michigan to GTAP service sectors

Michigan sector number and name	GTAP sector number, code and name		
5 Construction	46	CNS	construction
6 Wholesale and retail trade	47	t_t	trade and transport
7 Transport storage and communication	47	t_t	trade and transport
8 Finance, insurance, and real estate	48	OSP	other services, private
	49	OSG	other services, government
9 Community, social, and personal services	48	OSP	other services, private
	49	OSG	other services, government

We now have four bilateral trade matrices, each corresponding to one GTAP commodity, but with the Michigan rather than the GTAP regional classification. Since the Michigan and GTAP regional classifications are quite different, we use an indirect procedure to map from one to the other. We first determine a new regional classification as the finest common aggregation of the Michigan and GTAP classifications. That is, the new classification breaks out all those regions and only those regions which can be expressed as aggregates both of the Michigan regions and of GTAP regions. It distinguishes twenty-six regions, as against the thirty-five regions of the Michigan classification, and the forty-five of the GTAP.

Having determined this classification, we aggregate the Michigan trade matrices to conform to it. We then disaggregate the resultant new-classification matrices to the GTAP classification, by simple share splits. We split the exporting region dimension using export shares, and the importing region dimension using import shares. We calculate the shares on a commodity-specific basis, using the regional services trade profile data described above.

For each commodity, we apply to the bilateral trade matrix a procedure we call *smearing*. This modifies the trade matrix in such a way as to replace zero values by small strictly positive values, while keeping the matrix total unchanged. This is a technical adjustment, applied to ensure that the RAS procedure, to be described below, will always succeed in meeting its targets.

For each commodity, we zero out selected diagonal elements of the trade matrix. The diagonal elements represent intra-region trade, or trade by a region with itself. Before this adjustment the diagonal elements are generally non-zero. That is reasonable for multi-country regions, such as “Rest of South Asia” or “Central America and the Caribbean”. But for single-country regions, such as the United States or Japan, it should be zero. We adjust the matrices accordingly to make it so.

For each commodity, we use the RAS procedure to adjust the initial trade matrices to meet the target row, column, and matrix totals, thus producing balanced matrices. First, to ensure consistency of targets, we rescale the target row totals and target column totals so that they are consistent with the target matrix total. We then determine and apply row and column scaling factors to make the matrix consistent with the target row and column totals.

The above steps create four main services trade matrices.

12.4.2 *Electricity*

For electricity we use a bilateral trade matrix, differentiated by exporting country and importing country, supplied along with the merchandise trade data by Mark Gehlhar (chapter 11A). The only processing required is to aggregate the exporter and importer classes from countries to GTAP regions.

12.4.3 *Non-tradeable service commodities*

We treat as non-tradeable three of the service commodities: gas manufacture and distribution (gdt), water (wtr), and ownership of dwellings(dwe). For each of these commodities, the trade matrix is an array of zeros.

12.4.4 *Re-export services*

From Mark Gehlhar we have data for re-export services supplied by Hong Kong, differentiated by country of destination of the re-exported goods. We treat these services as though they were non-margin exports of trade and transport services to the country of destination of the re-exported goods. It is as if, rather than buying merchandise at a price incorporating a re-export margin, the purchaser bought the merchandise and the re-export services separately.

To implement this treatment, we aggregate the re-exports service data from the country to the GTAP region level, and add re-export services to Hong Kong's non-margin exports of trade and transport services.

Construction of a vector of margins exports

The trade and transport sector in GTAP consists of both margins (shipping services or transport costs) and non-margins (other transport and retail trade) components. The trade matrix for trade and transport constructed above, by assumption, consists of only the non-margins components. The margin component of trade and transport forms the vital task of balancing global exports (*cif* values) with global imports (*fob* values). Global exports of margins (a single number) is derived as the difference between global merchandise imports and global merchandise exports (see also chapter 11.C). The global value of imports (exports) is the element sum of the version 4 merchandise trade arrays valued at *cif* (*fob*) prices for GTAP sectors 1 through 42 in the GTAP data base. The global margins exports is shared out across 40 regions in the version 4 GTAP data base using the share of non-margins exports of a region in the global exports of non-margins exports (This is the share of each row total in the element total of the trade and transport matrix).

12.5 Concluding remarks

In this chapter, we explained how services trade data have been assembled in the GTAP version 4 data base. A relatively elaborate procedure was followed to handle incomplete and inconsistent source data. Obtaining more suitable source data is an objective to aim for in future versions of the data base.

References

Swaminathan, P. 1997. "Services Trade Data" in McDougall (Ed), *Global Trade, Assistance, and Protection: The GTAP 3 Data base*, Center for Global Trade Analysis, Purdue University.