

Chapter 1

Introduction

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The goal of this chapter is to introduce readers to the Global Trade Analysis Project (GTAP) and provide a bit of history on the data base and software which accompany this documentation. Those readers who are already familiar with GTAP may wish to scan section 1.2 to get a feel for the history of the data base as well as future directions, before moving on to chapter 2. However, individuals who have not had extensive contact with this Project will likely find that this material provides a useful lens through which to view the version 4 data base and associated software.

1.1 Overview of GTAP

What is GTAP?

GTAP was established in 1992, with the objective of lowering the cost of entry for those seeking to conduct quantitative analyses of international economic issues in an economy-wide framework. The Project consists of several components:

- a fully documented, publicly available, global data base,
- a standard general equilibrium modeling framework,
- software for manipulating the data and implementing the standard model,
- a global network of researchers (over 200 are subscribed to our discussion list) with a common interest of multi-region trade analysis and related issues,
- a consortium of national and international agencies providing leadership and a base level of support for the Project, and

- a Worldwide Web site for dissemination of data, software and Project-related information (www.agecon.purdue.edu/gtap/).

Motivation for GTAP

As the world economy becomes more integrated, there is an increasing demand for quantitative analyses of policy issues on a global basis. One example is provided by the recent Uruguay Round negotiations under the auspices of the World Trade Organization. At the time these negotiations were being concluded, there was great interest in estimates of the likely impact of this agreement on individual countries, international trade and world-wide welfare. Sector-by-sector analyses provided a valuable input into this process. However, by its very nature, the WTO agreement affects all sectors and most regions of the world, so there is no way to avoid employing a data base which is exhaustive in its coverage of commodities and countries. A similar problem exists when one wishes to analyze the economic implications of attempts to reduce emissions of carbon dioxide, such as those recently agreed to in Kyoto, Japan. Carbon taxes affect not only the energy producing sectors, but also energy consumers and international trade. The Global Trade Analysis Project is designed to facilitate such multi-country, economy-wide analyses. As country coverage in GTAP improves, it is also being widely used to look at the impact of regional trade agreements in Asia (APEC), Latin America (MERCOSUR), Europe (expansion of the EU), and elsewhere.

GTAP data base

The central ingredient in GTAP's success has been the global data base. It combines detailed bilateral trade, transport and protection data characterizing economic linkages *among regions*, together with individual country input-output (I/O) data bases which account for intersectoral linkages *within regions*. (See glossary at the front of the document for a complete list of GTAP regions and commodities for the version 4 data base.) Construction and maintenance of this data base adheres to the following principles:

Public availability. The data base is made available to anyone requesting it, at a modest fee. This prevents needless duplication of effort in creating this public good. By charging for the data base we are also able to cover some of the costs incurred in constructing it. However, the bulk of the costs are covered by the GTAP consortium members. We also make aggregations of the data base available for free, via the GTAP Web site. New aggregations can be ordered, for a nominal fee, and are then added to the Web site. Finally, the full data base may be purchased, along with documentation and software, by those interested in performing their own aggregations.

Regular updates. The current release is the fourth (Version 4) since 1993.

Broad participation. The network of GTAP users represents an excellent resource for improvement of the data base. Another benefit from broad participation is the extensive scrutiny to which the data base is subjected. Those who identify areas for improvement or extension of the data base are free to make this available to GTAP staff in order to have it considered for incorporation into the version 5 data base. The operational concept is "if you don't like it, help fix it!"

Comparative advantage. By making the full data base available, and offering to incorporate improvements provided by members of the network, each individual is able to work to his/her own comparative advantage, while capitalizing on the contributions of others.

Documentation and replicability. One requirement for new contributions to the GTAP data base is that the sources and procedures used to create them be provided along with the data. This publication represents the complete documentation for the version 4 data base. However, as the data base has grown, we have found that it is not always possible to include *exhaustive* documentation in one single volume. In some cases, interested users will need to contact the individual contributors directly to obtain highly specific information, electronic copies of concordances, etc.

In addition to this policy of complete documentation, the associated model and software supporting GTAP applications are designed to permit applications to be readily replicated by others. Together these two features are designed to enhance the credibility and comparability of global trade analyses.

Model and software

In order to operationalize this large data base, a standard modeling framework has been developed. The components of this multiregion, applied general equilibrium model are relatively standard. However, distinguishing features include: the treatment of private household behavior, international trade and transport activity, and global savings/investment relationships. Also, quite a number of auxiliary variables have been introduced in order to facilitate a variety of alternative closures. For a complete description of the GTAP modeling framework and selected applications, see: Hertel, T.W. (editor) *Global Trade Analysis Using the GTAP Model*, New York: Cambridge University Press, 1997. A copy of the current version of the model and software for implementing it are freely available on the GTAP Web site.

This model is implemented using the GEMPACK software suite, developed at the Centre of Policy Studies, Monash University, under the direction of Ken Pearson. This software permits the user to conduct simulations of the standard model in which changes in policy, technology, population and factor endowments are examined. The user specifies the split between exogenous and endogenous variables (i.e., model closure). Behavioral parameters may also be altered. Outputs include a complete matrix of bilateral trade, activity flows (and percentage changes) by sector and region, private and government consumption, regional welfare, and a variety of summary variables. Users with access to GEMPACK may also modify the theory of the model. There are currently more

than 130 documented applications of the standard GTAP framework, worldwide, and many more are currently underway (see the Web site for a partial listing). These are aimed at addressing a great variety of issues including: trade policy reform, regional integration, energy policy, global climate change, technological progress, and links between economic growth and trade.

Short course in global trade analysis

Each year in July/August, a one-week short course is offered on the campus of Purdue University, with the goal of introducing newcomers to the GTAP model, software and data base. This intensive, hands-on training, has proven to be an excellent way for interested researchers to become operational with GTAP. This course is occasionally offered overseas as well. More information about these offerings is available on the Web site.

1.2 History and future directions of the data base

The version 4 data base documented in this monograph builds heavily on earlier work at Purdue, as well as research and data base development efforts at a number of national and international agencies. Indeed, the Global Trade Analysis Project was built very heavily on the SALTER Project which was undertaken at the Australian Industry Commission during the 1980's and early 90's. Version 1 of the GTAP data base used the same fifteen source I/O tables as SALTER (and much of the software for processing them), while supplying new bilateral trade and protection data. Versions 2 and 3 added new regions to the data base, while gradually updating the original SALTER I/O tables. Version 4 has replaced almost all of the original SALTER data bases, and it has added many more regions. Virtually all of these additions to the data base have been provided by members of the GTAP network, usually resident in the countries for which they are supplying data. We have also introduced the use of "composite regions" to cover countries for which no original source I/O tables are available. As a result, the version 4 data base now has 45 regions -- triple the number in the version 1 data base.

In addition to increasing the regional coverage in version 4, we have undertaken for the first time to depart from the original SALTER sectoral definitions. In particular we have disaggregated the 37 sectors previously used to the level of 50 sectors. Much of the additional detail is provided in food and agriculture. While there was already a great deal of detail in this area, it was not particularly useful detail, from the viewpoint of the GTAP Consortium members. In addition, version 4 breaks out autos and parts and electronic equipment, in light of their dominance in world trade.

Finally, electricity, gas and water are disaggregated in order to better serve the interests of those working on energy-environment issues.

One of the most important contributions of GTAP has been in the area of improved bilateral trade data for economic modeling. This work was begun by Marinos Tsigas at Purdue University in the late 1980's, and it has emphasized the use of automated procedures for the reconciliation of reported imports and exports, in addition to the estimation of bilateral trade margins (Tsigas, Hertel, and Binkley, 1992). Mark Gehlhar continued this tradition at Purdue and took this interest with him to the Economic Research Service of the USDA, where he has continued to refine his methods. Indeed, the procedures outlined in chapter 11A represent a significant new development which departs significantly from earlier work (e.g., Gehlhar *et al.*, 1997). Gehlhar's latest work involves reconciling bilateral flows at a disaggregate level, thereafter aggregating up to the GTAP commodity concordance. In addition he has now begun devoting special attention to the estimation of bilateral trade and transportation margins. This new work is also documented in chapter 11C. Finally, for the first time, Gehlhar has provided time series bilateral data (chapter 7) to go along with the benchmark (1995) data. These new data will provide researchers with an important historical perspective in bilateral trade flows.

The GTAP protection data base has also evolved considerably since the project's inception. Most of the work for the version 1 data base was conducted by Bradley McDonald, while he was employed at ERS/USDA. Tariff data was drawn from the GATT Trade Policy Reviews, while support and protection data for agriculture was taken from a combination of OECD and ERS/USDA country studies of Producer Subsidy Equivalents (PSEs). The culmination of the Uruguay Round negotiations provided a rare opportunity to improve GTAP's protection data base. With individual countries submitting tariff schedules to the WTO, a rich data base emerged. In version 2, we were able to build on disaggregated tariff data provided by the US Trade Representative's office. This data, documented in chapter 2 of the GTAP book cited above, was aggregated up from the tariff line level using import weights. In this way, the GTAP data base was able to capture bilateral variation in tariffs for the same composite products. This variation, due to the composition of trade interacting with varying tariff rates, has been found to be quite significant in some cases. The version 2 data base also witnessed introduction of a variety of non-tariff barriers, including antidumping duties, countervailing duties, price undertakings, and export restraints on textiles and wearing apparel.

The version 3 protection data base capitalized on work done for the World Bank's 1995 conference on the Uruguay Round and the Developing Countries (Martin and Winters, eds., 1996). Pre- and post- Uruguay Round protection data compiled by the World Bank, based on the WTO's integrated data base, as well as other sources, made this a unique data base. Unfortunately, this was a one-time effort which has not been continued. As a result, we were forced to turn to a different source for the version 4 protection data.

The version 4 protection data base has three main components. Tariff information is now sourced from the UNCTAD TRAINS data base. These data came through the International Trade Division of the World Bank, courtesy of Jersey Rozanski and Emiko Fukase. (See chapter 13.1 for

details.) While the TRAINS data base offers the prospect of obtaining *effectively applied* tariff rates, the data which we obtained for version 4 does not reflect this fact, due to technical problems in accessing this enormous data base. As those problems are overcome in the future, this should be an increasingly valuable source of tariff information.

The second main component of the version 4 protection data base relates to agriculture. Here, Marinos Tsigas contributed 1995 market price support and subsidy information based on the OECD's PSE data base. For the non-OECD regions we were forced to draw on version 3 protection information, adjusted for changes in world prices and hence average protection levels (see chapter 13.2 for details).

The third component of the version 4 data base relates to the non-agricultural, non-tariff barriers. Due to the fact that they are gradually becoming outdated, we have not formally incorporated the antidumping duties and price-undertakings from version 3 into the version 4 data base. However, this information is carried along with the data base and the interested user can scrutinize it and potentially introduce some, or all, of these distortions if they feel it is appropriate and useful for the task at hand. A new program exists for making adjustments to tax/subsidy rates in the data base. It is nicknamed "ALTERNATE" and it is available, via the Web site, as a GTAP technical paper.

A final area in which there have been some significant changes in the version 4 data base is that of primary factor splits; i.e. how much of the value-added in a given industry is attributable to labor, how much to capital, etc. Version 4 offers for the first time a split of labor payments into unskilled and skilled components for each of the 50 sectors in each of the 45 regions in the data base. This is done based on 15 national labor surveys which have been processed into a common format and definition by Tri Thanh Vo and Rod Tyers, with additional work by Jing Liu and Nico van Leeuwen (See chapter 18 for more details). By fitting a regression model to these data, the authors are able to predict industry splits for the remaining GTAP regions, based on per capita GDP and the stock of tertiary educated labor in the economy as a whole.

In addition to the labor splits, version 4 now breaks out a natural resource input into the forestry, fisheries, coal, oil, gas, and other minerals sectors. The cost share of this natural resource input has been chosen ("calibrated") in order to replicate a target elasticity of supply for each of these resource-constrained sectors. (See chapter 17.4 for more details.) These new constraints on supply response in the natural resource based sectors are likely to give the model a very different feel for those researchers working on agricultural and natural resource based problems. In previous versions of the data base and standard model, the supply response in these sectors has been unrealistically large, resulting in relatively little price action but lots of quantity action. Future applications will show more price volatility in these sectors.

Future development of the data base is being heavily influenced by the GTAP advisory board. This group is made up of representatives from each of the agencies in the GTAP Consortium. Based on the April, 1998 Advisory Board meeting we envision a number of substantial changes in the version 5 data base. Foremost among these are: (a) incorporation of an energy volumes data base,

(b) further disaggregation of services activities with additional attention to services trade and protection, (c) complete disaggregation of the European Union member states. In addition, we expect continued improvements to country coverage and updates of individual regions based on the efforts of members of the GTAP network.

In sum, the GTAP data base is a dynamic entity which is evolving in response to the needs and support of individual users as well as public agencies with an interest in international trade, natural resources and the environment. We encourage you to become involved in this network, subscribing to our discussion list, possibly attending the short course, and using this data base. We look forward to your feedback!

1.3 Outline of this document

The layout of the remainder of this monograph is in two parts. Part II, comprising chapters 2-10, presents summary data derived from the entire GTAP data base as well as an overall summary of some of the associated utilities. The data base overview chapters include macrodata by region (chapter 2), disposition of sales and costs by commodity and by region (chapter 3), and protection data (chapter 4). Chapter 5 computes effective protection rates. This is a new feature of the version 4 documentation. Chapter 7 provides a brief summary of the bilateral trade data included on the CD-Rom. Chapters 8-10 describe the GTAP data base and the software used in aggregations and in viewing data.

Part III begins with a detailed documentation of the trade data starting with reconciling merchandise trade data (chapter 11A), estimating re-export markups for Hong-Kong (chapter 11B), trade and transportation margins (chapter 11C), and service trade data (chapter 12). Protection data, including bilateral imports, output and export subsidies, is described in chapter 13. In chapter 14, I/O tables for 18 GTAP regions are described and the procedures followed in making source I/O tables to conform with GTAP specification are outlined. Chapters 15 and 16 are new to the version 4 data base and fully document the procedures followed in disaggregating agricultural and non-agricultural sectors to conform with the expanded version 4 commodity aggregation. Chapter 17 describes the macroeconomic, capital stock, and energy data used in the data base. The chapter also documents the methodology used to derive primary factor shares and supply response in natural resource-based industries. Another addition to the version 4 documentation is chapter 18 which outlines the methodology used in splitting factor payments into skilled and unskilled labor. Chapter 19 describes how the initial estimates for the GTAP behavioral parameters were obtained. Chapter 20 summarizes the procedure (FIT) for updating the regional I/O tables to the base year 1995. Finally, chapter 21 describes the methodology for calibrating the CDE functional form for private household demand.

References

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