The Global Trade Analysis Project

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Outline

- **The Project**
- **The Network**
- **The Data Base**
- **The Model**
- **Other GTAP Offerings**
- **An Illustration of GTAP: The PE-GE model**

The Project

- International network of economic/policy researchers and policy-makers
- Quantitative analysis of international policy issues within an economy-wide framework
- Co-ordination: Center for Global Trade Analysis, Purdue University
- Funding:
  - Consortium subscriptions
  - Data Base Sales
  - Project-based

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The Network

- 31 Consortium Board Members (US Govt agencies, EC, OECD, WB, UN, WTO, etc.)
- Over 9000 network members from 159 countries
- Over 2000 contributing members from 99 countries

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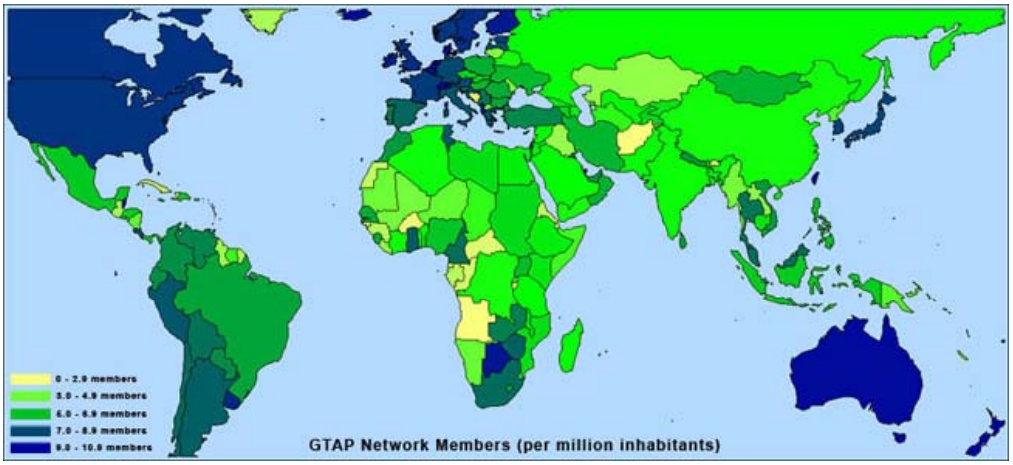
The Network



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GTAP Data Base

- Multi-country multi-sector economic data
- Input-Output (I-O) data
- Trade data: imports, exports, margins.
- Macro-economic data: GDP, population, consumption, investment, government expenditure, savings…
- Energy data: volumes, taxes, prices
- Protection data: taxes, domestic support, subsidies, tariffs, preferences, quotas…
- Satellite data: Land-use, Emissions, Bio-fuels...

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History

Release	Released	Regions	Sectors	For
GTAP 1	1993	15	37	1990
GTAP 2	1994	24	37	1992
GTAP 3	1996	30	37	1992
GTAP 4	1998	45	50	1995
GTAP 5	2001	66	57	1997
GTAP 6	2005	87	57	2001
GTAP 7	2008	113	57	2004
GTAP 8*	2011*	112+	57	2004,2007

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How can you use GTAP Data?

- International Computable General Equilibrium Modeling: Some GTAP Applications
  - Global Trade Analysis: FTAs, PTAs, WTO, etc.
  - Poverty
  - Energy, Environment and climate change
  - Land Use and agricultural issues
  - Migration and labor issues
  - Growth and development
  - Factor movements and technology

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How is GTAP Data Base constructed?

- Collect the I-O tables from contributors
- "Process" them
- Reconcile them with international datasets
- Assemble the data into a single consistent and balanced database

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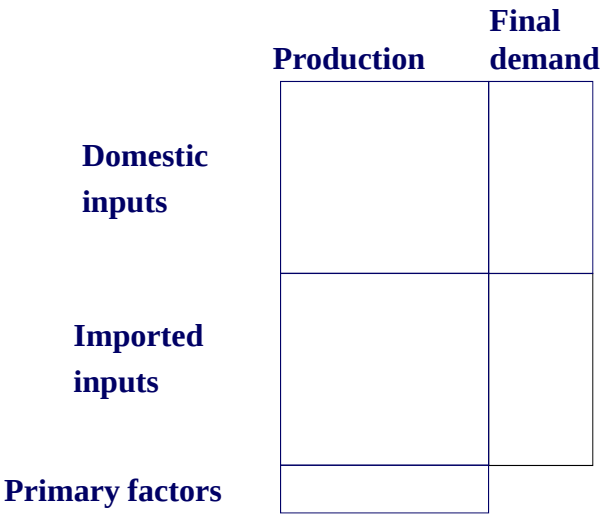
I-O Data



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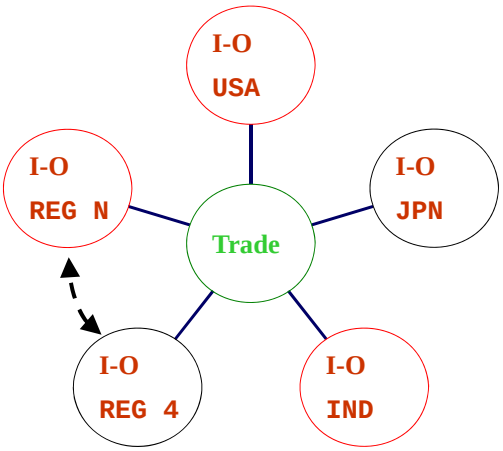
Data File Content



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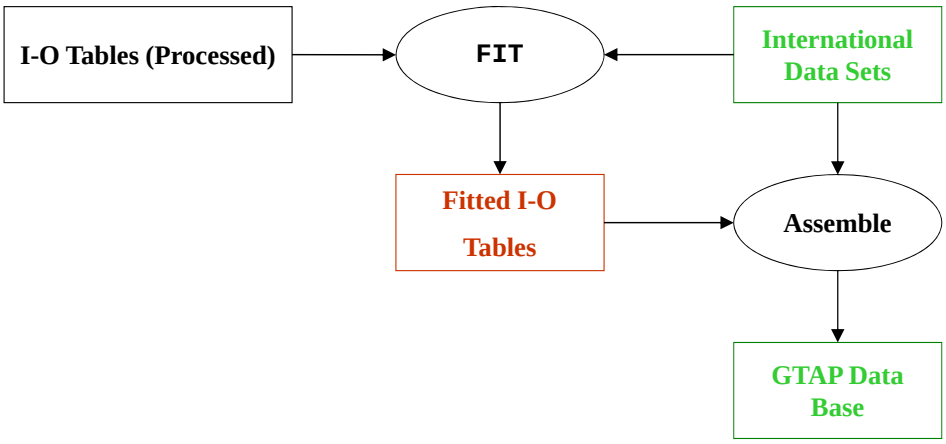
Construction Process



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Clean, Disaggregate, Synthesize

- **Clean**
  - **Remove small remaining problems with balance and sign.**
- **Disaggregate**
  - **Of the 113 regions in GTAP 7: only 35 I-O tables have all 57 sectors; no disaggregation needed**
  - **40 tables need agricultural disaggregation; use agricultural I-O data set.**
  - **17 tables need non-agricultural disaggregation; use representative table.**
- **Synthesize**
  - **Create 19 composite regions.**

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FIT: Updating and Reconciliation

- **Eliminate changes in stocks**
- **Reconcile with international data sets**
- **Entropy theoretic approach**

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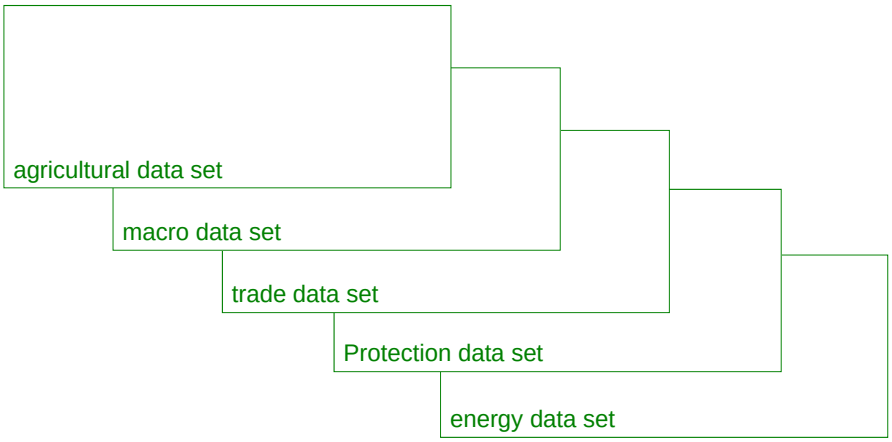
International Data Sets in GTAP



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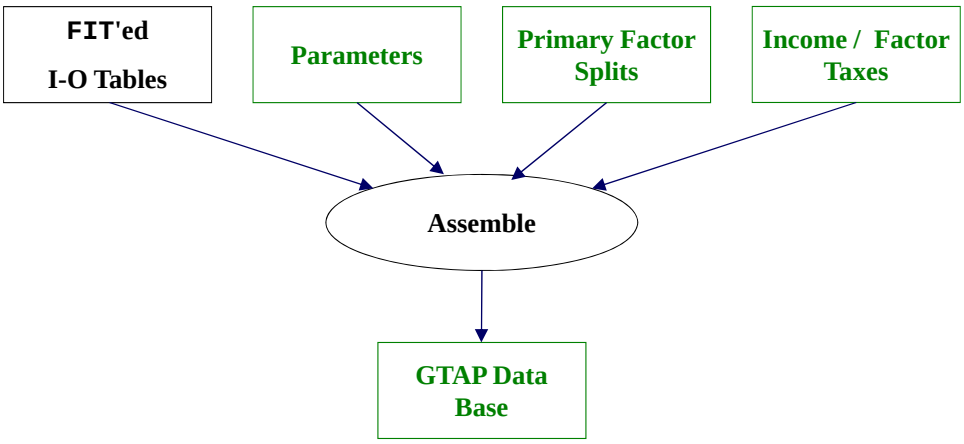
Data Assembly



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Data Base Modification Tools

- **Beginners: ViewHAR, GTAPAgg, FlexAgg**
- **GAMS users: HAR2GDX, GDX2HAR**
- **Advanced users:**
  - **SplitCom , MSplitcom– preserve the overall balance in the data while disaggregating the sectors using specified weights.**
  - **Altertax – tax rate/tariff changes while preserving the balance, using a specific GE closure with appropriate elasticities with least possible changes to other data**

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Main Data Construction Program

- **one job with run time: 10 hours**
- **215 data handling programs, 17k data files**
- **22 top level modules: trade, energy, *etc*.**
- **with sub-modules: 38 modules total**
- **Make: build management tool to keep outputs up to date with inputs and programs**
- **error handling inbuilt**

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Formats and Software used

- initial data: HAR, GEMPACK text
- internal data: HAR
- data handling: TABLO
- text processing: Unix utilities
- miscellaneous: Bash, GAMS

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GTAP Model

- Hertel (1997)
- Elasticities: calibrated/estimated econometrically
- Demand = Supply in all markets (price = marginal cost)
- Taxes: wedge between prod & cons prices
- Int'l trade: Armington CES substitution across sources
- Firm Production Inputs: intermediate & factors: Leontief
- Intermediate: imported/domestic: CES
- Factors: Labor, Capital, Land: CES
- Regional Household: Y=C+I+G+X-M: constant shares
- Private HHLD (C): CDE demand system: Hanoch (1975)
- Global savings (Fixed share of income, ROR): investment
- Welfare Decomposition: EV

Other GTAP Offerings

- GTAP Model and data extensions: Land use, agriculture, bio-fuels, dynamic, migration, climate change, poverty, imperfect competition
- Short courses
- Conferences
- Online resources
- Mailing list: GTAP-l
- Other models/utilities: GTAPinGAMS, FTAP, CRUSOE, etc.

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An Illustration: the PE-GE model

- Tariff Variations at Disaggregate Level➔ Tariff aggregation problems
- "False competition"
- So, disaggregated Partial Equilibrium (PE) models are used as inputs to negotiations. Is PE enough? What about welfare gains and economy-wide effects?
- We develop a GTAP PE-GE model with provisions to do tariff analysis at disaggregate level.
- Indian auto industry is a good example: heterogenous, divergent tariffs, contentious tariff cut proposals.

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An Illustration: the PE-GE model

- **Model Summary**
  - **CET and CES nests used to aggregate supply and demand, respectively; corresponding price linkages.**
  - **Armington nest and CES nest between domestic and import demand: based on GTAP model.**
  - **Market Clearing to determine Market Prices**
  - **Transport Margins: Based on GTAP model**
  - ***Welfare Decomposition extended to the disaggregated level: AE and TOT Effects***
  - ***Slack Variables used to link GE and PE parts***

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An Illustration: the PE-GE model

Database

- **GTAP Data Base version 6.2**
- **TASTE software for MacMAP HS6-level trade and tariff data, mapped to GTAP aggregation**
- **Tariff adjustments in GTAP to accommodate MacMAP: Altertax simulation**
- **Regions:**
  - **India (IND)**
  - **East and South East Asia (SEA)**
  - **Rest of the World (ROW)**

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An Illustration: the PE-GE model

Database (Contd…)

Sectors *TRAD_COMM*

1. Food *(food)*
2. Sectors that supply Raw Materials to Auto (*autorms*)
3. Energy *(energy)*
4. Auto *(AUTO):* → Disaggregated Sector *DAGG_COMM*

a. Motor Cycles (*MCYC*)
b. Motor Cycle Parts (*MCYP*)
c. Automobiles other than motorcycles *(ATML)*
d. Engines and other Parts of Automobiles *(ATMP)*
e. Other Transport Equipment *(OTHR)*

Sub-Sectors *SSECT_COMM*

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The Database (Contd.)

	India's Tariff Rates of Imports from:		*Share of SSECT Imports in Auto Imp from:*		*Region-wise Import-weighted Tariff Average*		*Shares of India's Imports in SSECT in its Total Auto Imports from:*		
Reg. ➔	*SEA*	*ROW*	*SEA*	*ROW*	*SEA*	*ROW*	*SEA*	*ROW*	*Total*
Motorcycle	59.70	48.16	0.00	0.00	0.06	0.01	0.78	0.22	1
Mcycle-parts	19.79	16.06	0.05	0.00	0.93	0.02	0.95	0.05	1
Auto-mobiles	51.97	33.56	0.03	0.06	1.62	2.07	0.24	0.76	1
Engines and Auto Parts	19.80	16.06	0.59	0.21	11.74	3.31	0.62	0.38	1
Other Trans	12.86	7.93	0.33	0.73	4.22	5.79	0.21	0.79	1
Total			1	1	18.56	11.20	0.37	0.63	1

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The Database (Contd.)

- **Some Inferences from the database:**
  - Divergent tariffs: Highest for Automobiles, MCs
  - All tariffs for imports from SEA are higher than for those from ROW, most divergent for OtherTrans, Automobile, MC.
  - OtherTrans (ROW) and Engines&Parts (SEA) dominate India's Auto imports
  - SEA's share in India's total imports is lower for AUTO than in MCs, MC parts and Engines&Parts

Closure

PE Model	GE Model	PE-GE Model
Exogenous: Changes in total output and demand in all sectors and regions. Changes in all price, tax and quantity variables for non-Auto sectors at *i* level. Changes in import tax and import-augmented technical-change ($amsk_{krs}$) variables at *k*-level. Slack variable for tradeables market-clearing at *k*-level. **Endogenous:** All other price, tax and quantity changes and slack variables.	**Exogenous:** Changes in endowment output, world price index for primary factors, distribution parameters for savings, government and private consumption and population. Slack variables for consumer goods, endowments, income, profits, savings price and tradeables' market clearing; All technical and tax change variables. **Endogenous:** All other price and quantity changes and slack variables.	**Exogenous:** Changes in endowment output, world price index for primary factors, distribution parameters for savings, government and private consumption and population. Slack variables for consumer goods, endowments, income, profits, savings price and tradeables' market clearing; Slack variables for different prices, quantities and welfare-count-variables are exogenous for non-Auto sectors. All technical and tax change variables at *i* level, except tms_{irs} txs_{irs} tm_{ir} tx_{ir} and ams_{irs} that are exogenous for non-Auto sectors. **Endogenous:** All other price, tax, technical and quantity changes and slack variables.

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Results

Imports from ROW

	SSECT Sectors					AUTO	
	Motor-cycles	Motor cycle Parts	Auto-mobiles	Engine and Parts	Other Trans Equip ment	PE-GE / PE	GE
PE-GE Model							
Domestic Penetration	201.9	34.3	113.1	44.1	20.5	**33.3**	28.0
Substitution Effect	-16.0	-11.5	-13.5	-9.0	-5.4	**-12.0**	-10.9
Total Change in Imports (qxsk)	185.9	22.8	99.6	35.1	15.1	**24.5**	17.1
PE Model							
Domestic Penetration	156.5	19.5	85.0	27.3	52.3	**25.7**	28.0
Substitution Effect	-15.5	-9.5	-13.0	-8.5	-50.3	**N.A.**	-10.9
Total Change in Imports (qxsk)	141.0	10.0	72.0	18.8	1.9	**9.7**	17.1

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Results (Contd.)

Imports from SEA

	SSECT Sectors					AUTO	
	Motor-cycles	Motor cycle Parts	Auto-mobiles	Engine and Parts	Other Trans Equip ment	PE-GE / PE	GE
PE-GE Model							
Domestic Penetration	356.6	49.4	285.4	58.6	28.5	**52.1**	49.9
Substitution Effect	6.3	0.8	70.4	6.7	24.9	**9.5**	26.8
Total Change in Imports (qxsk)	362.9	50.2	355.8	65.2	53.4	**70.0**	76.7
PE Model							
Domestic Penetration	282.6	33.6	222.5	38.5	7.5	**25.7**	49.9
Substitution Effect	6.3	0.8	69.4	6.6	28.0	**N.A.**	26.8
Total Change in Imports (qxsk)	288.9	34.4	291.9	45.1	35.5	**49.3**	76.7

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Results (Contd.)

Results from Systematic Sensitivity Analysis

Model	India's Imports From (*qxsk*) :		India's Imports (*qimk*)	Import Prices (*pimk*)	Domestic Prices (*pdk*)	Market Prices (*pmk*)	Import Prices From (*pmsk*):	
	SEA	ROW					SEA	ROW
PE-GE								
Lower Bound	67.3	24.0	40.5	-12.9	-2.3	-0.5	-16.3	-10.6
Upper Bound	72.5	24.8	43.4	-12.8	-2.3	-0.5	-16.2	-10.5
GE	76.7	17.1	38.7	-12.4	N.A.	-0.4	-15.6	-10.1
PE	49.3	9.7	24.0	-20.5	-12.8	-12.1	-16.7	-11.0

Results (Contd.)

Welfare: Aggregate Results

	Allocative Efficiency		Terms of Trade		Total Welfare Gain	
	GE	**PE-GE**	**GE**	**PE-GE**	**GE**	**PE-GE**
SEA	**4.7**	**(5.9,10.4)**	**75.1**	**63.5**	**67.8**	**(57.7,62.2)**
IND	**11.3**	**(24.1,27.7)**	**-96.2**	**-101.4**	**-80.9**	**(-73.1,-69.5)**
ROW	**15.9**	**(17.7,23.2)**	**21.0**	**37.9**	**44.9**	**(63.2,68.7)**
Total	**31.9**	**(47.6,61.3)**	**0.0**	**0**	**31.8**	**(47.6,61.3)**

Results (Contd.)

Welfare: Import-tax-related Results in Indian Auto Sector

Sub-sector	Imports from SEA			Imports from ROW			IND Auto Imports	
	Base Tariff	Import Change	Welfare Count	Base Tariff	Import Change	Welfare Count	Import Change	Welfare Count
Motorcycles	59.7	2.8	0.6	48.2	0.4	0.1	3.2	0.7
MCycleparts	19.8	18.3	1.7	16.1	0.5	0.0	18.7	1.8
Automobiles	52.0	85.9	17	33.6	85.7	13.2	171.6	30.2
EnginesParts	19.8	300.3	27.6	16.1	101.0	8.0	401.3	35.6
OtherTrans	12.9	136.0	8.3	7.9	154.2	6.3	290.3	14.5
Auto: PEGE	**18.6**	**543.4**	**(52.4,56.1)**	**11.2**	**341.8**	**(26.9,28.3)**	**885.2**	**(79.3,84.4)**
Auto: GE	**18.6**	**595.2**	**50.7**	**11.2**	**238.7**	**14.2**	**833.9**	**64.9**

Conclusions

- **PE Model captures sub-sector info but ignores economy-wide impacts ➔ Huge price adjustments, little quantity changes!**
- **GE model ignores sub-sector-level details.**
- **PE-GE results: closer to GE, but quite different.**
- **Auto imports by India rise sharper in PE-GE**
- **Heavy influx of automobiles and Mcycles!**

Conclusions (Contd…)

- **"False Competition" in some sub-sectors ➔Substitution from ROW to SEA: lesser extent in PE-GE, as SEA has a lower share in India's AUTO imports, but not at SSECT level.**
- **Welfare differences are notable:**
  - **India's net welfare loss is much lower in PE-GE**
  - **India loses more in TOT and gains more!**
- **Results not sensitive to assumed elasticities.**