



The Global Trade Analysis Project: Report, Issues and Future Directions

2014

**Compiled by
Thomas Hertel**

**With contributions from
Angel Aguiar, Zeynep Akgul, Ginger Batta,
Caitlyn Carrico, Alla Golub, Zekarias Hussein,
Zeynep Burcu Irfanoglu, Wendy Kincaid,
Robert McDougall, Badri Narayanan,
Jeffrey Peters, Farzad Taheripour,
Wallace Tyner and Nelson Villoria**

**Center for Global Trade Analysis
Purdue University**

**Background Paper for the GTAP Advisory Board Meeting
Dakar, Senegal
June 16-17, 2014**

Table of Contents

I.	Highlights.....	4
II.	GTAP Advisory Board Members and Other Attendees	5
III.	Schedule for GTAP Advisory Board Meeting.....	8
IV.	Mission and Goals.....	11
V.	Center Staff, Research Associates, Graduate Students and Visitors	12
VI.	Objectives and Accomplishments.....	16
	Progress towards Goals over Past Year.....	16
	Proposed Activities over the next year and beyond.....	24
VII.	The GTAP Data Base and Other Data Projects: Progress and Future Objectives ..	25
	The GTAP 8 Data Base Cycle in 2013-14	25
	The GTAP Data Base: Priorities for Future Releases	26
	Other Data Related Activities: Progress and Priorities.....	34
VIII.	Research and Model Development: Progress and Future Objectives.....	35
IX.	Education and the Network	48
	Education and Courses.....	49
	Research Fellows.....	50
	Conference Proposals	50
	Report on GTAP Usage and the GTAP Network/Website.....	50
X.	Finances, Budgets and Staffing Plan.....	51
	Budgeting.....	51
	Staffing.....	51
XI.	Appendices	
	Appendix 1: A strategy for creating a standardized, interoperable GTAP-AEZ model and data base package	54
	Appendix 2: A research strategy for upgrading the bilateral transport margins, by mode, in the GTAP Data Base.....	55
	Appendix 3: Electricity Sector Disaggregation: GTAP Data Base Proposal.....	56

Dear Board Members,

This has been a year of transitions, and I have greatly appreciated your patience with the Center as we have navigated some major staffing changes. After ten years as GTAP Director, Terrie Walmsley stepped down last year. Needless to say, this left a big hole in our management structure. In addition, Meghan Alexander, Senior Program Manager, also resigned due to a family move, leaving us down two key people in our small Center. We have also had three maternity leaves this past year – another source of excitement! (Congratulations are due to Meghan, Ginger and Alla!) Fortunately, the remaining staff members have met the ensuing challenge, and we have also made several new hires. Dominique van der Mensbrugghe will join the Center as Professor and Director in late July. Ginger Batta has taken over as Senior Program Manager, and Jeremy Douglas has joined the Center as our new IT specialist. We are still seeking to fill a Research Economist position and appreciate any referrals you might have.

These staffing challenges notwithstanding, it has been a productive year. In February, 2014, we released GTAP 8.2, a board-only interim release, benchmarked to the world economy in 2007, and designed to make a suite of 6 new countries and 6 updated national data bases available for Board member use. One month later, the first GTAP 9 prerelease was made available to the Board. It offers consistent snapshots of the global economy for three years (2004, 2007 and 2011). This move towards a systematic time series in which data sources and methods are internally consistent is a great advance. Importantly, for the first time we have sourced the tariff data directly from the International Trade Centre, thereby linking GTAP directly to those assembling these critical policy data. In addition to the new national data bases, the v.9 data base also embodies a five-way labor split, building on data from the International Labor Organization. There have been many other important developments on the data base front which are detailed below.

This has also been an active year for education, outreach and network activities. In collaboration with the Center, Mary Burfisher taught GTAP 101 – a fully on-line introduction to CGE analysis – in the fall and spring semesters and Nelson Villoria took the annual GTAP short course to Istanbul. We are greatly anticipating the upcoming 17th Annual Conference on Global Economic Analysis, to be hosted by IFPRI in Dakar, Senegal. There were 260 abstracts submitted, of which about 170 will be presented. Thanks to the collaboration with AGRODEP, we will have a record number of participants from Africa, along with excellent participation rates from other continents.

In short, GTAP's future is bright! I am looking forward to meeting with you next month in Dakar!

Sincerely,



Thomas W. Hertel
Distinguished Professor and Executive Director
Center for Global Trade Analysis
Purdue University

I. Highlights

The list below highlights some of the most important accomplishments in the Center during the past year. Detailed discussion follows in the subsequent report.

Data Base and Models

- GTAP 8.2 released to the Board; it incorporates a dozen new national data bases
- GTAP 9 prelease 1 released to the Board covering 2004-2007-2011 time series
- New five-way division of labor services, by region and sector
- Board-funded, Non-CO₂ emissions database update released to the public
- Two new data bases on terrestrial carbon and CO₂ emissions from land use change published
- GDyn-E model published as technical paper and code released to the public
- MyGTAP framework for breaking out households and public accounts in a single country within GTAP published
- Proposal and proto-type for disaggregation of the electric power sector developed
- Major initiative to incorporate public procurement of goods and services initiated, with funding from the European Commission

Network

- Annual short course held in Istanbul
- Two offerings of the new GTAP101 online course
- Annual conferences for 2015 (Melbourne) and 2016 (Washington) on track

Research

- Strong external funding for selective research activities in the Center aimed at advancing the frontiers of GTAP-related data, modeling and policy analysis
- More than three-dozen peer-reviewed articles published

Staffing

- New GTAP Professor and Director hired: Dominique van der Mensbrugghe
- New Senior Program Manager hired: Ginger Batta
- New Web and IT Specialist hired: Jeremy Douglas
- New Research Economist position created; currently under recruitment

II. GTAP Advisory Board Members¹ and Other Attendees

Agricultural Economics Research Institute (LEI), The Hague, Netherlands

Hans van Meijl, hans.vanmeijl@wur.nl

Asian Development Bank (ADB), Manila, Philippines

Juzhong Zhuang, jzhuang@adb.org (absent)

Centre d'Etudes Prospectives et d'Information Internationales (CEPII), Paris, France

Sébastien Jean, sebastien.jean@grignon.inra.fr

Economic and Social Research Institute (ESRI), Tokyo, Japan

Susumu Suzuki, susumu.suzuki@cao.go.jp

Economic Research Service (ERS), US Department of Agriculture, Washington DC, USA

Gopinath Munisamy, gmunisamy@ers.usda.gov (absent)

Electric Power Research Institute (EPRI),

Global Climate Change Research Group, Washington DC, USA

Steven Rose, srose@epri.com (absent)

European Commission, Brussels, Belgium

Lucian Cernat, Lucian.CERNAT@ec.europa.eu

Food and Agriculture Organization of the United Nations (FAO), Rome, Italy

Aziz Elbehri, aziz.elbehri@fao.org

Department of Food and Resource Economics (IFRO), University of Copenhagen, Frederiksberg, Denmark

Hans Grinsted Jensen, hans@IFRO.ku.dk

Inter-American Development Bank (IADB), Washington DC, USA

Paolo Giordano, paolog@iadb.org (absent)

Carlos Ludena, carlosl@iadb.org

International Food Policy Research Institute (IFPRI), Washington DC, USA

Antoine Bouët, a.bouet@cgiar.org

International Trade Centre, Geneva, Switzerland

Anders Aeroe, aeroe@intracen.org (absent)

Mondher Mimouni, mimouni@intracen.org

KPMG, Canberra, Australia

Ashley Winston, awinston@kpmg.com.au

¹ Agency reports are available at: http://www.gtap.agecon.purdue.edu/events/Board_Meetings/2014/

Organisation for Economic Co-operation and Development (OECD), Paris, France
Frank van Tongeren, frank.vantongeren@oecd.org

Productivity Commission, Melbourne, Australia
Patrick Jomini, pjomini@pc.gov.au (absent)

Research Institute of Economy, Trade and Industry (RIETI), Tokyo, Japan
Yasuhiko Yoshida, info@rieti.go.jp (absent)
Kenichi Kawasaki, kawasaki-kenichi@rieti.go.jp

The MIT Joint Program on the Science and Policy of Global Change, Cambridge, MA, USA
Sergey Paltsev, paltsev@mit.edu (absent)
Niven Winchester, niven@mit.edu

The World Bank, Washington DC, USA
Will Martin, wmartin1@worldbank.org

Thünen Institute of Market Analysis, Braunschweig, Germany
Janine Pelikan, janine.pelikan@ti.bund.de (absent)
Martin Banse, martin.banse@ti.bund.de

United Nations Conference on Trade and Development (UNCTAD), Geneva, Switzerland
Ralf Peters, ralf.peters@unctad.org (absent)
Pramila Crivelli, pramila.crivelli@unige.ch

United Nations Economic and Social Commission for Western Asia (UNESCWA), Beirut, Lebanon
Mohamed Hedi Bchir, hedi.bchir@gmail.com

United Nations Economic Commission for Africa (UNECA), Addis Ababa, Ethiopia
Stephen Karingi, skaringi@uneca.org

University of Hohenheim, Stuttgart, Germany
Martina Brockmeier, martina.brockmeier@uni-hohenheim.de (absent)

US Department of Energy (DOE), Washington DC, USA
Bryan Mignone, Bryan.Mignone@hq.doe.gov

US Environmental Protection Agency (EPA), Washington DC, USA
Richard Garbaccio, garbaccio.richard@epa.gov (absent)

US International Trade Commission, Washington, DC, USA
Marinos Tsigas, marinos.tsigas@usitc.gov

World Trade Organization, Geneva, Switzerland

Roberta Piermartini, roberta.piermartini@wto.org (absent)

Member at Large

Mark Horridge, mark.horridge@gmail.com

Centre of Policy Studies, Victoria University

Guests of the Board

Philip Adams, philip.adams@vu.edu.au

Centre of Policy Studies, Victoria University

Bert Saveyn, bert.saveyn@ec.europa.eu

European Commission, DG Joint Research Centre (JRC)

Institute for Prospective Technological Studies - IPTS

Maryla Maliszewska, mmaliszewska@worldbank.org

The World Bank

III. Schedule for GTAP Advisory Board Meeting

Location: King Fahd Palace Hotel, Room B01
Pointe des Almadies, BP: 8181, Dakar, Senegal

Monday, June 16, Room B01 (Level 0)	
9:00am-10:30am	<p>Welcome and Overview Chair: Hans van Meijl</p> <ul style="list-style-type: none"> • Overview and Issues (30 min) <ul style="list-style-type: none"> - Thomas Hertel <p><i>Discussion (30 min)</i></p> <ul style="list-style-type: none"> • The GTAP Data Base: Progress and Future Directions (20 min) <ul style="list-style-type: none"> - Badri Narayanan <p><i>Discussion (10 min)</i></p>
10:30am-11:00am	Coffee Break, Hotel Forecourt (near lobby)
11:00am-12:15pm	<p>The GTAP Data Base: Updates on core components Chair: Ken Kawasaki</p> <ul style="list-style-type: none"> • I-O tables (15 min) <ul style="list-style-type: none"> - Angel Aguiar <p><i>Discussion (10 min)</i></p> <ul style="list-style-type: none"> • Agricultural production and energy data bases (15 min) <ul style="list-style-type: none"> - Robert McDougall <p><i>Discussion (10 min)</i></p> <ul style="list-style-type: none"> • Trade and protection datasets (15 min) <ul style="list-style-type: none"> - Badri Narayanan and Mondher Mimouni <p><i>Discussion (10 min)</i></p>
12:15pm-1:45pm	Lunch, Jardin de l'Océan Room (located near the swimming pool)

1:45pm-3:15pm	<p>The Network Chair: Stephen Karingi</p> <ul style="list-style-type: none"> • 2014 Conference Report (5 min) <ul style="list-style-type: none"> - Antoine Bouët <p><i>Discussion (10 min)</i></p> <ul style="list-style-type: none"> • 2015 Conference Report (5 min) <ul style="list-style-type: none"> - Philip Adams <p><i>Discussion (10 min)</i></p> <ul style="list-style-type: none"> • 2016 Conference Report (5 min) <ul style="list-style-type: none"> - Will Martin <p><i>Discussion (10 min)</i></p> <ul style="list-style-type: none"> • Research Fellows: Lucian Cernat, Committee Chair <ul style="list-style-type: none"> - Nominations, discussion and vote for the 2014 – 2017 class of Fellows (15 min) - Proposal for at-large nominations (30 min)
3:15pm-3:45pm	<p>Coffee Break, Hotel Forecourt (near lobby)</p>
3:45pm-4:15pm	<p>Education Plan Chair: Aziz Elbehri</p> <ul style="list-style-type: none"> • Education Plan (15 min) <ul style="list-style-type: none"> - Nelson Villoria <p><i>Discussion (15 min)</i></p>
4:15pm-5:30pm	<p>Other Data and Modeling Issues raised by Board (aka: Parking Lot) Chair: Lucian Cernat</p> <p><i>Discussion items to be determined by Board Members</i></p>
7:00pm	<p>Dinner: Alkimia Restaurant (http://www.alkimiadakar.com/bar_restau.html) Route des Almadies (Méridien), Dakar Ph: +221 33 820 68 68</p> <p>Meet in the hotel lobby at 6:40 for departure.</p> <ul style="list-style-type: none"> • If weather is nice, the IFPRI Dakar staff has indicated the restaurant is walkable from the hotel. If the weather is poor, Ginger will arrange for a shuttle. • Roughly 30,000 XOF/person (credit card and cash accepted)

Tuesday, June 17, Room B01 (Level 0)	
9:00am-10:30am	<p>New developments at the interface of data and modeling Chair: Sébastien Jean (5 min presentation/10 min discussion)</p> <ul style="list-style-type: none"> • Public procurement and restrictions on origin of goods and services: Angel Aguiar • Terrestrial carbon and GHG emissions from land use change: Nelson Villoria • GTAP-Power: a data base and framework for analyzing electricity supply: Jeffrey Peters • GEOSHAREproject.org: a widget for accessing climate impacts in agriculture: Nelson Villoria • Introducing firm heterogeneity into the standard GTAP model: Nelson Villoria and Zeynep Akgul • Mainstreaming Non-CO2 emissions factors: Thomas Hertel
10:30am-11:00am	Coffee Break, Hotel Forecourt (near lobby)
11:00am-12:30pm	<p>Priorities for Forthcoming Year Chair: Frank van Tongeren</p> <ul style="list-style-type: none"> • Budget and Staffing (20 min) <ul style="list-style-type: none"> - Thomas Hertel <p><i>Discussion (20 min)</i></p> <ul style="list-style-type: none"> • Revisit Priorities for Next Year (20 min) <ul style="list-style-type: none"> - Thomas Hertel <p><i>Discussion (30 min)</i></p>
12:30pm-2:00pm	Lunch, Jardin de l'Océan Room (located near the swimming pool)
2:00pm-3:30pm	Additional Meetings, Room B01 (Level 0)
2:00pm-2:45pm	GTAP-Power proposal (Robert McDougall, Chair)
2:45pm-3:30pm	Improving the representation of the EU in GTAP (Bert Saveyn, Chair)
3:30pm-4:00pm	Mainstreaming the non-CO2 emissions data base (Thomas Hertel, Chair)

IV. Mission and Goals

Our Mission

To provide leadership in economic policy analysis by fostering collaboration to achieve better data and research outcomes.

We value:

- *International Collaboration* because it increases quality of data and analysis.
- *Objectivity and transparency* because they are crucial to our data work and analysis.
- *Discovery* because improving methodology leads to better policy analysis.
- *Learning* because it creates critical vibrancy both within the Center and in the expanding network and improves the quality of analysis undertaken.
- *Engagement* because it helps us serve policy analysts and decision makers with better data and analysis.

We believe that:

- Better data leads to better policy analysis which leads to better policy.
- Reconciling data makes data better.
- CGE modeling provides useful policy insights.
- Avoiding duplication in data production is efficient.
- Collaboration enhances individual efforts.
- Having more trained users enriches policy debates.

Goals

1. ***Data Goal:*** To Improve the quality of data products through:
 - a. Improving the quality of contributed I-O data
 - b. Addition and improvement of other datasets
 - c. Monitoring of data quality using comparison programs
 - d. Version control and documentation
2. ***Research Goal:*** To actively participate in quantitative economic analysis of pressing global concern in the areas of Trade and Development and Global Environmental Issues
3. ***Model Goal:*** To promote further development of GTAP-based models
4. ***Education Goal:*** To expand and improve education for global economic analysis worldwide
5. ***Staffing Goal:*** To actively seek and encourage talented staff and graduate students
6. ***Collaboration Goal:*** To actively seek opportunities for fostering collaboration with institutions around the world

V. Center Staff, Research Associates, Graduate Students and Visitors

Center Staff

Angel Aguiar, Research Economist and Data Base Construction Specialist

Angel is a Data Base Construction Specialist and Research Economist. His responsibilities include the macro datasets and working with the contributors of the regional I-O data for the GTAP Data Base. Angel also teaches in GTAP Short Courses and undertakes economic research on global trade and migration.

Ginger Batta, Senior Program Manager

Ginger manages the proposal phase, logistics, budgets, participant relations, execution and reporting for all events including the GTAP conferences, advisory board meetings, short courses, dynamic short courses and GTAP 101 courses. She also manages the sales, distribution, licensing and reporting for all GTAP products.

Mary Burfisher, Senior Education Advisor

Mary is leading development of GTAP 101, the Center's new online, introductory course on the GTAP Model and applied economic analysis. She is also engaged in a research project on preferential trade agreements in the Pacific Rim.

Jeremy Douglas, Web and Information Technology Specialist

Jeremy is responsible for the design, development, and maintenance of the GTAP website.

Alla Golub, Research Economist

Alla is Research Economist at the Center working on analysis of energy and climate change mitigation policies. Alla's responsibilities include extending GTAP Model to enhance its applicability to analysis of climate change mitigation policies and responding to requests by sponsor institution for analysis of particular climate policy options.

Thomas Hertel, Executive Director and Distinguished Professor

Thomas focuses on strategic issues and new research directions for the Center, as well as Consortium member development. He also supervises graduate students and is heavily involved in a number of environment-related projects at the Center.

Wendy Kincaid, Research Account Coordinator

Wendy assists the Center staff with the research account process from proposal to reconciliation and closing. Wendy is responsible for all University-Center processes. She also tracks and reports Center finances, formats the GTAP Data Base Documentation, and coordinates the technical and working paper series.

Robert McDougall, Senior Research Economist

Robert works on special projects which significantly improve the GTAP Data Base and Models. This year he has been working on energy data, energy modeling, and the development of programs to compare databases and ensure data base quality.

Badri Narayanan, Data Base Manager and Research Economist

Badri is in charge of the management and construction of GTAP Data Base releases and documentation. This year, Badri has been working on construction of the GTAP 9 Data Base. Badri is also conducting research on a range of issues, including child labor, tariff policies, FTAs, energy issues and domestic support. He teaches in the GTAP short courses as well.

Wallace Tyner, Senior Policy Advisor and Professor

Wally advises the Center on policy. Most recently he has been spearheading a number of large research projects and proposals in the areas of energy, climate change, and biofuels.

Dominique van der Mensbrugghe, Director and Research professor (as of July 21, 2014)

Dominique will oversee the day-to-day activities of the Center, as well as focusing on new initiatives in development of the GTAP Data Base and models and policy applications. He will also supervise graduate students, in the context of his ongoing research on trade, development and the environment.

Nelson Villoria, Research Assistant Professor and Associate Director for Educational Outreach and Strategy

Nelson is part of the Center's management committee, leads the annual GTAP Short Course, advises graduate students, maintains the GTAP-AEZ modeling and database framework, and conducts research on improving bilateral transport margins in the GTAP Data Base as well as including heterogeneous firms in the GTAP framework. His research interests are on global land use and agricultural international trade.

Research Associates

Zekarias Hussein, Postdoctoral Research Associate

Zekarias received his PhD in Agricultural Economics from Purdue University in December 2013 and began his postdoctoral position in GTAP in March 2014. Zekarias' dissertation focused on documenting the impact of climate change mitigation policies on poverty in developing countries. He is now working on improving the representation of government in the GTAP model. The other project Zekarias has been working on is preparation of Agricultural Protection Targeting data for Version 9 of the GTAP databases. Zekarias' research interests are CGE modeling, international trade, and environmental policies.

Zeynep Burcu Irfanoglu, Postdoctoral Research Associate

Burcu received her PhD in Agricultural Economics from Purdue University in December 2013 and began her postdoctoral position in GTAP in January 2014. Burcu's dissertation was about viability of trade sanctions as an enforcement mechanism in global GHG mitigation agreements. Lately, she has been working on a FAO funded project which is about impacts of reducing global food loss and waste on food security, trade, GHG emissions and land use. The other project Burcu has been working on is preparation of the Versions 8 and 9 non-CO₂ emissions databases. Burcu was also the teaching assistant of GTAP 101 online course. Burcu's research interests are multilateral environmental agreements, international trade, and post-harvest crop losses.

Roman Keeney, Faculty Research Associate

Roman is an Associate Professor with the Department of Agricultural Economics and Research Associate of the Center. He works on agricultural issues such as land use and biofuels and teaches in the GTAP Short Course.

Farzad Taheripour, Faculty Research Associate

Farzad is a Research Assistant Professor with the Department of Agricultural Economics and Research Associate of the Center. He has developed data and models to introduce bio-fuels into the GTAP framework and link the GTAP Model with water and energy models. He also has accomplished a major revision of the natural gas sector in the GTAP data base. He works on emissions due to land use changes associated with the production of first and second generations of bio-fuels.

Graduate students (country of origin)²

Zeynep Akgul (Turkey)

Zeynep Akgul is a Ph.D. student in the Department of Agricultural Economics. She has worked on macroeconomic mechanisms and alternative closures in the GTAP Model. She is currently working on the implementation of firm heterogeneity and monopolistic competition into the GTAP Model. Zeynep holds a BS (2007) and a MS (2009) in Economics from the Middle East Technical University in Turkey.

Uris Baldos (Philippines)

Uris Baldos is a PhD student in the Department of Agricultural Economics. He has worked on updating the global land use data bases for GTAP versions 7 and 8. He is currently preparing the necessary files/data to update the Land Use and Land Cover Data Base for version 9.

Caitlyn Carrico (USA)

Caitlyn Carrico is a Ph.D. student in the Department of Agricultural Economics. She has worked on expanding labor statistics from two skill types to five occupational types used in GTAP Data Base versions 8.1L and 9. She has also worked on the USITC-funded project that disaggregated U.S. households using the MyGTAP framework. Currently, she is working on further developing the GTAP MRIO.

Jing Liu (China)

Jing is a PhD student in the Department of Agricultural Economics. She contributes to incorporating water into GTAP database and models. Jing also works on a DOE-funded project to investigate the economic implications of water variability in the context of climate change.

Jeffrey C. Peters (USA)

Jeffrey is a PhD candidate in the Department of Agricultural Economics after transferring from Civil Engineering in May 2013. He is working on a redesign of the electric power sector for GTAP. His dissertation work revolves around the interactions between energy demand growth in the developing world, energy efficiency in the developed world, and possible resource futures (e.g., shale oil and gas).

² See supplementary materials for graduate student CVs.

Visitors to the Center

Rod Tyers, University of Western Australia

Michael Ferrantino, The World Bank

Ralph Ossa, University of Chicago

Chandra Kiran Krishnamurthy, Umea University

Thomas Rutherford, University of Wisconsin-Madison

Sofia Boza, Universidad de Chile

Yongyang Cai, University of Chicago and Hoover Institution

VI. Objectives and Accomplishments

Progress towards Goals over Past Year

Below is an assessment of our progress towards the core objectives outlined last year in the Board meeting summary:

1. **Data Goal:** To Improve the quality of data products

<i>Tasks</i>	<i>Individuals</i>
Improving the quality of contributed I-O data (core)	Aguiar
Primary Priority	
<ul style="list-style-type: none"> • Develop programs that would facilitate the contribution of Supply and Use tables and alternative formats more consistent with those coming out of statistical offices. 	Aguiar Grad Student
<i>Work has commenced, programs and documentation are expected to be made in the later part of 2014.</i>	
<ul style="list-style-type: none"> • Work with contributors to improve the EU IO Tables 	Aguiar
<i>Angel Aguiar visited IPTS in Seville, Spain, and met with three research teams to obtain more institutional support for updating the EU tables. (We had previously only been working with one of these research teams). IPTS has agreed to contribute a set of 2010-based tables by the end of 2015. The contribution of 28 EU countries is a tremendous effort, but having three units collaborating towards this goal makes it a more feasible objective. This will greatly enhance the quality of future versions of the GTAP data base.</i>	
<ul style="list-style-type: none"> • Work more closely with National Statistical Offices (NSOs) and OECD 	Aguiar
<i>NSO offices have been contacted directly. We have received letters of intent to contribute IO tables for Zimbabwe, Norway, India, Indonesia, USA, Philippines, Ukraine, Yemen, Bangladesh, and Croatia. Yemen is a country not yet in GTAP and Bangladesh and Croatia are currently on the ‘chopping block,’ which means that they could eventually be dropped if the data bases are not updated.</i>	
<ul style="list-style-type: none"> • Further examination on whether the treatment of the dwellings sector can be improved 	Aguiar McDougall
<i>We made several improvements to the treatment of dwellings sector towards the end of version 8 data cycle. However, the lack of any real international data source on dwellings or knowledge about its structure has made us wary of implementing further changes. Discussions with statistical agencies also suggest that there is no consistent treatment being applied across countries. Hence, we have decided that, until we have a better understanding of what is being done, we will continue to be cautious about making changes to the dwellings sector in the GTAP Data Base.</i>	
<ul style="list-style-type: none"> • Capital stock and depreciation 	Aguiar
<i>Updated capital stock for 150 countries based on data from the World Bank.</i>	

<ul style="list-style-type: none"> Continue to improve Energy Module 	McDougall Irfanoglu Peters Taheripour
<p><i>Robert McDougall and Zeynep Burcu Irfanoglu have been working on updating the documentation for the energy module. This will be released to the public shortly. Jeffrey Peters, a doctoral student in the Center, is currently working to redesign the electricity sector in GTAP to allow for separate modelling of ‘transmission and distribution’ as well as a suite of power generation technologies. We have an initial commitment of funding from MIT, but are in need of further contributors to bring this project to scale so it is usable by Board members and eventually the broader community. Jeff will provide a brief overview of GTAP-Power during the board meeting and a full presentation during the conference for those interested. We are also proposing a post-Board meeting discussion of this topic for interested Board members.</i></p> <p><i>Jeffrey Peters, Rob McDougall, and Farzad Taheripour are working on a GTAP research memorandum on the representation of natural gas (production ‘gas’ versus distribution ‘gdt’) in the database and how this can be improved.</i></p>	
<ul style="list-style-type: none"> Updates to the Agricultural disaggregation modules 	Narayanan Peterson McDougall Irfanoglu
<p><i>Everett Peterson has provided a new dataset for this purpose. We expect to update the data being used for agricultural disaggregation within the version 9 construction cycle. No further work has been carried out as regards non-agricultural disaggregation, since agricultural disaggregation is the higher priority item. This is due to the fact that it is used more heavily in the course of GTAP data base construction.</i></p>	
<p>Secondary Priority</p>	
<ul style="list-style-type: none"> Agricultural Production Targeting in construction 	Narayanan
<p><i>No further work has been undertaken on the agricultural production targeting module, since this involves changes in the FIT program – these are expected to be made in the later part of 2014.</i></p>	
<p>Addition/Improvement of Other Datasets in GTAP Data Base (core)</p>	
<p>Primary Priority</p>	
<ul style="list-style-type: none"> Respond to feedback on Labor Splits 	Walmsley Carrico Narayanan
<p><i>Terrie Walmsley and Caitlyn Carrico have completed a GTAP Technical Paper documenting the new 5-way labor splits embodied in the v.9 data base. This is currently under peer-review, and we are using the opportunity to actively engage the ILO in this area. To recap the major elements of this work, we began with employment and wage data provided by Marinos Tsigas for 5 ILO labor categories, 12 sectors and up to 95 countries. Two alternative approaches to the filling out of this data set were explored. First, the data was filled out to the full GTAP sector and country levels using standard</i></p>	

techniques employed elsewhere in the GTAP Data Base. This approach was applied to the GTAP 8 Data Base and implemented in v8.1-L as well as in GTAP 9 data cycle. Walmsley, Golub and Carrico also explored an alternative, statistical approach to filling out the data by estimating labor share payments as a function of educational attainment, level of economic development and other variables. However, results showed that only a low proportion of sample variance in the shares of labor payments can be explained by the regressors, indicating that above-mentioned data filling method is preferred.

• Investigate Services trade data from Francois	McDougall
---	-----------

This is ongoing work.

• Update income tax rates for all years	Aguiar
---	--------

This is ongoing work, to be implemented in pre-release 2.

• Improved estimation of International Transport Margins	Villoria
--	----------

This work will be completed by October 2014.

• FIT Module changes (taxes & domestic support)	McDougall Narayanan
---	------------------------

No further work has been carried out on the FIT module this year. It remains a high priority for v9, as modification of this program is a key element of our data plan.

• Agricultural disaggregation module updates	Peterson
--	----------

Everett Peterson has provided us the dataset. We are working on including it in the data base.

• Energy module fixes in African countries	McDougall
--	-----------

This is ongoing work.

• Incorporation of Agricultural production targeting into main construction build process	McDougall
---	-----------

This is ongoing work.

• Processing of ITC tariff dataset for version 9	Mimouni
--	---------

This is completed.

• Finalize reference year and set labels for v9	Narayanan
---	-----------

Reference years have been finalized, but set labels remain unchanged for now. This will be reconsidered once the new Director (van der Mensbrugghe) is on board.

• Updates to non-agricultural disaggregation modules	Narayanan
--	-----------

Given the higher priority needed for agricultural disaggregation and the lack of staff resources, we decided not to pursue this task for version 9. This may be taken up in version 10.

Secondary Priority

• Examine possibility of targeting trade balances	McDougall
---	-----------

No progress has been made here, given the other primary priorities.

• Examine the availability of NSO data (production, etc., by year) To update IO tables as part of FIT process (when redo FIT)	Aguiar McDougall
---	---------------------

No progress has been made here. This is a longer term goal which will be implemented gradually over several versions.

• Domestic Margins	McDougall Aguiar
--------------------	---------------------

No progress has been made here. This is a longer term goal which will be implemented gradually over several versions.

- Domestic support, PSE database for Africa - MAFAP Narayanan
-

Domestic support estimates for non-OECD member economies have been revised (for 2004) and updated (for 2007) in version 8.1. Indonesia is a new addition, while we have five other non-member countries.

During the last board meeting there was some discussion about using MAFAP (FAO) data as a potential data source for African countries. We found that MAFAP data have been released on their website, but we are not sure whether these measures are OECD compliant: <http://www.fao.org/mafap/database/en>

If there are any ideas on incorporating this dataset in the GTAP Data Base, then please let us know.

*Further information on this can be found on the FAO website at:
http://www.fao.org/fileadmin/templates/mafap/documents/MAFAP-Methodology_Paper__Preliminary_Draft__29_April.pdf*

In addition, Carlos Ludena has brought to our attention a new, OECD-compliant, domestic support data base being developed for Latin America and the Caribbean. Both of these developments are promising and offer scope for greatly extended coverage of domestic support for agriculture.

Addition/Improvement of Protection Data (core)

- Work with ITC-Geneva to make the MAcMaps data and online tools available to board members and then to the network Narayanan Mimouni
-

Badri Narayanan and Janine Pelikan visited the ITC to work with the MacMAPS team and procure the tariff dataset for GTAP 9 Data Base. This was completed and these data were successfully incorporated in the first pre-release done in March 2014.

- Finalize report and distribute Narayanan Bouët
-

The report on ITC protection data, done by Antoine Bouët, was finalised and posted on the Board website.

- Update TASTE to v8 Pelikan Guimbard Laborde Horridge
-

This has been completed and will be released on the GTAP website to the public.

Version Control and Documentation

- Begin to implement pre-release process for version 9 McDougall Aguiar
-

This has been started and the first pre-release was done in March 2014.

- Finalize Documentation Narayanan Aguiar McDougall
-

Updates to the documentation are taking place on an ongoing basis. Documentation for

the GTAP 8 Data Base is largely complete. This is always a challenge, as it involves dozens of contributors, many of whom are very busy. However, it is an essential feature of the GTAP landscape. References to the work of contributors also represent an important means of acknowledging these important contributions. The documentation is available on the website at:

www.gtap.agecon.purdue.edu/databases/v8/v8_doco.asp.

- | | |
|---|---------------------|
| <ul style="list-style-type: none"> • Release GTAP 8.1 Data Base and Africa Data Base | Narayanan
Aguiar |
|---|---------------------|

All these datasets have now been released.

Monitoring Data Quality using Comparison Programs (core)	Narayanan
---	------------------

- | | |
|---|----------------------------------|
| <ul style="list-style-type: none"> • Undertake more pre- and post-data Comparisons | Narayanan
Aguiar
McDougall |
|---|----------------------------------|

This is ongoing work. We undertake these comparisons during every release and circulate them to the Board.

Communication (core)	Narayanan
-----------------------------	------------------

- | | |
|--|--------|
| <ul style="list-style-type: none"> • Add a number of FAQs to the website to address questions like: Is GTAP SNA compatible? | Aguiar |
|--|--------|

This is ongoing work. We keep adding to the FAQs based on the responses we provide to the questions that come up on gtap-support and gtap-l.

- | | |
|--|---------|
| <ul style="list-style-type: none"> • FAQ/Website: where does my money go? | Kincaid |
|--|---------|

This has not been pursued so far. We will do this later this year, once the new staff are on board.

Satellite Data	
-----------------------	--

- | | |
|---|----------------------------------|
| <ul style="list-style-type: none"> • Finalize Non-CO₂ emissions satellite dataset | Ahmed
Steve Rose
Irfanoglu |
|---|----------------------------------|

This task is completed, thanks to supplementary funding from the Board. Tom Hertel will present a summary of the work undertaken on this data at the board meeting, as well as a proposal to 'mainstream' this work in the future so that all of the GHG emissions data are released at the same time as the main data base.

- | | |
|--|-----------------------|
| <ul style="list-style-type: none"> • Make GTAPAgg more flexible and provide GTAP-E GTAPAgg for (CO₂ emissions) | Narayanan
Horridge |
|--|-----------------------|

Mark Horridge is working with the GTAP staff to finalize a new GTAPAgg. This will be included before the final release of GTAP 9 Data Base.

- | | |
|---|--------------------|
| <ul style="list-style-type: none"> • Incorporate land use construction into main build | Baldos
Villoria |
|---|--------------------|

This is ongoing work and will be done towards the final release of GTAP 9 Data Base.

- | | |
|---|---|
| <ul style="list-style-type: none"> • Land use data and GTAPAgg/FlexAgg program | Baldos
Hertel
Villoria
Narayanan |
|---|---|

This task is completed. GTAP 8 Land Use and Land Cover Data Base were added to

the GTAP Satellite Data and Utilities. Land use dataset together with the standard data base for 2004 and 2007 were included in a single FlexAgg package.

Publish more papers on the GTAP Data Base construction process

- Papers on data base construction process, including specific examples on why data do not match original data
- Aguiar
McDougall
Narayanan
-

In 2013, one research memorandum, one book chapter and one journal article documenting the GTAP data base and construction processes were published, these are listed in this document.

- Papers documenting construction and impacts of processing (e.g., comparing changes in I-O tables during the construction process)
- Narayanan
Aguiar
-

*A working paper for new users documenting the GTAP Data Base has been produced. This has also been published in Japanese in the Life Cycle Assessment Journal. www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=3965
A second paper, aimed at more advanced users and documenting the GTAP Data Base construction process is currently being written.*

2. **Research Goal:** To actively participate in quantitative economic analysis of pressing global concern

<i>Tasks</i>	<i>Individuals</i>
Trade and Development; Global Energy and Environmental Issues	

- Continue to publish papers on trade, poverty, migration/labor, energy and environmental issues
- GTAP Staff
Grads
-

This was a banner year for research publications in the Center. These are listed below.

3. **Model Goal:** To promote further development of GTAP-based models

<i>Tasks</i>	<i>Individuals</i>
Technical Papers	
Primary Priority	

- Finalize technical paper on GDyn-E Model
- Golub
-

A paper documenting the GDyn-E model was published in September 2013.

- Finalize paper on macro transmissions mechanisms
- Villoria
Walmsley
Hertel
McDougall
Akgul
-

The paper on macro transmissions is being completed and will be sent for external review in Summer 2014.

- Finalize poverty technical paper appendix; obtain country contributions
- Hertel
-

Based on the methodology outlined in the GTAP-POV technical paper, Carlos Ludena is supporting development of poverty modules for 16 countries in Latin America and the Caribbean. In the process, the GTAP-POV technical paper is being revised by Eduardo Magalhaes, an expert on the processing of household surveys, to reflect improved methodologies and more clear-cut instructions to contributors.

- Paper on incorporation of specific tariffs into the data base and standard model

Narayanan
Villoria

This was presented in the Shanghai conference and will be submitted to a journal later this year.

Secondary Priority

- Technical paper on a Firm Heterogeneity Model

Villoria
Walmsley
Akgul

The introduction of heterogeneous firms into the standard GTAP Model is advancing with a technical paper prepared for external review in the Summer of 2014. This will also be a featured application in the 2014 GTAP short course, thereby ensuring that these important developments in trade theory are available to all members of the GTAP community.

- Finalize technical paper on tariff aggregation tools

Martin

Will Martin and colleagues are continuing to finalize this paper in light of reviewer comments.

4. **Education Goal:** To expand and improve global economic analysis education worldwide

Tasks

Individuals

Education

Primary Priority

- GTAP Short Course (Istanbul, Turkey)

Villoria

Course was successfully completed. Thanks are due to our host, Emre Akel at the Turkish Ministry of Economy, and to the instructors on this course: Angel Aguiar, Mark Horridge, Robert McDougall, Badri Narayanan, Anna Strutt, and Nelson Villoria.

- Implement Education plan

Villoria

We have a full short course this year, having also implemented graduate student fellowships which we believe will help us reach the next generation of CGE modellers. In addition, GTAP 101 is off and running at full steam, with its third course offering starting later this year. Depending on time commitments we may add more advanced online courses (e.g. GTAP 201 and GTAP 301), but not this year!

Secondary Priority

- Live forums on topics of interest to the Network

Narayanan
Aguiar
Batta

There were no live forums this year, owing to frequent travel of the staff and changes in staffing. We will pursue this avenue of outreach in the coming year.

5. **Staffing Goal:** To actively seek and encourage talented staff and graduate students

<i>Tasks</i>	<i>Individuals</i>
Recruitment	
Primary Priority	
<ul style="list-style-type: none"> Active recruitment of graduate students 	Hertel Villoria
<i>Recruitment activities are carried out annually and include a meet-and-greet with incoming students, as well as ongoing involvement with the graduate program. Formal course offers, especially, AGECE 618 - a PhD course in General Equilibrium Analysis - as well as two seminars on frontier topics on land use, resources, and energy economics: AGECE 596 by Thomas Hertel, and AGECE 690 by Nelson Villoria, have expanded the academic offerings of the Center.</i>	
<ul style="list-style-type: none"> Undertake management restructure and develop hiring plan 	Hertel
<i>In the fall of 2013 we held a strategic planning meeting and came up with a hiring plan. We have subsequently hired a new Director (Dominique van der Mensbrugge), a new Senior Program Manager (Ginger Batta) and a new IT specialist (Jeremy Douglas). We are still searching for one more position – a Research Economist to join the Data Team.</i>	

6. **Collaboration Goal:** To actively seek opportunities for fostering collaboration with institutions around the world

<i>Tasks</i>	<i>Individuals</i>
Primary Priority	
Seek partners and funding opportunities for collaboration (core)	
<ul style="list-style-type: none"> Attend IO meetings 	Aguiar
<i>Angel Aguiar was invited to teach a GTAP Input-Output contribution course at the International Conference of the Input Output Association in Japan. Angel also attended and presented at the Spanish Association of Input Output (SHAIO) in Seville, Spain, which gave him the opportunity to meet with staff at the EU-JRC in Seville.</i>	
<ul style="list-style-type: none"> Ongoing work with contributors, see IO report 	Aguiar
<i>Visited IPTS to talk about the contribution of EU tables.</i>	
<ul style="list-style-type: none"> Extend collaborations with the ILO 	Walmsley Hertel
<i>The ILO has been going through a reorganization. However, remain interested in collaboration and Tom has been corresponding with them in this regard. They are currently reviewing the draft GTAP Technical Paper on splitting labor categories in the GTAP data base.</i>	
<ul style="list-style-type: none"> Explore ways to help board members get the message out to other divisions 	Alexander
<i>Meghan departed in early October and this has not been pursued. We will revisit our overall communication plan in the coming year.</i>	
<ul style="list-style-type: none"> Link with geospatial community through GEOSHARE/AgMIP 	Hertel Villoria

Joshua Elliot from the Agricultural Modeling Intercomparison and Improvement Project (AgMIP) and Nelson Villoria (GEOSHARE) have released a “GEOSHARE Tool for aggregating projected crop yields from the AgMIP's Global Gridded Crop Model Intercomparison Project,” which is available at <https://geoshareproject.org/tools/cropdatatool/>. In addition, a post-doctoral Fellow will funded by GEOSHARE and other non-GTAP sources in the coming year. This will enable us to exploit these spatial data econometrically to support behavioural responses in the GTAP-AEZ model.

Proposed Activities over the next year and beyond

(to be completed in time for the Board meeting)

VII. The GTAP Data Base and Other Data Projects: Progress and Future Objectives

In this section we concentrate on the primary product of the GTAP network – the GTAP Data Base. In the first sub-section, we summarize the post-releases of GTAP 8 Data Base. In the second subsection, the timetable and priorities for future versions of the GTAP Data Base and satellite datasets are discussed.

The GTAP 8 Data Base Cycle in 2013-14

An overview of the evolution of the GTAP Data Base and Project is provided on the website:

<http://www.gtap.agecon.purdue.edu/about/history.asp#db>

We made several releases of the version 8 Data Base available for the Board and subsequently to the public in 2013. They include the GTAP 8.1 Data Base and all the satellite datasets associated with it. A special labor splits dataset was released to the Board only. An Africa release was also made publicly available. Subsequent to the last Board meeting, we had two major releases in GTAP 8 Data Base cycle. Firstly, the GTAP 8.2 Data Base was made available to the Board only. This includes six new, as well as six updated, IO tables (see below). Secondly, the non-CO2 emissions dataset was made available to the Board and then to the public.

In February 2014, the GTAP 8.2 Data Base was made available to the Board. Following are the IO tables introduced (new) and updated in this version:

New:

Brunei Darassalam, contributed by Ken Itakura

Jordan, contributed by Mohamed Hedi Bchir, Sandra El-Saghir Sinno, and Angel Aguiar

Dominican Republic, contributed by Carlos Ludena and Mark Horridge

Jamaica, contributed by Carlos Ludena and Mark Horridge

Trinidad and Tobago, contributed by Carlos Ludena and Mark Horridge

Puerto Rico, contributed by Carlos Ludena and Mark Horridge

Updated:

China, contributed by Yu Liu and Jie Chen

New Zealand, contributed by Anna Strutt and Papu Siameja

Pakistan, contributed by Dario Debowicz, Sherman Robinson, Hamza Syed Haider, and Paul Dorosh

Paraguay, contributed by Martin Cicowiez, Horacio Santander and Carlos Ludena

Senegal, contributed by Angel Aguiar

Turkey, contributed by Mustafa Acar and Levent Aydin

A full report on the IO tables is available in the supplementary materials:

https://www.gtap.agecon.purdue.edu/events/Board_Meetings/2014/supp_material.asp

Satellite Data and Utilities

In March 2014, the non-CO2 emissions dataset was released to the public after several revisions and improvements based on feedback from the Board and efforts by the contributors, namely, Amer Ahmed, Zeynep Burcu Irfanoglu, Steve Rose and Tom Hertel. Based on feedback from Hom Pant and Joe Francois, a decision was made to constitute a committee that will examine the possibility of automatic updating of non-CO2 emissions dataset, much like how the CO2 emissions dataset is constructed, within the standard data base construction build. There will be a short post-Board meeting on Tuesday afternoon to discuss this work.

TASTE Tool: Janine Pelikan, with inputs from Mark Horridge and David Laborde, updated TASTE for GTAP 8.1 Data Base. However, the bound tariff rates, which are crucial for the use of the *TASTE tool* for WTO analyses, are not available. Therefore this version is being made public shortly, as an add-on for *TASTE tool* for version 8.1. Currently Janine Pelikan has prepared a *TASTE tool* for version 9 and we shall release it to the Board shortly.

Ensuring Quality: Comparisons, Reviews and Outstanding Concerns

Quality reports and issues related to the GTAP Data Base are placed on the GTAP website and updated regularly.

- a) The issues raised since the recent public release of the GTAP Data Base and our response to these issues can be found at:

https://www.gtap.agecon.purdue.edu/access_board/GTAP8.asp#issues

- b) The annual report on the quality of contributed I-O tables is included in the supplementary materials for the board meeting:

https://www.gtap.agecon.purdue.edu/events/Board_Meetings/2014/supp_material.asp

The GTAP Data Base: Priorities for Future Releases

In this section we outline a few priority areas for public release of version 9. We also provide a schedule for this release. In keeping with our goal of extending the data set into a meaningful time series, with consistent source data and methodologies across all years, the reference years of this release will be 2004, 2007, and 2011. Following this we provide a list of a few additional items we are currently considering to further improve the GTAP Data Base in either version 9 or beyond. We would be interested in hearing the extent to which these should be prioritized. The first pre-release of version 9 was made available to the Board in March 2014.

The GTAP 9 Data Base

Tariff Data

As agreed last year, ITC provided us the 2011 and 2007 tariff datasets for version 9 by September 2013. In this context, one aspect worth noting is that it is highly desirable to have as much consistency as possible for the sources and methodologies used for data for all the reference years. Thus, one priority in this area will be to ensure that we use new datasets for 2004 as well in the final release of version 9, to be consistent with the 2007 and 2011 datasets. In version 8, we did not fully achieve this goal, as the 2004 tariff dataset was not revised following the earlier contribution in version 7. The problem is that tariffs are often revised and if we use versions

submitted at different times, they are not fully consistent and therefore disrupt the quality of the time series which we are gradually extending.

Protection Data Processing Module

Whenever the source data on tariffs are updated, we must also engage in some additional processing of the tariff data in-house. In particular, we must remove tariffs on travelers' expenditures, which show up in the trade flows, and retain tariffs on zero trade flows, by using reference-group-weighted tariff for zero or very small trade flows. This will be done for the version 9 time series.

Export subsidies for 2004 were contributed in version 7, by Aziz Elbehri, while for 2007, they were contributed by David Laborde, with many revisions in methodology, including increased country and sector coverage, bilateralization of subsidy rates, and inclusion of export taxes as well as subsidies. Thus the export subsidies data for 2004 and 2007 were not strictly comparable in version 8. This will be addressed in version 9, since David Laborde will be contributing a revised dataset for 2004, 2007, and 2011.

Energy subsidies from OECD

The energy subsidies committee has had ongoing discussions over e-mail about the possibilities of including OECD energy subsidies data in the standard GTAP Data Base. A presentation was made to the Board in Shanghai. However, this has not progressed further. This is an issue which likely requires a champion to move it ahead and do the necessary legwork – much as we had for the agricultural subsidies data base.

Commodity Taxes and Domestic Support

A number of technical changes are required to the FIT Module to ensure that we no longer remove commodity taxes from IO tables and that we appropriately target domestic support rates in the protection module. Targeting the domestic support rates will also help us re-include the decomposition of the domestic support, which was removed from GTAP 8.1 Data Base, owing to the lack of conformity of the decomposition numbers with the actual domestic support data. These issues will be resolved in the course of finalizing version 9.

In addition, it is desirable to extend the coverage of domestic support to more countries. In version 8.1, we included Indonesian data from the OECD dataset, in addition to other non-member economies. This exercise has also been useful for learning how to utilize the new format of the OECD domestic support data within the GTAP Data Base.

The IPTS team (George Philippidis and Pierre Boulanger) have kindly agreed to work together with Hans Jensen on the domestic support dataset for the EU member countries. DG Agriculture in the European Commission, Brussels, has permitted this team to use the CATS database (with full pillar 2 support representation) for this purpose. This means that the dis-aggregation of the EU domestic support dataset will be more precise than our earlier work where we made some general assumption about co-financing of pillar 2 support payments. We will start off by dis-aggregating the EU PSE for the new base year 2011 of the version 9 database and subsequently return to the years 2007 and 2004 to recalculate the disaggregated EU PSE tables given the better

data found in the CATS database. This will make the representation of the EU Common Agricultural Policy more consistent across GTAP databases.

Income Taxes

In version 8, new income tax data were not collected for the new reference year. Instead, older 2004 rates were applied to the new data. While this assumption may be reasonable in many cases, up to date income tax information is readily available. In future versions we intend to collect additional data from international datasets such as those provided by the IMF and the World Bank to update the tax rates in each version.

Labor Skill Splits

New wages and employment data for 5 ILO skills categories, 12 GTAP sectors and up to 95 countries have been received from Marinos Tsigas and Alison Weingarden. This dataset was filled and applied to the GTAP Data Base by Terrie Walmsley, Caitlyn Carrico and Badri Narayanan. Previously released in version 8.1-L, the new skill splits will become publically available with the official release of version 9.

Agricultural Production Targeting

Agricultural production targeting was introduced to improve the consistency between the GTAP Data Base and the European IO tables, as well as the OECD protection expenditures. This agricultural production targeting is currently done prior to the database construction process itself and is susceptible to human error as files get transferred between staff members. Since agricultural production targeting is still desired by board members, we have decided that it should be included in the main build process (i.e. automated) in the future so that such errors can be reduced.

Agricultural Disaggregation

In version 9, we will update the FAO agricultural data, with the help of Everett Peterson, for disaggregating agriculture in those IO tables requiring further disaggregation. Burcu Irfanoglu assisted Everett Peterson, with inputs from Badri Narayanan, to process the data from FAO for this purpose. We also procured UN commodity production statistics dataset to fill in the missing data for a few agricultural and food processing sectors. The data has been contributed by Everett Peterson and this will be incorporated into the version 9 data cycle by the end of this year.

Energy

A few improvements in the construction of energy volumes, prices, taxes and emissions datasets are expected to be made in the version 9 data cycle. One issue needs special attention. Malawi, Mauritius and Uganda have significant oil sectors. In the construction process, we revise the energy sector to conform better to IEA data, which records data for these countries not individually, but as part of "Rest of Africa." Therefore, "Rest of Africa" produces and exports oil in significant quantities. We apportion those flows, with other energy flows, among "Rest of Africa" member countries according to GDP shares. The problem with this approach is that the production and exports actually belong to Chad and Equatorial Guinea, which are not separately identified in our the data base, but end up reassigned to other countries like Uganda, which are. We plan to bring in data from other sources (such as UN commodity production statistics) to improve our disaggregation of the IEA energy balance data countries and avoid this problem.

Dwellings Module

Angel Aguiar made several improvements to the treatment of dwellings sector towards the end of version 8 data cycle. However, the lack of any real international data source on dwellings or knowledge about its structure has made us wary of implementing further changes. Discussions with statistical agencies also suggest that there is no consistent treatment being applied across countries. Hence, we have decided that until we have a better understanding of what is being done, we will continue to be cautious about making changes to the dwellings sector in the GTAP Data Base.

Set Labeling

Some of you may have noticed that a couple of the 3-letter *country* codes are identical to existing 3-letter *sector* codes. While this does not seem to result in any big issues for GAMS or GEMPACK users, it can affect the ordering of countries when some lesser-known GAMS programs are used. As a result we may change our commodity codes in version 9. If you have any preferences please feel free to express them to Badri Narayanan.

GTAPAgg

GTAP Agg is the tool used by many in the network in order to aggregate the core GTAP data to a level appropriate for the application at hand. There are two issues with the current implantation of GTAPAgg. First of all, with the proliferation of satellite datasets, the number of aggregation programs has increased significantly. This increases the number of datasets and accompanying GTAPAgg/FlexAgg programs which need to be downloaded, as well as increasing the number of checks that we need to undertake to ensure aggregation is done properly and the software is compatible.

Second, increasingly we would like the flexibility to add extra variables ('headers') which should not be aggregated, but should be retained for information, or which might need to be aggregated in a more complicated way. Mark Horridge has been working on a new GTAPAgg software package that addresses these issues above. A draft version has been reviewed by the GTAP staff and a final version is expected to be used in the later pre-releases of version 9.

International Transport Margins

Nelson Villoria is leading the project on improving the data on modal shares used in international transport margins. A detailed proposal is available in the appendix.

Changes in Construction Programs

Apart from the changes in methodologies, we also expect to make major changes in the data construction programs. The most important of these is to separate programs and data to avoid possibilities of confusions and mix-ups arising from multiple reference years in the data base, while also making sure that we use exactly the same set of programs for all years. Another challenge with increasing the number of years in future releases is about how to arrange the data files. So far, the strategy has been to prepare separate GTAPAgg and Flexagg packages for every reference year, which we expect to continue through version 9. A preferred long run solution might be to construct just one set of data files with all years indexed therein, along with programs that split it into single-year data bases. Your feedback will be useful for our planning for future releases, in this regard.

Base Years

For all future releases, we will include all the previous reference years starting from 2004. For version 9, we will have 2004, 2007, and 2011, for example. We had internal discussions on the choice of the latest base year for version 9. While 2010 would have translated into uniform time steps between reference years, we chose 2011 because the source data sets on the macro-economy, trade and tariffs were available. Furthermore, the ITC was able to provide greater geographical coverage for 2011 than for 2010. For these reasons, we chose 2011 as the latest base year for version 9. This would also improve the lag between the release year (2015) and the latest base year (2011), by one year compared to version 8.

Schedule for version 9

Below is the schedule for the GTAP 9 Data Base. The first pre-release was made available to the Board in March 2014, the second and third pre-releases are expected to be available after the 2014 board meetings in Senegal in July and October, respectively. The final release candidate is expected to be made available to the Board by December 2014.

Release	Updates	When?
Pre-release 1	Macro-economic, Merchandise Trade, tariff, labor splits	March 2014
Pre-release 2	(Part of) Services trade data, Domestic Support, Export Subsidies, Part of energy (volumes)	July 2014
Pre-release 3	Agricultural Input-Output tables for disaggregation, Energy, Demand parameters, Fixes to the targeting of domestic support and commodity taxes, Dwellings, International transportation margins	October 2014
Final release candidate		December 2014

Detailed tasks and priorities for the data base are summarized below:

Task	Who?	When?	Priority
Data Updates:			
1. Macro-economic datasets: GDP and its components, government and income & factor employment taxes, capital-stock, depr.	Aguiar	done	HIGH (for all components)
2. Trade data: Merchandise Services	Narayanan Narayanan/McDougall Narayanan	Done (for 2011) October 2014 Done (2004 pending)	
3. Tariff data	Narayanan		
4. Labor splits	Narayanan	Done	
5. Domestic Support	McDougall Aguiar	July 2014 May-August 2014	
6. Energy data	Narayanan (Laborde)		
7. IO Tables	Narayanan/McDougall	Continuous	
8. Export Subsidies		August 2014	
9. Agricultural IO tables	Villoria	August 2014	
10. International Transportation Margins	Hertel	October 2014	
11. Parameters		November 2014	
Data Base Modules:			
1. Separation of programs from data	Narayanan	June 2014	High
2. Improvements in specific modules	Narayanan/McDougall	Ongoing	High
I-O 'Fitting' Module:			
1. Commodity tax and domestic support fix	McDougall	August 2014	HIGH
2. Agricultural Production Target	McDougall McDougall		Medium/Low Medium/Low
3. Other industries' targeting	Narayanan		Medium/Low
4. Travelers' Expenditure			

Energy Module: 1. Fixes for Africa 2. Other fixes	McDougall	August 2014	High
Protection Module: Use energy-adjusted country-level trade data to average tariffs. Remove tariffs on travelers' expenditure (involves protection, energy, FIT and assembly module fixes) Retain tariffs on zero trade flows Use RG Weighted tariff for zero/tiny trade flows	Narayanan	August 2014	Medium
Dwellings Module	Aguiar/McDougall	June 2014	Medium
Sets labelling/GAMS GTAPAgg2	All Narayanan/Horridge	July 2014 December 2014	High High
Land use data base	Villoria	Late 2014	High
Disaggregation Module	McDougall/Aguiar/Narayanan	2015	Low
Domestic Margin	McDougall/New person	2015	Low

Satellite Datasets

Most of the satellite datasets for version 9 are expected to be available along with the final release candidate. Hans Jensen suggested that the land use dataset in GTAP Data Base should be synchronized with the GTAP-AEZ dataset, so that the standard release and satellite datasets are completely consistent with each other. This seems like a good idea. The data team in the Center shall investigate this further in the context of the version 9 final release.

There has been a lot of interest among the Board members and the network in releasing GTAP Non-CO2 dataset along with the standard release, by automating the process. This idea will be investigated by a committee that will be formed during this Board Meeting.

Other GTAP Data Base Priorities

At the Center's annual strategic planning meetings in the fall of 2012 and 2013, the staff discussed a number of ways in which the database could be further improved in light of concerns raised about our methods and the development of new global datasets (e.g., EXIPOL and WIOD). The following additional changes to the GTAP Data Base were discussed.

Supply and Use Tables (SUT)

It was decided that we should develop programs to convert supply and use tables in house, so that GTAP can now start to accept supply and use tables that are in a standardized format. This would also help to ensure that the EU tables are updated more frequently. Angel Aguiar is working on these programs; they are expected to be released along with documentation later this year.

In addition to accepting SUTs it was also decided that we should try to work more closely with the OECD and National Statistical offices. Angel Aguiar is increasingly in contact with NSO.

Trade balances

We are also considering targeting outside data on trade balances which can presently diverge from ‘official’ sources due to the bilateral trade reconciliation procedure used in GTAP. This would allow us to better match all the components of GDP, but would require scaling of the balance discrepancies. This may be pursued after releasing version 9.

Targeting Production Data

It is our understanding that annual production data exists for a selection of industries. We are considering adjusting the regional data (IO Tables) to match production by sector for the reference year. This would help update the country data for any structural changes, particularly for those IO tables that have older reference years. It could also assist us in addressing the African energy issue discussed above. We will begin exploring potential data sources after version 9 is released.

Papers and Comparisons

Staff at the Center also decided that they need to publish more papers on the construction of the GTAP database and how the regional data changes as a result of that process. As a result we have started to develop a number of research papers, including the following that have been published over the last year:

Walmsley, T.L., Angel Aguiar and G. Badri Narayanan (2013). “A Global Dataset of Input-Output Tables Linked by International Trade and Policy Data,” *The Journal of Life Cycle Assessment*, Japan 9(2): 76-83.

Walmsley, T.L., Angel Aguiar and G. Badri Narayanan (2013). “Introduction to Global Trade Analysis Project and Data Base,” In Ed. Manfred Lenzen and Joy Murray, *The Sustainability Practitioner’s Guide to Multi-Regional Input-Output Analysis*, Common Ground Publishers and The University Press at Urbana Champaign, Illinois, USA.

Services Data

We are currently using bilateral services trade data provided by the CPB, Netherlands, although we recently received a different set of services trade data from Joe Francois, which was used in the WIOD project. We hope to compare the two data sources to see if there is potential to improve the current data, during the course of version 9 data production.

Domestic Margins

This has long remained on the GTAP Data Base wish list, however, due to current limitation on personnel, we have not yet been able to complete this task.

Multi-Regional Input-Output (MRIO) Tables

Terrie Walmsley and Tom Hertel worked with David Hummels to develop a GTAP-based MRIO for an ADB funded project on supply chains in Asia. For this project, three alternative GTAP-based MRIOs were developed and analytically compared. Further, a new model, GTAP-SC, was developed to incorporate the additional dimensions of an MRIO. This was used to assess the supply chain impacts of localized disasters.

Currently, Caitlyn Carrico is working with Tom Hertel and Terrie Walmsley to improve upon the GTAP-MRIO. This involves determining the optimal splitting strategy to allocate bilateral trade sourcing at the “agent” level (i.e. industries and final demands).

Other Data Related Activities: Progress and Priorities

Tariff dataset and policies

GTAP staff members (Badri Narayanan in particular), along with the ITC team (Xavier Pichot and Mondher Mimouni), Janine Pelikan, Ken Kawasaki, Arata Kuno and Houssein Guimbard, have been involved in various research and data projects related to trade and protection in the GTAP Data Base. Findings will be presented in an organized session in the upcoming conference in Dakar. The areas of work include compound tariffs, tariff concessions and utilization of tariff preferences. As a part of these projects, we expect to release a data resource consisting of the final tariffs implied by the plethora of tariff concessions implemented in the Asia-Pacific region.

Different types of taxes, tariffs and support payments

In the GTAP 8 Data Base, we provided the break-down between ad valorem and specific tariffs in the data base files. We also included the break-down between different types of domestic support payments. While we have retained the former in the GTAP 8.1 Data Base and in future releases, we have removed the latter, since the numbers shown in this decomposition do not match those in the data base, owing to difficulties in targeting domestic support. We expect to address this in version 9. We expect these disaggregated datasets to trigger further research on taxes, tariffs and domestic support. Narayanan and Villoria have utilized these splits to investigate the interplay between specific and ad valorem tariffs. This work can be readily extended to other types of taxes, as well as to domestic agricultural support payments.

VIII. Research and Model Development: Progress and Future Objectives

Research Goal: To actively participate in quantitative economic analysis of pressing global concern in the areas of Trade and Development, Energy-Economy Interactions, Land Use and Climate Change

(In the past we have separated these topics. However, our recent work is very much focused on the integration of trade, energy, land use, climate and development, so such a separation no longer makes sense.)

Model Goal: To promote further development of GTAP-based models

The research and modelling goals have been combined here, since most of our research is model-based and much of this involves the development of new models.

Core Funded Projects

The further development of the Static and Dynamic GTAP Models continue to be core research activities for Center staff. Related to this theme the following activities were conducted this year:

- Alla Golub has developed a dynamic version of the GTAP-E Model and corresponding technical paper to analyze US and global carbon pricing policies. The GDyn-E technical paper has been through peer review and is now published on the GTAP web site.
- Zeynep Akgul, in collaboration with Nelson Villoria and Thomas Hertel, is incorporating the basic theory of trade with heterogeneous firms (the Melitz model) into the standard GTAP modeling framework. This work will be presented at the 17th Annual Conference on Global Economic Analysis and will be an application in the 22nd Annual Short Course in Global Trade Analysis. In short, our goal is to ‘mainstream the Melitz model into the GTAP community.
- Jeffrey Peters is working on a prototype model and data base which would permit the electric power sector to be disaggregated by power generation source, as well as transmission and distribution, within the GTAP framework. He will present his proof-of-concept work at the Board meeting and Conference. We will have a post-board meeting to discuss possibilities for scaling this up to the full data base. Doing so will require some additional funds from interested Board members. Here, we envision something very much like the Non-CO2 data base project, wherein a pilot project is undertaken, results are shared with the Board members for testing, the data are eventually released to the public, and we seek to incorporate this methodology into the main build stream for GTAP.
- Nelson Villoria has been refining the data and modeling tools for land use and GHG emissions modeling within the GTAP-AEZ model. This has included creating an

aggregation tool for GTAP-AEZ, overseeing publication of improved emissions factors and tightening the link between GTAP-AEZ and the standard GTAP model.

- A key factor in the success of GTAP to date has been the tools available for decomposing and explaining results. Therefore, we are continually seeking to augment this toolkit. One area in which improved analysis is required is explaining the sources of emissions abatement in the face of carbon tax or GHG emissions constraint. Computation of Total Requirement Coefficients (TRCs) is required for this exercise. This work comprises three different stages, of which the first one is completed so far: development of cygpack software package to run GEMPACK programs in Cygwin environment; an application using standard GTAP model to illustrate the usefulness of TRCs; and decomposition of results from an illustrative GTAP-E model simulation.
- Zeynep Akgul has been assisting Robert McDougall, Terrie Walmsley, Thomas Hertel and Nelson Villoria in documenting a macroeconomic decomposition tool for the GTAP Technical Paper Series. This tool will aid GTAP users in better understanding the mechanisms driving economy-wide results in the GTAP Model.
- Badri Narayanan and Nelson Villoria are working on a version of the standard GTAP Model that includes both specific and ad valorem import tariffs. Results of this work are being prepared for publication. This work will be expanded to include other policy instruments where specific taxes and subsidies are prevalent (e.g. agricultural policies).
- Graduate student, Burcu Irfanoglu, under the supervision of Alla Golub and Juan Sesmero (Purdue University) has extended the GTAP-AEZ-GHG model to analyze the effectiveness of punitive tariffs and border tax adjustments as enforcement mechanisms in Global Greenhouse Gas Emissions Mitigation Agreements. A paper focusing on comparison of border tax adjustment and punitive tariffs viability in deterring free-riding has been presented at several professional meetings and is now under peer-review.
- Graduate student, Zekarias Hussein, under the supervision of Alla Golub and Tom Hertel, has incorporated the poverty module GTAP-POV into GTAP-AEZ-GHG model to analyze impacts of Annex I GHG mitigation and global carbon sequestration incentive policies on poor households in developing countries. This work has been published and he is presenting a follow-on paper at the upcoming conference in Dakar, Senegal.

Externally Funded Projects

1. Quantitative Analysis of Vulnerability Reduction and Diversification in Africa, World Bank and Netherlands Partnership program, 2011-13

Staff: Terrie Walmsley, Angel Aguiar, Badri Narayanan

Collaborators: Peter Minor, Will Martin, Stephen Karingi, Mary Burfisher, Scott McDonald, Anna Strutt, Maros Ivanic and Rob Davies

The GTAP Model is widely used to examine the impact of trade liberalization on the global economy; however the GTAP Model and database do not include many of the features prevalent in developing countries, such as the government's heavy reliance on foreign aid and import tax revenues, and the need for examining the impact of policies at the household level. Access to quality data in developing countries is also problematic. This year the project has involved mentoring five individuals from Africa to use the MyGTAP modeling suite, and the release of the African GTAP Data Base (in May). Three of the papers were presented at the 10th Partnership for Economic Policy (PEP) General Meeting, in Cape Town, South Africa on May 9, 2013.

- External Shocks and Adjustment Policy in Kenya by Christopher Hugh Onyang
- Evaluating Policy Options for Strengthening the Resilience of the Zimbabwean Economy to Higher Food and Fuel Prices by Godfrey Mahofa and Anna Strutt
- Impacts of Removing Refined Oil Import Subsidies in Nigeria on Poverty by Khalid Siddig, Angel Aguiar and Harald Grethe.

This project was completed in 2013.

2. Multiple Households in GTAP framework, USITC, 2012-2013

Staff: Angel Aguiar, Terrie Walmsley, Caitlyn Carrico

Collaborators: Marinos Tsigas (US International Trade Commission)

This project disaggregated U.S. households into 13 types, delineated by income brackets, and labor into 22 occupational types in GTAP. The project used the MyGTAP framework, which separates the household from the government and allows for multiple households. This new model was used to analyze the effects of the Trans-Pacific Partnership on U.S. households. Results demonstrate the potential for increasing U.S. GDP and household income, particularly for lower income households. Detailed results from the project will be presented as part of the Organized Session "Labor, trade, and investment linkages: data, models, and scenarios" of the 17th Annual Conference on Global Economic Analysis (June 18-20, 2014).

3. Understanding the effects of food price policies on food nutritional security in South Asia, World Bank. August 2013-August 2014.

Staff: Nelson Villoria

This study evaluates the effect of the Minimum Support Price policy applied to India to a comprehensive set of crops, prominently rice and wheat, on production, consumption, trade, and commodity prices in countries within South Asia region. The study is part of a larger effort that seeks to assemble empirical evidence on performance of food policies in South Asia, the extent to

which markets for food commodities are integrated – both within and across countries, and draw implications for a regional food price stabilization agenda/policy.

4. Estimating the economy-wide impact of water scarcity in South Asia, World Bank, October 2013-October 2014.

Staff: Farzad Taheripour, Badri Narayanan and Thomas Hertel
Collaborators: Sebnem Sahin (World Bank).

The economy of South Asia is expected to face serious environmental and economic challenges over the coming decades. The World Bank is conducting a set of comprehensive analyses to understand these challenges and help regional decision makers develop policies to manage these challenges in particular for India and Bangladesh. This research offers a macro modeling framework (consists of modified versions of GTAP-E dynamic and GTAP-BIO-W model) and provide economic analyses to support the World Bank research in this area.

5. Center for Robust Decision Making under Uncertainty for Climate and Energy Policy, National Science Foundation, 2010-2015

Staff: Tom Hertel, Jevgenijs Steinbuks (departed July 2013), Alla Golub (begun July 2013)
Collaborators: K. Judd, Y. Cai and T. Munson

Global land use research to date has focused on quantifying uncertainty effects of three major drivers affecting competition for land: the uncertainty in energy and climate policies affecting competition between food and biofuels, the uncertainty of climate impacts on agriculture and forestry, and the uncertainty in the underlying technological progress driving efficiency of food, bioenergy and timber production. The market uncertainty in fossil fuel prices has received relatively less attention in the global land use literature. Petroleum and natural gas prices affect both the competitiveness of biofuels and the cost of nitrogen fertilizers. High prices put significant pressure on global land supply and greenhouse gas emissions from terrestrial systems, while low prices can moderate demands for cropland. In a recently published paper in *Environmental Research Letters*, Steinbuks and Hertel use a perfect foresight, partial equilibrium model, based in large part on GTAP data, in order to assess and compare the effects of these core uncertainties on the optimal profile for global land use and land-based GHG emissions over the coming century. The model that we develop integrates distinct strands of agronomic, biophysical and economic literature into a single, intertemporally consistent, analytical framework, at global scale. Their analysis accounts for the value of land-based services in the production of food, first- and second-generation biofuels, timber, forest carbon and biodiversity. The authors find that long-term uncertainty in energy prices dominates the climate impacts and climate policy uncertainties emphasized in prior research on global land use.

Outputs of this research include the development of a dynamic forward-looking model of socially optimal land-use decisions. The results have been published in GTAP Working Paper 64 and have also been presented in a number of research conferences (EMEE, AGU, ASSA, EAERE, GTAP). Ongoing work on a second paper, aimed at the environmental sciences audience is underway.

Further work in progress involves the development of stochastic extensions of this intertemporal model.

Jevgenijs Steinbuks has moved to the World Bank and so Alla Golub has recently joined the team working on this project.

6. International Agricultural R&D Investment Needs for Global Futures, USDA-ERS Cooperative Research Agreement, 2013-2015.

This project represents a collaboration between Uris Baldos and Thomas Hertel (Purdue) and Keith Fuglie at ERS-USDA to identify the global investment in agricultural research and development (R&D) needed to generate sufficient productivity growth through 2050 to (i) meet projected increases in food demand, (ii) alleviate substantial malnutrition in low-income countries, (iii) offset yield impacts of climate change, and (iv) address the environmental concern of greenhouse gas emissions from agriculture. The analysis will explore implications of how R&D spending in developed, developing, and international research institutions might differentially influence progress toward these food security and environmental objectives. The work builds on the SIMPLE model developed by Baldos and Hertel.

7. Research in Integrated Assessment Inter-Model Development, Testing and Diagnostics, Stanford-AIM/DOE, 2010-2013

Staff: Tom Hertel, Uris Baldos, Jing Liu

Collaborators: Many

Noah Diffenbaugh, Tom Hertel and Monika Verma have used the GTAP model in conjunction with high resolution climate simulations for North America, and a statistically estimated, climate impacts model, in order to investigate the role of climate change in shaping future commodity market volatility under alternative economic scenarios. In a paper published in *Nature Climate Change*, they find that US corn price volatility exhibits higher sensitivity to near-term climate change than to energy policy influences or agriculture-energy market integration, and that the presence of a biofuels mandate enhances the sensitivity to climate change by more than 50%. The climate change impact is driven primarily by intensification of severe hot conditions in the primary corn-growing region of the US, which causes US corn price volatility to increase by a factor of 4 in response to global warming projected over the next three decades. Closer integration of agriculture and energy markets moderates the effects of climate change, unless the biofuels mandate becomes binding, in which case corn price volatility is instead exacerbated by a factor of 1.5. In further work (under review) the authors explore more fully the role of economic integration in facilitating adaptation to climate change. Here, they find that intersectoral integration between the agricultural and energy markets can be a double-edged sword, absorbing a portion of increased volatility in the source market, but also inheriting price volatility from the newly integrated energy markets. For US corn, market-driven intersectoral and international trade integration both appear to offer potential for adaptation, with the former reducing future corn price variation by about 27% relative to baseline. A mandate-driven intersectoral integration, however, exacerbates the future corn price variation by about 54% relative to the baseline.

8. *GEOSHARE: with funding from the ILSI Foundation, ERS-USDA, UK-DFID and UK-DEFRA*

Staff: Tom Hertel, Nelson Villoria

Collaborators: Navin Ramankutty, Stefan Siebert, Jawoo Koo, Andy Nelson, Carol Song, Paul Preckel, Delphine Derying

This is a pilot project aimed at assessing the feasibility of doing for the geospatial community something like GTAP has done for the trade community. It is focused on several countries in Africa and South Asia and aims to create high quality, interoperable, geospatial data on agriculture, poverty and the environment. One product of GEOSHARE would be high quality satellite data bases for use with GTAP-type models. More recently, the ILSI Foundation has supported exploratory work to automate and open source IFPRI's Spatial Allocation Model (SPAM) and to improve the capacities of PEGASUS, a global crop model authored by Delphine Derying. As a by-product of this collaboration, Joshua Elliot from the Agricultural Modeling Intercomparison and Improvement Project (AgMIP) and Nelson Villoria (GEOSHARE) have released a "GEOSHARE Tool for aggregating projected crop yields under alternative climate scenarios and management assumptions from the AgMIP's Global Gridded Crop Model Intercomparison Project," which is available at:

<https://geoshareproject.org/tools/cropdatatool/> .

9. *CIF21 DIBBs: Integrating Geospatial Capabilities into HUBzero. National Science Foundation, 2013-2017*

Staff: Nelson Villoria, Tom Hertel

Collaborators: Carol Song

In the context of this NSF-funded research project, partial funding is coming for a Post-Doctoral Research Associate (PDRA) looking to combine data, analytics, and software involving spatial data. As part of the core activities of the position, s/he will conduct econometric analysis using publically available global geospatial datasets available in GEOSHARE and elsewhere in order to fill critical knowledge gaps in our understanding of global land use change and other relevant issues. In particular, the PDRA will conduct econometric estimation geared towards informing two of the most contentious and controversial issues in global land use change analysis, namely, the ease with which land is converted into agriculture given changes in land rents (land supply elasticities) and evaluation of the productivity of lands that are currently out of agriculture (productivity of marginal lands). Additionally, the PDRA will make available the results of these analyses in the form of geospatial databases published on GEOSHARE's hub. Finally, the PDRA will also build a tool that employs data currently produced by other workflows to build the database used by the GTAP-AEZ model.

10. *Understanding the cross-country correlation of supply shocks to agricultural production. Incentive Award from Purdue University Global Policy Research Institute, 2011-13*

Staff: Nelson Villoria, Thomas Hertel

Collaborators: Hao Zhang, David Ubilava, Dev Niyogi

Although weather correlation across countries is crucial for the analysis of trade (and its interactions with storage) it is largely ignored in the literature. As our understanding of climate processes – variability and change - improves, so does our understanding of the evidence of correlated climates across large geographic regions. Under auspices of the Purdue Global Research Institute the collaborators above are preparing a response for the most recent call from the US Department of Agriculture for competitive grants in the area of Markets and Trade. The proposed research will fill the gap between trade- storage- and weather links by explicitly modeling the effects of geographically correlated weather patterns on bilateral trade patterns. This research has a heavy statistical component and explicit policy relevance that comprises of reducing the large climatological datasets used to simulate future climate using general circulation models and using these variables to explain bilateral trade patterns. From the statistical work, we will parameterize a computational economic model that allows relating weather shocks to the uses of agricultural supply: consumption, trade, and storage. Such tools will offer valuable insights into various policy issues for dealing with food price instability.

11. Public procurement data base extension and modelling modifications for analysis purposes, European Commission, 2014-15

Staff: Thomas Hertel, Angel Aguiar, Robert McDougall, Badri Narayanan, Zekarias Hussein, Caitlyn Carrico

Collaborators: Joseph Francois (World Trade Institute & CEPR), Robert Stehrer (The Vienna Institute for International Economic Studies, wiiw), Lucian Cernat (European Commission)

The objective of this project is to improve the government representation in a general equilibrium model and underlying data base of the world economy. The current structure of GTAP poses serious limitations when it comes to analyzing public procurement. First of all, it is likely that the current data base does not accurately capture the mix of domestic and imported goods which are purchased by governments. This is because the source IO tables usually have just one vector of imports, which the contributor distributes across uses following the domestic or total (domestic plus imports) allocation. Secondly, even when accurate information about the composition of imports is available, the GTAP Data Base does not provide specific information on which countries supply the current purchases. The absence of such sourcing information is problematic, as it holds the key to determining which countries will benefit from a liberalization of public procurement rules. Finally, since the GTAP Data Base fails to distinguish public from private investment, a large share of public procurement — namely that associated with infrastructure development — is not available for analysis.

In order to remedy these limitations, we are currently undertaking a project, funded by the EU Commission which is focused on both data and modelling extensions. In this paper, the extended data base is discussed to gain insight into the current state of play with public procurement at global scale. We then use it in conjunction with a modified model to test the implications of several liberalization scenarios. Preliminary work will be presented at 17th Annual Conference on Global Economic Analysis (June 18-20, 2014).

12. Quantifying the impacts of reducing food losses and wastes on prices, trade, emissions and resources, Food and Agricultural Organization of the United Nations, 2013 – 2014

This project seeks to provide an analysis of the economic and environmental impacts of food losses and waste—estimated to represent some 30 percent of global food production. It is based in the SIMPLE model of global crop production, consumption and trade, developed by Baldos and Hertel. The project is being led by Burcu Irfanoglu, with inputs from Uris Baldos, Thomas Hertel and Dominique van der Mensbrugghe.

13. Updating the GTAP-BIO data base to 2011 – funded by a consortium led by the National Biodiesel Board, 2014.

This project involves a complete updating of the GTAP-BIO data base from 2004 to 2011. All of the data base and model modification that have been done on the current version of GTAP-BIO data base will be carried forward to the 2011 data base. This will require collection of large amounts of data including data on land cover, harvested area, crop production, data on cropland pasture for US and Brazil and similar land in other regions, data on biofuels and their prices, data on biofuel policies, data on biofuel production technologies and their costs, and data on production, trade and consumption of vegetable oils and meals. The project is being led by Farzad Taheripour and Wallace Tyner.

14. Modifications to the GRAP-E and natural gas sector data base – internally funded by non-GTAP sources, 2013-14.

In 2013 we began a research project on shale oil and gas. In so doing, we completely modified the nesting structure of demand for energy of the GTAP-E model to represent new developments in energy market. We also made some modifications to model expansion in shale resources. In developing a proper data base for the new model we discovered significant errors in the GTAP data base in the natural gas related sectors. Specifically, we found:

- The GTAP data base ignores the link between “gas” and “gdt” and does not capture the values of gas sold from “gas” to “gdt” for distribution,
- The GTAP data base underestimates gas values used by commercial firms and households,
- The “gas” and “gdt” sectors in GTAP do not properly represent the production and distribution of gas as they operate in world.

Steps have been taken to correct these problems, and the details are provided in Taheripour, Tyner, and Sarica (2014) and in a paper being presented at the 2014 GTAP conference. This project is led by Farzad Taheripour and Wallace Tyner.

Publications

Aguiar, A. and T.L. Walmsley. “The Importance of Timing in the U.S. Response to Undocumented Immigrants: A Recursive Dynamic Approach,” *Economic Modelling*, forthcoming.

Avetisyan, M., T.W. Hertel and G. Sampson (2013). “Is Local Food more Environmentally Friendly? The GHG Emissions Impacts of Consuming Imported vs. Domestically Produced Food,” *Environmental and Resource Economics*, doi:10.1007/s10640-013-9706-3.

- Baldos, U.C. and T.W. Hertel (2014). "Global Food Security in 2050: The Role of Agricultural Productivity and Climate Change," *Australian Journal of Agricultural and Resource Economics*, (58):1-18, doi: 10.1111/1467-8489.12048.
- Baldos, U.C. and T.W. Hertel, "Looking Back to Move Forward on Model Validation: Insights from a Global Model of Agricultural Land Use," *Environmental Research Letters*, (8): doi:10.1088/1748-9326/8/3/034024.
- Britz, W., T.W. Hertel, and J. Pelikan (2014). "How Green are Agricultural Set Asides? An Analysis at the Global and Regional Levels," *Journal of Agricultural Economics*, doi:10.1111/1477-9552.12065.
- Britz, W., I. Perez and G.B. Narayanan. "Analyzing Results from Large-Scale Agricultural Economic Simulation Model Results: Recent Progress and the Way Ahead," *German Journal of Agricultural Economics*, submitted.
- Byerlee, D., J. Stevenson, N.B. Villoria (2014). "Does Intensification Slow Crop Land Expansion or Encourage Deforestation?" *Global Food Security*, forthcoming.
- Chandramouli, M, G.B. Narayanan and G. Bertoline (2013). A Graphics Design Framework to Visualize Multi-dimensional Economic Datasets, *Engineering Design Graphics Journal*, 77(3): 1-14.
- Hertel, T.W. and D. Lobell (2014). "Agricultural Adaptation to Climate Change in Rich and Poor Countries: Current Modelling Practice and Potential for Empirical Contributions," *Energy Economics*, in press.
- Hertel, T.W., J. Steinbuks, and U.C. Baldos (2013). "Competition for Land in the Global Bioeconomy," *Agricultural Economics*, 44:129-138, <http://onlinelibrary.wiley.com/doi/10.1111/agec.12057/pdf>.
- Hertel, T.W. and W.E. Tyner (2013). "Market-Mediated Environmental Impacts of Biofuels," *Global Food Security*, <http://dx.doi.org/10.1016/j.gfs.2013.05.003>.
- Hussein, Z., T.W. Hertel and A. Golub (2013). "Poverty Impacts of Climate Mitigation Policy," *Environmental Research Letters*, 8 (2013) 035009 (10pp): doi:10.1088/1748-9326/8/3/035009.
- Konar, M., Z. Hussein, N. Hanasaki, D.L. Mauzerall, and I. Rodriguez-Iturbe (2013). "Virtual Water Trade Flows and Savings Under Climate Change," *Hydrology and Earth System Sciences*, doi: 10.5194/hessd-10-67-2013.
- Liu, J., V. Hull, M. Batistella, R. DeFries, T. Dietz, F. Fu, T.W. Hertel, R.C. Izaurralde, E.F. Lambin, S. Li, L.A. Martinelli, W. McConnell, E.F. Moran, R. Naylor, Z. Ouyang, K.R. Polenske, A. Reenberg, G. Rocha, C.S. Simmons, P.H. Verburg, P.M. Vitousek, F. Zhang and

- C. Zhu (2013). "Framing Sustainability in a Telecoupled World," *Ecology and Society*, 18 (2): 26, <http://www.ecologyandsociety.org/vol18/iss2/art26/> .
- Lobell, D., U.C. Baldos and T.W. Hertel (2013). "Climate Adaptation as Mitigation: The Case of Agricultural Investments," *Environmental Research Letters*, 8:1-12, doi:10.1088/1748-9326/8/1/015012.
- Meyfroidt, P., E.F. Lambin, K. Erb and T.W. Hertel (2013). "Globalization of Land Use: Distant Drivers of Land Change and Geographic Displacement of Land Use," *Current Opinion in Environmental Sustainability*, <http://dx.doi.org/10.1016/j.cosust.2013.04.003>.
- Mirza, T., G.B. Narayanan and N. van Leeuwen (2014). "Impact of Chinese Growth and Trade on Labor in Developed Countries," *Economic Modelling*, 38(2): 522-32.
- Narayanan, G.B. and S. Khorana (2014). "Tariff Escalation, Export Shares and Economy-wide Welfare: A Computable General Equilibrium Approach," *Economic Modelling*, in press. DOI: 10.1016/j.econmod.2014.05.006 .
- Narayanan, G.B. and P. Vashisht (2014). "Indian Auto Industry: A Global Hub in Making?" *Review of Development and Change*, in press.
- Narayanan, G.B. and R. Vasundhara (2014). "Export Subsidy Reforms and Productivity Improvements: The Case of Indian Textile and Clothing Sector Margin," *The Journal of Applied Economic Research*, in press.
- Ouraich, I. and W.E. Tyner. "Climate change impacts on Moroccan agriculture and the whole economy: An analysis of the impacts of the Plan Maroc Vert in Morocco." UNU-WIDER working paper WP/2014/083 (2014), http://www.wider.unu.edu/publications/working-papers/2014/en_GB/wp2014-083/.
- Sarica, K. and W.E. Tyner, "Alternative Policy Impacts on US GHG Emissions and Energy Security: A Hybrid Modeling Approach," *Energy Economics* 40 (2013), pp. 40-50.
- Siddig, K., A. Aguiar, H. Grethe, P. Minor, and T.L. Walmsley (2014). "Impacts of Removing Fuel Import Subsidies in Nigeria on Poverty," *Energy Policy*, in press.
- Steinbuks, J. and T.W. Hertel (2013). "Energy Prices Will Play an Important Role in Determining Global Land Use in the Twenty-First Century," *Environmental Research Letters*, doi:10.1088/1748-9326/8/1/014014.
- Steinbuks, J. and G.B. Narayanan. "Fossil Fuel Producing Economies Have Greater Potential for Inter-fuel Substitution," *Energy Economics*, revised and resubmitted.
- Stevenson, J.R., N.B. Villoria, D. Byerlee, T. Kelley, and M. Maredia (2013). "Green Revolution Research Saved an Estimated 18 to 27 Million Hectares from Being Brought into Agricultural Production," *Proceedings of the National Academy of Sciences*, 110(21):8363-8368.

- Suttles, S. A., W.E. Tyner, G. Shively, R.D. Sands and B. Sohngren. "Economic effects of bioenergy policy in the United States and Europe: A general equilibrium approach focusing on forest biomass." *Renewable Energy*, 69 (2014), pp. 428-436.
- Taheripour, F., T.W. Hertel, and J. Liu (2013). "The Role of Irrigation in Determining the Global Land Use Impacts of Biofuels," *Energy, Sustainability and Society*, 3:4 doi: 10.1186/2192-0567-3-4.
- Taheripour, F. and W.E. Tyner. "Incorporating Recent Land Use Change Data into Simulations of Biofuels Land Use Change." *Applied Sciences* 3 (2013) 14-38.
- Taheripour, F., W.E. Tyner, and K. Sarica. "Assessment of the Economic Impacts of the Shale Oil and Gas Boom." *USAEE Dialogue*, Vol. 21 No. 3 (October 2013). <http://dialogue.usaee.org/index.php/assessment-of-the-economic-impacts-of-the-shale-oil-and-gas-boom>
- Taheripour F., W.E. Tyner. "Welfare Assessment of the Renewable Fuel Standard: Economic Efficiency, Rebound Effect, and Policy Interactions in a General Equilibrium Framework." In: *Modeling, Optimization and Bioeconomy*. Pinto, A, Zilberman, D (Eds.) (Springer-Verlag, 2014).
- Taheripour, F., W.E. Tyner and K. Sarica (2014). "Shale gas boom, trade and environmental policies: Global economic and environmental analyses in a multidisciplinary modeling framework." *Issues in Environmental Science and Technology, Vol. 39 Fracking*. R. E. Hester and R. Harrison. Cambridge, UK, Royal Society of Chemistry.
- Tyner, W.E., and F. Taheripour (2013). "Land-use Changes and CO₂ Emissions Due to US Corn Ethanol Production." In Levin, S.A. (ed.) *Encyclopedia of Biodiversity*, second edition, Volume 4, pp. 539-554, Waltham, MA: Academic Press.
- Tyner, W.E., and F. Taheripour. "Advanced Biofuels, Economic Uncertainties, Policy Options, and Land use Impacts." Chapter in *Plants and Bioenergy*, Advances in Plant Biology 4, Springer Science + Business Media (2014), pp. 35 -48.
- Villoria, N.B., D. Byerlee, and J. Stevenson (2014). "The Effects of Technological Progress in Agriculture on Deforestation: What do we really know?" *Applied Economic Policy and Perspectives*, forthcoming.
- Villoria, N.B., A. Golub, D. Byerlee, J. Stevenson (2013). "Will Yield Improvements on the Forest Frontier Reduce Green House Gas Emissions? A Global Analysis of Oil Palm," *American Journal of Agricultural Economics*, 95 (5): 1301-1308.
- Walmsley, T.L., A. Aguiar and S.A. Ahmed (2013). "Labor Migration and Economic Growth in East and Southeast Asia," World Bank Policy Research Working Paper No. 6643, submitted to *World Economy*.

Walmsley, T.L., A. Aguiar and G.B. Narayanan (2013). "A Global Dataset of Input-Output Tables Linked by International Trade and Policy Data," *The Journal of Life Cycle Assessment*, Japan 9(2): 76-83.

Wicke, B., F. van der Hilst, V. Daioglou, M. Banse, T. Beringer, S. Gerssen-Gondelach, S. Heijnen, D. Karssenberg, D. Laborde, M. Lippe, H. van Meijl, A. Nassar, J. Powell, A.G. Prins, S. N. K. Rose, E. M. W. Smeets, E. Stehfest, W. E. Tyner, J. A. Versteegen, Valin, H., D. P. van Vuuren, S. Yeh and A. P. C. Faaij (2014). "Model collaboration for the improved assessment of biomass supply, demand, and impacts." *GCB Bioenergy*.

Presentations

Aguiar, A. "Breaking GTAP's Single Household Assumption." 5th Spanish IO Association Bi-annual Conference, Seville, Spain, September 18, 2013 and 16th Annual Conference on Global Economic Analysis, Shanghai, China, June 10, 2013.

Akgul, Z., T.W. Hertel, A. Golub, R. McDougall., T.L. Walmsley, N.B. Villoria (2013). "The Distributional Consequences of Climate Change Mitigation Policies in Developing Countries: Macroeconomic Decomposition Approach." Presented in the AERE Sessions at the 2013 AAEA Annual Meeting, Washington DC, August 2013.

Akgul, Z., N.B. Villoria, T.W. Hertel. "Introducing Firm Heterogeneity into the GTAP Model with an Illustration in the Context of the Trans-Pacific Partnership Agreement." To be presented at the 17th Annual Conference on Global Economic Analysis, Dakar, Senegal, June 2014.

Baldos, U.C. and T.W. Hertel, "Looking Back to Move Forward on Model Validation." Presented at the Global Land Project Open Science Meetings, Berlin, Germany, March 21, 2014.

Hertel, T.W. "Environmental Sustainability and Food Security in an Integrated Global Economy." Presentation at the Global Land Project Open Science Meetings, Berlin, Germany, March 20, 2014.

Hertel, T.W. "Global Change and the Challenges of Sustainably Feeding a Growing Planet." Plenary presentation to the Global Land Project Open Science Meetings, Berlin, Germany, March 20, 2014; seminar presented at CEPII, Paris, March 18, 2014; seminar presented at the United Nations Economic Commission for Latin America and the Caribbean, Santiago, Chile, December 17, 2013; Distinguished Lecture, College of Arts and Sciences, Ivy Tech, Lafayette, Indiana, October 14, 2013.

Hertel, T.W. "Open Data for Sustainable Agriculture." Panel discussion, ILSI Research Foundation, Washington, D.C., October 9, 2013.

Hertel, T.W., based on work with M. Avetisyan, "Is Local Food More Environmentally Friendly? The GHG Emissions Impacts of Consuming Imported vs. Domestic Foods." Invited Presentation, the Ecological Society of America, Minneapolis, August 8, 2013.

Hertel, T.W., written with U.C. Baldos. "Bursting the Bubble: A Long Run Perspective on Food

Prices.” Presented at the Center for Food Security and the Environment, April 29, 2014.

Hertel, T.W. and U.C. Baldos. “Global Commodity Markets and Food Security in the 21st Century.” Presented at the Symposium on ‘Feeding with World without Consuming the Planet,’ MIT, Cambridge, November 5, 2013.

Hertel, T.W., written with U.C. Baldos and N. Ramankutty, “Does Agricultural Intensification Spare Land? Revisiting History and Exploring the Future.” Presented to the Department of Earth and Environmental Systems Science, April 23, 2014 and the Department of Applied Economics, University of Minnesota, April 4, 2014 and presented at the Global Land Project Open Science Meetings, Berlin, March 20, 2014.

Hertel, T.W., based on a paper with D. Lobell and U.C. Baldos. “Adaptation as Mitigation: Agricultural Productivity, Global Land Use and GHG Emissions.” Presented to the Department of Agricultural Economics, Universidad Catolica, Santiago, Chile, December 18, 2013.

Hertel, T.W., based on work with J. Steinbuks, “Optimal Global Land Use under Uncertainty.” University of Chicago, October 3, 2013.

Narayanan, G.B. and N.B. Villoria. “A GTAP Model Extension for Specific Tariffs.” Presented at the 16th Annual Conference on Global Economic Analysis, Shanghai, China, June 2013.

Steinbuks, J., Y. Cai, J.W. Elliott, T.W. Hertel, and K.L. Judd. “Optimal Path for Global Land Use under Climate Change Uncertainty.” Presented at Agricultural and Applied Economics Association Annual Meetings, Washington, D.C., 2013.

Villoria, N.B., A. Golub, D. Byerlee, and J. Stevenson. "Will Intensification of Oil Palm Production Reduce Green House Gas Emissions from Deforestation?" Invited paper at the 2013 Winter ASSA Meetings, San Diego, CA, January 2013.

IX. Education and the Network

New Technical Papers, Working Papers and Research Memoranda

New Technical Papers

Analysis of Climate Policies with GDyn-E

by Golub, Alla

Publication: GTAP Technical Paper No. 32

Publication Year: 2013

New Estimates of Soil and Biomass Carbon Stocks for Global Economic Models

by Gibbs, Holly, Sahoko Yui and Richard Plevin

Publication: GTAP Technical Paper No. 33

Publication Year: 2014

Agro-ecological Zone Emission Factor (AEZ-EF) Model (v47)

by Plevin, Richard, Holly Gibbs, James Duffy, Sahoko Yui and Sonia Yeh

Publication: GTAP Technical Paper No. 34

Publication Year: 2013

New Working Papers

Fossil Fuel Producing Economies Have Greater Potential for Interfuel Substitution

by Steinbuks, Jevgenijs and Badri Narayanan

Publication: GTAP Working Paper No. 73

Publication Year: 2013

Deport or legalize? An Economic Analysis of US Immigration Reform

by Aguiar, Angel and Terrie Walmsley

Publication: GTAP Working Paper No. 74

Publication Year: 2013

The Importance of Timing in the U.S. response to Undocumented Immigrants: A Recursive Dynamic Approach

by Aguiar, Angel and Terrie Walmsley

Publication: GTAP Working Paper No. 75

Publication Year: 2013

The GTAP Data Base Construction Procedure

by Harslett, Philip

Publication: GTAP Working Paper No. 76

Publication Year: 2013

Introducing Water by River Basin into the GTAP-BIO Model: GTAP-BIO-W

by Taheripour, Farzad, Thomas Hertel and Jing Liu

Publication: GTAP Working Paper No. 77

Publication Year: 2013

MyGTAP Model: A Model for Employing Data from the MyGTAP Data Application- Multiple Households, Split Factors, Remittances, Foreign Aid and Transfers

by Walmsley, Terrie and Peter Minor

Publication: GTAP Working Paper No. 78

Publication Year: 2013

MyGTAP: A Program for Customizing and Extending the GTAP Database for Multiple Households, Split Factors, Remittances, Foreign Aid and Transfers

by Minor, Peter and Terrie Walmsley

Publication: GTAP Working Paper No. 79

Publication Year: 2013

New Research Memoranda

GDP Consistency in GTAP 8

by Aguiar, Angel

Publication: GTAP Research Memorandum No. 25

Publication Year: 2013

Understanding the Slowdown in Foreign Investment in China

by Ianchovichina, Elena, Thomas Hertel and Terrie Walmsley

Publication: GTAP Research Memorandum No. 26

Publication Year: 2014

Alternative Agricultural Price Distortions for CGE Analysis, 2007 and 2011

by Jensen, Hans Grinsted and Kym Anderson

Publication: GTAP Research Memorandum No. 27

Publication Year: 2014

Education and Courses

The Center continues to re-examine the way in which it educates graduate students, staff, visitors and network members. Demand for the GTAP Short Course has recovered and we expect to have one of the largest courses in recent years. The past year the Center also two editions of GTAP 101 (October 14 - November 17, 2013 and January 27 - March 14, 2014), designed, directed, and taught by Mary Burfisher. This is a basic level course that provides an entry point to the GTAP Data Base and modeling framework, by providing under-qualified applicants for the short course with more preparatory materials. Another development in the educational area is the introduction of graduate student fellowships for the standard GTAP Short Course, which cover \$2,500 of the \$4,000 fee.

This year the Center will hold two courses:

- The GTAP Short Course will be held at Purdue University in early August. We expect nearly 40 participants, of which six are graduate students under fellowships.
- GTAP 101 will be offered from September 15 - October 25, 2014.

Research Fellows

Lucian Cernat will report on the committee's decisions at the Board meeting. The committee includes Lucian Cernat (Committee Chair), Tom Hertel and Ken Kawasaki; with Wendy Kincaid and Ginger Batta providing support.

Conference Proposals

Dakar, Senegal 2014

Antoine Bouët, International Food Policy Research Institute (IFPRI), will help welcome everyone to Dakar and present an update on preparations for the 2014 conference at the board meeting. This event is being jointly organized and hosted by AGRODEP, facilitated by IFPRI with sponsorship from CGIAR Research Program on Policies, Institutions and Markets; Food Security Portal, facilitated by IFPRI; the United Nations Economic Commission for Africa and The World Bank; and partnership from the World Trade Organization.

Melbourne, Australia 2015

In light of staffing changes at the Center, in late 2013, the decision was made to change the location and partnering organization for the 2015 conference. The Centre of Policy Studies at Victoria University in Melbourne graciously offered their partnership and local leadership for this event. Philip Adams will present the updated conference proposal at the board meeting.

Washington DC, United States 2016

The World Bank in Washington DC, site of the 2004 annual conference, will once again partner with the Center to host the conference in 2016. We expect other board members in the Washington, DC area to join in the effort, contributing financial and logistical support as well as sponsoring special sessions. A preliminary proposal will be presented for board approval at the Dakar meetings.

Proposals for each conference (when available) may be accessed at:

https://www.gtap.agecon.purdue.edu/events/Board_Meetings/2014/supp_material.asp

Report on GTAP Usage and the GTAP Network/Website

Three search sources have been examined to set up a baseline to document the impact of GTAP:

- 1) Econlit: AEA's electronic bibliography of economics literature,
- 2) IDEAS: a freely available, online bibliographic database dedicated to Economics, and
- 3) Google Scholar: Google's dedicated engine for searching scholarly literature.

These reports are contained in the supplementary materials provided on the board website.

https://www.gtap.agecon.purdue.edu/events/Board_Meetings/2014/supp_material.asp

X. Finances, Budgets and Staffing Plan

Budgeting

To be handed out and discussed at the board meeting.

Staffing

Staffing Goal: To actively seek and encourage talented staff and graduate students

As noted previously, we have had quite a few staffing changes over the past year. One opening remains – namely that of Research Economist. We will be meeting with potential candidates at the upcoming conference in Dakar.

Allocation of Resources over the next year

An overview of how individuals are funded and all the activities they will spend their time over the next 12 months is given below. As you can see, many of the Center's staff are externally funded (i.e. not supported by Consortium funds or Data Base sales.)

<i>Angel Aguiar</i>	50% core	Working with I-O Table contributors	I-O Peer Review Process and documentation	I-O Educational materials	Data Base (Pre-processing of macro data, dwellings, I-O disagg)	Research and Courses		
<i>Ginger Batta</i>	100% core	Event Management (conferences, board meetings, courses, live forums)	Product Management (Sales, Distribution, Licensing and Reporting)	Promotional Materials (Design, Development)	GTAP Network Communication	General Center administrative duties		
<i>Jeremy Douglas</i>	100% core	Website						
<i>Alla Golub</i>	100% Projects	Dynamic GTAP-E Model	Energy and Environ research	Satellite data	Grad student supervision	Document GTAP-E Model	Short Courses	
<i>Thomas Hertel</i>	25% core	Assist with Conference	Research	Grad Student Supervision	Satellite data			
<i>Wendy Kincaid</i>	100% core	Assist with Grants	Staff visas and hiring	Budgeting and Finances	General Center administrative duties			
<i>Robert McDougall</i>	100% core	Data Base Issues (Taxes, Energy and FIT)	Mentoring of data team	Documentation	Document GTAP-E Model	Research and Courses		
<i>Badri Narayanan</i>	80% core	Oversee release schedule	Website and data documentation	Data Base (Protection, trade, agricultural production targeting and support)	Satellite data schedule	Live sessions and seminars	GTAPAgg and FlexAgg	Research and Courses
<i>Dominique van der Mensbrugghe</i>	50% core							
<i>Nelson Villoria</i>	50% Projects	Short Course and education plan	International Transportation Data	Grad student supervision	Research	Heterogeneous firms	Land Use and Land Cover	

							Database and Aggregation Software	
Zeynep Burcu Irfanoglu	100% Projects							
Zekarias Hussein	100% Projects							
Graduate Students	Various	Macro transmission Tech paper	Heterogeneous firms	Data Base (Agr Production Targeting, macro, Elasticities, Electricity Disaggregation)	Short Courses	Special data Projects (Skills)	Research Projects	Satellite data projects (Land use, CO2)

XI. Appendices

Appendix 1: A strategy for creating a standardized, interoperable GTAP-AEZ model and data base package

Responsible: Nelson Villoria

Collaborators/Resources: Alla Golub, Badri Narayanan, Farzad Taheripour, Uris Baldos

The land use data comprise land rents and taxes by AEZs for the 12 land-based GTAP sectors. It also provides output quantities and harvested area for the eight GTAP crop sectors. Area covered by forests, pastures, cropland, and other (four) land types are also available. Starting with V8, subscribers to both the GTAP and land use databases receive both dataset in a customized FlexAgg package ready to consistently aggregate across countries, sectors, and/or AEZs. The original GTAP-AEZ database, created using data on crop production circa 2000 from Monfreda et al. (2008) was released for GTAP 5, and has since then updated to years 2004 (V7, V8) and 2007 (V8) using information on aggregated land rents from the GTAP database, the national-level crop production data from FAOSTAT and updated time-series data on cropland and pasture cover (see Baldos and Hertel, 2012 for details). Recognizing the importance of the land use and cover data for the GTAP community, the overall aim of this activity is to establish a standardize framework to maintain the GTAP-AEZ model and database by performing the following activities:

- (i) To update the land use and cover data to match reference years of new GTAP releases using the procedures documented in Baldos and Hertel (2012). This activity will be performed in coordination with Badri Narayanan for each release of the database (next major upgrade is planned for end of 2014). Included in this activity is an internal pre-release for testing performed independently by Farzad Taheripour, Alla Golub, and Nelson Villoria.
- (ii) To incorporate newer and improved information on land use and cover into new datasets as they become available. The data on global land use and land cover are dated (circa 2000). However, within the context of GEOSHARE we expect to have updated versions of these datasets over the next one to two years. A main goal of the strategy is to bring the newer physical data to update the GTAP-AEZ database as soon as it is available to us. To the extent possible we will rely on previous procedures (e.g., Baldos and Hertel, 2012) to ensure compatibility. Execution of this activity will depend on the evolution of GEOSHARE.
- (iii) Development of FlexAgg-based aggregation programs that facilitate creating aggregated land use and cover, as well as land-use related GHG emission factors, matching user-defined aggregation schemes. This activity is performed with each release of the GTAP data, and is performed by Badri Narayanan and Nelson Villoria.
- (iv) Inclusion of the GTAP-AEZ framework in the Annual GTAP Short Courses: The theoretical underpinnings of the GTAP-AEZ model have already been documented (Hertel et al., 2009), thus, in this activity we focused on generating training materials employed for the first time in the 2013 Annual Short Course (Istanbul). These materials consist on a two-page theoretical brief, a guide to replicate the results in Stevenson et al (2013), as well as a simple GTAP-AEZ model with an add-on module for land-use related greenhouse gas fluxes. These materials were prepared by Golub and Villoria.

Appendix 2: A research strategy for upgrading the bilateral transport margins, by mode, in the GTAP Data Base

Responsible: Nelson Villoria

The distribution of bilateral margins (difference between FOB and CIF prices) among transportation modes (land, air, ocean) is currently performed assuming that the sectoral transportation patterns between the US and its trading partners are representative of all the possible transportation patterns among the 129 regions and 43 sectors in the current GTAP Database. It is often the case that this assumption leads to unreasonable modal splits of the FOB-CIF margins. Thus, a stronger empirical basis for splitting current margin modal splits is highly desirable. In recent work, Cristea et al (2012) combine data for the US, Latin America, and Europe, and demonstrate that explicit modal data is available for about 75% of world trade. Moreover, around 23% of the countries without explicit modal shares are not land-adjacent, so it is reasonable to assume that most of their bilateral trade occurs via ocean or air. In order to estimate the missing modal shares, they fit an econometric model inspired in the gravity modeling of trade that explains mode-specific transport margins in terms of the composition of bilateral trade (approximated by bilateral trade weight and value), distance between countries, adjacency and fixed effects. Their model yields a high R² (0.75), suggesting that the explanatory variable capture a meaningful portion of the variation in modal shares. The parameter estimates of this model are then used to predict the missing modal shares.

In this activity, we will use the econometric procedure proposed by Cristea et al (2012) to improve the modal splits in the GTAP database. Specifically, we will combine data for the European Union (Eurostat), the US, and Latin America (ALADI) for which we have explicit modal share data and we use out of sample prediction to generate modal splits for the remaining countries. We aim to include these margins in the second pre-release of the GTAP Database V9, in February-March 2013. An additional deliverable is a fully documented set of procedures, including the estimating equations, to ensure the process is replicable in further releases of the data.

Cristea, A., D. Hummels, L. Puzzello, and M. Avetisyan. 2012. "Trade and the greenhouse gas emissions from international freight transport." *Journal of Environmental Economics and Management*. DOI: 10.1016/j.jeem.2012.06.002.

Hertel, T.W., H.-L. Lee, S. Rose, and B. Sohngen. 2009. "Modeling Land-use Related Greenhouse Gas Sources and Sinks and their Mitigation Potential." In T. W. Hertel, S. Rose, and R. Tol, eds. *Economic Analysis of Land Use in Global Climate Change Policy*. London and New York: Routledge, pp. 123–154.

Appendix 3: Electricity Sector Disaggregation: GTAP Data Base Proposal

Responsible: Jeffrey C. Peters, Rob McDougall, Thomas Hertel, and Sergey Paltsev

Collaborators/Resources:

1. Motivation

Many users of the GTAP database have indicated a desire for a disaggregated electricity sector. Currently there is one sector ('ely') which encompasses "production, collection and distribution of electricity." Because electricity from different technologies (e.g., fossil fuels, nuclear, hydro, renewables) are highly substitutable but vary greatly in produced emissions and other impacts, several users of GTAP data have independently disaggregated the electricity sector in the GTAP data for their particular research purposes. The assumptions and procedure varies between researchers and limitations in available data inevitably requires "educated guesswork" to some extent.

Table 1: Example research with disaggregated electricity sector. Note: non-exhaustive and summarized based on available documentation. Most disaggregation processes seem to be un- or weakly documented.

Researcher(s)	Electricity Sectors	Method	Example Research Purposes
MIT – Joint Program	coal, gas, oil, nuclear, hydro, biomass, wind & solar, (various advanced technologies)	Subtract nuclear and hydro from GTAP data using engineering cost data, the residual is fossil, other techs are backstop.	Climate change and carbon mitigation policy, future of fuels, future of power technology
JGCRI - Phoenix	coal, gas, nuclear, hydro, oil, biomass, wind, solar, (various advanced technologies)	Positive mathematical programming approach using LCOE and input cost shares (Sue Wing, 2008)	Climate change and carbon mitigation policy
GTEM	coal, oil, gas, nuclear, hydro, waste, biomass, solar, wind, renewables (includes some CCS tech)	"Data on the cost structure of electricity generation."	Climate change and abatement policy, trade analysis, coal-use in Asia
OECD ENV-Linkages	coal, oil, gas, hydro, nuclear, wind&solar, renewable	"...calibrated based on the projections from the IEA's World Energy Outlook"	Climate change and abatement policy
Productivity Commission	coal, oil, gas, biogas, hydro, nuclear, renewables	Combination of output prices for fuels (baseload/peaking) and cost shares of generation technology	

2. Proposal

The proposed GTAP activity will:

- i) review current methods of disaggregation within and outside of the GTAP community,
- ii) seek input (and, ideally, consensus) from stakeholders on reasonable assumptions and a procedure for disaggregation, and
- iii) provide a GTAP database with a disaggregated electricity sector for interested GTAP researchers.

The result will be a database to provide greater consistency across researchers modeling the electricity sector. The intent is to separate transmission and distribution from electric power generation technologies. Generation technologies will be further disaggregated based on the current relevance of the technology globally and in a manner informed by both levelized costs for the technology and relative input shares from the original GTAP data. Tables 2 and 3 on the following page provide an illustrative example.

Table 2: The current GTAP database. Note: trade, tax, and region dimensions not shown

	Input 1	...	Input n	ely
input 1				
...				
input n				
ely				
Factor 1				
...				
Factor n				
PTAX				



Table 3: The GTAP database with disaggregated electricity sector into transmission and distribution (T&D) and electric power generating technologies. Note: trade, tax, and region dimensions not shown

	Input 1	...	Input n	T&D	Tech. 1	...	Tech. n
input 1				COLUMN WEIGHTS			
...							
input n				CROSS WEIGHTS			
T&D	ROW WEIGHTS						
Tech. 1							
...				COLUMN WEIGHTS			
Tech. n							
Factor 1							
...							
Factor n							
PTAX							

Cost shares in vertical should reflect levelized cost shares of capital, O&M, fuel, etc. from engineering data.

Cost shares in horizontal should reflect relative costs (to other technologies) of capital, O&M, fuel, etc. from engineering data.

3. Data

3.1 Total Electric Power Output

The IEA (International Energy Agency) Electricity Information database contains gross and net electricity production (GWh) from each of the inputs listed above for the 34 OECD and over 100 non-OECD countries to determine total production by the disaggregated electric power sectors (IEA, 2013). Net production can be used in conjunction with cost data (see Section 2.2: Levelized Cost of Electricity) to allocate cost-weighted shares of value to the disaggregated electric power technologies in both the Row and Column Weight Matrices in Table 3.

3.2 Splitting "Transmission and Distribution" and "Electric Power Generating Technologies"

The transmission and distribution sector includes all activity from point of electricity generation to the point of final demand. The EIA provides levelized cost estimates for transmission investment for different technologies in the US. Combined with net electricity output, the total value share of transmission (and distribution) can be separated from the electricity generation. Currently unknowns remain in transmission costs in other countries (which may change based on several factors like accessibility and geography) and the distribution of capital, labor, and intermediates in the transmission cost structure.

3.3 Fuel Inputs to Electric Power Technologies

The input sectors from the IEA Electricity Information database (IEA, 2013) will be mapped to the fuel sectors in GTAP (i.e., "coa", "gas", "gdt", "p_c" (petroleum and coal products), and "oil") (Narayanan, Dimaranan, and McDougall, 2012). Some GTAP commodities may be inputs to multiple electric power technologies (e.g., "p_c" into coal, oil, and/or gas). A combination of IEA data along with the fuel value inputs to electricity in the existing GTAP dataset will be used to reasonably distribute the inputs shares for fuel commodities for the Column Weight in Table 3. Sectors specific to certain fuels such as gas transport, over land transport, and water transport will also be distributed to the relevant sectors.

3.3.1 Coal Power

The coal power sector takes "coal and coal derived products," as defined in the IEA energy statistics database, and converts these into electricity: anthracite, coking coal, sub-bituminous coal, other bituminous coal, lignite/brown coal, peat, patent fuel, coke oven coke and lignite coke, gas coke, coal tar, BKB/peat briquettes, and oxygen steel furnace gas. 100% of the "coa" and "wtr" (water transportation) sectors and a share of "p_c" sector inputs to the original "ely" sector will be mapped to the coal power sector.

3.3.2 Gas Power

The gas power sector only includes plants which use *natural* gas as an input to produce electricity. 100% of the "gas" and "gtd" (gas manufacture and transportation) sector and a share of "otp" (land and pipeline transportation) and "p_c" sector inputs to the original "ely" sector will be mapped to the gas power sector.

3.3.3 Oil Power

The oil sector takes "crude, NGL and petroleum products," as defined in the IEA energy statistics database, and converts these into electricity: crude oil, natural gas liquids, refinery gas, liquefied petroleum gases, naphtha, kerosene type jet fuel, kerosene, gas/diesel oil, fuel oil, bitumen, petroleum coke, and non-specified petroleum products. 100% of the "oil" sector and a share of "otp" and "p_c" sector inputs to the original "ely" sector will be mapped to the oil power sector.

3.3.4 Nuclear Power

The nuclear power sector takes uranium as an input to generate electricity. 100% of the "omn" sector inputs to the original "ely" sector (a very small value) will be mapped to the nuclear power sector.

3.3.5 Hydroelectric Power

The hydroelectric power sector does not currently use any GTAP-relevant fuel inputs (i.e., water).

3.3.6 Renewables and Other

The renewables and other power sector includes the following technologies: geothermal, solar, solar photovoltaic, solar thermal, tide, wave, and ocean, wind, municipal waste, wood/woodwaste/other solid waste, landfill gas, sewage sludge as, other biogases, and liquid biofuels. Any residual is also included in this sector.

3.4 Levelized Cost of Electricity

Levelized costs represent the uniform annual cost breakdown based on costs which may, in reality, vary in magnitude over the life of a project. These are used for relative comparisons of technologies which may vary greatly in cost structure. Valuations of levelized costs include, but are not limited to, overnight capital cost, fixed operating and maintenance, variable operating and maintenance, heat rate, capacity factor, fuel, life-span, interest rate, and technology specific costs as inputs to generate costs of electricity with a breakdown of levelized capital, operating and maintenance, fuel, and tax costs.

The Energy Information Administration (EIA) provides levelized cost of electricity (capital, operating and maintenance, fuel, and transmission investment) estimates for the relevant electric power technologies listed above for the United States (EIA, 2013).

The Organization of Economic Co-operation and Development (OECD) published levelized cost of electricity estimates from 16 OECD member countries, 4 non-OECD member countries, and 5 industry organizations. The costs are broken down to investment, operations and maintenance, fuel, carbon, and decommissioning levelized costs (IEA/NEA, 2010).

Full factor and intermediate shares to electricity production and regional information is limited. A complete GTAP data set with disaggregated electricity will be created using the available levelized cost of electricity data along with reasonable assumptions for particular inputs and regions. Accuracy of the disaggregated data set may be increased via input from regional experts.

The levelized cost information is relevant in both the columns and the rows of the Column Weight Matrix in Table 3. The cost shares in the columns of the Column Weight Matrix should reflect the investment, operations and maintenance, and fuel cost shares of the specific technology. The inputs to electricity generation (represented by the rows of the Column Weight Matrix in Table 3) should be distributed to the individual generation technologies based on total production and the relative portion of the total levelized cost. For example, a capital intensive technology should have more capital input per GWh than a less capital intensive technology.

3.4.1 Investment Inputs to Electric Power Technologies

The IEA levelized costs of investment includes upfront capital, engineering, procurement, construction, and other services (IEA/NEA, 2010). The GTAP sectors which are relevant to investment will be grouped together to provide target values for both engineering cost and relative input share consistency. The most significant GTAP sectors which will be grouped as investment are: ‘capital’, ‘obs’ (real estate and rental activities), ‘cns’ (construction), ‘ofi’ (financial intermediation), and ‘ome’ (machinery and equipment). This signifies that these inputs have the same relative weights in current production as original investment levels.

3.4.2 Operating and Maintenance (O&M) Inputs to Electric Power Technologies

The O&M levelized costs will be appropriated based on total GWh output and relative input intensities to the less significant non-fuel intermediate inputs and labor (both skilled and unskilled). Labor would be a portion of fixed O&M costs in regions where there is information about fixed and variable O&M costs. There may be additional opportunities to differentiate labor costs from O&M (e.g., total labor intensity, skilled vs. unskilled labor) for each different technology if data exists or reasonable assumptions can be made.

3.5 Trade and Tax Information

Original GTAP trade information related to inputs to electricity (domestic/imported) will be distributed to the technologies in the same proportion. Also, we will assume no differentiation in trade of specific generating technologies, so electricity will be imported and exported with the same electricity mix as is produced by the exporting country.

Similarly, taxes on inputs to electricity will be congruent with the original GTAP database. However, investment and production taxes (or subsidies) on specific generation technologies will

need to be added on a country by country basis, especially where distortions are large and do not match well when reconciling the data based on the above information.

4. Reconciling the Data

GTAP currently uses two sectoral disaggregation processes for regional input-output tables which are incomplete due to data availability constraints. For agricultural disaggregation blocks, sub-matrices of the I-O tables, with sales and/or cost components are matched between the contributed (aggregated) and agricultural (disaggregated) I-O tables. Row- and column-specific scaling factors are combined with block scaling factors so each cell is scaled by three factors. For non-agricultural disaggregation only column-specific and block scaling factors are used since there is no region-specific information on row and column totals. (McDougall, 2009).

For matrix filling and data balancing problems RAS, or bi-proportionate adjustment model, has been commonly used. Later, entropy optimization methods have been proposed for balancing I-O models (Golan et al., 1996). It has been shown that the standard RAS is a special case of the entropy optimization model based on a specific minimand and constraints on the known column and row totals in disaggregation. Also, as opposed to some proposed entropy-based models, RAS preserves the ordering of input intensities across the disaggregated sectors (McDougall, 1999). This is an important feature for electric power technologies as substitutes to generation (e.g., high capital-fuel ratio vs. low capital-fuel ratio technologies). Lahr and de Mesnard (2004) survey alternatives and extensions to the traditional RAS model namely with respect to reliability of known interior cell information. One example of an extension of RAS is to incorporate constraints on arbitrarily sized sub-matrices or “blocks” (as mentioned above) instead of only on row and column totals (Lenzen et al., 2009).

McDougall (1999) alludes to possible gains from the standard RAS formulation by less restricted entropy optimization models for tri-proportionate adjustments, as in the row-specific, column-specific, and block scaling factors described above in the GTAP data set and for disaggregating the electricity sector. Golan and Vogel (2000) introduce structural and supply-side information (e.g., capital-labor ratio) in the entropy maximization problem. Similarly, Robinson, et al. (2001) present a cross entropy approach which includes additional informational detail (e.g., *a priori* knowledge, error, and inequality constraints). They show gains compared to the standard RAS formulation.

Sue Wing (2008) uses positive mathematical programming approach (Howitt, 1995) to incorporate technological detail (e.g., input shares from engineering cost data) in a disaggregation of the GTAP electricity sector.

A full data availability assessment is necessary before selecting or developing a specific algorithm for the proposal. An ideal balancing algorithm for disaggregating the electricity sector would optimize entropy subject to available, yet incomplete, *a priori* information such as: i) total GWh output, ii) constraints on “known” elements (e.g., fuel inputs), iii) levelized costs of capital/investment, labor, fuel, and other cost shares by technology, and iv) relative levelized cost shares by technology while also preserving important features such as ordering of input intensities mentioned above.

5. Timeline and Budget

Activity	2014											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Collect raw data from databases	■											
Collect trade and tax data		■										
Convert data to GTAP formulation			■									
Design reconciliation method			■	■								
Verify reconciliation					■							
Document procedure					■							
GTAP Annual Meeting						■						
Peer-review of procedure							■	■				
Incorporate into GTAP database									■	■	■	
Document GTAP database procedure										■	■	■

GTAP Researcher	Jeffrey C. Peters	Rob McDougall	Badri Narayanan	TOTAL
Duration	12 months	1 month	2 weeks	
Salary	\$ 21,957.36	\$ 7,654.16	\$ 2,748.96	\$ 32,360.48
Graduate fees	\$ 10,260.00	\$ -	\$ -	\$ 10,260.00
Fringe	\$ 1,500.00	\$ 2,449.33	\$ 984.13	\$ 4,933.46
Travel (Dakar, Senegal)	\$ 4,348.00	\$ -	\$ -	\$ 4,348.00
Subtotal	\$ 38,065.36	\$ 10,103.49	\$ 3,733.09	\$ 51,901.94
Overhead @ 36%	\$ 10,009.93	\$ 3,637.26	\$ 1,343.91	\$ 14,991.10
TOTAL	\$ 48,075.29	\$ 13,740.75	\$ 5,077.00	\$ 66,893.04

References:

- Burniaux, J-M., Chateau, J. (2010). Background Report: An Overview of the OECD ENV-Linkages model. Background report to the joint report by IEA, OPEC, OECD, and World Bank on “Analysis of the Scope of Energy Subsidies and Suggestions for the G-20 Initiative.” May 2010.
- Golan, A. and Vogel, A. (2001). Estimation of Non-Stationary Social Accounting Matrix Coefficients with Supply-Side Information. *Economic Systems Research*. Vol. 12, No. 4, pp. 447-471.
- Howitt, R. (1995). Positive Mathematical Programming. *American Journal of Agricultural Economics*. Vol. 77, No. 2, pp. 329-342.
- International Energy Agency (IEA) (2013). Electricity Information – 2013 Edition. Published by the OECD/IEA.
- International Energy Agency (IEA) and Nuclear Energy Agency (NEA) (IEA/NEA) (2010). Projected Costs of Generating Electricity – 2010 Edition. Published by OECD. Paris, France. 2010.
- Lahr, M., and de Mesnard, L. (2004). Biporportional Techniques in Input-Output Analysis: Table Updating and Structural Analysis. *Economic Systems Research*. Vol. 16, No. 2, pp. 115-134.
- Lenzen, M., Gallego, B., and Wood, R. (2009). Matrix Balancing under Conflicting Information. *Economic Systems Research*. Vol. 21, No. 1, pp. 23-44.
- McDougall, R.A. (1999). Entropy Theory and RAS are Friends. GTAP Resource #300. Center for Global Trade Analysis. West Lafayette, IN, 47907.
- McDougall, R.A. (2009) GTAP 7 Data Base Documentation - Chapter 8.D: Disaggregation of Input-Output Tables. GTAP Resource #3167. Center for Global Trade Analysis. West Lafayette, IN, 47907.
- Narayanan, B., Dimaranan, B., McDougall, R. (2012). GTAP 8 Data Base Documentation – Chapter 2: Guide to the GTAP Data Base. GTAP Resource #3777. Center for Global Trade Analysis. West Lafayette, IN, 47907.
- Robinson, S., Cattaneo, A., and El-Said, M. (2001). Updating and Estimating a Social Accounting Matrix Using Cross Entropy Models. *Economic Systems Research*. Vol. 13, No. 1, 47-64
- Sue Wing, I. (2008). The synthesis of bottom-up and top-down approaches to climate policy modeling: Electric power technology detail in a social accounting framework. *Energy Economics*. Vol. 30, No. 2, March 2008, pp. 547-573.

United States Energy Information Administration (EIA) (2013). Levelized Cost of New Generation Resources in the Annual Energy Outlook 2013. Published by EIA. Accessed http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.