



The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.



**Why, How and When did GTAP Happen?
What has it Achieved?
Where is it Heading?**

by

Alan A. Powell*
Centre of Policy Studies, Monash University

GTAP Working Paper No. 38
2007

WHY, HOW AND WHEN DID GTAP HAPPEN? WHAT HAS IT ACHIEVED? WHERE IS IT HEADING?

Alan A. POWELL*

Centre of Policy Studies, Monash University

*Special Paper Commissioned for the Plenary Session on:
“Future Directions for the Global Trade Analysis Project”
Tenth Anniversary Conference on Global Economic Analysis
Purdue University, June 9, 2007*

ABSTRACT

Team research has been much more widespread in the natural sciences than in economics. Yet when it comes to modeling an economy (especially the global economy) in detail, the quantity and range of inputs necessary makes team work the only viable option. Drawing some inspiration from Australian experience, GTAP's founder, Tom Hertel, realized this from his Project's inception in 1993.

The data base required to model international trade flows could not have been developed without the enthusiastic cooperation of many individuals and institutions around the world. Funding GTAP's central team at Purdue required external support. National agencies in Australia, Denmark, France, Germany, Holland, Japan, and the US are members of the supporting research consortium. The natural interest of international economic agencies led to GTAP having five such supporting agencies by 1997, which grew to ten by 2006.

GTAP has striven to put the maximum feasible amount of its data, methodology and models into the public domain. It has run numerous residential intensive training courses in the use of the GTAP data and model: these have been held in the US, Europe, Africa, Asia and Latin America. The success of these courses reflects the modeling experience of the teams of course instructors and the availability of special-purpose software which allows simulations to be run without programming skill or previous knowledge of the software used.

Researchers making use of GTAP have been prolific in number, and in their output. In mid April 2007, applications listed on the GTAP web site numbered 781. There were 366 subscribers to the GTAP data base at the end of April 2007, but the number of individuals making use of GTAP data exceeded 4,000. A web search using Google Scholar for the 1997 GTAP monograph records more than 1,150 citations, while versions 3 and 5 of GTAP's data base are cited 279 and 389 times respectively.

It is clear that GTAP has engendered a community of quantitatively-oriented trade economists, and has integrated their efforts with those of other economists having an economy-wide perspective, especially those working on economic development.

GTAP's success as a policy tool has led to an ever increasing demand for its extension to cover more commodities, regions, and economic issues: international migration of labor and climate change, for instance. With the current level of financial support, such expansions to GTAP's range are possible only on a limited scale.

* I would like to thank the following people for their support during my preparation of this paper: Ginger Batta, Peter Dixon, Tom Hertel, Mark Horridge, Kavitha Muthuraman, Ken Pearson, Jo Powell, Maureen Rimmer, Terrie Walmsley and Glyn Wittwer, none of whom is responsible for any deficiencies in it. I would also like to take this opportunity to acknowledge the extraordinary contribution made to GTAP by Judy Conner over the period 1991 through 2006, both to its administration and to its relationships to its far-flung associates, and especially to me.

CONTENTS

<i>Prehistory</i>	1
<i>Getting Started</i>	2
<i>Rapid Growth</i>	5
<i>Data, Data, Data!</i>	5
<i>Communication and Openness</i>	9
<i>Training Courses in the use of GTAP</i>	10
<i>Software</i>	11
<i>Early Applications</i>	12
<i>Expanding GTAP's Range</i>	13
<i>Achievements to date</i>	14
<i>Tom Hertel's Wish List</i>	14
<i>Where to Now?</i>	16

TABLES

<i>Table 1: Foundation members of the GTAP Research Consortium</i>	3
<i>Table 2: Members of the GTAP Consortium other than International Agencies, 1997 and 2006</i>	6
<i>Table 3: International Agency Members of the GTAP Research Consortium, 1997 and 2006</i>	7
<i>Table 4: Early GTAP Applications Appearing in the 1997 GTAP Monograph</i>	13

FIGURES

<i>Figure 1: Composition of the GTAP Consortium, 1997 and 2006</i>	5
<i>Figure 2: Increase of sectoral and regional detail in GTAP Data Bases 2 through 6</i>	8

APPENDIX

<i>Table A1: The first twelve Global Economic Analysis Conferences</i>	19
--	----

**WHY, HOW AND WHEN DID GTAP HAPPEN?
WHAT HAS IT ACHIEVED?
WHERE IS IT HEADING?**

Alan A. POWELL¹

Centre of Policy Studies, Monash University

In the mid-1980s, Dr. Tom Hertel became disillusioned with how CGE modeling was being conducted in Europe and North America. Not only was the data unavailable publicly, there was no way to verify the results that economists were presenting at professional conferences. His frustration led him to consider whether to continue in the field of CGE modeling or move on to another area.

— from the GTAP website, <https://www.gtap.agecon.purdue.edu/about/history.asp>

Prehistory

It will surprise no one that the GTAP (Global Trade Analysis Project) story cannot be told separately from the personal history of Tom Hertel. My first contact with Tom was in the late nineteen eighties when he raised the prospect of his visiting the IMPACT Project at the University of Melbourne during a sabbatical he was planning. At the Australian end we were very enthusiastic. He successfully applied for a Senior Fulbright Fellowship and spent a nine month period during 1990-91 with us. During this period he also visited IMPACT's principal institutional backers at the Industry Commission (now the Productivity Commission), then headquartered in Canberra.

Tom's visit was unusual in the following respect: he believed that the Australian experience in policy applications of general equilibrium modeling had been singularly successful, and he wanted to find out why. In fact, as a policy-oriented agricultural economist, he had long been convinced that an economy-wide approach to modeling was often necessary to obtain sound policy recommendations in agriculture, and elsewhere. And because so many agricultural products were traded globally, for many topics it would be necessary to model not just one economy, but many: ideally the whole world. But he was also aware that getting policy advising institutions to take such work seriously, or to support it financially, was by no means easy. And this was partly because much of the applied work then being done in the GE [general equilibrium] area had low credibility among policy economists and policy advisers.

The leader of the applied GE model building team at IMPACT was Peter Dixon, who designed the ORANI models of Australia in the 1970s² and 1980s³, the MONASH model of Australia in the

¹ This paper has only been possible because of the excellent documentation available on the GTAP web site:

<https://www.gtap.agecon.purdue.edu/about/project.asp>

In addition I have had access to Advisory Board papers. I have used these materials throughout this paper, where possible making explicit citations of GTAP documents. Much material comes from the short history of GTAP located on the GTAP web site. Sandra Rivera played a key role in assembling many of these materials in the context of GTAP's strategic plan.

² P.B. Dixon, B.R. Parmenter, G.J. Ryland and J. Sutton (1977), *ORANI, A General Equilibrium Model of the Australian Economy: Current Specification and Illustrations of Use for Policy Analysis*, Vol. 2 of the First Progress Report of the IMPACT Project, Australian Government Publishing Service, Canberra, pp.xii + 297.

³ Dixon, P.B., B.R. Parmenter, J. Sutton and D.P. Vincent (1982), *ORANI: A Multisectoral Model of the Australian Economy*, North-Holland Publishing Company, Amsterdam.

1990s⁴, and the MONASH-style USAGE model of the US in the period 2000 until the present.⁵ In a paper presented at this conference he argues that AGE [applied general equilibrium] modeling flourished in Australia because it was the country with the right issue, the right institutions and the right model.⁶

At the time of Tom Hertel's visit, the institutional set up at IMPACT was unique in Australia, and possibly in the world. In the *Foreword* which I penned for the book launching GTAP⁷ upon the world scene in 1997, I wrote:

'Given that a practical AGE model involves a very heavy investment of intellectual effort and data-garnering, it would be amazing if economists did not recognize the potential for economies of scale and scope. The realization of such economies requires the proprietor of a model building effort to see most of the model's core ingredients – such as its standard or default equation listing, data base, and parameter file – as public goods. Around such publicly (or semipublicly) available tools, we would expect a community of modelers to develop. Yet such has tended to be the exception rather than the rule.'

A decade later we know that GTAP is *the* extraordinary exception. From the GTAP web site in 2007 we read:

'A global network of individuals and institutions conducting economy-wide analysis of trade, resource, and environmental policy issues has emerged. More than four thousand of these researchers now use a common data base, supplied by ... GTAP. ... Participants are given an opportunity to present their work, interact with other professionals in the field, and learn about the most recent developments in global economic analysis.'

In the discipline of economics there has never been a research oriented community as large or as enthusiastic as the associates of GTAP. How did this come about?

Getting Started

Back in 1991 Tom's big problem was to obtain institutional and financial backing for his proposal to establish the project that was shortly to become known as GTAP. He invited me to visit Purdue and to attend the Annual Meeting of the International Agricultural Trade Research Consortium (of which he was an organizer) in New Orleans in December 1991. At that meeting I gave an account (co-authored by my late colleague, the international trade economist, Richard Snape) of the impact on Australian economic policy – especially on the reversal of its protectionist policies – of applied GE modeling.^{8,9}

⁴ Peter B. Dixon and Maureen T. Rimmer (2002), *Dynamic General Equilibrium Modelling for Forecasting and Policy, A Practical Guide and Documentation of MONASH*, North-Holland Publishing Company, Amsterdam.

⁵ USAGE is a 500 industry dynamic computable general equilibrium model of the US economy developed by the Centre of Policy Studies, Monash University, in collaboration with the US International Trade Commission. For documentation, see: Peter B. Dixon and Maureen T. Rimmer (2004), "The US economy from 1992 to 1998: results from a detailed CGE model", *Economic Record*, Vol. 80 (Special Issue), September, pp.S13-S23; Peter B. Dixon, Maureen T. Rimmer and Marinos E. Tsigas (2007), "Regionalizing results from a detailed CGE model: macro, industry and state effects in the U.S. of removing major tariffs and quotas", *Papers in Regional Science*, Vol. 86 (1), March, pp. 31-55; Peter B. Dixon, Stefan Osborne and Maureen T. Rimmer (2007), "The economy-wide effects in the United States of replacing crude petroleum with biomass", paper presented at this conference; U.S. International Trade Commission (2004 and 2007), *The Economic Effects of Significant U.S. Import Restraints*, 4th and 5th updates, U.S. International Trade Commission, Washington, D.C.

⁶ Peter B. Dixon, "Evidence-based Trade Policy Decision Making in Australia and the Development of Computable General Equilibrium Modelling", paper presented at this conference.

⁷ Thomas W. Hertel (ed) (1997), *Global Trade Analysis: Modeling and Applications*, Cambridge University Press, New York.

⁸ Alan A. Powell and Richard H. Snape (1993), "The Contribution of Applied General Equilibrium Analysis to Policy Reform in Australia", *Journal of Policy Modeling*, Vol. 15 No.4 (August), pp. 393-414.

⁹ In June 1994 Tom Hertel gave a presentation entitled "Taking IMPACT Abroad: The Global Trade Analysis Project" at the Amsterdam meetings on Computational Methods in Economics and Finance of IFAC (the International Federation of Automatic Control). He emphasized several of the features common to the two projects, including the objective of building a data base and standard model which:

- are fully documented

Not surprisingly, show-casing the Australian experience was not enough to elicit immediate support for GTAP from the institutional representatives attending the New Orleans meeting, but it did initiate discussion. It was fairly obvious from the beginning that among GTAP's potential supporters, the USDA was a key player, and that its Economic Research Service (ERS) was a logical ally. Among the international agencies, the World Bank was also a potential ally, as it had on its staff at least one senior policy economist who was well versed in the Australian experience.

The first question was how to institutionalize the support of these public agencies. This was a problem both for the agencies, who were not used to providing open-ended support for research, and for Purdue University, which was not accustomed to hosting consortia in which public agencies played a key role. Fortunately, Tom's boss at Purdue, Wally Tyner, an ardent supporter of GTAP, was able to convince the administration of the value of this undertaking, and, after six months of legal wrangling between Purdue and the World Bank, the GTAP Consortium came into existence.

The first meeting of the GTAP Consortium took place in 1993. The founding Consortium member institutions, and their representatives, are listed in Table 1.

Table 1
Foundation members of the GTAP Research Consortium

Institution	Representative at 1993 Advisory Board Meeting
Center for Global Trade Analysis, Purdue University	Tom Hertel (Convenor)
World Bank (IBRD)	Will Martin
Economic Research Service (ERS) of the USDA	Matt Shane
Australian Industry Commission	Philippa Dee
Australian Bureau of Agricultural and Resource Economics (ABARE)	Vivek Tulpulé

I attended the inaugural meeting as a Member-at-Large and, later in 1999, was joined in this role by Joe Francois, who had played a key role in getting the World Trade Organization (WTO) engaged with GTAP.

The 1993 meeting came after a particularly hectic year in which the core GTAP model and its first database were constructed by Hertel, his graduate students, and collaborators from other institutions. This was when Robert McDougall's FIT, a computer program developed by him at the Australian Industry Commission for fitting the national data bases to international targets, became famous at Purdue.¹⁰

-
- others may build on
 - are easy to use
 - permit more emphasis on economics, less on technical aspects of modeling.

His paper is item **PPAP0077** in the CoPS archive and may be downloaded from:

<http://www.monash.edu.au/policy/archivep.htm>

¹⁰ See *The Growing Years* in *About GTAP: History* on the GTAP web site,

<https://www.gtap.agecon.purdue.edu/about/history.asp>

(accessed by the author on March 13, 2007).

Tom had met Robert during his 1990 visit to Canberra and was impressed by the SALTER model¹¹ and data base – Robert was the chief architect of both of these. Later when GTAP got under way, Tom’s appreciation of Robert’s analytical capabilities led to a job offer at Purdue, which Robert took up in 1994. Robert’s activities have included oversight of the maintenance and development of the GTAP data base (in which his principal co-worker has been Betina Dimaranan¹²); development and applications of the dynamic version of GTAP (in which his principal co-workers have been Elena Ianchovichina and Terrie Walmsley^{13,14}); and application of entropy/information theoretic methods to data base construction (on which he has also worked with Terrie Walmsley).¹⁵

By today’s GTAP standards, much of the initial data work was relatively crude: for example, ‘the tariff data were extracted by hand from various issues of the WTO *Trade Policy Reviews*’¹⁶. (This work was undertaken by Bradley McDonald at ERS/USDA, who subsequently moved to the WTO and introduced that organization to GTAP.) As GTAP’s trade policy profile rose, so too did the need to have the tariff data firmly anchored in international statistics. This is an area where Will Martin, at the World Bank, played a key role. Martin, working closely with World Bank colleague Jerzy Rozanski, and Hiroaki Kuwahara at UNCTAD, managed to provide a greatly improved tariffs data base for use in analysis of the Uruguay Round. Indeed, this formed the basis for most of the quantitative studies reported in the high profile Martin and Winters (1997) volume¹⁷. More recently, leadership in the tariffs data base has shifted to CEPII (the *Centre d’Etudes Prospectives et d’Information Internationales*) where David Laborde, Sebastien Jean, Lionel Fontagné, Antoine Bouët and others pioneered the MAcMap data base¹⁸. Their treatment overcame many of the previous limitations – most notably coming to grips with tariff preferences and specific tariffs. Not only has this work improved the quality of the core GTAP data base, it has also opened the way to the future frontier of trade policy analysis: partial and general equilibrium analysis at the tariff line!¹⁹

¹¹ The SALTER model is documented in P. Jomini, R. McDougall, G. Watts, and P.S Dee (1994): *The SALTER Model of the World Economy: Model Structure, Database and Parameters* (Canberra: the Industry Commission). This monograph may be downloaded (without charge) from the Australian Productivity Commission web site:

<http://www.pc.gov.au/ic/research/staffresearch/saltermodel/index.html>

¹² See Betina Dimaranan (ed.) (2006), *Global Trade, Assistance, and Production: The GTAP 6 Data Base*, Center for Global Trade Analysis, Purdue University. Betina joined the Agricultural Economics Department at Purdue as a Ph.D. student and graduate research assistant. Since completing her PhD in 1999 she has worked at GTAP. Before coming to Purdue, she gained valuable research experience from having worked at the University of the Philippines, the International Rice Research Institute and the International Food Policy Research Institute (IFPRI). This year (2007) she intends to return to IFPRI.

¹³ Robert McDougall and Elena Ianchovichina (1996), “Incorporating Dynamics and International Capital Mobility into the GTAP Model”, Paper presented at the GTAP Follow-Up/50th EAAE Conference, Giessen, Germany, Oct 15-17; Elena Ianchovichina and Robert McDougall (2000), “Theoretical Structure of Dynamic GTAP”, *GTAP Technical Paper* No. 17 (GTAP Resource 480); Terrie Walmsley (2006), “A Baseline Scenario for the Dynamic GTAP Model for the GTAP 6 Data Base” (GTAP Resource 2204). GTAP resources are available on the GTAP web site.

¹⁴ In 2000, Walmsley helped to organize the GTAP Dynamic Course, with Ianchovichina and McDougall. Meanwhile, then-graduate student Ken Itakura began working with his Japanese connections in METI (Ministry of Economy, Trade and Industry); this led to several important projects utilizing the Dynamic GTAP model, plus building support for GTAP in Japan.

¹⁵ See Robert McDougall (1999), “Entropy Theory and RAS are Friends” *GTAP Working Paper* No. 06; Terrie Walmsley and Robert McDougall (2004), “Using Entropy to Compare IO tables”, *GTAP Research Memorandum* No. 9 (GTAP Resource 1676), available on the GTAP web site.

¹⁶ *About GTAP: History, op. cit.*

¹⁷ Will Martin and L. Alan Winters (eds) (1995), *The Uruguay Round and the Developing Economies*, World Bank Discussion Paper No. 307 which was later (1997) published as a monograph by Cambridge University Press.

¹⁸ Market Access Map (MAcMap) is a database developed jointly by ITC (UNCTAD-WTO, Geneva) and CEPII (Paris). It provides a disaggregated, exhaustive and bilateral measurement of applied tariff duties, taking regional agreements and trade preferences exhaustively into account.

¹⁹ See, for example, papers in the organized session chaired by Lionel Fontagné at this conference.

Rapid Growth

By 1997 the GTAP Consortium had 16 paid-up members²⁰. Perhaps surprisingly, the number of members from countries of medium sized economic mass (Australia, Denmark and Holland) outnumbered those from the USA and Japan combined.

Nine years later the Consortium's membership had grown to 25 with a doubling of the number of US members and also of international agencies (see Figure 1). The international agencies providing GTAP with financial support in 1997 and 2006 are shown in Table 3; the other Consortium members at these two dates are shown in Table 2.

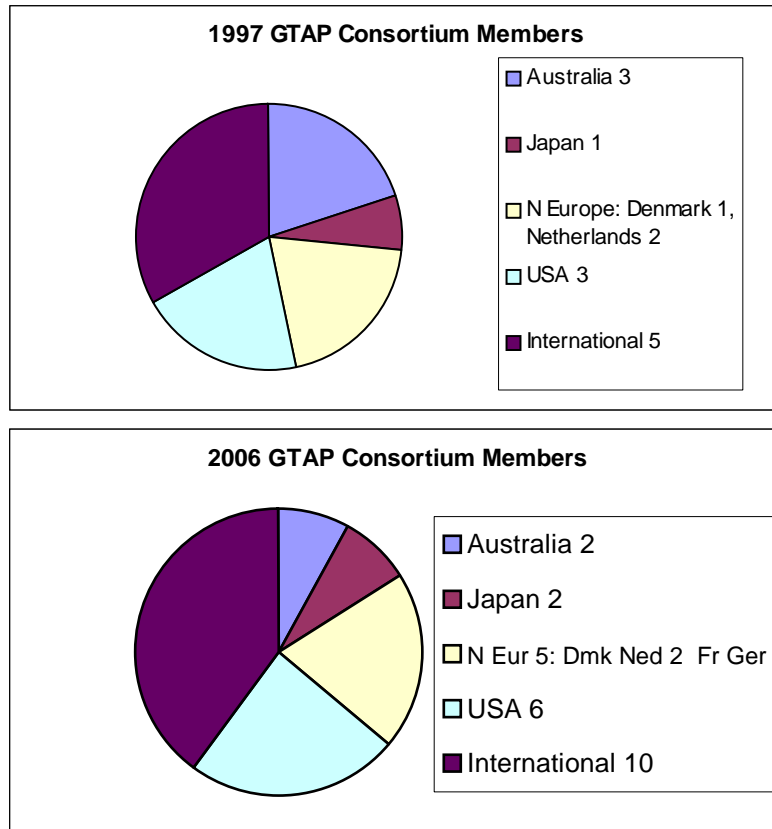


Figure 1: Composition of the GTAP Consortium, 1997 and 2006

Data, Data, Data!

Perhaps at this point we can hypothesize an answer to *Why* GTAP came into being. At the most basic level, the 1990s presented a politically ripe time for closer intimacy between countries in trade and capital flows. Yet analysis of the benefits (and/or costs) which might be expected to flow from such closer relations required an analytical framework from which such outcomes could be estimated. This in turn required a comprehensive data base depicting as accurately as possible: (a) bilateral trade flows between each pair of countries; (b) protection levels imposed by each country on such flows; (c) the production technology of each country; (d) the resource

²⁰ By paid-up members I mean institutions committing an annual subscription (which in 2007 is \$US18,200) to support GTAP's costs. Purdue continues to make its major contribution in kind, and is included among the US supporters in this discussion.

Table 2
*Members of the GTAP Consortium other than
International Agencies, 1997 and 2006*

1997	2006
<ul style="list-style-type: none"> • Agricultural Economics Research Institute (LEI-DLO) The Hague, The Netherlands • Australian Bureau of Agricultural and Resource Economics (ABARE) Canberra, Australia • Australian Centre for International Agricultural Research (ACIAR) Canberra, Australia • Center for Global Trade Analysis Purdue University, West Lafayette IN, USA • Danish Institute of Agricultural and Fisheries Economics (DIAFE) Copenhagen, Denmark • Economic Planning Agency Tokyo, Japan • Economic Research Service of the US Department of Agriculture (ERS) Washington D.C., USA • Electric Power Research Institute (EPRI), USA • Industry Commission (later Productivity Commission) Melbourne and Canberra, Australia • Netherlands Bureau of Economic Policy Analysis (CPB) The Hague, The Netherlands 	<ul style="list-style-type: none"> • Agricultural Economics Research Institute (LEI-DLO) The Hague, The Netherlands • Australian Bureau of Agricultural and Resource Economics (ABARE) Canberra, Australia • Centre d'Etudes Prospectives et d'Information Internationales (CEPII), Paris, France • Center for Global Trade Analysis Purdue University, West Lafayette IN, USA • Danish Research Institute of Food Economics (FOI) Copenhagen, Denmark • Economic and Social Research Institute (ESRI) Tokyo, Japan • Economic Research Service of the US Department of Agriculture (ERS) Washington D.C., USA • Environmental Protection Agency, Economy and Environment Division (US-EPA) Washington D.C., USA • Federal Agricultural Research Centre (FAL) Braunschweig, Germany • International Trade Commission (US-ITC) Washington D.C., USA • MIT Joint Program on the Science and Policy of Global Change Cambridge MA, USA • Nathan Associates, Inc Arlington VA, USA • Netherlands Bureau of Economic Policy Analysis (CPB) The Hague, The Netherlands • Productivity Commission Melbourne and Canberra, Australia • Research Institute of Economy, Trade and Industry (RIETI) Tokyo, Japan

Table 3
*International Agency Members of the GTAP Research
Consortium, 1997 and 2006*

1997	2006 <i>those listed on the left, plus:</i>
World Bank (IBRD)	Inter-American Development Bank (IDB)
World Trade Organization (WTO)	International Food Policy Research Institute (IFPRI)
Asian Development Bank (ADB)	Food and Agriculture Organization of the UN (FAO)
OECD Development Centre	UN Conference for Trade and Development (UNCTAD)
European Commission	UN Economic Commission for Africa (UNECA)

endowment of each country; (e) details of consumption and saving behavior in each country; (f) detailed information on the taxation structure in each country. Whilst the primary source of such data would usually be from national accounts and related sources in particular countries, the total picture generated by them would have to be free from internal contradictions: the exports from A to B would have to equal the imports into B from A; moreover, this balance would have to be preserved on a commodity-by-commodity basis, for all commodities.

Thus the decision to set up GTAP was indeed courageous: the required data base simply did not exist, although at least for the better developed countries, satisfactory starting points were available, but rarely in mutual agreement.

This inconsistency of bilateral trade data, and the need for reconciliation prior to incorporation into a global applied GE model, was one of the big problems facing the Australian SALTER project mentioned above. Fortunately, this was an issue that some of the Purdue staff had spent time on. In particular, then graduate student Marinos Tsigas, together with Professors James Binkley and Tom Hertel, had worked on an approach to trade data reconciliation. In exchange for the reconciled trade data, the SALTER project, under its director Philippa Dee, shared its core I-O (input-output) tables with the Center for Global Trade Analysis, and the first GTAP Data Base was on its way. Mark Gehlhar, then a graduate student with the Center (and subsequently on the staff of the ERS of the USDA), took over the task of reconciling the trade data, and since then has vastly improved on the early approaches. His work on this topic now defines the state of the art in this area.^{21,22}

²¹ The foregoing paragraph is taken with only slight editing from *About GTAP: History* on the GTAP web site,

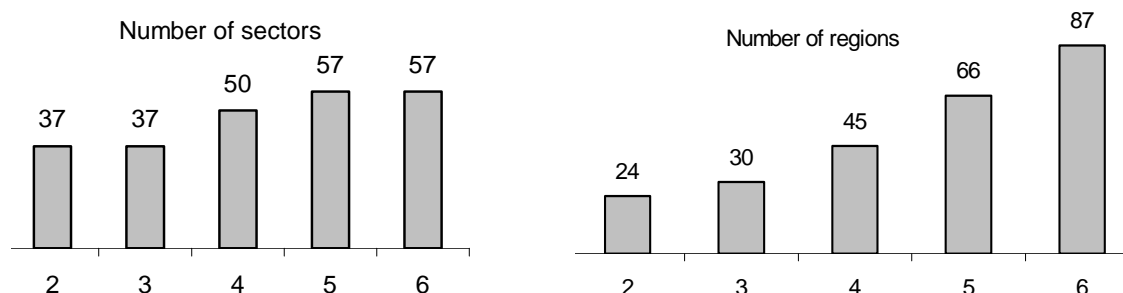


Figure 2: Increase of sectoral and regional detail in GTAP Data Bases 2 through 6

Trade flows are not the only item of data that needs attention in obtaining an internally consistent data base. With such a large array of data, intelligent automation is absolutely necessary. The FIT program lies at the heart of the GTAP Data Base construction process: it uses entropy theoretic methods to update and create a consistent data base, where all the data – input-output tables, trade, protection, macro and energy – are consistent with each other. It is this consistency which is the core of the value added by the GTAP Data Base²³.

Some AGE modelers prefer to view their data as a social accounting matrix (SAM). They may find it more satisfactory to approach the GTAP Data Base *via* McDonald, Robinson and Thierfelder's representation of GTAP data in this format.²⁴

There has been a constant demand for increased detail in GTAP data. Data bases were released in 1994, 1996, 1998, 2001 and 2004. The sectoral and regional dimensions of these five data bases are shown in Figure 2. Right throughout its life, GTAP's availability of detail has been at, or has exceeded, the power of computers available to most or all GTAP users for computing model solutions. Consequently software has been made available for users to aggregate the data in order to keep computational loads manageable whilst preserving the detail needed for their particular research project.

Perhaps ideally the number of regions would equal the number of countries in the world, but the rather large number of very small countries makes this an unrealistic ambition. In the version 6 Data Base (released in December 2004), for instance, the region *Rest of Oceania*, which excludes the single-country regions Australia and New Zealand, contains 22 'countries' (where the latter term is used broadly). The region *Rest of Sub-Saharan Africa* contains 35 countries. Some of the latter are sizeable, both in land area and in population.

Figure 2 reveals that geographic detail has been easier to add than sectoral detail. This reflects the willingness and ability of members of the GTAP network to supply data for the region in which they reside or on which they are working. It is also the case that adding new regions does not require GTAP staff to revisit existing data bases, whereas adding sectors requires all of the domestic data bases to be disaggregated. So the costs of adding

<https://www.gtap.agecon.purdue.edu/about/history.asp>

²² Indeed, Gehlhar has organized a special session on methods for dealing with trade data at this year's conference.

²³ The foregoing paragraph is almost a word-for-word quotation from *Background Paper for the GTAP Advisory Board Meeting*, Lübeck, Germany, June 6-7, 2005.

²⁴ Scott McDonald, Sherman Robinson and Karen Thierfelder (2005), "A SAM Based Global CGE Model using GTAP Data January 2005", Department of Economics, University of Sheffield, Working Paper, SERP Number 2005001, downloadable from:

<http://www.shef.ac.uk/content/1/c6/03/91/72/SERP2005001.pdf>

an additional sector are vastly greater than those associated with adding another country. Since 2000, Terrie Walmsley has overseen new contributions to the GTAP data base. Under her leadership, the number of countries has grown rapidly (101 in pre-release 1 of the version 7 data base).

As policy-oriented agencies have become more sophisticated in their analyses, the demand for sectoral disaggregation has experienced a resurgence of interest. At present, GTAP consortium members meet these demands by using the SplitCom facility, developed by Mark Horridge of the Centre of Policy Studies.²⁵ This enables users to disaggregate sectors “on the fly” by supplying share-weights for costs, sales and trade associated with the sub-sector(s) of interest. GTAP staff are waiting to see how many resources member agencies are willing to put into sectoral disaggregation, and which sectors are of highest priority. This information will likely guide future efforts to disaggregate the core GTAP data base.

Communication and Openness

GTAP was lucky to have a Canadian visitor in the early 1990s who foresaw how important the internet could be for communication among the associates of GTAP. During his sabbatical at Purdue, Randy Wigle was working with the HTML language, which would later form the backbone of the World-Wide Web. It took him several months to get Tom Hertel to look at this new software, but when Randy finally cornered him and explained the potential, a light went on for Tom, who agreed that it was the perfect technology to disseminate information about GTAP and to promote the global network. This led to his commissioning Randy to produce the first GTAP web site, which soon became the life-blood of the project.^{26,27}

The early attempts to make the GTAP Data Base 100 percent open ran into problems that had also occurred at IMPACT: the costs of producing and delivering the data could not be met by the amount of public funding that was available.

‘Being economists interested in maximizing social welfare, the GTAP staff made the first Data Base available free of charge. The one hitch was that one could only get a 10×10 aggregation, which was roughly the size of most large models in those days. In the wake of this experiment, the Center found that there was infinite demand for their product offered at a zero price, and were overwhelmed with aggregation requests. There was also another troubling negative externality: researchers did not take the Data Base seriously. This was the first of many failed experiments from which the GTAP staff learned valuable lessons.’²⁸

The pricing policy that has evolved involves three departures from one hundred per cent (costless) openness:

- (1) To obtain the latest public version of the Data Base as soon as it is produced in final draft form, a client must be either a member of the GTAP Consortium or a contributor to the Data Base; others will have to wait 6 - 18 months for the data to be checked further and finalized ready for wider public use.²⁹

²⁵ This utility is available at: <http://www.monash.edu.au/policy/splitcom.htm>

²⁶ The foregoing paragraph is taken almost word for word from ‘The Growing Years’ in *About GTAP: History* on the GTAP web site: <https://www.gtap.agecon.purdue.edu/about/history.asp>

²⁷ The GTAP web site was managed from 1998 to 2005 by Melanie Bacou. It has been managed by Ginger Batta since 2005.

²⁸ ‘The Growing Years’, *loc. cit.*

²⁹ Consortium members and contributors to the Data Base are able to make important additional inputs to its accuracy over the course of the pre-release period before its public availability.

- (2) Interim releases containing newly contributed countries are made available to members of the GTAP consortium and contributors approximately every six months, but these new country contributions are not made public until the following public release – the Center endeavors to make a public release every 2-3 years.
- (3) The most recent publicly released version of the Data Base at any time can be obtained by those outside the consortium at a differential cost whereby government agencies and consulting firms are expected to contribute substantially to development costs, whereas single-user academics, students, and individuals from developing countries are charged a far lower fee.

Training Courses in the use of GTAP

Whilst the GTAP Data Base is used widely in many different ways, its commonest role is in applied general equilibrium policy analysis. Besides the data base, a model, and software to run it, users also need sufficient knowledge to design and carry out interesting and economically sensible simulations. The experience of the IMPACT Project suggested that there would be no better or more efficient way to impart this type of knowledge other than short, intensive, live-in, training courses. GTAP has been holding such courses annually since 1993³⁰. These short courses are restricted to 32 participants, and typically involve about eight instructors as well as several graduate assistants. The aims of the courses are:³¹

- to introduce participants to a standardized framework for conducting global trade analysis in an applied general equilibrium setting;
- to provide participants with ample hands-on training with software that has been tailored to global trade analysis; and
- to give participants the opportunity to interact with economists working on global trade and resource use issues and become part of an international network.

A novel feature of these courses is the provision of two months of distance-learning instruction prior to the on-site component. The distance-learning component is delivered online and via CD-ROM. Under the guidance of an experienced instructor (most recently, Dr Mustafa Acar, a former Purdue graduate student, now on the faculty at Kirikkale University in Turkey), each participant works her/his way through a set of exercises designed to remedy any gaps in the background necessary to ensure that the seven live-in days of lectures, labs, and individualized instruction, are productive in introducing all the basic features of the model and data base to all participants.

‘These activities culminate in a major application undertaken by small groups and presented on the final day of the course. Each group is assigned two instructors who are intimately familiar with their project to act as resource persons. Participants leave with the capability of designing, conducting, and analyzing their own simulations.’³²

Access to GTAP in Europe has been facilitated by holding some of the annual short courses there. In 1994-95 Dr Martina Brockmeier spent her sabbatical year at the Center for Global Trade Analysis. This led to a specifically European Short Course taking place in Frankfurt in 1995 (which was in addition to the Third Annual Short Course held at Purdue

³⁰ The next short course will be held at Purdue in August 2007. As usual, it is fully booked, and there is a substantial waiting list – despite the rather substantial cost (nearly \$3,500).

³¹ As stated on the GTAP web site (7 April 2007).

³² From the GTAP web site (7 April 2007).

in the same year). That special course motivated new EU consortium alliances, plus a workshop in which authors – mostly from the EU – presented their general equilibrium analyses. The sixth, tenth and thirteenth annual short courses were held respectively in The Hague (1998), Sheffield (2002) and Heraklion, Crete [Greece] (2005). The Sheffield course was the first not attended by Tom Hertel. It was run by Terrie Walmsley, the current Director of GTAP, who has recently taken over responsibility for the short courses.

Access by developing countries has been facilitated by short courses held in Africa (Johannesburg, 1998)³³, Latin America (Buenos Aires, 2004)³⁴ and South Asia (Mumbai, 2006). In 2006 a three-week GTAP training program for officials from the Ministry of Finance and the Central Bank of Paraguay took place in Asunción.³⁵

Intensive live-in courses of a more advanced or specialized type are also held from time to time. In 1996 and 1997 advanced level short courses were held at Purdue, and in 2000 and 2006 short courses on the dynamic version of GTAP were held there. In 2005 a one-day ‘dynamic learning session’ on dynamic GTAP was held in conjunction with the eighth Annual Conference in Lübeck, Germany.

Software

The courses, as well as the majority of GTAP users, use the GEMPACK software suite developed by Ken Pearson and associates. Experienced GAMS users may prefer to use instead Thomas Rutherford’s GTAPinGAMS package that builds on his powerful GAMS/MPS GE modeling software.³⁶ The GAMS approach has been taken by Dominique van der Mensbrugghe and others using GTAP data in models built at, or in association with, the World Bank³⁷.

The GEMPACK software was developed initially to support Australian policy work in applied GE analysis, but currently is used in more than 60 countries.³⁸ Ken Pearson

³³ Dr William Masters of Purdue University generated support for this special short course.

³⁴ This short course began the long-awaited entry of GTAP into Latin America. Sponsored by the Inter-American Development Bank, it enabled the Center for Global Trade Analysis to connect with critical policy makers and economists needed to improve the regional data. Graduate students Ernesto Valenzuela and Carlos Ludena were critical in the execution of the course.

³⁵ These events required special funding to be sought from national and international donor agencies.

³⁶ Thomas F. Rutherford (1998), *The GTAPinGAMS software package*, published at the University of Colorado, Boulder, Colorado – <http://robles.colorado.edu/~tomruth/gtapingams>; Thomas F. Rutherford (1999), “Applied General Equilibrium Modeling with MPSGE as a GAMS Subsystem: An Overview of the Modeling Framework and Syntax”, *Computational Economics*, Vol. 14, Iss. 1-2 (Oct.), pp. 1-46.

³⁷ Van der Mensbrugghe has been an important user and data contributor from the World Bank side. He is the principal author of Chapter 2, ‘The Coming Globalization’, pp. 29-65 in *Global Economic Prospects—Managing the Next Wave of Globalization* (Washington DC: The World Bank, 2007). The projections made in this chapter were generated by the Bank’s *Linkage* model, which ‘relies on the Global Trade Analysis Project (GTAP) database (release 6.1...) to calibrate initial parameters’ (p. 37).

³⁸ Tom Hertel met Ken Pearson and Mark Horridge, and became familiar with GEMPACK, during his visit to Australia in 1990-91. At the time there was confusion among some influential CGE modelers who mistakenly identified the practice (common among the Australian school led by Peter Dixon) of specifying the equations of the model in linearized (percentage-change) form with the idea of settling for a rough approximation to the solution of the model under exogenous shocks. Whilst GEMPACK accepted the linearized specification, its solution procedure gave accurate solutions to the non-linear model. See Thomas W. Hertel, J. Mark Horridge, and Kenneth R. Pearson (1992), “Mending the Family Tree: A Reconciliation of the Linearization and Levels Schools of Applied General Equilibrium Modeling”, *Economic Modeling*, Vol. 9, pp. 385-407. The theoretical proof of the convergence of iterated small-change solutions to the solution of the non-linear parent model, which is the result demonstrated empirically in this paper, had been set out by Dixon in Dixon *et al.* (1982), *ORANI... (op. cit.)*, Section 35, *Appendix on the solution of differential equations by Euler’s method*, pp. 235-244.

worked very closely with Tom Hertel to assist him in developing the content of the early GTAP short courses. Ken looked after software and was an instructor at all GTAP short courses (both Annual and other) up to and including the Twelfth Annual Short course held in August 2004. He was also a key instructor at the 2006 Mumbai course.

RunGTAP, created by the current Director of GEMPACK software, Mark Horridge³⁹, is a visual interface to various GEMPACK programs. RunGTAP allows the user to run simulations interactively in a Windows environment using the core GTAP general equilibrium model. No previous knowledge of GEMPACK or programming skill is necessary to use the program. Results and complementary information for the analysis are provided in a Windows environment and can be accessed interactively.

The software comes with AnalyseGE, a tool which assists modelers to analyze results by moving quickly between different information sources. It gives users "point and click" access to the equations of the model, the data, and the simulation results.

AnalyseGE can build on the small-change representation of model equations by decomposing the total percentage change in some variable into a series of terms on the right-hand side of a linearized equation. For example, the modeler can see how much of textile output growth (or decline) may be attributed to changes in export demand, and how much to substitution by local users between domestic and foreign textiles. Such information helps the modeler explain model results, rather than merely reporting them.

These facilities greatly enhance the productivity of economists undertaking applied and partial equilibrium policy analysis.

Early Applications

The first major landmark in GTAP's history was the publication in 1997 of *Global Trade Analysis: Modeling and Applications*⁴⁰. In addition to material giving a detailed account of the GTAP data base, and of the specification and solution procedure for the core model, this volume contains reports of the seven different applications shown in Table 4.

Other applied GE modelers were prompt in making use of early versions of the GTAP data base. With their own model, which included allowance for scale effects, Glenn Harrison, Tom Rutherford and David Tarr used Version 2 of the GTAP data to examine the effects of the Uruguay round of reforms, publishing their results in 1997.⁴¹ Published in the same year was Kym Anderson, Betina Dimaranan, Tom Hertel and Will Martin's study of prospects for Asia-Pacific Food Markets in 2005, which used the core GTAP model and Version 3 of its data base.⁴²

³⁹ In April 2007 Ken Pearson handed the Directorship of GEMPACK Software over to his long term colleague, Professor J. Mark Horridge.

⁴⁰ Thomas W. Hertel (ed.) (1997), *op. cit.*

⁴¹ Glenn Harrison, Thomas Rutherford and David Tarr (1997), "Quantifying the Uruguay Round," *Economic Journal*, Vol 107, No. 444 (September), pp. 1405-1430.

⁴² K. Anderson, B. Dimaranan, T. Hertel and W. Martin (1997), "Asia-Pacific Food Markets in 2005: A Global, Economywide Perspective", *Australian Journal of Agricultural and Resource Economics*, Vol. 41, No. 1, pp.19-44.

Table 4
*Early GTAP Applications Appearing in
the 1997 GTAP Monograph**

Author/s	Application
Robert McDougall and Rod Tyers	Developing country expansion and relative wages in industrial countries
Donald MacLaren	An evaluation of the Cairns Group strategies for agriculture in the Uruguay Round
Linda M. Young and Karen M. Huff	Free trade in the Pacific Rim: On what basis?
Yongzheng Yang, Will Martin and Koji Yanagishima	Evaluating the benefits of abolishing the MFA in the Uruguay Round Package
Marinos E. Tsigas, George B. Frisvold and Betsey Kuhn	Global Climate Change and Agriculture
Carlo Perroni and Randall Wigle	Environmental Policy Modeling
George B. Frisvold	Multimarket effects of agricultural research with technological spillovers

* Source: Thomas W. Hertel (ed.) (1997), *op. cit.*

Expanding GTAP's Range

In the decade since 1997, many qualitative and quantitative changes have taken place. There has been a large increase in both the number of countries and the number of commodities explicitly recognized in the Data Base (see Figure 2). Both the model and data have been extended to deal with contemporary issues; e.g., energy, the environment, international movements of labor, the Doha Round. Development of a data base on Land Use and Green House Gases (GHGs) has been undertaken in a project sponsored by the US Environmental Protection Agency which began in 2002 and is ongoing.⁴³

Work which integrates a version of the GTAP model with inter-regional population and workforce movements has been under way for five years or more.⁴⁴ Research efforts led by Terrie Walmsley at the Center for Global Trade Analysis, together with:

- Sussex University's Development Research Centre on Migration, Globalization and Poverty,
- the U.K. Department for International Development and
- the World Bank

have given rise to the GMig2 model and a bilateral migration data base to examine the impact of population movements. The data base includes a 226×226 bilateral matrix

⁴³ Support from the US Environmental Protection Agency and the US Department of Energy has funded a series of researchers at GTAP, including Drs Gerard Malcolm, Truong P. Truong, Jean-Marc Burniaux, Huey-Lin Lee and Alla Golub.

⁴⁴ Terrie L. Walmsley and L. Alan Winters (2002) "An Analysis of the removal of restrictions on the Temporary Movement of Natural Persons", Mimeo, University of Sheffield.

showing the home and host countries of the world's 176.6 million international migrants.⁴⁵ An aggregation is available as an 87×87 matrix in which home and host correspond to the regions of the GTAP 6 Data Base. The GMig2 data base also contains information on bilateral migrant labor and wages by skill, and on bilateral remittance flows.^{46,47}

Such expansions inevitably involve quite large resource inputs. The Center for Global Trade Analysis has a staff of just seven full-time members and six graduate students. The thesis work of the latter is on both data- and model-related projects relevant to GTAP's further development. It is difficult to see how current expectations for research in a large number of new areas of policy analysis can be accommodated with the budget that the Center for Global Trade Analysis is likely to have at its disposal in the near future.

Achievements to date

One vehicle to help judge the impact of GTAP on the profession of economic policy analysis is a web search using Google Scholar. The 1997 GTAP monograph receives more than 1,150 citations, while versions 3 and 5 of GTAP's data base are cited 279 and 389 times respectively.⁴⁸

Through its program of Short Courses GTAP has added a large increment to the worldwide stock of human capital in AGE modeling, particularly so for the analysis of international issues. In 1999 the list of applications of GTAP on the Project's web site numbered 227 items; by mid-April 2007 it had increased to 781. Whilst this number and its rate of growth may be astonishing, the range of topics covered is equally so: Doha, China, climate change, and labor migration to mention just a few.

Towards the end of April 2007 GTAP had 366 subscribers to the Data Base. The early versions of the GTAP data base were used in several influential studies of the Uruguay Round of trade reforms, and the latest version of the data base has been employed in many studies of the Doha Round. In several (probably most) of these studies the core GTAP model has either been the vehicle of analysis, or the base frame upon which a specialized model has been built.

It is clear that GTAP has engendered a community of quantitatively-oriented trade economists, and has integrated their efforts with those of other economists having an economy-wide perspective, especially those working on economic development.

What of the future? Perhaps we should start this discussion with the vision for GTAP held by its founder at the turn of the century.

Tom Hertel's Wish List

In 1999 Tom Hertel wrote a paper in which he imagined what he might write about GTAP a decade later. The function of that paper, entitled "Future Directions in Global Trade

⁴⁵ Christopher Parsons, Ronald Skeldon, Terrie Walmsley and Alan Winters (2005), "Quantifying the international bilateral movements of migrants", DRC Working Paper No WP-T13, Sussex University.

⁴⁶ Terrie Walmsley, Syud Amer Ahmed and Christopher Parsons (2005), "The GMig2 Data Base: A Data Base of Bilateral Labor Migration, Wages and Remittances", *GTAP Research Memorandum* No.6.

⁴⁷ For applications see Terrie Walmsley, Alan Winters, Syud Amer Ahmed and Christopher Parsons (2005), "Measuring the Impact of the Movement of Labour Using a Model of Bilateral Migration Flows", paper presented at the 8th Annual Conference on Global Economic Analysis, Lübeck, Germany, June; and Syud Amer Ahmed, and Terrie Walmsley (2006), "The Liberalization of Temporary Migration: India's Story", paper presented at the 9th Annual Conference on Global Economic Analysis, Addis Ababa, Ethiopia, June.

⁴⁸ This paragraph did not appear in the conference version of this paper. The web search was made in September 2007.

Analysis”⁴⁹, was to state where he hoped GTAP would be in 2010, and in what direction/s it would then be heading. One of his hopes will actually be achieved a year earlier than proposed: the annual Global Economic Analysis Conference for 2009 will be held in Santiago de Chile (see Appendix Table A1 below); that is, in the locale in which Tom’s fictitious 2010 paper is presented.

Tom’s wish list is breath-taking. He sees the opportunity to put policy analytic research, and day-to-day policy analysis, on a much firmer footing than they have held in the past. His latent optimism is not outrageous given that virtually no one in 1992 would have predicted how far GTAP would have progressed by 2007. Nevertheless, much of what was hoped for in 1999 has not yet materialized. Consider:

‘After a decade of proprietary status, the GTAP consortium fully embraced the “open source” standard for the database in 2003. This dramatically accelerated database development work. Indeed, from our present perspective in 2010, it hardly seems possible that there was a time (less than ten years ago) when virtually all of the GTAP database modules were developed in the Center for Global Trade Analysis on the campus of Purdue University! As was the case at the end of the last century with the IBM-PC, the open architecture approach (vs. Apple’s proprietary approach) has permitted the GTAP database to tap into the enormous talents of economists, statisticians and computer programmers around the world. The comprehensive data bases on domestic taxes, and environmental endowments and pollution, which we now take for granted, would not have been possible without the concentrated efforts of individuals in more than a dozen countries around the world.’⁵⁰

Critics will remark that this vision of the future was too optimistic on two counts. First, it assumed that the Consortium supporting GTAP financially would include at least one member with access to very substantial financial resources who would see the global welfare advantages of the open source data proposal as compelling. Second, it probably assumed that there would be a greater supply of dedicated professionals in the GTAP mould than is actually the case.

The second point may be easier to contradict than the first: in fact there are dedicated professionals in many countries supporting the expansion and refinement of GTAP data bases under the current set-up in which the final work is done at Purdue. Given finance, and training, these people and their associates could assume greater responsibility for generating data bases. As Tom saw it,

‘The key feature in fostering a common standard, to which these diverse researchers can work, has been establishment of the GTAP Database Short Course ... [at which] individuals learn how to construct the GTAP database from scratch. Having done so, they are in a position to modify the inputs and assumptions and produce a new database, perhaps with a few additional regions or sectors. Because ... products based on the open access version of the database must also be made freely available, there has been no incentive to splinter the database. Improvements have been fed back to the Center for Global Trade Analysis where they have often been incorporated into the next version of the database. The privilege of having one’s work formally included in the formal

⁴⁹ Thomas W. Hertel (1999), “Future Directions in Global Trade Analysis”, GTAP Working Paper No. 04, 1999, available on the GTAP web site.

⁵⁰ *Ibid.*

database release has also proven to be a strong incentive for sharing of software and data.’⁵¹

Another important ingredient of the improvement in policy analytic work foreseen in Tom’s paper is in the area of replicability:

‘Only a few of those in the audience today in Santiago will remember the pre-GTAP era, when replication of someone else’s applied GE study was viewed as a major accomplishment! Open sourcing of models based on the GTAP database ushered in a new era in which replication became routine.’⁵²

This easy replicability of course also assumes that the particular version of the core GTAP model, or of a related special-purpose model, will be easily transferred between researchers. With software (such as GEMPACK) in which the source code is written in an algebraic language, this transfer is straightforward and relatively easy.

The ease of replication would have a further advantage. Having become interested in (or perhaps startled by!) the conclusions generated by an author’s AGE study, other researchers, having first replicated the original simulations, would

‘then test the robustness of the authors’ conclusions to key assumptions about the theory, database and parameters. The resulting dialogue ... [would reinvigorate] ... the field of applied general equilibrium analysis, and ... [leave] ... other fields of empirical economics scrambling to define similar standards for their databases and software.’

Tom also foresaw a dramatic increase in journal editors’ willingness to publish studies based on AGE modeling:

‘... the GTAP network provides an excellent source of well-informed reviewers who can quickly discern high quality work from research of lesser value. Secondly, unlike many other empirical studies, editors can now require that GTAP-based AGE studies be independently replicated. This removes all doubt about the scientific integrity of the work.’⁵³

Finally, several advances in teaching applied general equilibrium, even at the undergraduate level, were foreseen by Tom. Some of these have been realized, though not yet globally.

Where to Now?

GTAP’s mission statement reads:

The Center for Global Trade Analysis is the publicly funded, university-based home for GTAP, a global network of researchers and policy makers conducting quantitative analysis of international policy issues. Our purpose is to improve the quality of global economy-wide analysis through education and by developing analytical data bases, economic models, and innovative methodologies. Our unique institutional structure enables us to foster collaboration among academia, public sector, and private sectors worldwide.

Proof of the final assertion above is clearly visible among the essential ingredients of today’s GTAP, which are:

⁵¹ *Ibid.*

⁵² *Ibid.*

⁵³ *Ibid.*

- a data base giving factual evidence of the patterns of production and bilateral trade flows among regions around the world
- an international network of agencies and individuals contributing to this data base
- detailed information about taxes on trade flows
- a highly skilled central group of analysts at Purdue who reconcile disparate information into a global data base that is free from internal contradictions
- a Consortium supporting GTAP financially which includes most of the important international economic policy agencies (see Table 3), plus a dozen national economic policy agencies in seven countries (see Table 2)
- a core AGE model of world production and trade disaggregated into 87 regions and 57 sectors
- access to software that has been tailored to global trade analysis and which does not require programming skill
- a program of distance-plus-residential intensive training courses in applied general equilibrium analysis (centered on the core GTAP model and its supporting data base) which offers courses annually at Purdue, and which has held other courses in Europe, Africa, Latin America and South Asia
- a large network of researchers using GTAP as a major tool for policy analysis who are linked via the worldwide web and who make use of, and contribute to, the GTAP web site
- extraordinarily insightful and energetic leadership of the Project by its founder, by its current Director, and by their colleagues.

With all this in place, one option for the future might seem to be: ‘business as usual’.

There are two major difficulties with this approach. Firstly, although a front office in academia was almost certainly essential for the conception and birth of GTAP, such a location would experience tension if the work of the Project became purely routine: leading research institutions must lead! Secondly, many extensions of GTAP’s range are possible: energy, pollution, climate change and migration of labor provide examples of areas where there is strong demand for the Project to undertake more work.

The Purdue research team must be sufficiently well supported to allow its members to continue to conduct and publish intellectually innovative material. But the requests by Consortium members and others for more detailed data, and for extensions of the model, are likely to grow at a much faster rate than the financial resources necessary to meet them.

One example of how this might come about is as follows: an agency or other friend of the Project requests a particular extension to the data base that it needs for satisfactory analysis of a pressing policy problem. Those requesting such an extension may recognize the cost of carrying it out, and offer financial support. On the (perhaps overly optimistic) assumption that a suitable professional labor input can be found to do the work, the likelihood is that today’s pressing policy problem will not be tomorrow’s. If the additional item has been incorporated into the standard data base, the initial work to achieve this is just the start of a recurring item of expense. Those requesting the

extension are unlikely to be prepared (or perhaps able) to offer the continuing support needed.

The public-good nature of much of GTAP's output of course makes it vulnerable to free riding by users who, if the truth were told, could afford to contribute to development costs. This conundrum has no satisfactory solution in theory. However, with good will, a solution of sorts can be found in practice. It requires that all putative members of a research community must recognize that, without cooperation, all are likely to be worse off. Having faced up to this, they must then agree to behave as responsible members of a cooperative modeling community. This implies meeting a share of the funding where possible, and agreeing that modeling infrastructure developed in house will be shared by all. Members of the GTAP Consortium deserve congratulations for having made a commitment in this spirit (although, as has been spelt out above, members of the Consortium do receive earlier access to data, and a more direct input into management).

A more appealing solution to the funding problem is to find a public-sector supporter ready to make grants on a scale that can allow the Project to develop in at least some of the areas in which policy makers are seeking additional inputs from modelers. The quintessentially international nature of GTAP poses a special problem: whilst many countries have public bodies funded by government that distribute substantial research grants for advancement in science, there is no equivalent international body. In the physical sciences this would be less of a problem: leadership in research tends to be regarded (at least implicitly) by national grant giving bodies as a precondition for leadership in adaptation and market development for new products and profits. It is tougher in the social sciences. There is nevertheless a chance that one or more national grant giving institutions might see the point of Tom Hertel's open-source proposal for the GTAP Data Base (as outlined above).

One of the purposes of this tenth anniversary Conference is to seek wide consultation on funding the further development of GTAP. I look forward to hearing other viewpoints to the one I have put above.

Appendix Table A1

The first twelve Global Economic Analysis Conferences

	Conference Theme/s	Venue, year	Local institutional support provided by:
I	Exchange of ideas among economists conducting quantitative analysis on issues of global significance — particular emphasis on applied general equilibrium methods, data, and applications — related theoretical and applied work	Purdue University West Lafayette, IN, USA June 1998	Center for Global Trade Analysis, Purdue University
II	The same as above	Danish Institute for Agricultural and Fisheries Economics, Copenhagen Denmark June 1997	Danish Institute for Agricultural and Fisheries Economics, Copenhagen Denmark
III	The role of model-based analysis in policy formation	Mount Eliza, Victoria, Australia June 2000	Centre of Policy Studies and IMPACT Project, Monash University, Melbourne, Vic Australia
IV	A very large range of topics — a few of them were: global climate change, free trade agreements, tourism and travel, effects of tax structures on trade and development, the mobilization of protection data for China	Purdue University West Lafayette, IN, USA June 2001	Center for Global Trade Analysis, Purdue University
V	Sustainable Development and the General Equilibrium Approach	Taipei, Taiwan June 2002	Center of Sustainable Development, National Tsing Hua University
VI	Integration, Environment, Development, Empirical Work (parameter estimation)	Scheveningen, The Hague, Netherlands June 2003	Netherlands Bureau for Economic Policy Analysis (CPB), Agricultural Economics Research Institute (LEI) Erasmus University of Rotterdam
VII	Research and policy analysis related to: International Trade, Poverty and the Environment.	The World Bank, Washington DC June 2004	The World Bank, U.S. Environmental Protection Agency (EPA), USDA Economic Research Service (ERS), Inter-American Development Bank (IDB), U.S. International Trade Commission (ITC)
VIII	Global Climate, Labor Migration, Trade and Poverty, Cap and Direct Payments, Imperfect Competition, Adjustment Costs, Impact of Trade Liberalization on World Agricultural Markets & Developing Countries: Perspectives from CGE and Global Partial Equilibrium Trade-model-based Analyses	Lübeck, Germany June 2005	Institute of Market Analysis and Agricultural Trade Policy (FAL), Braunschweig, Germany
IX	Multilateralism, Bilateralism, and Development with the following sub-themes: Multilateral and Bilateral Trade Agreements; Trade and the Environment; Climate Change and Development; Trade; Poverty and Gender	UN Conference Center, Addis Ababa, Ethiopia June 2006	United Nations Economic Commission for Africa (UNECA), Addis Ababa, Ethiopia

X	Assessing the Foundations of Global Economic Analysis. Celebrate the first decade of conferences by evaluating progress & exploring possible future directions; revisit the foundations of global economic analysis	Purdue University West Lafayette, IN, USA June 2007	Center for Global Trade Analysis, Purdue University
---	---	--	---

Forthcoming Conferences

XI	Future of Global Economy	Helsinki, Finland June 2008	Government Institute for Economic Research (VATT) and the United Nations University, WIDER Institute, Helsinki, Finland
XII	Trade Integration and Sustainable Development: Looking for an Inclusive World	Santiago, Chile June 2009	(United Nations) Economic Commission for Latin America and the Caribbean <i>and</i> Inter-American Development Bank