Chapter 13

Protection data

This chapter describes the construction of the tariff data and other protection instruments for the year 1995 in the Global Trade Analysis Project (GTAP) version 4 data base. Section 13.1 describes the sources for the merchandise tariff data. Sections 13.2 and 13.3 look at the agricultural protection data for OECD and non-OECD countries, and section 13.4 at the Multifibre Arrangement. Finally, section 13.5 describes how these various data were assembled together to form the GTAP protection data set.

13.1 Source of the merchandise tariff data

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There are two major sources for merchandise tariff data. The primary source comes from the World Bank and was supplied by Jersey Rozanski, based on the UNCTAD TRAINS data base. However, due to the incomplete regional coverage and other gaps, this data base was supplemented by the merchandise tariff data in the GTAP version 3 data base.

13.1.1 Merchandise tariff data from the World Bank/TRAINS

Table 13.1 below lists the countries that have available merchandise tariff data from the World Bank, along with the tariff years.

Table 13.1 Import country and tariff year

Short name	Long name	Tariff year
ARG	Argentina	1995
AUS	Australia	1993
BGD	Bangladesh	1995
BOL	Bolivia	1995
BRA	Brazil	1995
CAN	Canada	1996
CHL	Chile	1995
CHN	China	1995 or 1996
CMR	Cameroon	1995
COG	Congo	1993
CRI	Costa Rica	1995
DZA	Algeria	1993
ECU	Ecuador	1997
EGY	Egypt	1995
EUN	European Union	(not available)
GAB	Gabon	1995
GTM	Guatemala	1995
HND	Honduras	1995
HUN	Hungary	1993
IND	India	1995
ISL	Iceland	1993
JPN	Japan	1996
KEN	Kenya	1994
KOR	"Korea, Republic of"	1995
LKA	Sri Lanka	1995
MAR	Morocco	1993
MDG	Madagascar	1995
MEX	Mexico	1995
MYS	Malaysia	1993
NIC	Nicaragua	1995
NOR	Norway	1995
NZL	New Zealand	1996
PHL	Philippines	1995
POL	Poland	1995
PRY	Paraguay	1995
SAU	Saudi Arabia	1994
SLV	El Salvador	1995
TTO	Trinidad and Tobago	1992
TUR	Turkey	1993
USA	United States	1996
VEN	Venezuela	1995
ZAF	South Africa	(not available)
VNM	Vietnam	(not available)
CHE	Switzerland	1995(empty)
COL	Colombia	1997(empty)
OMN	Oman	1992(empty)
PER	Peru	1995(empty)
THA	Thailand	1995(empty)
TUN	Tunisia	1995(empty)
TWN	China(Taiwan Prov)	1992(empty)
URY	Uruguay	1995(empty)

Each country has 16 fields as listed below:

"ReporterCode",
"TariffYear",
"TradeYear",
"UserProdCode",
"PartnerCode",
"Min_Of_AppliedDutyRate",
“Max_Of_AppliedDutyRate",
"Total_Count_Of_TrfLines",
"Count_Of_TrfLines_With_Duties",
"Sum_Of_Total_Import_Value",
"Simple_Duty_Rate",
"Weighted_Duty_Rate",
"Sum_Of_Import_Value",
"Sum_Of_Weighted_Value",
"StDevOfAppliedDutyRate",
"VarOfAppliedDutyRate"

The first field identifies the importing country; the fourth one refers to the GTAP merchandise sectors code (1-42); the fifth one identifies the exporting country. The remaining fields are related to the trade volume and tariff rate and are self-explanatory.

For several tables (Switzerland, Colombia, Oman, Peru, Thailand, Tunisia, Taiwan Province of China, Uruguay), the tariff rate field is empty. These countries are still included in the construction process, but their tariff matrices are essentially overwritten by the GATT IDB data (see section 13.1.3 below for details).

In all the tables, the European Union (EUN) and the individual EU members appear as partners in some cases. We exclude EUN as a partner in all the importing countries/regions. A comparison shows that out of more than 2000 trade flows from the EUN, only 70 or so trade flows are bigger than/equal to the sum of the trade flows from the individual EU countries.

The initial step in data manipulation was to extract the relevant information and reformat it. There were 268 partner countries that appeared in all the tables and since we have 42 GTAP merchandise sectors, for each country, we extract the information into two 268 by 42 matrices, one for the tariff rates, one for the trade volumes. The set of 268 partner countries is the union of all the importing countries' sets of partner countries. In general, the set for a specific importing country is always a subset of the total set. So there are always missing entries in the 268x42 matrix. Missing entries are initially represented by special flags. Then for missing tariff rates, we calculate a weighted average tariff rate using the import value shares (derived from the same source of data, i.e., TRAINS). We then use this weighted average tariff to fill in the value for those countries that have a missing tariff rate for that commodity. If there is no import for that commodity, and hence no average tariff rate available, we leave the special flags unchanged. The next step is to aggregate the

268 partner countries into GTAP 45 regions so that we have one tariff matrix of the dimension 45 by 42. Again, the tariff rates are the import-value-weighted rates (still using TRAINS). For countries that do not trade with the reporting country, the tariff rate should be the simple average tariff for that

13.1.2 Merchandise tariff data from the GATT IDB

Detailed information on this data set is available from the documentation of the GTAP version 3 data base (McDougall 1997: chapter 13). Table 13.2 below is taken from that source. In order to make use of this data set as a supplement to the World Bank data, we have to update both the sectoral and regional classification. The sectoral classification for the World Bank data is GTAP 42 merchandise commodities, so we have to develop a method for expanding the GTAP Version 3 sectors into the new classification. Also, most of the tariff data from the World Bank are at the country level, so we want the IDB data to match them at the same regional level. A third adjustment is in relation to the trading partners for each of the reporting countries. Those partners need to be expanded to the 45 GTAP version 4 regions. Because we maintain a good "parent-child" mapping

Table 13.2 Import market aggregation: Version 3 of the GTAP data base

1	AUS	Australia
2	NZL	New Zealand
3	JPN	Japan
4	KOR	Korea
5	IDN	Indonesia
6	MYS	Malaysia
7	PHL	Philippines
8	SGP	Singapore
9	THA	Thailand
11	HKG	Hong Kong
13	IDI	India
14	RAS	Rest of South Asia (composite region) (Sri Lanka)
15	CAN	Canada
16	USA	United States
17	MEX	Mexico
18	CAM	Central America and the Carribean (composite region) (includes: Jamaica, El Salvador)
19	ARG	Argentina
20	BRA	Brazil
21	CHL	Chile
22	RSM	Rest of South America (composite region) (includes: Colombia, Peru, Uruguay, Venezuela)
23	E_U	European Union 12 (includes: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, United Kingdom)
24	EU3	Austria, Finland, and Sweden
25	EFT	EFTA (composite region) (includes Iceland, Norway, Switzerland)
26	CEA	Central European Associates (composite region) (includes: Czech Republic, Hungary Poland, Romania, Slovakia)
28	MEA	Middle East and North Africa (composite region) (includes: Tunisia)
29	SSA	Sub Saharan Africa (composite region) (includes: Senegal, Zimbabwe)

between GTAP 3 and GTAP 4 sectoral classification, the rule to expand the tariff rate in the commodities dimension is quite simple: each GTAP 4 sector inherits the tariff rate from its GTAP 3 parent. For the partner dimension, there is a mapping between the GTAP 3 region and GTAP 4 region. Again, the direct inheritance rule is applied. For the reporting country/region, we let all the members for each GTAP 3 regions fully inherit their respective parents' tariff information. Thus, we get 39 tariff matrices of dimension 45x42. Note that FSU, EU, and ROW are not further decomposed. The other 36 matrices are at the country level.

13.1.3 Combining the two merchandise data sources

Now we have two data sets ready at the same partner level (GTAP 4 regions) and, the same commodity level (GTAP 4 commodities), but the sets of reporting countries sets are different. In order to maximize the usage of both data sets and with the priority put on the World Bank data, we develop the following combination rule: We find the union (denoted as U) of the two reporter sets (W for the World Bank/TRAINS data, and G for the IDB data).

— For those reporters that appear in the W set, but not in the G set, we use only TRAINS data.
— For those reporters that appear in the set G, but not in the W, we use only IDB data.
— For those reporters that appear in both sets, i.e. the intersection, we prefer data from TRAINS but use IDB data to fill in any missing tariff rates in that portion of the World Bank/TRAINS.

If after the above procedures are completed, there are still gaps in the tariff matrix, then other methods are used (for details, see subsequent sections).

The next step is to aggregate the reporters into GTAP 4 regions. This task requires a mapping from the set U into GTAP 4 regions. Again, tariff rates have to be share-weighted. The shares used here are Mark Gehlhar's trade data (chapter 11A). Gehlhar's data set are at the country level (there are more than 200 countries). So we have to aggregate that data set into the GTAP 4 region level before using them as weights.

The end products of these steps are 45 regional tariff rate matrices of dimension 42x45.

13.2 Agricultural protection, OECD countries

Marinos Tsigas

This section discusses the agricultural policy measures which have been incorporated into the GTAP version 4 data base for the OECD member countries. In particular, it discusses policy measures regarding border measures and producer subsidies.

13.2.1 Border measures

In the case of importables, import tariffs can be used to raise the domestic market price, P_M, above the world price, P_W. Price comparisons are usually expressed as a percentage difference between the domestic market price and the world price. The ad-valorem tariff equivalent is expressed as: $100*[P_M - P_W]/P_W$.

In the case of exportables, export subsidies can be used to raise the domestic market price above the world price. They can be specified in the same way as tariffs since an export subsidy is merely a negative export tax. On the agricultural export side, we have taken a different approach in version 4 as compared to versions 2 and 3. In the previous versions of the data base, we used information from country submissions to the WTO, on export subsidy expenditures, in the Uruguay Round base period. In addition to their potential inconsistencies with the price comparison-based import protection data, adjusting these to the 1992 base period was problematic. For this reason, we have opted to carry the price comparison approach over to the export side as well in the version 4 data base.

13.2.2 Producer subsidies

Producer subsidies can be used to raise the producer price, P_S, above the domestic market price, P_M. The ad-valorem producer subsidy equivalent is expressed as: $100*[P_S - P_M]/P_M$.

The powers of these measures of support (i.e., one plus the tariff or subsidy rate) may be denoted as, using GTAP notation:

power of the producer subsidy equivalent: $$PTO(i,\ r) = \frac{VOA(i,\ r)}{VOM(i,\ r)}$$

power of the import tariff equivalent (average): $$PTM(i,\ r) = \frac{\sum_{s \in REG} VIMS(i,\ s,\ r)}{\sum_{s \in REG} VIWS(i,\ s,\ r)}$$

power of the export subsidy equivalent (average): $$PTX(i,\ r) = \frac{\sum_{s \in REG} VXMD(i,\ r,\ s)}{\sum_{s \in REG} VXWD(i,\ r,\ s)}$$

13.2.3 Data sources

Our estimates of producer subsidies and border measures for agricultural commodities are based on producer subsidy equivalent (PSE) calculations done at the OECD for the year 1995.[1] The OECD information are provided in the form of spreadsheets and describe the PSE calculations for agriculture on an annual basis. The regional and commodity specification in the OECD data base is shown in table 13.3.

Table 13.3 Regional and commodity specification in the OECD PSE data base

Countries/regions		Commodity groups	
Australia	Mexico	Wheat	Milk
Canada	New Zealand	Maize	Beef and Veal
Czech Republic	Norway	Other grains	Pigmeat
European Union--15	Poland	Rice	Poultry
Hungary	Slovakia	Oilseeds	Sheepmeat
Iceland	Switzerland	Sugar	Wool
Japan	Turkey		Eggs
	United States		

Notes: PSE and border measure estimates are not yet available for Korea (OECD, 08-Apr-1997, pp. 40-41); Slovakia is not an OECD member country.

PSE data for the Czech Republic, Hungary and Slovakia are used to construct estimates of producer subsidies and border measures for the Central European Associates (CEA) region in the GTAP data base.[2] Data for Iceland, Norway and Switzerland are used to construct estimates of producer subsidies and border measures for the EFTA region in the GTAP data base.

[1] Thanks are due to David Blandford and Dimitris Diakosavvas of the OECD for providing us with recent estimates of PSEs.

[2] Note that the CEA region in GTAP includes Bulgaria, Romania and Slovenia in addition to the three countries mentioned in the text.

13.2.4 Assumptions

Several types of policy measures are included in the OECD PSE calculations: market price support; levies on output; budgetary payments paid directly to producers; reduction in input cost (e.g., interest and insurance subsidies; subsidies on the purchase of fertilizers, seeds, feed); general services (e.g., measures that in the long-term reduce costs but which are not directly receivable by producers such as research, advisory, training, and pest and disease control); programs funded at the local or regional level; and other indirect support (e.g., tax concessions).

Market price support is an indicator of the annual monetary value of the transfer from consumers and taxpayers to the agricultural producers in the form of price gaps between domestic market prices and border prices of agricultural commodities. These price gaps are caused by the policy measures which include tariffs, import quotas, administered prices, or trade licensing arrangements. In our calculations, the market price support component of the PSE determines the border measure [i.e., the power of the import tariff equivalent, PTM(i,r), and power of the export subsidy equivalent, PTX(i,r)].

The total gross PSE less the market support component determines the producer subsidy [i.e., the power of the producer subsidy equivalent, PTO(i,r)].

13.2.5 Estimates of protection

Tables 13.4 and 13.5 show our estimates of the power of the producer subsidy equivalent, PTO(i,r), and the power of the import tariff equivalent, PTM(i,r), respectively. Where it is relevant in the GTAP data base, the power of the export subsidy equivalent, PTX(i,r), is equal to the power of the import tariff equivalent.

Producer subsidies: On a commodity by commodity basis, the highest rates are concentrated in three regions: the EU, EFTA, and the United States. The EU has the highest rates of producer subsidies in wheat, other grains and oilseeds. EFTA has the highest rates of support for sugar beets and all livestock commodities, except wool. The United States has the highest rate of support for rice and wool.

On a country by country basis, in the European Union, Japan, and Mexico, the highest rate of support is for oilseeds; whereas in Australia and Canada the highest rate of support is for wheat. In EFTA and Turkey, the highest rate of support is in raw milk production. In the United States, the highest rate of support is in wool production.

Import tariff equivalents: On a commodity by commodity basis, the highest rates of protection are in just two regions. Japan has the highest rates of protection for raw milk production and all crops, except oilseeds. In the EFTA region, we observe the highest rates of protection in oilseeds and all livestock commodities, except raw milk production.

On a country by country basis, in Australia, New Zealand, Canada, Turkey, and the CEA, the highest rate of protection is for a livestock product; in the European Union, Japan, EFTA, and the United States, the highest rate of protection is for a crop product.

The sharp devaluation of the Mexican peso in 1995 led to higher world commodity prices in relation to domestic prices in pesos. As a result, border protection for Mexico is negative for almost all commodities.

Table 13.4 Powers of producer subsidy equivalents, PTO(i,r), for 1995.

Commodities	Regions			
	AUS	CAN	EU	JPN
1 PDR	1.048687	1.000000	1.035014	1.185551
2 WHT	1.076889	1.214389	1.580248	1.240482
3 GRO	1.054812	1.114586	1.531343	1.227945
4 OSD	1.046746	1.141311	2.095072	1.418152
5 C_B	1.048509	1.091949	0.973225	1.152689
6 CTL	1.067088	1.147699	1.220255	1.151841
7 OAP	1.046922	1.142124	1.089920	1.024740
8 RMK	1.004547	1.119454	1.089078	1.142984
9 WOL	1.070559	1.000000	1.000000	1.000000
	NZL	USA	EFT	MEX
1 PDR	1.000000	1.403235	1.000000	1.211602
2 WHT	1.010502	1.175986	1.093593	1.222100
3 GRO	1.010502	1.085217	1.434751	1.238830
4 OSD	1.000000	1.075811	1.217027	1.277115
5 C_B	1.000000	1.081886	1.217027	1.051042
6 CTL	1.021478	1.049065	1.490294	1.063466
7 OAP	1.010141	1.042222	1.180619	1.051537
8 RMK	1.014973	1.039919	1.468797	1.053736
9 WOL	1.015033	1.616004	1.046919	1.000000
	CEA	TUR		
1 PDR	1.000000	1.000000		
2 WHT	1.050600	1.124339		
3 GRO	1.048857	1.078034		
4 OSD	1.059966	1.061210		
5 C_B	1.039728	1.106922		
6 CTL	1.061318	1.092330		
7 OAP	1.051750	1.039700		
8 RMK	1.059347	1.133777		
9 WOL	1.000000	1.000000		

Source: OECD PSE data base.

Table 13.5 Powers of import tariff equivalents, PTM (i,r), for 1995

Commodities	Regions			
	AUS	CAN	EU	JPN
1 PDR	1.011712	1.000000	2.287459	6.029520
2 WHT	1.000000	1.003181	1.124039	6.351463
3 GRO	1.000000	1.002454	1.442018	5.500242
4 OSD	1.000000	1.000000	1.000000	1.000000
5 C_B	1.041595	1.072830	1.765637	2.428582
6 CTL	1.000000	1.000000	2.111534	1.481000
7 OAP	1.002980	1.058034	1.186797	1.612390
8 RMK	1.000000	1.000000	1.000000	1.000000
9 WOL	1.000000	1.000000	1.000000	1.000000
10 CMT	1.000000	1.000000	2.111534	1.481000
11 OMT	1.002980	1.058034	1.186797	1.612390
12 VOL	1.000000	1.000000	1.000000	1.000000
13 MIL	1.288688	1.861142	2.163386	4.504928
14 PCR	1.011712	1.000000	2.287459	6.029520
15 SGR	1.041595	1.072830	1.765637	2.428582
	NZL	USA	EFT	MEX
1 PDR	1000000	1.002646	1.000000	0.960798
2 WHT	1000000	1.017674	3.351261	0.771381
3 GRO	1000000	1000000	2.604362	1.049478
4 OSD	1000000	1000000	6.009883	0.918561
5 C_B	1000000	1.638355	3.769610	0.844777
6 CTL	1000000	1.000116	3.050738	0.769366
7 OAP	1.444100	1.017811	2.873294	0.861221
8 RMK	1000000	1.000000	1.000000	1.000000
9 WOL	1000000	1.084212	1.509197	1.000000
10 CMT	1000000	1.000116	3.050738	0.769366
11 OMT	1.444100	1.017811	2.873294	0.861221
12 VOL	1000000	1.000000	6.009883	0.918561
13 MIL	1000000	1.517755	3.650717	0.986778
14 PCR	1000000	1.002646	1.000000	0.960798
15 SGR	1000000	1.638355	3.769610	0.844777
	CEA	TUR		
1 PDR	1.000000	1.000000		
2 WHT	0.820930	0.866690		
3 GRO	0.846698	0.998343		
4 OSD	1.038081	1.377847		
5 C_B	1.290685	1.223559		
6 CTL	1.023176	1.600669		
7 OAP	1.337598	1.646337		
8 RMK	1.000000	1.000000		
9 WOL	1.000000	1.000000		
10 CMT	1.023176	1.600669		
11 OMT	1.337598	1.646337		
12 VOL	1.038081	1.377847		
13 MIL	1.205425	1.629676		
14 PCR	1.000000	1.000000		
15 SGR	1.290685	1.223559		

Source: OECD PSE data base.

13.3 Agricultural protection, non-OECD countries

Mustafa Acar

Agricultural import tariffs and export subsidies are generated using the OECD data for OECD and Central and Eastern European countries. For the rest of the regions, indirect estimates are generated using the GTAP version 3 data base as the source. This section describes the adjustment procedure used based on 9 OECD regions (Australia, Canada, EU, Japan, New Zealand, USA, EFTA, Mexico and CEA (Central European Associates)) and thirteen agricultural sectors **(pdr, wht, gro, osd, c_b, ctl, oap, rmk, wol, cmt, omt, vol, mil, pcr, sgr**) (see the front of this volume for a full description of GTAP 4 sectors).

13.3.1 Adjustment procedure

The version 4 agricultural protection levels are generated for non-OECD regions using the following 4-step approach:

Step 1: derive the version 3 tariff/subsidy rates,
Step 2: compare the new and old protection levels for the nine regions specified above and adjust the version 3 tariff/subsidy rates for non-OECD regions accordingly,
Step 3: map the adjusted tariff/subsidy rates to the version 4 sectoral classification,
Step 4: combine the new protection data for OECD countries with the adjusted rates for the other regions. Details about the calculations and adjustment procedure follow.

13.3.2 Import tariffs

In step 1, the GTAP version 3 data base is used to derive the version 3 tariff rates. For this purpose, imports at world prices for a given region are summed over the exporting regions to get the total value of imports at world prices. Likewise, imports at market prices are summed over the exporting regions to get the total value of imports at market prices. Then, the following formula is used to calculate the version 3 tariff rates:

Average Import Tariff Rate = [(VIMS / VIWS) - 1.0], where VIMS and VIWS represent the value of imports at market prices and the value of imports at world prices, respectively.

In step 2, these rates are adjusted using an “adjustment factor.” This adjustment factor is calculated in the following way:

— New tariff rates (1998) are calculated for the nine regions mentioned above using the data obtained from the OECD.
— Fifteen sectors included in the OECD data set are mapped into the version 3 GTAP sectoral classification. As a result, 15 sectors were aggregated to 10, using the following mapping:

Version 4	Version 3
pdr	pdr
wht	wht
gro	gro
osd	ngc
c_b	ngc
ctl	olp
oap	olp
rmk	olp
wol	wol
cmt	met
omt	met
vol	ofp
mil	mil
pcr	pcr
sgr	ofp

— Then, the new tariff rates calculated from the OECD data are compared with the old version 3 rates for the corresponding regions, and “shift factors” are calculated for each region and for each sector by dividing the new rates by the old ones. Extreme values are ignored and a single representative rate, the medium shift factor, is chosen for each sector.
— The old (version 3) rates for the rest of the regions are adjusted by multiplying the average version 3 tariff rates by the medium shift factor.

In step 3, the adjusted tariff rates are mapped to the version 4 sectoral classification. Through this procedure, adjusted average tariff rates for non-OECD regions with the new version 4 classification are obtained.

For commodities where there is a good mapping between the old and the new sectors, we retain the adjusted rates; but for commodities where the mapping is not so good, we discard the adjusted rates and report missing values. The commodities for which we retain the adjusted rates are `pdr`, “paddy rice”, `wht`, “wheat”, `gro`, “cereal grains nec”, `wol`, “wool, silk worm coccoons”, `cmt`, “bovine cattle, sheep and goat, horse meat products”, `omt`, “meat products n.e.c.”, `mil`, “dairy products”, and `pcr`, "processed rice". We discard the rates for `osd`, “oil seeds”, `c_b`, “sugar cane, sugar beet”, `pfb`, “plant-based fibers”, `ctl`, “bovine cattle, sheep and goats, horses”, `rmk`, “raw milk”, `vol`, “vegetable oils and fats”, and `sgr`, “sugar”.

In the last step, the version 4 tariff rates calculated from the OECD data for the 9 regions mentioned above are combined with the adjusted average tariff rates for the rest of the regions.

13.3.3 Export subsidies

A similar procedure was followed for calculating the export subsidies. In this case, however, the original source data provided by Merlinda Ingco in the context of the version 3 is used as the estimate for export subsidies. The five-step approach to generate export subsidies is described below.

Step 1: From the data provided, average export subsidy rates are calculated by the formula:

Average Export Subsidy Rates = [(VXMD / VXWD) - 1.0],

where VXMD and VXWD represent the value of exports at market prices and the value of exports at world prices, respectively. The value of exports is calculated by summing over the destinations at market and world prices respectively.

Step 2: Following the same procedure described in step 2 for import tariffs, the version 3 export subsidy rates are compared with the new rates for the nine regions. Assuming a similar trend for the rest of the regions, their subsidy rates are adjusted using the medium shift factors.

Step 3: The adjusted export subsidy rates are mapped into the version 4 sectoral classification. By this operation, the version 4 average export subsidy rates are generated for the rest of the regions.

Step 4: Discard the adjusted rates for certain commodities, replacing them with missing values, as with the import tariffs (sub-section 13.3.2).

Step 5: In the last step, the two data sets (one produced from Merlinda Ungco's data and the other calculated from the adjustment process described above) are combined to make the new export subsidy rates for the version 4 GTAP data base.

13.4 MFA export tax equivalents

One of the more challenging aspects of the construction of the GTAP 4 data base was in the provision of data which represent the protective effect of the Multifibre Arrangement (*MFA*). In version 2, we used the data prepared by Yongzheng Yang, drawing on estimates by himself and others (Hertel 1997, Saad 1993, Yang 1992). For version 3, we extended those estimates in an *ad hoc* manner to cover the newly disaggregated regions, as described in Huff (1997). In version 4, with the change of the reference year from 1992 to 1995, we considered those estimates as too dated, but updating them in a straightforward manner was not possible. The source data on which the estimates were based are not available for more recent periods. We were therefore forced to consider either to begin anew, or to cease to provide the MFA data.

Until fairly late in the GTAP 4 construction cycle, it appeared that the provision of the MFA data might have to be discontinued. Then Linda Linkins of the US ITC agreed to contribute a new data set, using the methods developed by Hamilton (1988) and Trela and Whalley (1990). These methods extrapolate from the few direct estimates now available, to provide data for the MFA imports into the United States from all sources. With the contribution of this data set, covering a wide range of trade flows using a consistent method, the provision of MFA data in GTAP 4 became feasible.

In the discussion below, Section 13.4.1 documents Linkins' data set for the MFA imports into the USA. Section 13.4.2 describes the use of Linkins' data in the construction of the GTAP MFA data set.

13.4.1 Development of tax equivalent estimates for MFA exports to the United States

Linda Linkins[3]

Various methods can be used to estimate the price effects or the tariff or export tax "equivalents", of quantitative restraints. For a foreign-held quota, a straightforward approach is to calculate the price gap generated by the restraint:

$$TE = \frac{P_{fob}}{P_{xf} * (1 + t_x) * (1 + t_c)} - 1, \qquad \textbf{(4)}$$

where TE represents the export tax equivalent of the rents captured by the exporter, P_{fob} denotes the f.o.b. unit value, P_{xf} is the ex-factory price or some measure of the undistorted export price, t_x represents any export taxes or other fees assessed by the foreign government, and t_c represents any additional transaction costs incurred by the exporter that are contained in the f.o.b. price. In the case of the quotas applied to textiles and apparel under the Multi-Fiber Arrangement (MFA), data and other limitations make this approach impractical.[4] However, when quota rights are traded and resulting pricing data for the license rights are available, these data can be used as a proxy for the price gaps induced by the restraints. This approach assumes that the license market is competitive

[3] The author is an employee of the US International Trade Commission. The results of this research and the views expressed above do not necessarily represent in any way the views of the Commission or any of its individual Commissioners.

[4] Econometric approaches are also difficult given these limitations.

and that the price represents the scarcity value of the quota. Because data on license transfers have generally been available, the approach has been used to estimate exports of apparel from Hong Kong (Morkre 1984; Hamilton 1986, 1988).

Hamilton (1988), and subsequently Trela and Whalley (1990), developed approaches to estimate export tax equivalents for quota-restricted exports from countries affected by the MFA and for which license prices were not available.[5] The shortcomings of this approach have been discussed in Yang (1994) and Krishna, Martin, and Tan (1997).[6] In particular, Krishna, Martin, and Tan identify four potential sources of bias associated with Trela and Whalley's approach. First, the assumption of constant labor shares may contribute to the divergence between estimates based on actual license prices and the extrapolated values. Second, differences may result from differences in product quality and/or the composition of trade (since the quota categories are themselves relatively aggregated). Third, there may be cost differences related to differences in administrative procedures. Fourth, the extrapolation approach assumes that the product market is competitive. The net effect of these potential sources of bias is uncertain, both in terms of magnitude and direction.

13.4.1.1 Data sources and coverage for Hong Kong

Hong Kong quota license prices for 1995 were obtained from the US International Trade Commission. The data consist of weekly license prices for 53 quota categories.[7] Although the pricing data are limited to quota categories covering apparel products, both series cover products made from different types of fiber (cotton, cotton blends, man-made fiber, wool, and silk blends).[8]

13.4.1.2 Estimation process for Hong Kong

For the 53 US quota categories discussed above, unit costs are calculated by the following:

$$C_i^{HK} = P_i^{HK} - L_i^{HK}, \tag{5}$$

[5] For example, after directly calculating the Hong Kong export prices based on license prices, Trela and Whalley multiply these export prices by the ratio of the supplying country's unit labor costs to those of Hong Kong to yield an estimated export (i.e., supply) price for the other exporter country. Trela and Whalley further adjust this value by multiplying it by the supplying country's value of gross output per worker compared to that of Hong Kong.

[6] Krishna, Martin, and Tan (1997) calculate export tax equivalents for Indonesian exports of apparel to the United States directly from license prices and compare those estimates to respective export tax equivalents extrapolated from Hong Kong export prices. They found that the extrapolated tax equivalents were higher than those calculated directly from the license prices.

[7] These data were provided to the USITC by the International Business and Economic Research Corporation (IBERC).

[8] The pricing data were originally reported in Hong Kong dollars per the unit of measurement (e.g., dozens, kilograms, or single units). The data were then converted to US dollars and were converted to square meters using conversion factors developed by the Office of Textiles and Apparel, US Department of Commerce (OTEXA).

where C_i denotes the estimated unit cost, P_i represents the f.o.b. export price, and L_i is the average annual license price for product category i.[9,10] The export tax equivalents for each of these categories were then calculated by: L_i^{HK}/C_i^{HK}. The quota categories were grouped in terms of fiber type and import-weighted average rates were calculated for each group. In the case of apparel categories for which no license prices were reported, unit costs were estimated based on the average rate for the respective fiber group as follows: $C_i^{HK} = P_i^{HK}/(1+te)$, where te represents the average rate. Unit costs for textiles and other textile products were estimated by applying adjusted apparel tax equivalents to the textile quota categories within each fiber group. In the case of textiles (e.g., thread, yarn, and fabrics), the average apparel rate was reduced by 50 percent. The corresponding average apparel TE was reduced by 25 percent for textile products.[11]

13.4.1.3 Estimation process and data sources for other supplier countries

Following the general approach of Trela and Whalley, export tax equivalents for the other supplier countries can be extrapolated from the estimated Hong Kong export prices by the following:

$$C^{O} = C^{HK}\left(\frac{W^{O}}{V^{O}}\right)\left(\frac{V^{HK}}{W^{HK}}\right). \qquad \textbf{(6)}$$

Here, C represents the estimated unit cost for the restricted good. The superscripts denote either Hong Kong (HK) or other country supplier (O), W represents total labor compensation per worker, and V represents the value of gross output per worker.[12] Potential problems associated with the data reported by UNIDO are discussed in Linkins (1997). Where possible, Linkins used data reported by Kurt Salmon Associates (KSA).[13] She calculated C^O by multiplying C^{HK} by the ratio of measure reported by KSA for the other country over that reported for Hong Kong and then calculated the export tax equivalents as $(P^O - C^O)/C^O$. The estimates reported in Linkins (1997) were then aggregated to match the respective GTAP sectors -- textiles and wearing apparel.

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[9] The f.o.b. unit values are calculated from US import data provided by OTEXA. The values and quantities of US imports of textiles and apparel are reported on a "Customs Value" basis, which does not include insurance, freight and other costs.

[10] The value data reported for US imports from Hong Kong do not include the cost of the quota license under certain circumstances (i.e., when the quota rights are held by a third party). However, industry estimates suggest that this may apply to less than 10 percent of US imports from Hong Kong. Since it is not possible to adjust for this, given the lack of data documenting the value and volume of affected imports, the tax equivalents are calculated on the basis of the f.o.b. unit values. For further discussion, see Anderson and Neary (1994).

[11] The reduction of the tax equivalents for textiles (i.e., yarn, thread, and fabric) is based on Cline (1987). See also Trela and Whalley (1990). The smaller reduction for textile products such as home furnishings is based on the assumption that these goods more closely resemble apparel products (both in terms of production and demand) than textiles (Linkins 1997).

[12] The value of gross output per worker can be calculated using data reported in UNIDO (1996). Labor compensation data are also reported by UNIDO. Moreover, 1993 labor compensation data are reported in Werner International Management Consultants (1993).

[13] Estimates of production costs per standard apparel minute developed by KSA (1995) were used instead of the wage to gross output ratios described above. These production cost estimates are potentially better measures than the composite measures because in addition to labor compensation costs and productivity, the measures include all other operating costs.

13.4.1.4 Other points to note

For both Hong Kong and the other supplier countries, the estimated export tax equivalents are calculated on the assumption that the quotas are restrictive only if the utilization rate is 90 percent or greater.[14] When the utilization rate is less than 90 percent, the operative assumption is that the quota has no effect on the export price.[15] Moreover, the United States affords some countries non-restricted access for exports that meet certain criteria under various programs. Exports entering under guaranteed access levels (GALs) and exports from Mexico entering under the special regime are treated as unrestricted. The aggregate estimates for the export tax equivalents reflect this trade.

The estimates do not reflect any market power on the part of importers that results in possible rent-sharing. Although there is some evidence that rent-sharing has taken place in earlier years, accounting for this behavior was not possible given time and data constraints.[16]

13.4.2 Adaptation to GTAP

Robert McDougall

For an MFA data set for GTAP, we need estimates of export subsidy equivalent (*ESE*) rates for the MFA, for 1995, differentiated by exporting country, importing GTAP region, and GTAP commodity. The availability of Linkins' ETE data set described above made the preparation of a GTAP MFA data set feasible. But in preparing it, several issues remained to be resolved. In addressing them we were greatly assisted by information and advice from Linkins, and from Will Martin of the World Bank.

— As noted above (section 13.4.1), Linkins' estimation procedure is indirect. Starting from quota premia estimates for exports from Hong Kong, she extrapolates to other exporting countries. While every care has been taken, the accuracy of these extrapolated results remains uncertain.
— Linkins' data set provides only some of the data we need; it covers imports only into the United States, but we need estimates for the other MFA importing regions, Canada, the European Union, and EFTA.
— Linkins' data are mostly for 1993, whereas the GTAP 4 data reference year is 1995. For 1995 Linkins has ETE estimates for Hong Kong, and data suggesting that between 1993 and 1995,

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[14] Data on utilization rates are reported by OTEXA in *Expired Performance Reports*, for the respective years.

[15] In the case of Hong Kong, license prices were reported for eight categories that had fill rates of less than 85 percent. The calculated export tax equivalents associated with these quota categories range from 0.7 to 6 percent. For the purpose of this exercise, these quotas were considered non-binding and the export tax equivalents were not included in the aggregate calculations. However, the reported license prices may represent costs associated with the quota regime (Linkins 1997).

[16] See, for example, the discussion in Bannister (1994) and Krishna, Erzan, and Tan (1994).

for certain exporting countries, the quotas on exports to the United States ceased to be binding (Linkins, pers. comm.).

A first step towards resolving these issues is to obtain further data. While data are scarce, we do have a few more data points, deriving from a study of export quotas in India (Kathuria and Bhardwaj, 1997).

Kathuria and Bhardwaj (1997) calculate ETEs for India, based on observed quota licence prices. They estimate quota premia at the quota category level; these vary widely, between 0.9 and 134 per cent. They then aggregate the estimates, using import weights, from the quota category level to two broader commodity groups. They present estimates for exports both to the United States and to the European Union. The numbers reported refer to 1995; the paper also presents charts showing change in average ETEs over time. Their paper presents average rates for apparel; Will Martin (pers. comm., 1998) provided average rates for textiles, not published in their paper, but derived from the same study.

From this material we obtain two things: a point of comparison with Linkins' estimates for exports to the US, and our only data for exports to other regions.

Linkins's estimates and Kathuria and Bhardwaj's are not fully comparable, in that Linkins' relate to 1993 and Kathuria and Bhardwaj's to 1995. However, Kathuria and Bhardwaj's time-series charts show little change in weighted average ETEs for the United States between 1993 and 1995.

Converted to a common basis, Kathuria and Bhardwaj's estimates are far lower than Linkins'. Expressing ETEs as percentages of *fob* value, for exports of textiles from India to the United States, we have from Linkins an estimate of 48 per cent, and from Kathuria and Bhardwaj 8.4 per cent. For apparel we have from Linkins 124 per cent, and from Kathuria and Bhardwaj 25 per cent.

The wide variation between Linkins' and Kathuria and Bhardwaj's estimates suggests that the estimates are sensitive to the estimation method. The wide variation in quota premia across quota categories suggests that results for broad commodities may be sensitive to the aggregation scheme.

Another comparison of extrapolated and directly observed ETE estimates is presented by Krishna et al. (1997). They too find the estimates derived by extrapolation to be generally higher than those derived from direct observation. They also find that the magnitude of the divergence differs widely across quota categories.

Without making a detailed evaluation of the estimates we have on hand, where there is overlap we prefer estimates derived from direct observation to those derived indirectly. We infer that the extrapolated estimates may overstate ETEs greatly for some regions, though not necessarily for all. Indeed, the divergence between the extrapolated estimates and actual quota premia is unlikely to be uniform across countries, and may even vary in sign.

Given the uncertainty in the ETE estimates, we make it a rule when in doubt, to err on the side of underestimation rather than overestimation. The rationale is that in performing CGE simulations with the data base, while it is undesirable to omit genuine welfare changes because tax wedges are understated, it would be worse to report spurious welfare changes arising from overstated tax wedges.

With this in mind we undertake preparation of the GTAP MFA data set. First we adjust and update Linkins' data for imports into the United States; then we extrapolate from the United States to other MFA importing regions.

In adjusting Linkins' data, we begin by setting to zero, ETEs for exports from countries for which the MFA was not binding in 1995. We consider the MFA not binding if, for almost all quota categories, less than 80 per cent of the quota is filled. Using this rule, non-zero ETEs are changed to zero for Brazil, Bulgaria, Hungary, Laos, and Lesotho (Linkins, pers. comm.).

Next we convert Linkins' ETEs to ESEs (*cif* based), and rescale them using scaling factors drawn from the comparison with Kathuria and Bhardwaj. We apply scaling factors of 0.17 for textiles, and 0.20 per cent for apparel. For India, these scaling factors align Linkin's rates with Kathuria and Bhardwaj's. We exempt exports from Hong Kong from this rescaling, since there Linkins' rates derive from observed licence prices.

Since the Kathuria and Bhardwaj rates are for 1995, and Linkins' for 1993, the rescaling incorporates an update factor. But most of the rescaling reflects divergence between the Kathuria and Bhardwaj and the Linkins estimates. In applying these scaling factors, we surely underestimate ETEs for many exporting countries, in some cases perhaps severely. But this is consistent with the rule stated above, when in doubt to err on the side of underestimation.

Next we extrapolate the ESE rates from the United States to other importing regions. Again referring to the Kathuria and Bhardwaj material, we have for textiles from India, ETEs of 8.4 per cent for imports into the United States, and 5.5 per cent for imports into the European Union. For garments we have ETEs of 25 per cent for the United States, and 8.6 per cent for the European Union. From this we derive for exports from India, US-to-EU scaling factors of 0.66 for textiles, and 0.35 for apparel. To extrapolate from the United States to the European Union, we apply these scaling factors to exports from all regions. Then for imports into Canada, we use the US rates, and for imports into the EFTA, the EU rates.

This gives us a complete set of MFA ESEs, by exporting country, importing GTAP region, and GTAP commodity. Two steps remain. We convert the rates from a *cif* to an *fob* basis, using CIF:FOB ratios from Mark Gehlhar's trade data (ch. 11A, "Reconciling merchandise trade data"). And we aggregate the exporter dimension from country to GTAP region. This gives us the GTAP MFA data set.

Evidently the preparation of the GTAP MFA data involved some considerable difficulties and some arbitrary but pragmatic solutions. In our view, the resulting data set is not suitable for use as a source of information on the MFA. For that we would refer the reader to the underlying studies, Linkins (1997) and Kathuria and Bhardwaj (1998). In nevertheless incorporating it into the GTAP data base, we were influenced by two considerations. First, we want the data base to be useful to CGE modelers. In CGE simulations with GTAP, we consider the current approach preferable to either of the two clear alternatives: on the one hand, ignoring the MFA altogether, effectively setting MFA rates at zero; on the other, using MFA rates that appear far too high in some cases. Second, in exposing the data and making it available for use, we hope to encourage feedback and contributions from users.

Since preparing the GTAP MFA data, more information has become available supporting comparisons between Linkins' indirect estimates and direct estimates of ETEs. First, Linkins (pers. comm.) has directly estimated the ETE for exports of apparel from China to the United States, at 37 per cent on an *fob* basis. This compares with an indirect estimate of 109 per cent, giving a scaling factor of 0.35. While still a large revision, it is not so large as for India. Second, Linkins has estimated the average ETE for apparel imports into the United States from regions for which the MFA quotas are binding. Aggregating over exporting countries, she obtains an average rate of 21 per cent. Using a different but still indirect approach, Yang (1994) estimates ETEs on MFA apparel imports into the United States from individual countries at between 23 and 49 per cent. While the reference years differ (Linkins' is 1993, Yang's 1986), the estimates do not appear to be greatly inconsistent. Taken together, these results suggest that it may be appropriate to apply smaller revisions for other exporting countries than for India.

Building on the work done for the version 4, we hope to see further improvements to the MFA data set in later versions of the data base. Possible improvements include direct estimates for more countries, estimates for more importing countries, and a more refined method for revising the indirect estimates.

13.5 Construction of the protection data

Wusheng Yu

After the construction of the merchandise tariff data, agricultural assistance data, and MFA data sets described above (sections 13-1 to 13-4), the next step is to assemble all these data into a unified GTAP protection data set.

The GTAP protection data set covers seven instruments: two import-side instruments, four export-side instruments, and output subsidies. The import-side instruments are ordinary import duties and anti-dumping duties. The export-side instruments are ordinary export subsidies, voluntary price undertakings, the MFA, and other voluntary export restraints. Voluntary price undertakings are agreements made between the European Union and some other countries, whereby the latter undertake to price certain exports to the European Union at or above some minimum level, in order to avoid anti-dumping action. For version 4, as noted below, up-to-date data were available only for some of these instruments.

The ordinary import duty array contains duty rates for each commodity, source region, and partner region. We assemble them from three sources: the merchandise tariff data (section 13.1), the agricultural protection data set (sections 13.2, 3), and the I/O tables (chapter 14). For each element in the array, we take the rate from the agricultural protection data set, if one is available; failing that, the rate from the merchandise tariff data; failing that also, the rate from the relevant I/O table.

An exception to that rule is that for one commodity, `oap`, “other animal products”, we do not use the rate from the agricultural protection data set even if it is available. This decision was made on the grounds that this is a heterogeneous commodity group for which the PSE/CSE data underlying the agricultural protection data set may not provide a good coverage. The treatment may be reviewed in later versions of the data base.

Similarly, for the export subsidy and output subsidy data we take rates from the agricultural protection data set, where available, elsewhere from the I/O tables.

We then adjust the import duty and export subsidy data to impose zero import duty and export subsidy rates within free trade areas. We recognize three of these, as shown in table 13.6. For NAFTA and the EU-EFTA trade area, we impose zero rates outside the agriculture and food processing sectors; for the EU itself and for ANZCERTA, we impose zero rates for all sectors, including agriculture and food processing.

Table 13.6 Free trade area in GTAP version 4 data base

Free trade area	Countries
NAFTA	USA, CAN, MEX
ANZCERTA	NZL, AUS
EU	GBR, DEU, DNK, FIN, SWE, REU
EU-EFTA	GBR, DEU, DNK, FIN, REU, SWE, EFT

Data for anti-dumping duties, and voluntary price undertakings is inherited from the GTAP version 3 data base and are reported for information only. (They are not incorporated into the version 4 borders wedges.) Simple inheritance rule applies when expansion of the regional/sectoral coverage is required. For voluntary export restraints other than the MFA, we do not attempt to adapt the version 3 data, but simply show zero rates.

References

Anderson, James E. and J. Peter Neary. 1994. "The Trade Restrictiveness of the Multi-Fibre Arrangement." *The World Bank Economic Review*, 8, No. 2, 171-189.

Bannister, Geoffrey J. 1994. "Rent Sharing in the Multi-Fibre Arrangement: The Case of Mexico." *Weltwirtschaftliches Archiv*, 130, No. 4, 801-827.

Hamilton, Carl B. 1986. "An Assessment of Voluntary Restraints on Hong Kong Exports to Europe and the USA." *Economica*, 53, No. 211, 339-350.

———. 1988. "Restrictiveness and International Transmission of the 'New' Protectionism." In *Issues in US-EC Trade Relations*, ed. Robert E. Baldwin, Carl B. Hamilton, and Andre Sapir, 199-224. Chicago: The University of Chicago Press.

Hertel, T.W. (ed.). 1997. *Global Trade Analysis: Modeling and Applications*. Cambridge: Cambridge University Press.

Huff, K. 1997. Other protection data. Ch. 15 in *Global Trade, Assistance, and Protection: The GTAP 3 Data Base*. West Lafayette: Purdue University.

Kathuria, S. and A. Bhardwaj. 1998. *Export Quotas and Policy Constraints in the Indian Textiles and Garments Industry*. New Delhi: World Bank, mimeo.

Krishna, Kala, Refik Erzan, and Ling Hui Tan. 1994. “Rent Sharing in the Multi-Fibre Arrangement: Theory and Evidence from US Apparel Imports from Hong Kong.” *Review of International Economics*, 2, No. 1, 62-73.

Krishna, Kala, Will Martin, and Ling Hui Tan. 1997. "Imputing License Prices: Limitations of a Cost-Based Approach." *Journal of Development Economics,* 52, No. 2, 375-393.

Kurt Salmon Associates. 1995. *Cost Comparisons Study*. Dusseldorf: Kurt Salmon Associates.

Linkins, Linda A. 1997. “Assessing the Economic Impact of the MFA: An Analysis of Estimation, Aggregation, and Modeling Methods,” Ph.D. Dissertation, American University, Washington, DC.

Morkre, Morris E. 1984. *Import Quotas on Textiles: The Welfare Effects of United States Restrictions on Hong Kong*, Bureau of Economics Staff Report to the Federal Trade Commission. Washington, D.C.: US Government Printing Office.

OECD. 1997. “Evaluation of Agricultural Policy Developments in OECD Countries,” Directorate for Food, Agriculture and Fisheries and Trade Directorate, COM/AGR/CA/TD/TC(97) 37/PART 2, 08-Apr-1997.

Saad, I. 1993. Indonesian manufacturing exports after the manufacturing boom: focusing on clothing and textiles. Ph.D. thesis, Australian National University.

Trela, Irene and John Whalley. 1990. "Global Effects of Developed Country Restrictions on Textiles and Apparel," *Economic Journal*, 100, 1190-1205.

United Nations Industrial Development Organization. 1996. *International Yearbook of Industrial Statistics*, *1996*. Brookfield, VT: Edward Elgar Publishing Company.

Werner International Management Consultants. 1993. "Hourly Labor Costs for the Apparel Industry," Mimeo.

Yang, Y. 1992. The impact of multifibre arrangement on world clothing and textile markets with special reference to China. Ph.D. thesis. Australian National University.

———. 1994. "The Impact of MFA Phasing Out on World Clothing and Textile Markets." *The Journal of Development Studies*, 30, No. 4, 892-915.