Documentation for Energy Price/Tax Database

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1. Introduction

This documentation describes one part of a project funded by the United States Department of Energy. The project aims to improve the analytical basis for the development of policies relating to carbon restrictions under the Framework Convention on Climate Change. Cost-effectiveness analysis demands some attention to the question of 'leakage' - how much are the restrictions on Annex I countries likely to be diluted by shifting patterns of trade and production? In addition, questions of international competitiveness have surfaced. Studies of this problem undertaken to date suffer from severe data limitations.

The goal of this project is to construct a publicly available data base which contains the necessary combination of (a) comprehensive input-output data by region, (b) bilateral trade and protection data, and (c) energy price, quantity and tax data. Our approach is to collect consistent data on energy quantity flows, prices and taxes, and incorporate these into the GTAP database. A special purpose data base known as GTAP 4-E has been constructed, which contains information on energy quantities. In addition, energy data in the publicly-released version 5 GTAP data base will be upgraded. These products will allow researchers analyzing the trade, production and welfare consequences of international carbon restrictions to provide more reliable assessments of the national costs and benefits of these policies.

In this document we outline the data sources and the procedures used in creating the price/tax data set. The price/tax data set is designed to be complementary to the volume data set, within the constraint of data availability. To provide maximum flexibility in integrating energy data into the main GTAP database, it would be preferable to have a price corresponding to each of the volume flows in the volume database. However, the level of detail available for data on prices is generally not the same as that for volumes. Producer prices and industry-specific prices are not widely available. On the other hand, the commodity detail of price data is generally greater than for the volume data, particularly for coal and refined oil products. We aim to draw information from a number of different sources. A full set of information on prices for every energy commodity, for every user, in every country is clearly impossible to obtain. Instead, our aim is to focus on collecting accurate information for the major energy-using countries, and to develop generic procedures for creating synthetic data in cases where none is available.

For the 'big six' energy users (i.e. USA, China, India, Japan, Russia and the EU) we attempt to gather country-specific data. For the other countries, actual data is used in cases where it is readily available in multi-country studies. Like the volume database, data are collected at a country level, rather than a 'GTAP region' level. Prices and taxes for which no data is available are estimated. Countries for which no data is available are not included.

For some energy commodities, we have encountered significant product heterogeneity. For Coal, there is steam coal and coking coal, and for Petroleum Products, there is heavy fuel oil, light fuel oil, diesel, and the various grades of petrol. In contrast, for crude oil, natural gas and electricity, there

is a reasonable degree of product homogeneity. Prices of the different types of Coal and Petroleum Products are found to differ significantly. The procedure we have adopted is to collect prices at the product level and later aggregate them to the commodity level.

Because of the likelihood of continuing revisions to the data base, no actual data are presented herein. Instead, the locations of data in the file PRICES.HAR are identified, so that the reader will be able to refer to these as necessary. This file contains data both on actual prices and taxes, and on estimated prices and taxes. PRICES.HAR is a binary Header Array file that can be viewed using the ViewHAR software, which is freely available.

Definitions

• 'Products' are steam coal (S), coking coal (C), crude oil (O), natural gas (N), HFO (H), LFO (L), gasoline (G), automotive diesel (D), and electricity (E).

• ' Commodities' are the GTAP commodities coal (COL), crude oil (OIL), natural gas (GAS), refined oil (P_C), and electricity (ELY).

• 'Users' are industry (I), household (H), utilities (U), and exports (X).

• 'Countries' are all countries for which any price information is available.

2. Data standardization

Prices come in many shapes and sizes. They vary by dimension (energy, mass, or volume), unit, and the time at which they were observed. We apply various conversion factors to standardize the available data to a consistent monetary unit (US$), physical unit (toe – tonne of oil equivalent), and time (1995). These conversion factors are:

- exchange rates in US$ for all countries (USXR)
- product-specific price indexes for 1990-1995 (INDEX)
- intra-dimension conversion factors (eg pound-kg, gal -bbl, kwh-toe) (EGYCF, MASSCF, VOLCF)
- inter-dimension product-specific conversion factors (eg tonnes-toe for coal) (CONFAC)

In general, prices pre-dating 1990 are not used. Nominal exchange rates are used for currency conversion. The product-specific wholesale price index is used except where not available, in which case the retail price index is used. For some countries, no price indexes are available. In this case, we assume that the ratio of prices of energy products between each country and the US are preserved; namely that the price index of each country is equal to the US price index adjusted for any change in the nominal exchange rate.

The following formulae show how the conversion factors and indexes are used to standardize prices. Twelve cases of 'data type' labeled (a) through (l) are distinguished in the conversion formulae. Given the appropriate conversion factors, these formulae can be used for both trade prices and domestic prices. For taxes, conversion factors can be used in the same way, but not price indices. In the tables on the following pages, describing the data available from the various sources, the 'data type' entry indicates which of the formulae (a) to (l) is needed to standardize the data.

(a) Original price is 1995 USD/toe:
(ADJUSTED PRICE) PRC(P,C) = (UNADJUSTED PRICE) UPRC(P,C);
Where, P indexes products and C indexes countries.

(b) Original price is 1995 USD/standard unit:
PRC(P,C) = UPRC(P,C) / CONFAC(P,C);
Standard units vary by product. For coal and HFO, the S.U. is tonnes, for crude oil, gasoline, LFO and diesel the S.U. is barrels, for natural gas it is cubic metres. There is no specific S.U. other than TOE for electricity.

(c) Original price is 1995 USD/non-standard unit:
PRC(P,C) = UPRC(P,C) / CONFAC(P,C) / EGYCF("N.S.U.","S.U.");

(d) Original price is 1995 local currency unit (LCU)/toe:
PRC(P,C) = UPRC(P,C) / USXR(C,"Y95");

(e) Original price is 1995 LCU/standard unit:
PRC(P,C) = UPRC(P,C) / CONFAC(P,C) / USXR(C,"Y95");

(f) Original price is 1995 LCU/non-standard unit:
PRC(P,C) = UPRC(P,C) / CONFAC(P,C) / EGYCF("N.S.U.","S.U.") / USXR(C,"Y95");

(g) Original price is pre-1995 USD/toe:
PRC(P,C) = UPRC(P,C) * [USXR(C,"Y?") / USXR(C,"Y95")]
* [INDEX(P,C,"Y95") / INDEX(P,C,"Y?")];

(h) Original price is pre-1995 USD/standard unit:
PRC(P,C) = UPRC(P,C) / CONFAC(P,C)
[USXR(C,"Y?") / USXR(C,"Y95")] * [INDEX(P,C,"Y95") / INDEX(P,C,"Y?")];

(i) Original price is pre-1995 USD/non-standard unit:
PRC(P,C) = UPRC(P,C) / CONFAC(P,C) / EGYCF("N.S.U.","S.U.")
* [USXR(C,"Y?") / USXR(C,"Y95")] * [INDEX(P,C,"Y95") / INDEX(P,C,"Y?")];

(j) Original price is pre-1995 LCU/toe:

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PRC(P,C) = UPRC(P,C) * [INDEX(P,C,"Y95") / INDEX(P,C,"Y?")] / USXR(C,"Y95");
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(k) Original price is pre-1995 LCU/standard unit:

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PRC(P,C) = UPRC(P,C) * [INDEX(P,C,"Y95") / INDEX(P,C,"Y?")]
                        / CONFAC(P,C) / USXR(C,"Y95");
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(l) Original price is pre-1995 LCU/non-standard unit:

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PRC(P,C) = UPRC(P,C) * [INDEX(P,C,"Y95") / INDEX(P,C,"Y?")]
        / CONFAC(P,C) / EGYCF("N.S.U.","S.U.") / USXR(C,"Y95");
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In the TABLO files, each set of data read in is identified as falling into one of these categories, and adjusted accordingly. The only exceptions are for prices which are denominated in a physical unit other than the usual non-standard unit (for example, a HFO price expressed in $/gallon rather than $/tonne or $/TOE), in which case an extra conversion factor (specific to each case) is applied.

1. Data sources

This section outlines each of the sources of information, and describes the particular form in which the data is reported and the procedures adopted in incorporating the source in the database.

International Energy Agency (IEA)

The IEA is the principal source of information. Information is available on user prices and taxes for OECD countries plus half a dozen others. There are some gaps in the data. Information was supplied to us in the form of a number of spreadsheets, which contain information published in IEA (1997).

Information	User prices
Source	IEA, 1997
Country(s)	All OECD countries, South Africa, Venezuela, Russia, Slovakia, India, Taiwan
Year(s)	1990-1995
Product(s)	S,C,N,H,L,G,D,E
Data type	a,g
Information	Import prices
Source	IEA, 1997
Country(s)	Some OECD countries
Year(s)	1993-1995
Product(s)	S,C,O,N
Data type	b,g

As well as domestic user prices, information is also available on spot prices for crude oil and certain petroleum products. These are treated as export (user) prices. The import price applied for Japan is for LNG, as opposed to pipeline natural gas for all others (IEA 1997, p31).

Information	User taxes
Source	IEA, 1997
Country(s)	All OECD countries, South Africa, Venezuela, Russia, Slovakia, India, Taiwan
Year(s)	1990-1995
Product(s)	S,C,N,H,L,G,D,E
Data type	e, f

For most products, the IEA (and other data sources) give a single price or tax, so there is no great difficulty in determining which is the appropriate price to apply in each case. The exception is gasoline, where most data sources give prices for a range of products, which vary from country to country. The IEA data available varies from country to country in terms of the types of gasoline for which prices and taxes are available. One of these was chosen in each case, in the following decreasing order of preference:

- Unleaded premium 95
- Unleaded premium 98
- Unleaded regular
- Leaded premium
- Leaded regular

For taxes, the results of this process were that unleaded premium 95 was chosen for 26 countries. Exceptions were Denmark (unleaded 98), Japan, Mexico and New Zealand (unleaded regular), India and South Africa (leaded premium) and Russia (leaded regular).

For gasoline user prices the petrol types used corresponded to these, except for Taiwan and South Africa, for which no data was available. For the USA, an overall average was available, and this was used (the gasoline type predominantly used in the USA is regular unleaded). If data on usage of gasoline by type was available, it would be more appropriate to select prices and taxes of the type most widely used, or a weighted average.

Organizacion Latino Americana de Energia (OLADE)

OLADE maintains a comprehensive energy database on many aspects of the energy sector (including prices). This is maintained in the SIEE database (Systema de Informacion Economica-Energetica), from which information was taken.

Information	Import prices
Source	SIEE database
Country(s)	some Latin American
Year(s)	1995
Product(s)	S,C,O,N,G,fuel oil*
Data type	b or similar

*SIEE doesn't distinguish LFO and HFO. A single price is available, which is assumed to be the price for both HFO and LFO.

Only 1995 data was used, as using earlier data (back to 1990) did not fill any gaps in the database. In the SIEE database, there is no facility available for calculating an annual average price. For import and user prices, the first chronological monthly price in 1995 available for each country was applied. An exception is for the natural gas import price for Mexico. This was very low for 1995 and earlier years. The price applied was that for January 1996, which was closer to international levels.

Information	User prices
Source	SIEE database
Country(s)	26 Latin American
Year(s)	1995
Product(s)	S,C,N,L,G,E
Data type	b,c

For gasoline, premium prices are used except for Brazil (because it is not available), where the regular price is used instead. As noted above, determining which type of gasoline is most widely used in each country would be a methodological improvement.

SIEE does not always clearly identify clear which end-user the price relates to. For electricity and natural gas, residential and industrial prices are separate. But for gasoline (both regular and premium), fuel oil, coking coal and steam coal, no separate prices are given. It is assumed that prices available for gasoline and fuel oil are those paid by households, and prices available for coking coal and steam coal are those paid by industry. Prices are also available for LPG, gas oil, kerosene and jet fuel, but these are not used.

In addition to the SIEE database, OLADE also supplied information on consumer prices inclusive and exclusive of taxes (Guzman, 1997). Data is available for most Latin American countries for premium gasoline, diesel, fuel oil and residential and industrial electricity, denominated in US$/gallon for fuels and USc/kWh for electricity, as at September 1997.

Information	User taxes
Source	Guzman, 1997
Country(s)	Most Latin American
Year(s)	1997
Product(s)	L,G,D,E
Data type	c

In this case, ‘fuel oil’ is considered to be LFO, because prices are those paid by domestic consumers.

Asian Development Bank (ADB)

The ADB carry out a periodic survey of energy sector conditions in member countries. This survey covers mainly volume flows and user prices. User prices are generally prices faced by households. Prices are denominated in local currency units per toe except for crude oil prices, which are denominated in US$/toe. In addition to the countries listed below, the survey also covers Fiji, Nepal,

Myanmar and Mongolia, but these are excluded, either due to a lack of price data or because they are considered too small.

Information	User prices
Source	ADB, 1994
Country(s)	Hongkong, Korea, Taiwan, Indonesia, Malaysia, Philippines, Thailand, India, Bangladesh, Nepal, Pakistan, Sri Lanka
Year(s)	1992
Product(s)	S,C,O,N,L,G,D,E
Data type	g, j

For Bangladesh, Hongkong, Pakistan and Taiwan, the single reported coal price is applied to both S and C, and the reported 'fuel oil' price applied to both HFO and LFO. For Korea, the price applied for natural gas is the reported propane price.

US Department of Energy

The US DOE publishes various energy statistics. The Petroleum marketing Monthly provides detailed data on crude and refined oil products. For our purposes, the 'refiner acquisition cost' of composite domestic/imported crude oil is useful.

Information	User prices
Source	DOE, 1997, table 1
Country(s)	USA
Year(s)	1995
Product(s)	O
Data type	b

DOE conducts a survey of selected petroleum product prices (including taxes) around the world for gasoline (a mixture of premium and regular prices), diesel, household prices of LFO, kerosene, and LPG, and industrial prices of LFO and HFO. All of the countries surveyed are included in the database except Grenada, Guyana, Suriname and Croatia, as these four are not included in the volumes database.

Information	User prices
Source	DOE, 1996
Country(s)	86 around the world
Year(s)	1/1996
Product(s)	H,L,G,D
Data type	b, c, special case for HFO

China Energy Databook

The CED is a compilation of materials related to China's energy sector, produced by Lawrence Berkeley National Laboratory of the US and the State Planning Commission of China. Various price data are available, including some basic price information.

For steam coal, the basic price is the 'average mine-mouth price of raw and washed coal at major state-owned mines'. Information is also available on transport costs to various ports. For gasoline and diesel the basic prices are 'ex-refinery oil products prices'. The price applied for gasoline is the 90 octane leaded gasoline price. This is chosen because the user price (see below) is also for regular gasoline. The price applied for diesel is the '#0' price.

Information	Basic prices
Source	Sinton, 1996, tables VI-1, VI-6
Country(s)	China
Year(s)	1992, 1994
Product(s)	S,G,D
Data type	k,i

Table VI-5 gives 'average retail prices of coal and oil products in major cities'. An unweighted average across cities is calculated. These user prices are more consistent with the basic prices above than the user prices derived from the DOE data (for which the user price for gasoline was lower than the basic price).

Information	User prices
Source	Sinton, 1996, table VI-5
Country(s)	China
Year(s)	December 1994
Product(s)	S,H,G,D
Data type	d,e

For electricity, a number of prices are available. These include average wholesale electricity prices (i.e. the price at which generators sell to the national grid); retail electricity prices by sector, and basic electricity rates for various types of customer. Unfortunately, most of these are at a regional or lower level. Averages of basic prices for 'residential' and 'large-scale industrial' are taken across all available provinces, to represent household and industry user prices respectively. The results of these calculations are similar to the values shown in Malhotra et al (1994).

Information	User price
Source	Sinton, 1996, tables VI-11 - VI-33
Country(s)	China
Year(s)	1993
Product(s)	E
Data type	k

TERI Energy Data Directory & Yearbook (TEDDY)

As for China, a country-specific compilation of energy sector data is available for India. This is produced by the Tata Energy Research Institute. Unfortunately prices and taxes are only available for a few products.

Information	User price
Source	TERI (1997)
Country(s)	India
Year(s)	1995
Product(s)	O
Data type	d

Information	User tax
Source	TERI (1997)
Country(s)	India
Year(s)	1995
Product(s)	S, O
Data type	e

Information	Basic price
Source	TERI (1997)
Country(s)	India
Year(s)	1995
Product(s)	S
Data type	e

A Survey of Asia's Energy Prices (World Bank)

A second survey of Asian developing country energy prices was carried out by the World Bank. The country coverage of the World Bank survey is very similar to that of the ADB survey described above. However, the product coverage is different. The ADB survey focuses on household prices, while the World Bank survey covers both household and industrial prices.

Information	User prices
Source	Malhotra et al (1994) Table 1
Country(s)	Thailand, Vietnam, Indonesia, Malaysia, Philippines, Korea, Papua New Guinea, India, Bangladesh, Pakistan, Sri Lanka
Year(s)	1992
Product(s)	E
Data type	similar to h

These data are 'average power tariffs' in major cities of the countries concerned. An average of prices for three Indian cities is applied. For Vietnam, the commercial price is used as a proxy for the industrial price, as no industrial price is given.

Information	User prices
Source	Malhotra et al (1994) pages 123-138
Country(s)	Thailand, Vietnam, Indonesia, Malaysia, Philippines, Korea, Papua New Guinea, India, Bangladesh, Pakistan, Sri Lanka
Year(s)	1992
Product(s)	N,H,L
Data type	similar to h

An irritant here is that the units reported are not consistent. For example, natural gas prices for utilities are reported for Indonesia, Korea, Bangladesh and Pakistan. The units used are US$/mmBTU, won/cubic metre, taka/mcft, and Rs./mcft respectively. This means that each price has to be separately converted.

2. Supplementary data

Import duties

Import duties are obtained from the GTAP database.

Exchange rates

Exchange rates are taken from the IFS (International Financial Statistics). Data for Cuba and Taiwan are missing. According to the SIEE database, the exchange rate for Cuba is 1 Cuban Peso = 1 USD for the entire period. Taiwanese exchange rates are obtained from IEA (1997).

Product-level volume flows

IEA Detailed Energy Balances are used for identifying each country's net energy trade position, and for calculating various weights. The B2020 database is used. This gives separate information for OECD and non-OECD countries.

For non-OECD countries, the only differences are that there is no Lignite category, and RESID use of motor gasoline is non-zero. For the former, it is excluded from the calculation of steam coal volumes, and for the latter it is added on to the Household Gasoline total.

Manipulation of this data is done using EXCEL spreadsheets (OECDVOLS.XLS and NONOVOLS.XLS) prior to creating HAR files.

3. Estimating missing data

User prices and taxes

The resulting collection of prices and taxes can be seen in arrays UPRC (user prices), UTAX (user taxes) and ABP (actual basic prices). Missing observations for prices are indicated by a zero value, and for taxes by a –1 value. Arrays UCNT and ICNT summarise the sparseness of these matrices, indicating how many of the 33 GTAP primary regions user prices/taxes and import prices, respectively, are available for. Arrays UCT6 and ICT6 do the same for the big six regions (with Germany used as a proxy for the EU). This section explains how we go about estimating values for these missing observations.

For domestic user prices, we split all the countries up into four groups. Missing user prices are then assumed to be equal to the average user price in 'similar' countries. Countries are grouped according to their general energy price level and net trade position, and averages are taken for these four groups. In fact the first of these criteria would be sufficient if we had enough information to determine it for each country. This process is necessary because we do not, and we regard the second criterion as a useful indicator of the first.

Countries are classified as net exporters if the sum (in volume terms) of energy exports less imports (taken from the IEA Detailed Energy Balances) is positive, and net importers otherwise. Global average prices are calculated for each product, and the (unweighted) sum of the differences between local prices (where available) and this average is calculated for each country. Countries with a positive sum of differences are classified as high price, and low price otherwise. The classification of each country can be seen in array DUM, where a 1 indicates a high-price exporter, 2 a high-price importer, 3 a low-price exporter, and 4 a low-price importer.

Average user prices are calculated for each of these four groups, for each product/user. The only price that cannot be calculated because of a lack of data, is the industry crude oil price for high-price exporters. This is assumed to be equal to the industry crude oil price for high-price importers. These averages can be seen in arrays HXAP, HMAP, LXAP and LMAP.

We have less data available for export prices than for domestic user prices. For this reason, we do not employ the same methods as described above for export prices. Instead, we take a simple global average export price for those products for which any export price data is available (all products except diesel and electricity) and apply this price to all regions for which no price is available. For diesel and electricity, we assume that the export price is equal to the region-specific industry user price net of any industry user taxes.

This method is quite crude and may artificially induce significant price homogeneity across heterogeneous exporters particularly for less homogenous traded goods such as gas and coal. In particular, we do not have specific export prices for some of the important exporters of coal and gas.

For example, no export prices for coal in South Africa and for gas in the Former Soviet Union are available. For future development, more detailed data and a treatment similar to that of the user prices are desirable.

At this stage, missing user taxes are assumed to be zero. This treatment is consistent with the standard GTAP approach of identifying gaps in the database with zero values. Unlike for prices, we do not have much confidence that tax rates are very similar across countries. We also have little confidence that tax rates are similar across products or across users, although the degree of similarity across each of these dimensions could usefully be further investigated. An alternative approach to this problem would be to use the existing tax rates from the GTAP database.

Import basic prices

Flows in the GTAP database are normally valued at basic prices, i.e. net of transport and wholesale/retail margins. For consistency with the rest of the database, we similarly need to value the energy volume flows at basic prices rather than (margin-inclusive) user prices.

While we have a good deal of information on user prices, basic prices for domestically-produced products are not generally reported. The only exceptions to this which have been identified are for Chinese steam coal, gasoline and diesel, and Indian steam coal. These actual basic prices are shown in array ABP of DATA.HAR.

To estimate basic prices, we first estimate margins, and then derive basic prices using the following equation:

basic price = (user price - user tax) / (1 + margin)

The following sections describe how margins are estimated.

Margins estimated from import prices

We assume that the basic prices of (duty-paid) imported commodities and domestically-produced commodities are the same. This enables us to use import prices to estimate overall basic prices, as we have a reasonable amount of data on import prices. Information on import duty rates is obtained from the GTAP database.

First we calculate an average margin for each product/user combination using the countries where we have enough information to calculate the margin, and then apply the average to other countries. For some commodities (especially the less-traded products such as gasoline), the averages are calculated from only a few observations and are not very reliable. As for export prices, this averaging is likely to result in an artificially high degree of homogeneity across countries. With more data available, it may be possible in future to group countries in the same way as is done for domestic user prices.

For some product/user/country combinations, this process yields implausible results, including negative or extremely high margins. There are various possible reasons for these, but in any case this sort of information isn't very useful. We can use two filtering methods to limit the influence of these implausible results on the average margin that is calculated:

- when calculating the margin, exclude countries where imports are not a significant share of total use (e.g. less than 20%), and
- exclude countries where the estimated margin is judged to be unreasonable (either negative or above 500%).

The first of these is not employed for practical reasons: When it is used, we are unable to calculate any margins for gasoline. The second approach is employed.

Using this process, we are able to calculate average margins for all relevant product/(domestic) user combinations except Diesel/Industry, Diesel/Household, Electricity/Industry, and Electricity/Household. This is not a problem for electricity, as all of the transmission distribution activity is part of the electricity sector. For diesel, we assume that the margin is identical to that for gasoline, as the physical nature and distribution channels of the two are rather similar. Country-specific margins are shown in array MGI, and average margins are shown in array MGAI.

We have assumed that margins are similar across countries. Alternative assumptions would be similarity across products or similarity across users. Both of these appear to be inferior assumptions in the case of margins, and are not used.

Margins estimated from IO tables

Because the margins estimated using the process described above are judged to be of limited reliability, we also make use of other sources of data on margins for certain major energy-using countries. For some countries, input-output accounts are maintained at both producer prices and user prices. In these cases, we can compare the two in order to arrive at margins. To date, this data has been obtained for the USA and for Japan. These margins are available at a more aggregate level (commodity-wise) than the price data: generally for 'coal', 'oil and gas' and 'petroleum products'. The margins obtained are applied to each of the products within each category. The margins estimated in this way are given in arrays MGJ and MGU.

This information is used in two ways. Firstly it is preferred unambiguously to the estimates obtained above for the two countries in question. Secondly, it is also given some weight (20% for each of the two) in determining the estimated margins for all other countries. The estimates above are given the remaining 60% weight. Combined margins are shown in array MG.

Estimating and unifying domestic basic prices

Once we have a complete set of estimated user prices, user taxes, and margins, it is straight-forward to estimate user-specific basic prices where actual basic prices are not available (i.e. in almost all cases).

These estimated basic prices are shown in array BPE. It is not meaningful to have different basic prices for different users. Therefore it is necessary to calculate a single basic price on domestic products which is faced by all energy users. This is done at the same time as we aggregate up to commodity level (see below).

It is worth noting that estimated basic prices often differ quite significantly across users, and as a result of this, unification of the basic price means that that the implicit margins which exist can differ significantly from the originally-estimated margins. Some are negative - see arrays MRGD and MRGP.

At this point it is worthwhile to assess the state of the database which has been assembled. To what extent have we achieved our objective of providing detailed price/tax data for the big six countries? How many prices and taxes are based on actual data, and how many are synthetic? As mentioned above, various arrays in the data file give an indication of the sparseness of the user price/tax and import price matrices. To find out how many import basic prices are based on actual data, we can examine array BPI. Import basic prices are most often available (not surprisingly, given the method of derivation) for the widely-traded primary energy products, and rarely available for processed products. The array shows that most of the big six regions have basic prices for about half of the nine products, except for Russia, which has none at all, and India, which has a basic price for steam coal only. This pattern reflects the fact that Russia and India are not major importers of most energy products. At present, the biggest gap in the database seems to be for Russia (and other former Soviet and Eastern European countries, but these are smaller).

4. Aggregating to the GTAP level

Aggregating from products to commodities

Prices are collected for steam coal and coking coal, and these need to be aggregated to give a single 'coal' price. Similarly, prices for HFO, LFO, gasoline and diesel need to be aggregated to give one price for 'petroleum products'.

Weights are calculated on both a user-specific and an all-user basis. The unified basic price is aggregated using the latter, while user prices and taxes use the former. Where data is insufficient to allow weights to be calculated, an average set of weights is calculated from the available weights, and this is applied instead. Weights are shown in arrays TWT (combined weights) and UWT (user-

specific weights) of the data file, and averages in ATWT and AUWT. These show steam coal to be the dominant type for all users. However, there is not a single dominant petroleum product for all users.

These weights are calculated from the IEA's Detailed Energy Balances ('DEB'). In the DEB, it appears that all gasoline purchases are treated as sales to the transport sector, not to final consumption. To overcome this problem, weights for household prices are calculated from the sum of 'RESIDENT' and 'ROAD' (transport) flows. This method in effect results in an opposite problem, namely that some portion of ROAD flows which in fact go to the transport industry are included in the calculation of final consumption weights.

Diesel and LFO are both classified as gas/diesel oil. This is addressed by assuming that the transport portion of this is diesel (which is assumed to be used entirely by industry), and the non-transport portion is LFO. For motor gasoline, the entire 'transport' use is assumed to be on the part of households. Thus the GASDIES flow to the ROAD sector is not included in the weights for household prices.

The DEB gives considerably more disaggregated flow data, but IEA price data is not available to the same level of disaggregation (although some of the other sources of data do give a more disaggregated set of prices, particularly for refined oil products). IEA statistics disaggregate gasoline further, but the DEB does not. As regards the DEB data, it seems to be reasonably complete. No problems of missing data are apparent. All flows are expressed in Mtoe so no conversion problems arise.

The first table below shows which of the flows measured in the DEB are used for weights for each of the different prices. Each of these flows are separated into a large number of different products. The second table shows the DEB product categories which are used to calculate the weights to be applied to each product price.

Price data for:	**Uses weights from DEB flow(s):**
Export price	EXPORTS
Import price	IMPORTS
Industry price/tax	TOTIND
Household price/tax	RESIDENT + ROAD
Utility price/tax	PUBELEC + AUTOELEC

Price data for:	**Uses weight from DEB product(s):**
Steam coal	BITCOAL + SUBCOAL + BROWN
Coking coal	COKCOAL
Heavy fuel oil	RESFUEL
Light fuel oil	GASDIES
Gasoline	MOTORGAS

Mapping to volume-consistent country basis

Prices and taxes have been collected for 91 countries. Volume data is available for 135 countries or composite regions. Prices from certain of the 91 countries that are judged to be 'similar' are used as proxies for the remainder of the set of countries. The prices applied to each country are shown in array PTOV.

Aggregating to GTAP region level

For GTAP composite (multi-country) regions, the regional basic price and user taxes are calculated using weights calculated from each country's domestic use of energy (production less exports plus imports). *Fob* prices are weighted according to each country's gross trade (exports plus imports). Region-level basic prices and *fob* prices are shown in arrays RGBP and FOBP respectively.

Prices for calculating targets

For calculating the energy targets, a number of different prices are used. Domestically-produced, domestically-sold products are valued at the unified basic price. Exports are valued at the *fob* export price. Imports are valued at the *cif* import price (plus duty).

Fob prices are obtained in the process of price data collection. *Cif* prices are generated from these *fob* prices, using the original trade margin data.

For targets of domestically-sold composite products, an average price AVPRICE is used, calculated as a weighted average of the basic price and import price:

```
formula
       (all,r,reg)(all,i,egycom: IMVOL(r,i) GT 0)
IMPPRICE(r,i)=sum(s,reg,[VIWS(i,s,r)*(1 + RMT(i,s,r)/100)]) / IMVOL(r,i);
        (all,r,reg)(all,i,egycom)
DOMWT(r,i) = (DPVOL(r,i)-EXVOL(r,i)) / (DPVOL(r,i)+IMVOL(r,i)-EXVOL(r,i));
        (all,r,reg)(all,i,egycom)
AVPRICE(r,i) = DOMWT(r,i) * REGBP(r,i) + (1 - DOMWT(r,i)) * IMPPRICE(r,i);
```

where VIWS and RMT are bilateral import flows and duty rates respectively, and DPVOL, IMVOL and EXVOL are volumes of domestic production, imports and exports respectively.

This average price is used, along with volume information, for calculating targets for intermediate and final consumption, and for taxes on these. This process is described in ‘Documentation for FIT-E’.

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