Chapter 19

Updating and Adjusting the Regional Input-Output Tables

Robert McDougall

Before incorporating the regional input-output (*I-O*) tables into the global database, we update them to the database reference year, eliminate the use category "changes in stocks", and remove the discrepancies between them and the international data sets. This chapter explains how we do that.

19.1 Overview

A single procedure achieves all three objectives. Since the international data sets match the data base reference year, adjusting the I-O tables to the international data sets is a method of updating them. Eliminating changes in stocks is just one more I-O table adjustment, and can conveniently be handled in the same procedure.

In general, we adjust the regional I-O tables to match the international data sets, rather than the other way around. One reason for this is that, as just noted, the international data sets are more up to date. Also, the trade and energy data sets are subject to international balance conditions, which the regional I-O tables do not collectively satisfy. Nevertheless, for reasons discussed below, we do make some small adjustments to the energy data.

We call the adjustment procedure *fitting* the I-O tables, after the program FIT that implements it. FIT applies entropy-theoretic methods (see e.g., Kapur and Kesevan 1992) 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 and rewritten for GTAP.

We apply the fitting procedure after disaggregating the primary I-O tables (chapter 13) and constructing composite tables for the residual regions (chapter 14). The inputs into the procedure are a complete set of fully disaggregated regional I-O tables, and the international data sets listed above; the outputs are the fitted I-O tables and an adjusted energy volumes data set.

The following targets are applied:

— from constraints imposed by the GTAP database structure: zero values for changes in stocks of domestic product and imports, by commodity;

— from the macroeconomic data set (chapter 18): values at purchasers' prices for aggregate private consumption, government consumption, and investment;

— from the trade data set (chapter 15, modified according to the energy data set, chapter 17): border values of exports and imports, by commodity;

— from the protection data set (chapter 16, modified and supplemented from the energy data set, chapter17): 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

— from the energy data set (chapter 17): 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: see further chapter 17).

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.

As noted above, 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. There are however some exceptions.

— We calculate target rates of tax on intermediate inputs into agriculture, based on the share of intermediate input subsidies in total domestic support, as given in the protection data set. But since the cost structures of the agricultural industries change during fitting, the domestic support shares in the fitted tables may differ from the target shares.

— In a very few cases, the target shares for domestic support are infeasible *ex ante*. This is liable to happen where the share of intermediate input subsidies in total domestic support is large, but the share of intermediate inputs in total costs is small. In such a case, the share target may imply negative post-subsidy costs for intermediate inputs. To avoid this we impose a ceiling on the subsidy rate of 90 per cent, that is, the subsidy may not exceed 90 per cent of the pre-subsidy cost.

— In a few cases, the energy targets prove infeasible. This is liable to happen where there is a relatively large energy usage target for a relatively small industry. Since we do not know in advance how large each industry will be after fitting, we cannot adjust the energy usage targets *ex ante*. Instead, we revise FIT so that it adjusts not only the energy use values in the regional I-O table, but also the energy use target from the energy data set. We set this up so that where possible, most of the adjustment is to the regional I-O table, but where necessary, large adjustments are made to the targets. We make the adjustment by reallocating the energy usage targets across demand categories in such a way that the overall usage target within each region is unchanged.

19.2 Deviations from Targets for Intermediate Input Assistance to Agriculture

As noted above, we expect the fitted tables to show some deviations from the targets for domestic support for agriculture. From the protection data set we have a target level of domestic support for each agricultural industry, expressed as a fraction of the market value of industry output. This domestic support is provided through various instruments, including subsidies on intermediate inputs. For each instrument we have a target share in total domestic support. Putting these together, we have in effect a target level of support for each instrument, expressed as the ratio of the subsidy payment to the market value of output.

Some issues of interpretation and reconciliation need to be addressed in applying the intermediate input subsidy targets to the I-O tables. Not all taxes or subsidies on intermediate inputs into agriculture need be interpreted as (negative or positive) support for agriculture; some may better be interpreted as support for the industry that produces the inputs, or as general government revenue raising measures. Also, besides the agricultural support targets, we have (from the energy module) target powers of taxes on energy inputs into agriculture. Our current stance on these is not to count taxes on energy inputs as (negative) domestic support to agriculture, but to count taxes and subsidies on all other intermediate inputs.

In preparing to fit the I-O tables, we calculate target powers of taxes for commodity inputs into agriculture, based on the target level of support through subsidies on intermediate inputs and on the initial I-O tables. Because the base for the power of the commodity tax is the market value of commodity inputs (excluding energy inputs), while the base for the domestic support target is the market value of industry output, the target for the power of the tax depends on the ratio of the input value to the output value. This ratio is liable to change during fitting. To achieve the domestic support value, we need the ratio from the fitted table; but since this is unavailable when we calculate the shocks, we take the ratio from the unfitted table as a proxy.

For example, in the case of French "other grains", the overall target for domestic support is 0.833 of the market value of output. Of this total, subsidies on intermediate inputs are to account for 11.9 per cent. So in effect, the target rate of support on intermediate inputs is equivalent to 0.0994 of the market value of output. In the initial I-O table, the market value of output of "other grains" is $6291 billion; applying the target rate of support to this figure gives us a target value of support of $625 billion. The initial market value of intermediate inputs into agriculture (excluding energy inputs) is $2036 billion. Applying the target value of support to this figure gives us a target power of the commodity tax of 0.693 or equivalently a commodity subsidy rate of 30.1 per cent of the market value of intermediate inputs. This subsidy rate is equal to the domestic support target of 0.0994, divided by the ratio (0.324 = 2036/6291) of the market value of intermediate inputs to the market value of output in the initial I-O table. If this ratio is stable during fitting, then the target power of the commodity tax is correct; if not, it is to some degree in error.

In two cases the formula yields subsidy rates in excess of 100 per cent: Greek oilseeds, and "other EFTA" wool. In these cases, we apply a 90 per cent subsidy. In other cases, deviations from the target rates are unplanned (though not unexpected) results of changes in cost structure during fitting.

Table 19.1 reports target and actual rates of domestic support, for selected cases involving significant deviations in support rates in industries of significant size. As it shows, the deviations from targets are sometimes considerable — more than 11 percentage points, in the case of Dutch "other grains" — and may be either upward, as for example in French "other grains", or downward, as for French oil seeds.

Again taking French "other grains" as an example, we find that in the fitted table, the market value of output is $5198 billion, while the market value of intermediate inputs (excluding energy) is $2505 billion, so the ratio of the input value to the output value has risen during fitting from 0.324 to 0.482. With this new ratio, the commodity subsidy rate of 30.1 per cent of the market value of intermediate inputs is equivalent to 14.5 per cent of the market value of output. Thus the change in the ratio during fitting has led to an error in targeting the domestic support target.

With the benefit of hindsight, it appears that the formula used to translate the domestic assistance targets into powers of commodity taxes was not well chosen. A better formula would take

account of the effect on the market value of output of changes in output subsidy rates and of the commodity subsidy shocks themselves. Such revisions to the formula would greatly reduce the deviations from the targets. Alternatively, we might seek to eliminate the deviations by adding the support rates themselves as target variables to the FIT program. This remains an area for work in future releases of the data base.

Table 19.1 Intermediate Input Support for Agriculture (Percent of market value of output)

Region	Industry	Output (US$ billion)	Target rate	Actual rate
Japan	Raw milk	6.640	3.9	4.7
Austria	Wheat	0.289	8.1	2.9
Denmark	Wheat	0.958	8.1	5.7
Denmark	Other grains	1.124	9.9	6.6
Finland	Other grains	0.854	9.9	4.8
France	Wheat	6.003	8.1	9.2
France	Other grains	5.198	9.9	14.5
France	Oil seeds	2.412	10.1	6.9
France	Cattle, sheep	10.619	2.1	1.3
Germany	Raw milk	8.591	2.4	3.0
Greece	Other grains	0.760	9.9	15.9
Italy	Wheat	3.765	8.1	6.3
Italy	Oil seeds	2.520	10.1	7.1
Italy	Cattle, sheep	8.978	2.2	1.7
Italy	Raw milk	8.643	2.4	1.9
Netherlands	Other grains	0.157	9.9	21.5
Portugal	Other grains	0.623	9.9	5.6
Portugal	Oil seeds	0.188	10.1	19.7
Spain	Other grains	1.576	9.9	12.6
Spain	Cattle, sheep	4.968	1.6	1.1
Sweden	Other grains	0.473	9.9	5.1
EFTA	Raw milk	1.222	22.4	29.9

19.3 Adjustment of Targets for Energy Usage

Another area of difficulty involves the energy usage targets. As noted above, these are sometimes infeasible, when the targeted value of total energy usage exceeds industry total costs. Table 19.2 records the infeasible cases; as it shows, there were just four of these, all involving small industries in small countries.

Besides adjusting the energy usage targets where necessary, the FIT procedure aims to keep the adjustments small where possible. Nevertheless all the targets are subject to change to some extent. These changes may be interpreted as a slight resistance to change in the energy use profile: the final profile depends mainly on the initial energy targets, but is also affected slightly by the initial profile.

Table 19.2 Energy Target Infeasibilities (US$ million)

Region	Industry	Target energy cost	Actual total cost
Botswana	Non-ferrous metals	3.2	1.1
Malawi	Non-ferrous metals	1.5	0.6
Mozambique	Non-ferrous metals	6.4	3.8
Uganda	Chemicals, rubber	9.8	5.6

Table 19.3 shows some of the larger changes made in cases where the initial targets are not infeasible. As it shows, these are not so large as to have a major effect on energy use profiles, but they are sometimes non-trivial. Of the listed adjustments, the largest in absolute terms is the $1.4 billion increase in private consumption of electricity in the United States; the largest in relative terms is the 19 per cent increase in usage of gas in the chemicals industry in Germany. As noted above, these adjustments are balanced out within each region and energy commodity, so that total energy usage is not affected.

Table 19.3 Selected Adjustments to Feasible Energy Targets (US $billion)

Region	Commodity	Use	Initial	Final
Japan	Electricity	Wood products	8.535	7.848
United States	Gas	Agriculture	5.806	5.320
United States	Petroleum products	Chemicals etc.	23.705	22.828
United States	Electricity	Other manufactures	10.544	9.547
United States	Electricity	Private consumption	57.225	58.623
Germany	Gas	Chemicals etc.	0.860	1.021
Germany	Gas	Private consumption	2.941	2.637
Soviet Union	Gas	Chemicals etc.	3.087	3.399
SACU	Electricity	Other manufactures	1.513	1.320

The United States electricity sector provides a simple illustration of the workings of the target adjustment mechanism. From table 19.3, we observe a reallocation of target energy usage away from "other manufactures" toward private consumption. The share of private consumption in total electricity usage is higher in the targets than in the initial I-O table; the I-O table share shifts most of the way down toward the target share, but there is also a small adjustment in the target share up toward the initial I-O table share.

The German gas sector presents a more complicated case. The private consumption share in total gas usage is higher in the initial I-O table than in the targets, yet both the target and the I-O table share are adjusted downward. The reason relates to differences in gas sourcing across demand categories. In the FIT procedure, domestic production of gas decreases relative to imports. Since the import share in private consumption of gas is very low, and the domestic product share very high, this tends to reduce the share of private consumption in total gas usage, so much so that in the absence of counteracting adjustments, the private consumption share would fall far below the target. A large counteracting upward adjustment is therefore made in the I-O table private consumption share; but a small downward adjustment is also made in the target share. As the target for private consumption rises, there are balancing increases in the targets for industry usage, most notably in the chemicals industry, where the import share is relatively high.

As we adjust the energy usage money value targets, we make matching adjustments in the energy volume data. The energy volume adjustments are proportional to the money value adjustments. Because the implicit energy prices are largely, but not entirely, uniform across use classes, the energy volume adjustments conserve totals over use classes approximately, but not exactly.

19.4 Comparison of Initial and Fitted I-O Tables

We now turn from adjustment of targets to examine the effects of the fitting procedure on the I-O tables. This is a large subject, covering a large number of cells in a large number of tables, almost a million cells in total. Obviously we need to be highly selective, to distill some insight without being overwhelmed by data.

To that end, we do not examine individual cells, but confine our examination to row and column totals. More specifically, we calculate totals for various use categories and input categories. The use categories include total costs for each industry, and total expenditure in each final demand category (fixed investment, private consumption, government consumption, and exports, but not inventory investment). The input categories include the market value of sales of each domestic commodity, the market value of sales of each imported commodity, and the market value of employment of each primary factor (labor, capital, land). Since the market value of sales of each domestic commodity is equal to the total costs of the corresponding industry, the use categories and input categories overlap.

We combine the input and usage categories together in a hybrid input/use category collection, and calculate a total for the whole collection. We then calculate the share of each category in the collection total, and compare the shares from the fitted table with those from the unfitted. For each region, we compute an entropy-theoretic measure of change in the share structure:

$$D = \frac{1}{2} V \sum_i (F_i - U_u)(\log F_i - \log U_i),$$

where U_i denotes the share from the unfitted table, and F_i the share from the fitted table for category i. We do not attempt a full motivation for this measure here, but note some of its properties that make it suitable for this task: it is non-negative, zero only when the fitted and unfitted values agree, and a linear combination of non-negative category-specific terms $(F_i - U_i)(\log F_i - \log U_i)$ that are symmetric between F_i and U_i, linearly homogeneous in F_i and U_i together, and approximately quadratic in the relative difference between F_i and U_i (see further Kullback, 1968.). A measure of 0 indicates that the fitted and unfitted table have the same structure, a result of 0.01 indicates that category shares change by an average of approximately 1 per cent

Table 19.4 records the results for each region. A high change measure indicates that the table had to change significantly in structure to accommodate the trade targets, energy usage targets, and so on from the international data sets. As the table shows, the largest changes are found in certain composite regions (for example, Southern Africa), regions with outdated I-O tables (e.g., Singapore), and some sub-Saharan African countries (e.g., Zambia). At the other end of the range, we observe relatively small changes in the largest industrialized economies, including the United States, Japan,

and Germany (all below 0.05). Some smaller industrialized economies however show larger changes, notably the Netherlands (0.21) and Denmark (0.13).

Table 19.5 provides summary statistics for each input or usage category: the number of regions where the category share increases, the number where it decreases, whether average category share increases or decreases, and the power of the increase or decrease. To save space, it omits categories with relatively small average changes.

The categories with the largest average changes include service, energy, and agricultural commodities. As the first row shows, there is a very large decrease in imports of "ownership of dwellings"; this reflects the assumption, imposed in constructing the services trade data set, that trade in this service is negligible. There are also large decreases in imports of several agricultural commodities, notably raw milk and sugar cane and beet; this may reflect differences in classification between some I-O tables and the merchandise trade data. We consider the energy and service sector summary results further below, in conjunction with salient results for individual regions.

Table 19.6 lists some of the major changes to individual I-O tables in the fitting procedure. Of the nearly eight thousand (region, category) pairs, we select those that make the largest contribution to the entropy distance measure discussed above, scaled by a measure of the size of the regional economy. This identifies large sectors in large regions with the large relative changes.

We divide the changes into three broad groups: energy sector, services sector, and miscellaneous. In the energy sector, we see several kinds of revision. In several energy-exporting composite regions, oil, gas, or "distributed gas" production is revised sharply upward. For example, in "other Middle East", oil production increases by a factor of 23. Similarly, in the former Soviet Union, oil production increases by a factor of 6, and gas production by a factor of 13; the former Soviet Union is not a composite region, but the source I-O data are especially problematic. These revisions can be attributed to limitations in the source I-O data.

Table 19.4 Change in I-O Structure Under Fitting, by Region, Sorted by Magnitude of Change

Region	Change	Region	Change
Other Southern Africa	0.55	Morocco	0.09
Singapore	0.33	Rest of South Asia	0.08
Rest of South America	0.28	Former Soviet Union	0.08
Zambia	0.27	Mexico	0.07
Malaysia	0.26	Rest of Central European Associates	0.07
Philippines	0.25	Chile	0.07
Luxembourg	0.24	Austria	0.07
Rest of EFTA	0.21	Switzerland	0.07
Malawi	0.21	Uganda	0.06
Netherlands	0.21	Portugal	0.06
Rest of Middle East	0.19	Brazil	0.06
Rest of North Africa	0.18	Rest of SACU	0.05
Thailand	0.17	France	0.05
Hong Kong	0.17	Rest of World	0.05
Tanzania	0.15	Germany	0.04
Central America/Caribbean	0.14	Turkey	0.04
Zimbabwe	0.13	Canada	0.04
Sri Lanka	0.13	Peru	0.04
Denmark	0.13	Bangladesh	0.04
Vietnam	0.13	Italy	0.04
Rest of Sub-Saharan Africa	0.12	Finland	0.03
Venezuela	0.12	Korea	0.03
Ireland	0.12	Poland	0.03
Rest of Andean Pact	0.12	India	0.03
Indonesia	0.11	New Zealand	0.02
Greece	0.11	United Kingdom	0.02
Argentina	0.10	Spain	0.02
Uruguay	0.10	China	0.02
Belgium	0.10	Colombia	0.02
Botswana	0.10	Japan	0.02
Mozambique	0.09	United States	0.02

Table 19.5 Changes Made in Fitting I-O Tables: Summary Statistics for Selected Categories

Category		Regions with:		Average change	
Name	Type	Increase	Decrease	Direction	Factor
Dwellings	M	0	66	–	985.79
Raw milk	M	37	29	–	44.97
Sugar cane	M	37	29	–	32.90
Water transport	M	63	3	+	2.97
Construction	M	56	10	+	2.83
Business services	M	54	12	+	2.81
Oil seeds	M	49	17	+	2.64
Gas distribution	D	13	53	–	2.55
Water	M	51	15	–	2.37
Air transport	M	59	7	+	2.36
Other transport	M	49	17	+	2.28
Insurance	M	56	10	+	2.16
Fishing	M	35	31	–	2.01
Gas	M	18	48	–	1.96
Financial services	M	51	15	+	1.86
Paddy rice	M	53	13	+	1.82
Oil	D	28	38	+	1.76
Vegetable oils	M	47	19	+	1.73
Other meat	M	48	18	+	1.71
Wool	M	36	30	–	1.70
Forestry	M	32	34	–	1.65
Petroleum	D	16	50	–	1.64
Coal	D	19	47	–	1.57
Petroleum	M	20	46	–	1.56
Dairy products	M	47	19	+	1.54
Health, education	M	57	9	–	1.52
Cattle, sheep	M	28	38	–	1.52
Animal products	M	47	19	+	1.51
Other grains	M	40	26	+	1.50
Textiles	M	53	13	+	1.49
Other minerals	M	22	44	–	1.46
Gas	D	16	50	–	1.43
Vegetables, fruit	M	43	23	+	1.42

D domestic product
F final demand
M import
P primary factor

Table 19.6 Selected Category Total Comparisons Between Unfitted and Fitted I-O Tables (US$ billion)

Region	Category	Type	Initial	Final
Hong Kong	Wearing apparel	M	27.922	4.229
Japan	Gas distribution	D	17.208	1.206
Japan	Health, education	D	904.499	678.350
Japan	Construction	M	0.000	6.918
Japan	Other transport	M	3.900	19.045
Japan	Health, education	M	0.613	10.323
Japan	Govt consumption	F	607.425	412.528
Japan	Exports	F	408.145	506.278
Indonesia	Machinery, equipt	M	1.386	12.522
Indonesia	Dwellings	M	3.742	0.004
Malaysia	Electronic equipt	D	2.115	44.097
Malaysia	Electronic equipt	M	4.596	26.916
Malaysia	Business services	M	0.030	7.568
Philippines	Electronic equipt	D	0.748	15.819
Philippines	Electronic equipt	M	0.443	13.237
Singapore	Petroleum	D	53.711	8.299
Singapore	Electronic equipt	D	5.479	60.868
Singapore	Electronic equipt	M	6.759	44.922
Thailand	Gas	M	3.935	0.000
Canada	Govt consumption	F	61.968	124.446
United States	Gas	D	48.570	1.949
United States	Gas distribution	D	108.281	41.901
United States	Gas	M	29.817	7.563
United States	Trade	M	0.083	14.565
United States	Other transport	M	3.160	29.821
United States	Water transport	M	0.001	4.700
United States	Communication	M	0.032	8.942
United States	Business services	M	3.617	31.938
United States	Health, education	M	122.889	18.838
United States	Investment	F	1165.290	1398.368
United States	Govt consumption	F	1521.008	1202.157
Mexico	Electronic equipt	D	3.866	19.960
Mexico	Machinery, equipt	D	10.209	33.156
Mexico	Electronic equipt	M	2.341	16.476
Mexico	Exports	F	60.738	115.312
Central America	Transport equipment	M	0.544	11.268

contd

Table 19.6 Selected Category Total Comparisons Between Unfitted and Fitted I-O Tables (US$ billion) (Continued)

Region	Category	Type	Initial	Final
Venezuela	Gas distribution	D	8.666	0.198
Argentina	Petroleum	D	40.745	4.880
Argentina	Trade	D	87.128	23.612
Brazil	Petroleum	D	92.453	14.381
Brazil	Gas	M	2.709	0.000
Brazil	Exports	F	110.747	59.201
Belgium	Oil	D	3.717	0.005
Denmark	Water transport	M	0.000	3.375
Denmark	Business services	M	0.000	4.380
France	Gas	D	13.611	0.229
France	Transport equipment	D	0.021	15.583
France	Transport equipment	M	0.009	12.320
France	Construction	M	0.000	2.346
Germany	Petroleum	D	54.487	15.963
Germany	Machinery, equipt	D	153.211	220.017
Germany	Gas distribution	D	17.871	1.562
Germany	Financial services	D	169.346	38.401
Germany	Oil	M	0.026	13.307
Germany	Machinery, equipt	M	25.496	71.509
Germany	Air transport	M	0.927	10.662
Germany	Business services	M	1.204	24.134
Germany	Exports	F	436.170	557.949
United Kingdom	Gas	D	9.866	0.334
Italy	Petroleum	D	50.497	14.470
Italy	Gas distribution	D	16.311	2.035
Italy	Water transport	M	0.002	5.932
Netherlands	Other metals	D	0.003	3.896
Netherlands	Textiles	M	0.000	5.418
Netherlands	Machinery, equipt	M	0.002	24.143
Netherlands	Construction	M	0.000	2.136
Netherlands	Other transport	M	0.001	5.178
Netherlands	Air transport	M	0.000	3.368
Netherlands	Communication	M	12.896	0.690
Netherlands	Business services	M	0.001	12.107
Sweden	Construction	M	0.000	2.900
Sweden	Business services	M	0.001	3.319

contd

Table 19.6 Selected Category Total Comparisons Between Unfitted and Fitted I-O Tables (US$ billion) (Continued)

Region	Category	Type	Initial	Final
Rest of EFTA	Oil	D	0.268	19.915
Rest of EFTA	Water transport	D	0.264	14.535
Former Soviet Union	Oil	D	7.163	42.997
Former Soviet Union	Gas	D	2.803	36.951
Former Soviet Union	Exports	F	78.053	147.627
Rest of Middle East	Oil	D	5.478	126.064
Rest of Middle East	Cattle, sheep meat	D	28.866	8.157
Rest of Middle East	Business services	M	2.401	17.215
Rest of Middle East	Health, education	M	0.422	14.136
Rest of Middle East	Private consumption	F	369.711	274.229
Rest of Middle East	Govt consumption	F	66.073	131.420
Rest of North Africa	Oil	D	0.172	21.261
Rest of North Africa	Gas	D	0.064	7.484
Rest of North Africa	Oil	M	8.236	0.155
Other Southern Africa	Oil	D	0.000	4.562
Rest of Sub-Saharan Africa	Oil	D	0.153	19.678
Rest of World	Petroleum	D	15.842	2.149

D domestic product
F final demand
M import
P primary factor

Second, in most non-energy exporting regions, production of gas, refined petroleum, and "distributed gas" is revised sharply downward. Across all regions , including energy exporters, the money value of "distributed gas" production decreases by an average factor of 2.6, refined petroleum by 1.6, and natural gas by 1.4. Much sharper declines are observed in some regions. For example, in the United States, gas production declines by a factor of 25, and "distributed gas" by a factor of 2.6; in Brazil, refined petroleum production declines by a factor of 6. Import values also generally decline for natural gas and refined petroleum ("distributed gas" imports do not decline overall, though these are of much lower value in any case).

These widespread declines may reflect differences in prices between the source I-O data and the energy module. There are also special issues associated with gas. The gas distribution industry may either use natural gas inputs or produce its own gas. In the source I-O data, it appears mostly to use natural gas, but the energy module treats it as though it produces its own gas. This is an area for work in future database releases.

Finally, there are energy sector changes that do not fit any obvious pattern, such as the decrease in oil production in Belgium, or the increase in crude oil imports into Germany.

In services sectors, we see many instances of sharp increases in imports. In "other business services", for example, all but twelve regions show increases in imports; overall, "other business service" imports increase by a factor of 2.8. Other service sectors showing large import increases include construction (where the growth factor is 2.8), air transport (2.4) and "other transport" (2.3). Not all service industries however show this pattern. For example, imports of "health and education" decrease globally; this decrease is entirely accounted for by a decrease in imports into the United States (by a factor of 6.5, with a money value of $104 billion).

The increases in services imports largely reflect differences between the source I-O data and services trade data. For "other business services" and "construction", for example, they reflect differences between the source I-O data and the main source data set for service trade, the IMF balance of payments statistics. For other sectors, such as air transport and "other transport", the difference arises because in constructing the services trade data we assign a large share of international travelers' expenditures to these consumption-oriented services sectors.

Finally there are many changes that fit no such widespread pattern, though they may fit narrower patterns. For example, there are increases in production and imports of electronic equipment in several rapidly developing economies with relatively old I-O tables (Malaysia, Philippines, Singapore), and various miscellaneous revisions to macro demand categories, especially exports and government consumption.

In conclusion, the major trends in the I-O table adjustments are an increase in trade in services and a revaluation of energy, with petroleum products increasing in value and gas decreasing.

References

James, M. and R.A. McDougall. 1993. "FIT: An Input-Output Data Update Facility for SALTER", SALTER Working Paper 17, Australian Industry Commission, Canberra.

Kapur, J.N. and H.K. Kesevan. 1992. *Entropy Optimization Principles with Applications*. Academic Press, New York.

Kullback, Solomon. 1968. *Information Theory and Statistics*. Dover Publications, Mineola, N.Y.