15.E

Services Trade Data

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This chapter covers the preparation of several services trade data sets, used in constructing the GTAP data base.

15.E.1 Introduction

We document here the preparation of four services trade data sets, covering non-margin services, margin services usage, margin services supply, and travelers' expenditures. The data adjustments for Hong Kong re-exports, which also have some service aspects, are covered not here but in chapter 15.C. The construction of the modal shares estimates (used in constructing the margin services data set; see below) is described in chapter 15.D.

In terms of the GATS modes, the travelers' expenditures data set corresponds to the GATS mode "consumption abroad", and the non-margin services data set to "cross-border supply" and "temporary presence of natural persons". The margin services data sets deal with international freight transport, which does not fit well within the GATS modes. The fourth GATS mode "commercial presence" is not covered.

The data sets whose construction we describe here all use the GTAP sectoral classification and the GTAP standard country classification (chapter 8). For non-margin services and travelers' expenditures, they comprise collections of bilateral trade matrices. For margin services, we do not provide bilateral trade data but separate usage and supply arrays, as discussed further below. The non-margin services data cover all GTAP service commodities except for electricity, gas, water, and ownership of dwellings. Electricity is covered in the merchandise trade data (chapter 15.B);

international trade in gas, water, and ownership of dwellings is assumed to be non-existent. The margin services data set covers the three GTAP transport commodities (water, air, other). The travelers' expenditures data set covers all GTAP commodities except for ownership of dwellings.

The main data source is IMF balance of payments statistics data as of 1999, packaged and supplied to us by UNCTAD (Luanga and Yu, 1999). For margin services, we also use the modal shares estimates (chapter 15.D) and the merchandise trade data (chapter 15.B). The merchandise trade data are relevant because they contains two values for each merchandise trade flow, one at *fob* prices and one at *cif*. The difference between these two valuations must equate to the sum of the margins on the flow. The task then is to deal with any internal problems in the balance of payments statistics data set, to convert it to a GTAP-compatible structure, and to reconcile it with the other data sources.

The IMF source data cover 140 countries. The country classification is generally GTAP-compatible, except that Belgium and Luxembourg are treated as a single country. We discuss the filling in of missing countries, and the disaggregation of Belgium and Luxembourg, in section 15.E.3.

Our problems in using the balance of payments statistics data set include:

— internal inconsistencies and missing data (discussed further in section 15.E.2),
— the treatment of travelers' expenditures, and
— the treatment of margin services.

"Travelers' expenditures" includes spending abroad by tourists, people working overseas for short periods, and the like. The balance of payments statistics treat these expenditures as a single services commodity. But to fit in with the I-O accounting framework in the GTAP data base, we need to resolve them into the standard GTAP commodities. So if a traveler abroad buys a T-shirt or a train ticket, we treat the expenditure as trade in apparel or in "other transport", not in "travelers' expenditures".

In processing the services trade data, we follow a general principle that applies across the whole data base construction process, that before combining data sets from different sources, we extend each data set to cover the complete list of GTAP standard countries. Another principle specific to this area, is that where the services trade data and the merchandise trade data are in conflict, we adjust the services trade data to agree with the merchandise trade data. This is because, at the relevant level of detail, we consider the merchandise trade data to be more firmly based.

The work to be done falls into several parts:

— remove any internal defects in the services trade source data and prepare preliminary data sets for margins services trade, non-margin services trade, and travelers' expenditures (section 15.E.2),
— fill in missing countries (section 15.E.3) to expand the country coverage to the GTAP standard country list,
— apportion travelers' expenditures across commodities (section 15.E.4),

— construct and balance the margin services usage data set (section 15.E.5), and
— balance the margin services supply data (section 15.E.6).

That done, we collect the various trade data sets into a single data set, and aggregate from countries to GTAP regions. We discuss that not here but in chapter 15.A, since the boundaries between services and merchandise trade are somewhat blurred (for example, much of travelers' expenditures ends up looking like merchandise trade), and since the aggregation step is common to both services and merchandise trade.

15.E.2 Preparing the Initial Data Sets

As discussed above (section 15.E.1, our task here is to prepare from IMF balance of payments statistics, preliminary data sets for non-margin services, margin services, and travelers' expenditures.

For our purposes, the IMF data set has several major advantages: it covers a large set of countries; the commodity classification is more than adequately detailed; and, it covers the GTAP 5 reference year, 1997. As always, there are also various disadvantages: it provides no bilateral detail, its treatment of travelers' expenditures is incompatible with GTAP's, it is non-uniform, in that there is a great deal of variation between countries in the level of commodity detail provided, it is subject to missing reports (that is, not all countries report for all years), and there are some internal inconsistencies (data reported for a more detailed level of commodity classification do not always agree with the corresponding data at a less detailed level). Perhaps its greatest limitation is that the national statistical collections on which it relies do not necessarily provide robust estimates for services at a detailed level. The level of detail sought by the IMF has increased considerably in response to the rise to prominence of trade in services in the Uruguay Round of trade negotiations, and it may be that not all statistical agencies have yet been able to adjust fully to the new priority.

There are 54 service commodities in the source data set, arranged in an almost-hierarchical system. At the top is a single "services" commodity; beneath that are eleven first-level commodities such as "transportation", "travel", and "communications"; some of these are divided in turn into second- and third-level commodities. For example, the first-level commodity "other business services" is divided into three second-level commodities — merchanting, operational leasing, and miscellaneous — and "miscellaneous" is subdivided into legal, advertising, research, and so on.

The situation for transportation is especially complex. This first-level commodity is subdivided in two different ways, by function and by mode. By function it is divided into passenger, freight, and other; by mode, into sea, air, and other. (It is because of these two complementary second-level systems that we describe the overall system as almost rather than strictly hierarchical.) Then cross-

classifying these, there are nine third-level commodities, from “passenger transport by sea” to “other”-mode other transport”.

Not all the IMF commodities map into the GTAP framework. “Travel” refers to travelers’ expenditures, and as discussed above (section 15.E.1) this needs to be mapped to the commodities that travelers actually purchase. “Royalties and license fees” are, in the GTAP framework, not a trade flow but an income flow.

There is a good deal of inconsistency in reporting between countries, so that not all countries report for all years or for all commodities. 31 countries do not report for our reference year, 1997. Of the remaining 109, not all report all commodities. For example, Hungary reports trade in transportation services by use category but not by mode, Brazil reports only total transportation, and Indonesia does not report transportation at all.

Furthermore there are some inconsistencies in the data reported, so that values reported for lower-level commodities do not always agree with those reported for higher-level commodities. Finally there are some negative flows. These arise especially in insurance, where the value of trade is calculated as premiums less payouts, so that when payouts exceed premiums, the reported value is negative.

From the full data set, we extract services exports and imports for the 109 countries that report at least partially for 1997, for 30 commodities. The 30 commodities include aggregate services, the eleven first-level commodities, the three second-level commodities under “other business services”, both sets of three second-level commodities under transportation, and the nine third-level commodities under transportation.

At this point we discard from the data set the 31 countries who do not report for the reference year, even though they do report for earlier years. It should however be possible to exploit the earlier-year data to estimate the reference-year data; this remains an area for work in future releases.

The next step is to eliminate negative trade flows. Where a flow is negative, we assign it a new positive value, based on the average share of the commodity in its parent commodity. We then rescale both positive and negative values so as to recover the original global value for trade in the commodity. The effect is to reallocate insurance exports away from countries with initial positive values (which includes most countries) toward countries with initial negatives (Korea, Finland and New Zealand). There is no effect on imports, or on commodities other than insurance, since their values are non-negative from the outset.

Next we fill in missing values, where possible, from the data set itself. In some cases values are present for disaggregated commodities but not for their parent commodities; in these cases, we use the disaggregated commodity values to estimate the parent commodity values. In other (much more numerous) cases, we have a value for the parent commodity but some or all of the lower-level commodities are absent; in those cases, we estimate values for the lower-level commodities using average shares. This last “filling down” step is by far the largest of these initial adjustments.

Because of the overlapping commodity categories, the effect of the adjustments can be measured in different ways. Counting only bottom-level commodities, commodities that are not further subdivided, we find that the initial filling-in increases global services exports by 13 percent or US$140 billion, from $1056 to $1196 billion. Global services imports increase by 22 percent or US$218 billion, from $978 to $1196 billion (the agreement with the global exports total is welcome but fortuitous).

Table 15.E.1 shows effects of the initial filling-in on trade totals, including both exports and imports, for individual commodities, both bottom-level and higher. Filling-in of the first-level commodities is relatively small, ranging between 0.0 percent (communication) and 12.9 percent (insurance) of the initial total. The effects on the lower-level commodities are higher, reflecting the tendency by many countries to report at the higher level but not at lower levels. The percentage increases range up to 45.5 percent for "other"-mode passenger transport services, but the most affected commodities are mostly small in total value.

Table 15.E.2 shows the effects of the initial adjustments on the thirty most affected countries. We define these as the countries with the largest absolute increase in estimated exports in bottom-level commodities. We show the sum of the estimates for bottom-level commodities, before and after filling-in.

The cut-off value for inclusion in the table is $1.1 billion, so for any country not in the table the absolute increase in the bottom-level estimates is $1.1 billion or less. The largest absolute increase is $109 billion, for Japan, and the largest percentage change is 1074 percent, for Oman. Even where the increase in the bottom-level estimates is very large, however, the initial data may be fairly complete at higher levels. Oman for example has complete information for first-level commodities, including transportation and "other business services"; all it lacks is the breakdown of transportation and "other business services" into second- and third-level commodities.

After the initial filling in, we rebalance the transportation estimates. As noted above, for transportation, we have two separate second-level classifications, by mode (sea, air, other) and by function (passenger, freight, other). The simple pro-rating method used to fill in the missing values cannot ensure that the second-level estimates are consistent with both sets of second-level estimates. In fact, as we apply it, it leaves them consistent with the modal classes but not with the functional classes. Furthermore, for some countries with complete initial information, the estimates in the source statistics are unbalanced.

Accordingly, after the initial filling-in, we rebalance the bottom-level estimates for transportation against both sets of second-level estimates. We use the RAS method, applying by-mode and by-function scaling factors to the third-level estimates to achieve the required by-mode and by-function subtotals. These adjustments do not change the total value of transportation exports or imports for any country, only the breakdown within that total. As table 15.E.3 shows, for exports this involves overall increases for passenger transport services, and decreases for freight and other

transport services. For imports (table 15.E.4), passenger and "other" transport services decrease, and freight transport services increase. Taken over all countries, the effects are quite moderate, though of course they may be more extreme for individual countries.

As tables 15.E.3 and 15.E.4 remind us, up to this point the export and import estimates have been handled separately. At this point however we have eliminated their internal inconsistencies, and are ready to reconcile them with each other (we can also simplify the data set by deleting all but the bottom-level commodities). We also need to combine them to generate bilateral trade estimates. We handle these two tasks together.

Table 15.E.1 Filling in of Services Trade Data, by Commodity (US$billion)

	Before	After	Change	Percentage Change
Transportation	586.7	639.7	53.0	9.0
Transportation, passenger	136.7	158.0	21.3	15.6
Transportation, freight	270.7	310.5	39.8	14.7
Transportation, other	148.0	171.2	23.1	15.6
Sea transport	212.0	263.6	51.6	24.3
Passenger transport by sea	6.1	8.3	2.2	36.8
Freight transport by sea	148.7	195.4	46.7	31.4
Other sea transport services	41.5	59.9	18.3	44.1
Air transport	184.1	231.6	47.5	25.8
Passenger transport by air	121.7	151.3	29.6	24.4
Freight transport by air	26.6	32.8	6.2	23.4
Other air transport services	32.8	47.5	14.7	44.8
Other transport	114.6	144.5	29.9	26.0
Passenger transport by other	2.6	3.8	1.2	45.5
Freight transport by other	48.9	68.2	19.3	39.4
Other transport by other	60.8	72.5	11.7	19.3
Travel	708.2	797.3	89.1	12.6
Communications	45.6	45.6	0.0	0.0
Construction	63.2	63.2	0.0	0.0
Insurance	51.6	58.3	6.7	12.9
Financial services	60.7	60.7	0.0	0.0
Computer and information services	25.7	25.7	0.0	0.2
Royalties and license fees	91.4	100.1	8.7	9.5
Other business services	567.8	571.3	3.5	0.6
Trade	76.1	99.1	23.0	30.2
Operational leasing	14.8	18.8	4.0	27.2
Miscellaneous business services	376.6	453.4	76.8	20.4
Personal and recreational services	30.1	30.2	0.1	0.2
Government services n.e.i.	30.1	30.2	0.1	0.2

Table 15.E.2 Filling in of Services Trade Data, for Selected Countries (US$billion)

	Before	After	Change	Percentage Change
Austria	44.6	51.6	7.0	16
Brazil	8.6	25.7	17.1	198
Chile	4.3	7.7	3.4	78
Colombia	5.6	8.5	2.9	51
Costa Rica	1.2	2.7	1.5	120
Denmark	16.6	30.1	13.5	82
Greece	5.9	13.9	8.0	136
Indonesia	10.3	23.5	13.3	129
India	5.6	21.3	15.7	279
Ireland	9.4	21.2	11.8	126
Israel	13.6	19.5	5.9	43
Japan	83.6	192.8	109.2	131
Kazakstan	0.8	2.0	1.1	131
Korea	34.5	56.3	21.8	63
Kuwait	4.1	7.0	2.9	72
Sri Lanka	0.6	2.2	1.6	293
Mexico	22.5	24.0	1.5	7
Malaysia	6.5	32.5	26.0	398
Nigeria	2.0	5.5	3.5	175
New Zealand	3.9	9.0	5.2	134
Oman	0.1	1.2	1.1	1074
Philippines	26.2	29.3	3.0	12
Russia	26.4	33.0	6.6	25
Singapore	14.1	50.0	35.8	253
Syria	2.0	3.1	1.1	54
Thailand	13.9	33.1	19.2	139
Tunisia	2.5	3.7	1.1	46
Turkey	23.7	27.9	4.2	18
Ukraine	5.7	7.2	1.5	27
South Africa	6.5	11.3	4.8	74

Table 15.E.3 Rebalancing Transportation Services Exports (US$ billion, before ÷ after)

	Passenger	Freight	Other	Total
Sea	4.5 ÷ 7.1	76.6 ÷ 72.5	20.0 ÷ 21.5	101.1
Air	75.0 ÷ 77.5	16.4 ÷ 18.0	20.8 ÷ 16.7	112.2
Other	2.1 ÷ 2.6	34.3 ÷ 35.7	40.9 ÷ 39.1	77.4
Total	81.6 ÷ 87.2	127.3 ÷ 126.2	81.7 ÷ 77.2	290.6

Table15.E.4 Rebalancing Transportation Services Imports (US$ billion, before ÷ after)

	Passenger	Freight	Other	Total
Sea	3.8 ÷ 4.3	118.8 ÷ 121.5	39.9 ÷ 36.7	162.5
Air	76.3 ÷ 65.1	16.4 ÷ 26.1	26.7 ÷ 28.1	119.4
Other	1.7 ÷ 1.4	33.8 ÷ 36.6	31.6 ÷ 29.1	67.1
Total	81.8 ÷ 70.8	169.0 ÷ 184.3	98.2 ÷ 93.9	349.0

First we set a world trade target for each commodity, calculated as the geometric mean of the estimates for world exports and world imports. Table 15.E.5 shows the initial estimates for world exports and imports, and the world trade targets. The biggest relative difference is for "other"-mode passenger transport, where the export estimate is almost 90 percent greater than the import estimate. The biggest absolute difference is for freight transport by sea, where the import estimate exceeds the export estimate by almost $50 billion.

We rescale the export and imports estimates for individual countries to match the common world target. We also construct a bilateral trade matrix for each commodity, by mutually pro-rating the rescaled exports and imports estimates. We then zero out the diagonal entries (that is, impose zero intra-country trade), and rebalance against the export and import estimates using the RAS procedure.

It would of course be desirable to obtain a statistical base for constructing the bilateral trade flows. Since bilateral trade statistics are indeed available, notably from EUROSTAT, this is a priority for future work.

This completes the internal reconciliation of the services trade data. The final stage in the initial preparation is recasting it in a more GTAP-compatible form. This includes mapping from the original service classification to the GTAP sectoral classification, and dividing the data into three data sets, for non-margin services, margin services, and travelers' expenditures.

Table 15.E.5 Derivation of World Trade Targets (US$ billion)

	Exports	Imports	Trade
Passenger transport by sea	7.1	4.3	5.5
Freight transport by sea	72.5	121.5	93.9
Other sea transport services	21.5	36.7	28.1
Passenger transport by air	77.5	65.1	71.0
Freight transport by air	18.0	26.2	21.7
Other air transport services	16.7	28.1	21.7
Passenger transport by other	2.6	1.4	1.9
Freight transport by other	35.7	36.6	36.1
Other transport by other	39.1	29.1	33.7
Travel	411.9	385.3	398.4
Communications	21.1	24.6	22.7
Construction	37.4	25.8	31.1
Insurance	22.4	35.8	28.4
Financial services	37.9	22.9	29.4
Computer and information services	12.2	13.5	12.8
Royalties and license fees	51.9	48.1	50.0
Trade	54.2	44.9	49.4
Operational leasing	7.6	11.2	9.2
Miscellaneous business services	234.4	219.0	226.6
Personal and recreational services	14.6	15.6	15.1
Government services, n.e.i.	47.0	49.2	48.1
Total	1243.2	1245.0	1234.8

In mapping to the GTAP sectoral classification, we exclude two of the original sectors. “Royalties and license fees” is not recorded as trade in the GTAP framework, but as factor payments; so we simply discard it. “Travel” represents travelers’ expenditures (not passenger transport services, which are classified elsewhere). As noted in the introduction, we do not treat these as a commodity, but seek to record them against the goods and services purchased (see further section 15.E.4). The remaining service sectors are mapped to the GTAP sectoral classification as shown in table 15.E.6. The mapping is fairly straightforward - not fortuitously, since the GTAP sectoral classification in the services area was designed with this data source in mind.

In dividing the data into margin and non-margin data sets, we treat freight transport services as margin services, and all other transport services as non-margin services. We don’t present bilateral trade matrices for the margin services, since these are not required for the GTAP data base; instead we provide separate arrays for exports and imports.

Areas for future work include exploiting bilateral trade statistics from other sources, and exploiting data from earlier years in filling in missing data for the GTAP reference year.

Table 15.E.6 Mapping Service Sectors to GTAP

Service sector	GTAP sector
Passenger transport by sea	Water transport (non-margin)
Freight transport by sea	Water transport (margin)
Other sea transport services	Water transport (non-margin)
Passenger transport by air	Air transport (non-margin)
Freight transport by air	Air transport (margin)
Other air transport services	Air transport (non-margin)
Passenger transport by other	Other transport (non-margin)
Freight transport by other	Other transport (margin)
Other transport by other	Other transport (non-margin)
Communications	Communication
Construction	Construction
Insurance	Insurance
Financial services	Other financial services
Computer and information services	Other business services
Trade	Trade
Operational leasing	Other business services
Miscellaneous business services	Other business services
Personal and recreational services	Recreational and other services
Government services, n.e.i.	Public administration etc

15.E.3 Filling in Missing Countries

As discussed above (section 15.E.1), the services trade data set has its own country classification. This classification omits some countries included in our standard country classification, and treats Belgium and Luxembourg as one country. So we need to fill in data for the missing countries, and separate Belgium and Luxembourg. In the process, the number of countries in the services trade arrays increases from 109 to 211.

In filling in the missing data for non-margin services we assume that the value of trade between any two countries depends on the scale of their economies. More specifically, estimated trade between any two countries is directly proportional to the scale of each country's economy. We use GDP as the scale variable. So our estimate for trade in a service commodity between two countries is equal to the product of their GDPs, multiplied by a commodity-specific proportionality factor. We estimate the proportionality factors as the average ratio of the trade value to the product of GDPs for the countries for which we have services trade data. In splitting out trade for Belgium and Luxembourg, we likewise used GDP shares.

We take a similar approach for margin services. But since the margin services trade data are not bilateral, we estimate each country's margin services exports or imports as equal to the product

of its GDP and a commodity-specific proportionality factor. As with non-margin services, we split out Belgium and Luxembourg using GDP shares.

For non-margin services, this step increases the estimated global value of trade from US$635 billion to $713 billion, or by 12 percent. For travelers' expenditures also, it increases global trade by 12 percent, from $398 to $446 billion. For margin services, it increases global trade from $152 billion to $160 billion, by 5 percent. Although almost half the countries in the expanded data set have made-up data, they are mostly small countries, and total trade is not greatly affected.

Table 15.E.7 indicates non-coverage of individual GTAP regions in the services trade data. For single-country regions, the indicator is either 0 or 1: 0 indicates that the country is covered in the services trade data, 1 that it is not covered. For multi-country regions, the indicator may lie between 0 and 1, if some countries in the region are covered and some are not. In such cases, the indicator is equal to the share of non-covered countries in the region's total services trade (exports plus imports, summed over commodities; including non-margin services, travelers' expenditures, and margin services). For brevity, we omit fully covered regions.

In the table, a non-coverage ratio of 0.00 should be taken as "non-zero, but less than 0.005". The United States and France appear in the table with ratios of 0.00 or close to it because of small overseas territories not covered in the source statistics — for example, Guam for the United States, and Réunion for France. A ratio of 1.00 indicates that the services trade data do not cover the region at all. This occurs for eight single-country regions, of which the largest in GDP are Taiwan, Switzerland, and Hong Kong. The multi-country regions generally have ratios between 0 and 1, with the exception of "Rest of South America", which has a ratio of exactly 1, none of its member countries (Paraguay, Guyana, and Surinam) being covered. At the other extreme, "Rest of EFTA", "Rest of SACU", and "Rest of South Asia" have ratios very close to zero, since only a few, very small member countries are omitted (Liechtenstein for "Rest of EFTA", Lesotho for "Rest of SACU", Bhutan for "Rest of South Asia").

We note that the table does not fully indicate the incidence of filled-in values in the final data set. In fact every country's trade is affected by the filling-in process, not just the omitted countries'. For example, the table omits Germany, since it has a ratio of exactly 0, being covered in the original data set. Nevertheless the filling-in procedure increases Germany's non-margin services exports by 6 percent, from $49 to $52 billion, and its non-margin services imports by 5 percent, from $59 to $62 billion. Although Germany is covered in the source data set, some of its trade partners are not; so we fill in trade values for 101 new (mostly small) partner countries.

Table 15.E.7 Non-coverage Ratios for GTAP Regions

GTAP Region	Ratio	GTAP Region	Ratio
Hong Kong	1.00	Rest of Middle East	0.29
Taiwan	1.00	Rest of North Africa	0.28
Vietnam	1.00	Botswana	1.00
Other South Asia	0.01	Rest of SACU	0.01
United States	0.00	Malawi	1.00
Rest of Central America	0.22	Mozambique	1.00
Rest of South America	1.00	Zambia	1.00
France	0.01	Zimbabwe	1.00
Switzerland	1.00	Other Southern Africa	0.32
Rest of EFTA	0.00	Rest of Sub-Saharan Africa	0.30
Soviet Union	0.06	Rest of World	0.71

The filling-in procedure offers several opportunities for improvement. Research undertaken after completing the trade modules suggests that merchandise trade would be a better scaling variable than GDP. Furthermore, we should be able to improve our estimates of trade between covered and omitted regions by using information about individual included regions instead of using the same proportionality constants for all regions. For example, as it appears from the source data that relative to GDP, Germany trades more intensively in services than does Japan, so it would be appropriate to use higher proportionality constants for Germany's trade than for Japan's. The current practice likely leads to underestimation of Germany's trade with non-reporters, and to overestimation of Japan's. Finally, it is not clear whether the filling-in procedure should increase the total trade of the included countries, or whether it should hold it constant, reallocating the trade away from their covered-country to their omitted-country partners. At the time of writing, we don't know enough about the construction of the source statistics to answer this.

Nevertheless, future improvements in the quality of the final data set are likely to arise more from improvements in the source data than in our processing of it. Since the share of made-up data in the final data set is rather small, the potential benefits from improving the estimation procedure are likewise limited. And as we see below (section 15.E.5), even among the covered countries the accuracy of the source statistics is in some places questionable.

15.E.4 Travelers' Expenditures

After expanding the preliminary services trade data sets to standard GTAP countries (section 15.E.3), for travelers' expenditures we have an extra step to perform. The services trade data gives us a bilateral trade matrix for travelers' expenditures treated as a single commodity. We have to divide this up between the 66 standard GTAP commodities, so that travelers' expenditures on, for example, accommodation abroad are treated as exports of the GTAP commodity "recreational and other services" from the country in which they are traveling to their country of residence.

In GTAP 5, the commodity composition of travelers' expenditures is not based on statistics but on synthetic estimates. We take as our starting point the commodity composition of private consumption in the exporting country. (There is a circularity here, because we take our estimates of commodity composition from the GTAP data base; we get around this by using a preliminary version of the data base.) We then adjust this judgmentally, increasing the shares of transport services, "recreational and other services", and government services, decreasing the shares of food commodities, and setting the share of ownership of dwellings at zero.

We use the commodity composition of the exporting country, rather than of the importing country, for reasons of expediency. If the consumption pattern in the importing country is very different from that of the exporting country, and travelers' expenditures are a significant source of demand in the exporting country, then fitting the exporting country's I-O data to the trade data (chapter 19) can strongly affect its industry structure, causing some previously insignificant industries to become large. Since we have little confidence in the commodity composition of travelers' expenditures, we want to avoid major impacts on the industry structure; basing it on the exporting country's consumption composition helps in that.

Given the large share of travelers' expenditures in services trade, and the availability of statistics, at least for a few countries, on their commodity composition, exploiting those statistics is one of the highest priorities for further work in services trade in future GTAP releases.

15.E.5 Balancing the Margin Services Usage Data

Our task now is to generate a margin services usage data set, using three inconsistent data sets covering margin services usage — the preliminary margin services trade estimates developed in section 15.E.2, the modal shares estimates (chapter 15.D), and the merchandise trade data (chapter 15.B).

As noted above (section 15.E.1), the margin usage array we seek to construct is indexed in four dimensions, by margin commodity, merchandise commodity, country of origin of the merchandise, and country of destination. Our margin services imports data set (sections 15.E.2, 15.E.3) covers two of these — the margin service and the country of destination. The merchandise trade data set (chapter 15.B) also implicitly provides margins values, as the differences between the *fob* and the *cif* value of each trade flow. These values are indexed by merchandise commodity, country of origin of the merchandise, and country of destination.

Since we consider the merchandise trade data relatively reliable, we prefer to adjust the margin services trade estimates to match them, rather than the other way around. Using these two data sets alone, we could extract margin services usage estimates from the merchandise trade data, and then split them across margin commodities by pro-rating according to the margin services imports estimates. This however would yield highly implausible estimates in which, for example, air transport was as likely to be used for coal as for electronic equipment, and land transport was as likely to be used in trade between the United States and Japan as between France and Germany.

It is for this reason that we have constructed the the modal shares data set (chapter 15.D). This covers all four of the required dimensions: the margin service, the merchandise commodity, the country of origin of the merchandise, and the country of destination. What it lacks is money values; it provides only the shares of the various margin commodities in each flow.

We could now combine the modal shares and the merchandise-trade-based estimates to obtain the required margin services usage matrix quite simply. Recalling however that the modal shares data set is constructed largely through heroic assumptions and extrapolation (chapter 15.D), whereas the margin services imports data set is relatively well grounded in source statistics (section 15.E.2), we prefer to make maximum use of the latter.

Our plan of procedure is:

— adjust the margin services imports data to match the merchandise-trade-based usage estimates;
— apply the modal shares estimates to the merchandise-trade-based estimates to obtain initial estimates for the full four-dimensional usage array; and
— balance those initial estimates against the merchandise-trade-based usage estimates and the adjusted margin services imports estimates simultaneously.

The merchandise-trade-based and the margin services import estimates have one dimension in common. Thus we compare margin usage by country between the two data sets and of course we can compare global margin usage.

According to the margin services imports data set, global margin usage is $160 billion; according to the merchandise trade data set it is $213 billion, 33 percent higher. So the two data sets agree on the order of magnitude of the global value.

As table 15.E.8 shows, the two data sets also differ in the distribution of margin services usage across countries. The table compares shares in global margin usage between the two data sets, for selected countries. The countries selected are those with relatively large revisions in relatively large

shares. For some countries, the differences are drastic. Passing from the margin imports to the merchandise-trade-based estimates, the Czech Republic's share in world margin services usage increases by a factor of more than 29; here it is possible that the services trade data reflect deficiencies in the statistics of an economy in transition. For Myanmar, the share decreases by a factor of more than 11; here the country is not covered by the services trade source statistics, and our filling-in rule (section 15.E.3) may have overestimated the usage value greatly. But even for large and mature economies we see quite substantial differences. For example, the United States' share grows by a factor of 1.8, from 9.2 percent to 16.2 percent of world margin services usage; the share of Italy declines by a factor of 2.2, from 6.8 percent to 3.0 percent.

To estimate global margin usage by mode of transport, we calculate global shares from the margin services import data. According to that data set, "other transport" accounts for 24 percent of total international margins, water transport for 62 percent, and air transport for 14 percent. Applying these shares to the merchandise-trade-based estimate of global margin usage, we get money values of $51 billion, $132 billion, and $30 billion, respectively.

Our next step is to balance the margin services imports data against these global by-margin totals and the by-destination totals from the merchandise trade data. Following the RAS procedure, we apply by-margin and by-destination scaling factors against the margin imports data set. This yields our final estimates of margin services usage by destination and commodity together.

To construct the full four-dimensional margin usage array, we need to apportion these estimates across freight commodities and source regions. For example, we have an estimate that the United States uses $21.8 billion of water transport margin services; we need now to estimate how much of this is incurred in importing oil from Saudi Arabia, how much in importing electronic equipment from Japan, and so on. Alternatively, we can look at the problem as one of apportioning the merchandise-trade-based estimates across the margin commodities.

As noted above, we construct our initial estimates for the full four-dimensional array by applying the modal shares estimates (chapter 15.D) to the merchandise-trade-based margin value estimates. For example, for imports of electronic equipment into the United States, the merchandise trade data set shows total margins of $582 million, while the modal shares data set shows the share of "other transport" as 0.5 percent, the share of water transport as 37.9 percent, and the share of air transport as 61.6 percent. Applying the shares to the total margin, we estimate money values of $3 million for "other transport", $221 million for water transport, and $359 million for air transport. Similarly, for imports of oil from Saudi Arabia, the transport margin data set shows a water transport share of 99.0 percent, so we calculate water transport margins as $603 million out of a total margin cost of $609 million.

Proceeding in the same way for all sources and countries, we obtain the initial estimates for the full four-dimensional usage array. Summing these over merchandise commodity and origin, we obtain totals for margin usage by margin and destination that we can compare with the final data set for margin usage by margin commodity and destination described above. Thus for imports into the

United States, we calculate totals of $4.8 billion for “other transport”, $23.4 billion for water transport, and $6.2 billion for air transport. The corresponding estimates from the margin-by-destination data set are $6.1 billion for “other transport”, $21.8 billion for water transport, and $6.6 billion for air transport. The two data sets show the same value for total margin usage by the United States, $34.5 billion, since both inherit it from the merchandise trade data set. Thus they differ only in modal composition.

Table15.E.8 Shares in World Margin Services Usage, for Selected Countries

Countries	From Margin Imports Data (%)	From Merchandise Trade Data (%)	Revision Direction	Revision Factor
China	4.36	8.37	+	1.9
Czech Republic	0.02	0.55	+	29.4
Denmark	1.62	0.55	!	3.0
United Kingdom	2.45	4.06	+	1.7
Indonesia	2.33	1.14	!	2.0
India	2.42	0.95	!	2.5
Italy	6.79	3.02	!	2.2
Japan	7.69	10.41	+	1.4
South Korea	1.49	3.48	+	2.3
Kuwait	0.65	0.16	!	4.2
Mexico	0.18	0.97	+	5.4
Myanmar	0.54	0.05	!	11.4
Netherlands	4.95	2.50	!	2.0
Poland	0.35	0.95	+	2.7
Thailand	3.20	1.31	!	2.5
United States	9.20	16.19	+	1.8

Table 15.E.9 compares the estimates derived from the modal shares data set with the rebalanced margin imports data set. It shows only selected countries, more specifically, the countries with the largest margin imports and the largest differences in their composition.

The most striking feature of table 15.E.9 is that in general, the estimates derived from the modal shares data set appear generally preferable to those from the rebalanced margin imports data set. This is remarkable, given that the modal shares data set is heroically extrapolated from a one-country data set, while the margin-by-destination array has a relatively strong statistically backing. The cases reported in the table fall into three classes.

— In several island or near-island countries, the initial estimates show low shares for “other” transport (essentially land transport), but the margin imports data set shows much higher shares. This happens with Singapore, Taiwan, the Philippines, and several other countries.

Table 15.E.9 Comparison of Margin Usage Estimates derived from (1) Modal Shares and (2) Margin Import Data Sets (US$ million)

Countries		"Other"	Water	Air
Bangladesh	(1)	176	212	53
	(2)	3	435	3
China	(1)	2486	10634	4687
	(2)	2880	13059	1868
Germany	(1)	5691	5527	2073
	(2)	7877	4881	532
Denmark	(1)	440	552	171
	(2)	14	1146	4
Egypt	(1)	184	707	168
	(2)	21	1034	5
France	(1)	3059	3317	1068
	(2)	1094	4247	2102
Indonesia	(1)	112	1793	522
	(2)	686	1088	654
Italy	(1)	2072	3531	830
	(2)	1221	4858	354
South Korea	(1)	996	4962	1442
	(2)	2385	4307	709
Mexico	(1)	954	832	279
	(2)	127	663	1276
Netherlands	(1)	151	2884	887
	(2)	1740	3392	189
Philippines	(1)	42	1418	562
	(2)	547	860	615
Saudi Arabia	(1)	194	759	164
	(2)	22	1085	11
Singapore	(1)	79	2916	1714
	(2)	1340	2130	1239
Sweden	(1)	576	799	263
	(2)	53	1562	24
Taiwan	(1)	66	2402	1115
	(2)	927	2173	483

Here the modal-shares-based estimates are much more plausible. The problem here is that in the initial processing of the source data (section 15.E.2), we fill in missing services trade data for these countries using average shares, but these countries must have much less than average "other" transport shares.

— On the other hand, there are several countries where the modal-shares-based estimates show a reasonably normal modal composition, but the margin imports data set shows vary small shares for air and "other" transport. Cases include Denmark, Sweden, and Egypt. It may well be that Denmark ,for example, consisting of a peninsula and an archipelago, has a higher-than-average water transport share; but that is no reason why its air transport share should be tiny (0.3 percent) compared to the global average (14.3 percent). Again the modal-shares-based estimates appear more plausible. The countries involved have reasonably complete reporting in the services trade source data; we suspect that the source data are simply inaccurate.

— There are also cases where both estimates appear broadly plausible, although quite different. For example, the margin imports data set shows higher shares for water and land transport and lower for "other transport" in France. Further investigation would be required to determine which set of shares is more accurate.

At this point it seems that we can simply declare the "initial" four-dimensional usage array to be also the final array, and discard the margin-imports-based margin-by-destination array. At the time at which the work was planned however, the comparisons summarized in table 15.E.9 had not been made, and the procedure was developed in the belief that the margin-imports-based data were more reliable (we were more concerned about the heroic extrapolation of the modal shares data, than by the filling in of the services trade data). Accordingly, we prepared the final four-dimensional usage array by adjusting the initial estimates to match the margin-imports-based data.

Specifically, for each destination country, we have a three-dimensional margin usage array, indexed by merchandise commodity, merchandise origin, and margin (mode). We balance this simultaneously against totals for usage by merchandise commodity and origin from the merchandise-trade-based estimates, and values for usage by margin from the margin-by-destination data set. Following the RAS procedure, we apply by-commodity-and-origin and by-margin scaling factors to the initial estimates, to obtain the final margin usage array.

Looking to the future, we expect that the quality of the source data will improve as the statistical collections for services mature. It is also clear that we need to reconsider the policy of preferring the margin imports data to the modal shares data. At a minimum, we should prefer the modal shares data for countries where the margin imports data have been filled in using average shares.

15.E.6 Balancing the Margin Services Supply Data

We now face the problem that the margin usage data are inconsistent with the margin supply data. For each margin commodity, total margin usage (summed over freight commodity, freight source country, and freight destination country) should be equal to total margin supply (summed over margin supply country), but this is not the case. We resolve this inconsistency by rescaling the margin supply data to agree with the margin usage data. Table 15.E.10 shows the initial and final margin supply values and the scaling factors.

Table 15.E.10 Margin Supply (US$ billion)

	Initial value	Final value	Scaling factor
"Other" transport	37.997	50.071	1.33
Water transport	97.693	131.717	1.35
Air transport	22.807	30.439	1.33

The scaling factors are all close to the average scaling factor of 1.33, the ratio of the global margin services value from the merchandise trade data set to the value from the margin services trade data set.

15.E.7 Final Overview

To summarize the work described in this chapter, we prepare four services trade data sets, covering:

— non-margin services trade, with an aggregate value of $712 billion,
— travelers' expenditures, with an aggregate value of $446 billion,
— margin services usage, with an aggregate value of $160 billion, and
— margin services supply, also with an aggregate value of $160 billion.

The final estimates generally respect the source data and pass sanity tests, though the modal composition of margins usage appears suspect for several countries. Major areas for future work include exploiting available statistics on the bilateral structure of services trade, and acquiring and exploiting statistics on the commodity composition of travelers' expenditures. There are also several opportunities for improvement in the procedures used to exploit the current data sources.

References

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