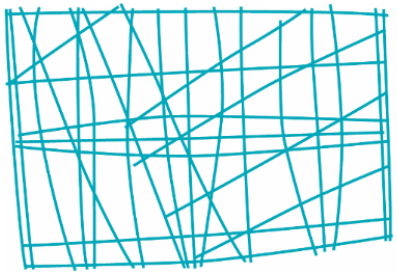


NEREUS

Núcleo de Economia Regional e Urbana da Universidade de São Paulo

The University of São Paulo Regional and Urban Economics Lab

LATES

LABORATÓRIO DE ANÁLISES TERRITORIAIS E SETORIAIS

fipe

Fundação Instituto de Pesquisas Econômicas

Modelos de Equilíbrio Geral Computável – Modelo GTAP

Prof. Dr. Fernando S Perobelli

Professor Titular do Departamento de Economia da UFJF

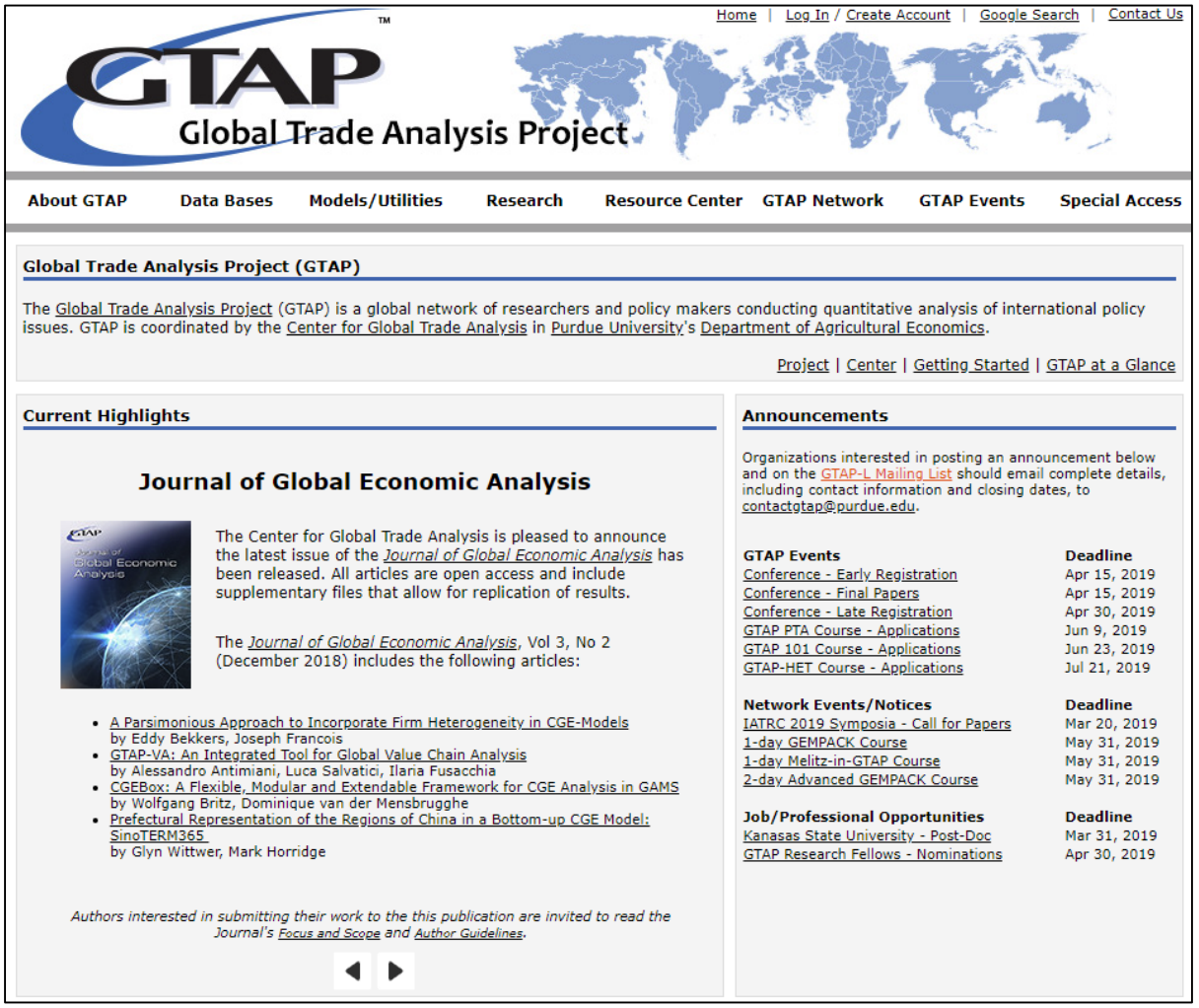
O que é o GTAP?

- The Global Trade Analysis Project (GTAP) is a global network of researchers and policy makers conducting quantitative analysis of international policy issues.

- GTAP is coordinated by the Center for Global Trade Analysis in Purdue University's Department of Agricultural Economics.

- GTAP's goal is to improve the quality of quantitative analysis of global economic issues within an economy-wide framework.

Global Trade Analysis Project



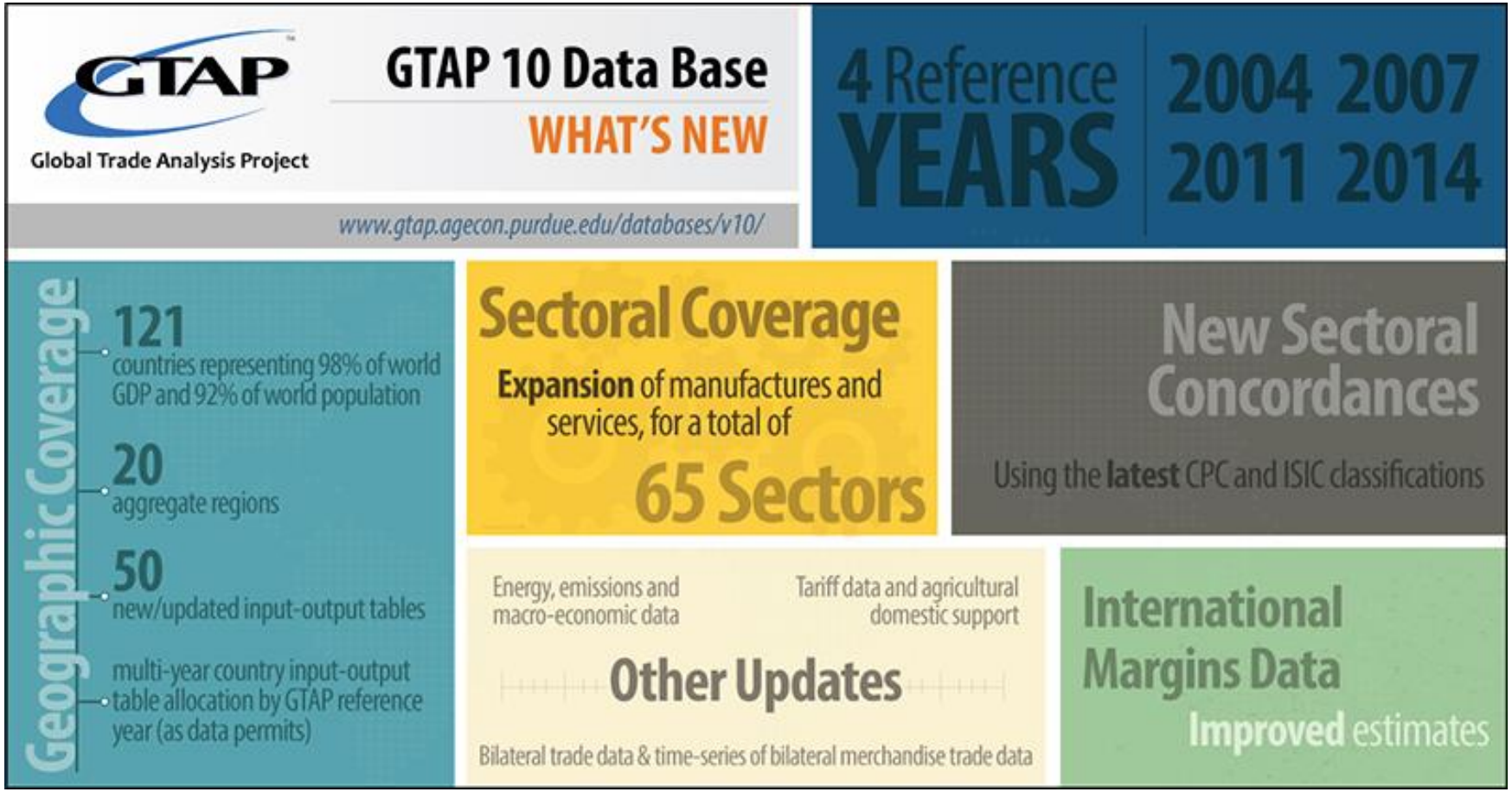
What is the GTAP Data Base?

- The centerpiece of the ***Global Trade Analysis Project*** is the ***GTAP Data Base***, a fully documented, publicly available global data base which contains complete bilateral trade information, transport and protection linkages.

- The GTAP Data Base represents the world economy and is utilized by thousands worldwide as a key input into contemporary applied general equilibrium (AGE) analysis of global economic issues.

- The current release, the GTAP 10 Data Base, features 2004, 2007, 2011 and 2014 reference years as well as 121 countries for all 65 GTAP commodities.

What is the GTAP Data Base?



What is the GTAP Data Base?

- The GTAP Data Base is most commonly used with the GTAP Model and ***RunGTAP*** software.

- First, the user must aggregate the data (regions, commodities and endowments) using the ***GTAPAgg (or FlexAgg)*** program provided with the data base to the desired level and then use with the GTAP or GTAPinGams model/s to analyze the impact of global policies (trade, environmental, migration policies are commonly examined).

- Alternatively a user may be interested in extracting country SAMs or IO tables from the GTAP Data Base for single country models. If you are interested in these alternative uses of the GTAP Data Base, we suggest you read through the points detailed on this page about what ***GTAP Data Base is not.***

The GTAP Data Base is NOT…

- … a repository of Input-Output tables.
- The GTAP Data Base is a consistent representation of the world economy in the year base of the current version.
- Underlying the data base there are national input-output tables, trade, macroeconomic, and protection data from several sources.
- The underlying input-output tables are heterogeneous in sources, base years, and sectoral detail, thus for achieving consistency, substantial efforts are made to make the disparate sources comparable.
- For these reasons, the objective of the GTAP Data Base is not to provide IO tables, but to facilitate the operation of economic simulation models ensuring users a consistent set of economic facts.

The GTAP Data Base is NOT…

- … a relational data base of economic variables.
- Except for trade data, the GTAP Data Base is a cross-section of consistent data on consumption, production, and trade.
- Some users assume that binding together different versions of the data base will give them time-series variation.
- The users considering to do this are strongly encouraged to get familiar with the processes underlying the construction of the GTAP Data Base, and to take into account that for many countries, the underlying IO tables do not change from version to version - most of the variability comes from adjustment processes based on macroeconomic/trade changes.

The GTAP Data Base is NOT…

- … a repository of time series on economic data.
- Users interested in economic data only for comparative purposes are better served by sources such as the World Bank Development Indicators, the IMF's financial statistics, or the FAO's agricultural statistics, to name a few.
- The data in the GTAP Data Base accurately depicts the magnitudes of economic variables, but they are presented in terms of the aggregates that serve CGE modeling.

- Mais informações em:
- https://www.gtap.agecon.purdue.edu/

Global Trade Analysis Project

- A base de dados do Global Trade Analysis Project (GTAP) é mantida por pesquisadores da Purdue University.
- A base inclui tabelas de insumo-produto, fluxos de comércio bilateral, custos de transporte, impostos, tarifas e outros dados associados as matrizes de contabilidade social.
- Além disso, a base de dados inclui parâmetros usados em modelos de Equilíbrio Geral Computável (EGC)

Global Trade Analysis Project

Release	Released	Regions	Sectors	Year
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	2012	134	57	**2004 & 2007**
GTAP 9	2015	140	57	**2004, 2007 & 2011**
GTAP 10	**2019**	**141**	**65**	**2004, 2007,2011 & 2015**

Global Trade Analysis Project

- A versão GTAP-10 abrange 65 commodities e 121 países, incluindo o Brasil, e 5 fatores de produção (terra, trabalho qualificado, trabalho não qualificado, recursos naturais e capital).

- As classificações setoriais do GTAP, por sua vez, seguem a seguinte estrutura:

- Setores agrícolas e de processamento de alimentos são definidos de acordo com a Central Product Classification (CPS);

- Demais setores de acordo com a International Standard Industry Classification (ISIC).

Global Trade Analysis Project

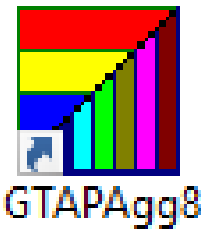
- Informações detalhadas do GTAP10 podem ser encontradas nos seguintes links

- https://www.gtap.agecon.purdue.edu/databases/v10/index.aspx

- https://www.gtap.agecon.purdue.edu/databases/v10/v10_doco.aspx

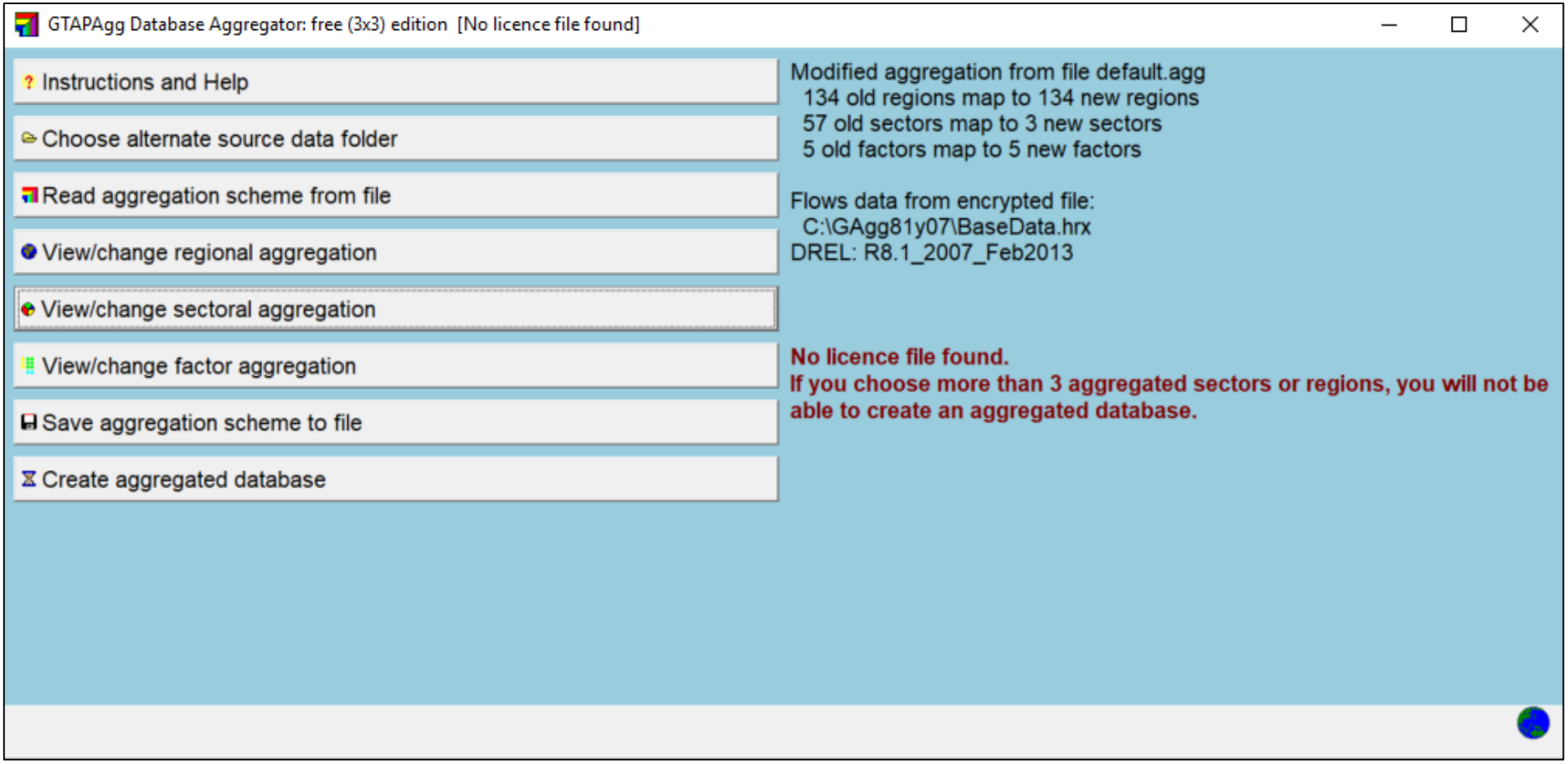
Programas

- No curso utilizaremos dois programas: RunGTAP e GTAPAgg.
- O GTAPAgg é utilizado para acessar a base de dados e definir a agregação setorial, regional e alguns parâmetros.
- O RunGTAP, por sua vez, é utilizado para fazer simulações - similarmente ao GEMPACK.
- Os ícones dos programas são:
  - GTAPAgg

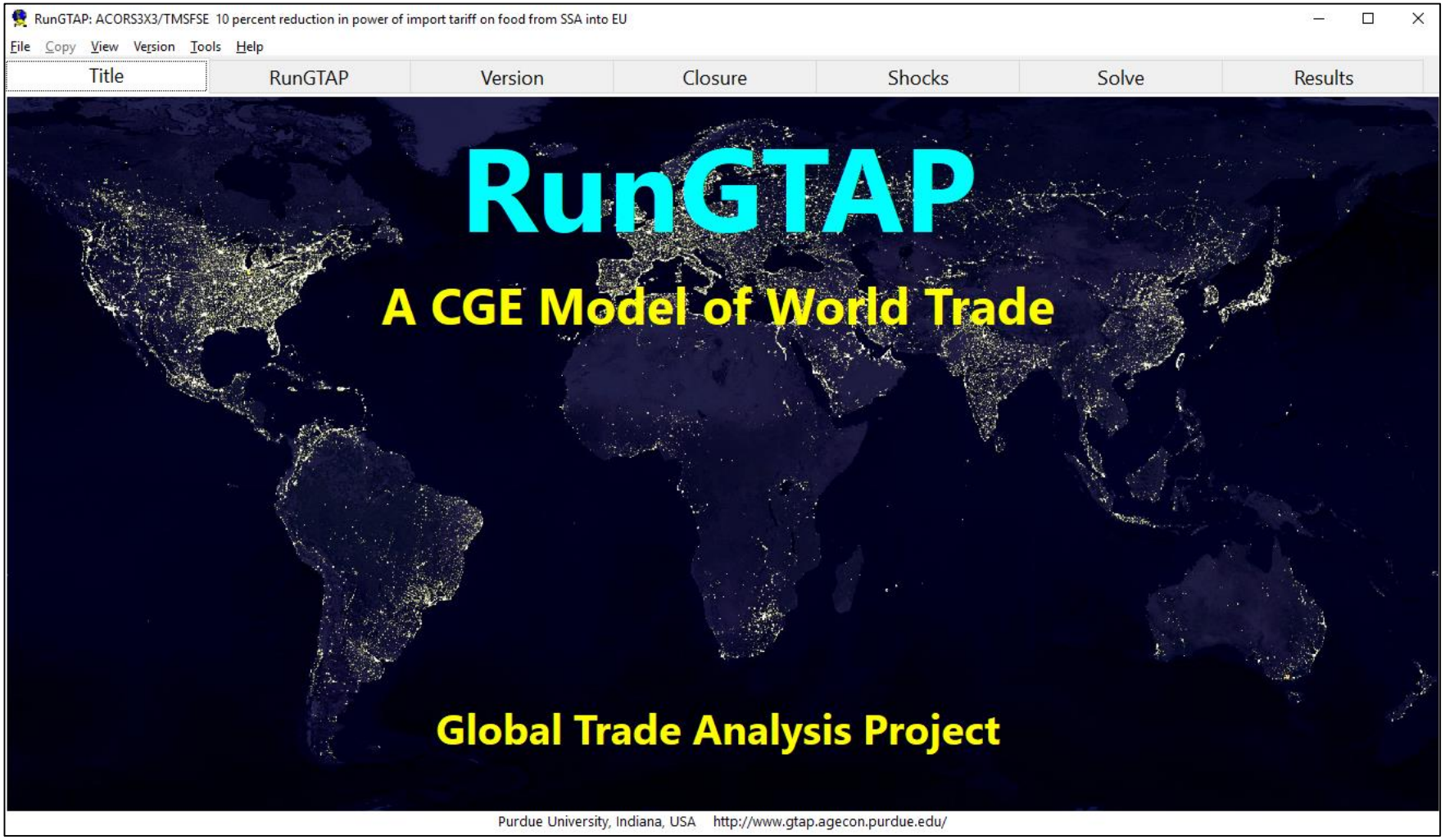


RunGTAP

GTAPAgg Database Aggregator



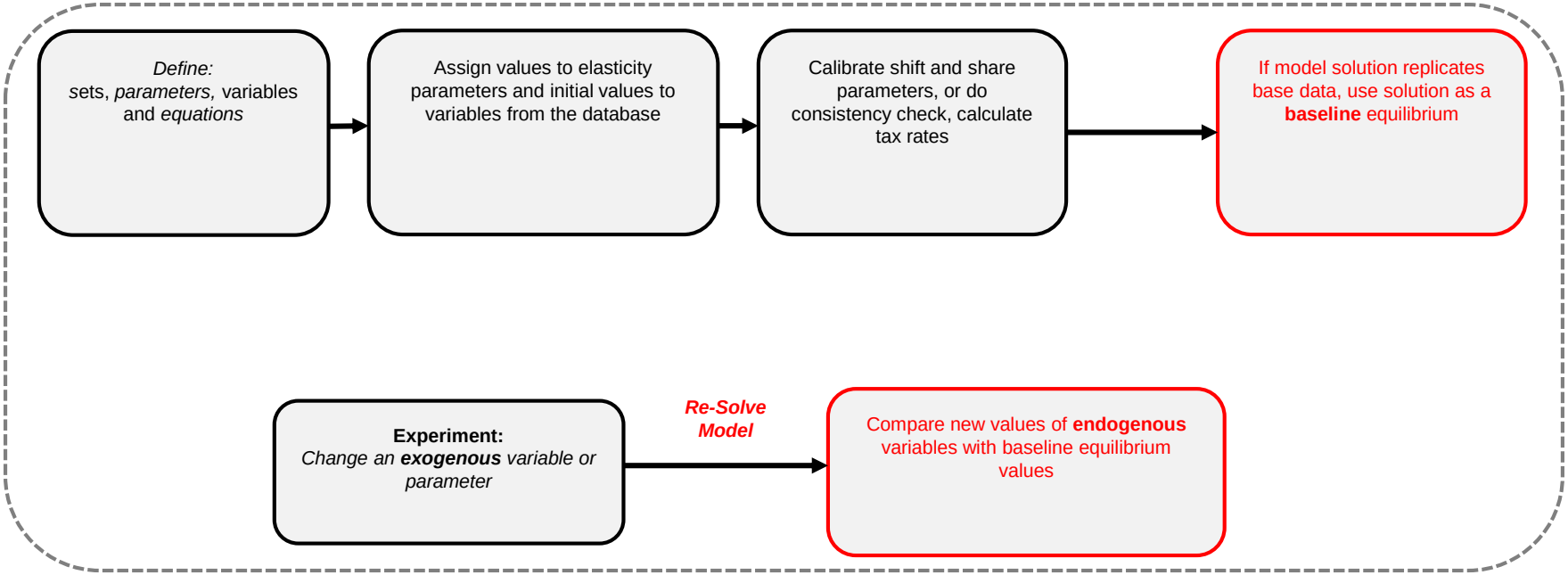
RunGTAP


RunGTAP: ACORS3X3/TMSFSE 10 percent reduction in power of import tariff on food from SSA into EU
File Copy View Version Tools Help
Title
RunGTAP
Version
Closure
Shocks
Solve
Results
RunGTAP
A CGE Model of World Trade
Global Trade Analysis Project
Purdue University, Indiana, USA http://www.gtap.agecon.purdue.edu/

Análise de Equilíbrio Geral Computável

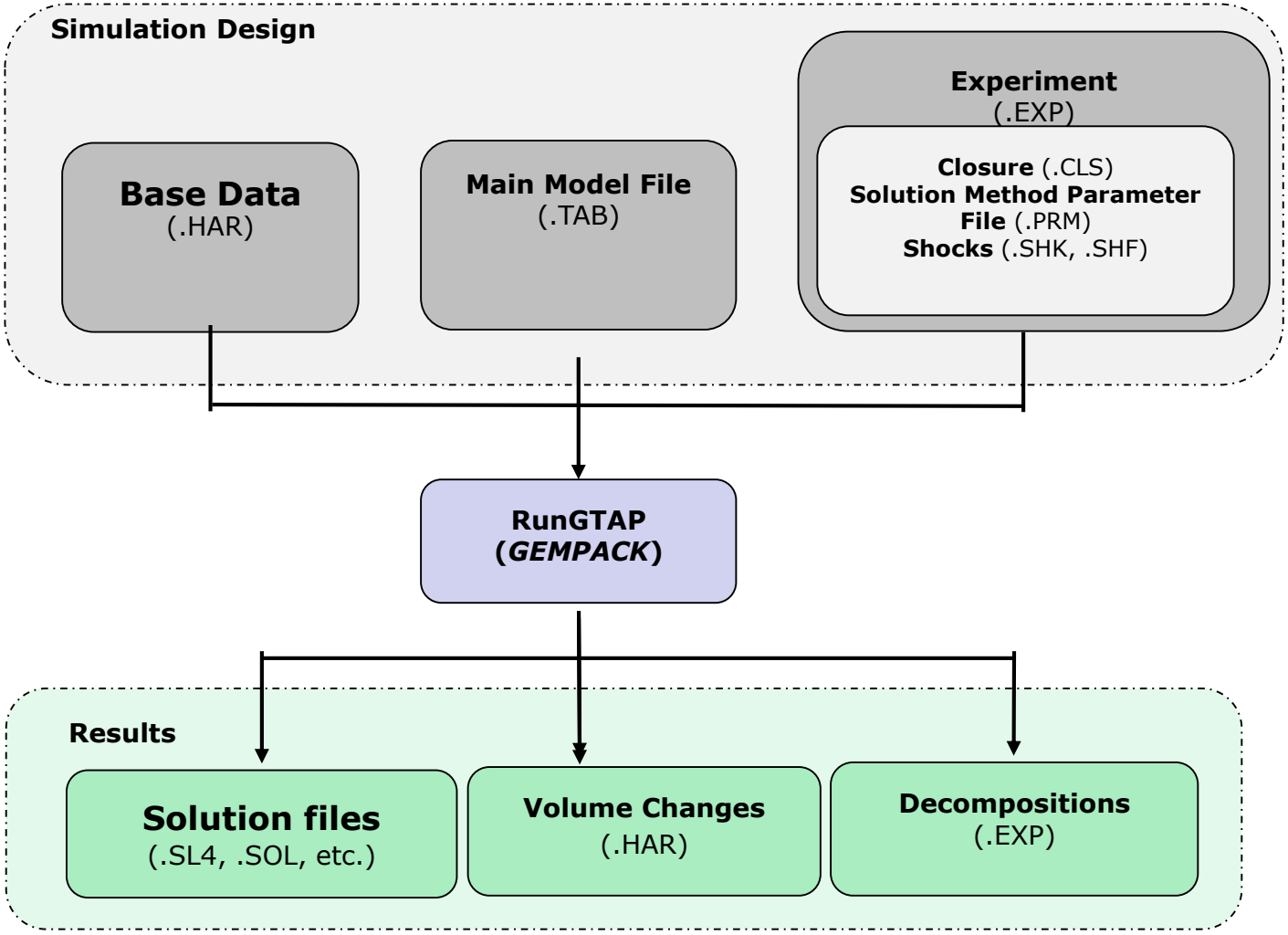
Análise de Equilíbrio Geral Computável

Structure of a CGE model and experiment



Source: Burfisher (2016).

Análise de Equilíbrio Geral Computável



Base de Dados

Base de Dados

- Os modelos de Equilíbrio Geral Computável (EGC):
  - Representam a economia como um todo
  - Descrevem os comportamentos de todos os agentes econômicos
    - Produtores, Consumidores, Setor Externo, Investidores, Famílias e Governo.
- Descrevem o fluxo circular da renda e dos gastos em uma economia nacional.

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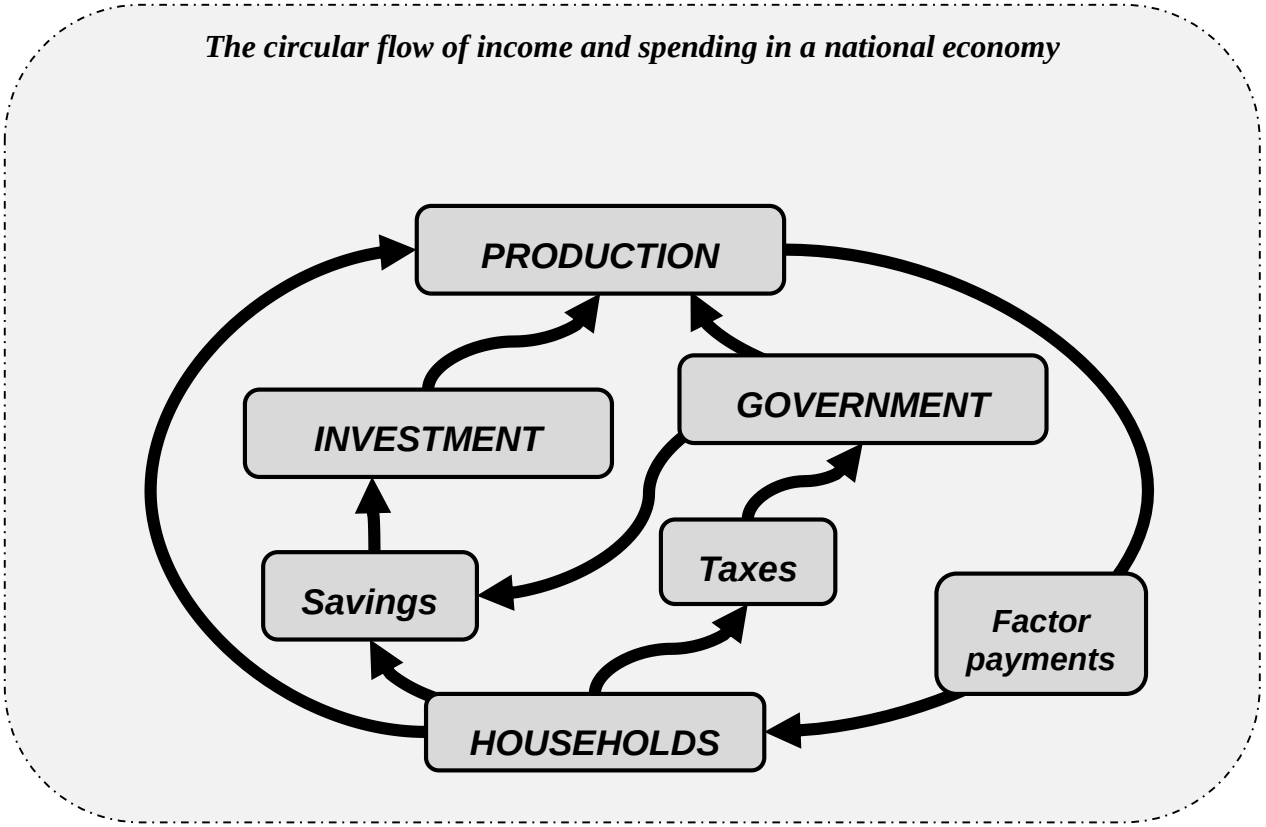


Source: Burfisher (2016).

Matriz de Contabilidade Social

- O banco de dados de um modelo de Equilíbrio Geral Computável (EGC) apresenta os valores de todas as transações do fluxo circular da renda e dos gastos em uma economia ao longo de um determinado período de tempo, geralmente um ano.

- **Matriz de Contabilidade Social:**

  - Organização lógica do banco de dados do modelo.

  - Fornece uma fácil leitura e visão das ligações entre os agentes na economia.

Matriz de Contabilidade Social

- As contas incluídas nas MCS muitas vezes diferem entre os modelos de EGC.
- Os modelos podem diferir em suas ***dimensões*** (número de setores, fatores de produção e/ou famílias).
- As contas na MCS podem variar também devido a ***estrutura teórica*** dos modelos de EGC.
- Um modelo de EGC, por exemplo, pode incluir uma ***Regional Household*** enquanto outro não.
- Nesse caso, as MCS serão diferentes: uma inclui contas linha e coluna para uma ***Regional Household*** enquanto a outra não.

Matriz de Contabilidade Social

- A ***Regional Household*** é uma conta macroeconômica presente em algumas MCS e modelos de EGC.

- É semelhante ao conceito do PIB pelo lado da renda e pelo lado do gasto:

  - **Linha:** descreve as fontes de renda nacional total a partir dos rendimentos dos fatores de produção e impostos.
  - **Coluna:** descreve a alocação dos gastos domésticos agregados em famílias, governo, e poupança nacional (Privada + Pública). Ou seja, mostra como a renda nacional é alocada em gastos pelos agentes supracitados.

- A ***Regional Household*** difere do PIB porque exclui depreciação.

Matriz de Contabilidade Social

- **Vantagem:**
- Indicador de bem-estar oferecido pela função de utilidade desta Regional Household .
- **Desvantagem:**
- Nenhuma ligação entre os gastos do governo e os impostos.

Matriz de Contabilidade Social

Accounts in a Social Accounting Matrix with a Regional Household

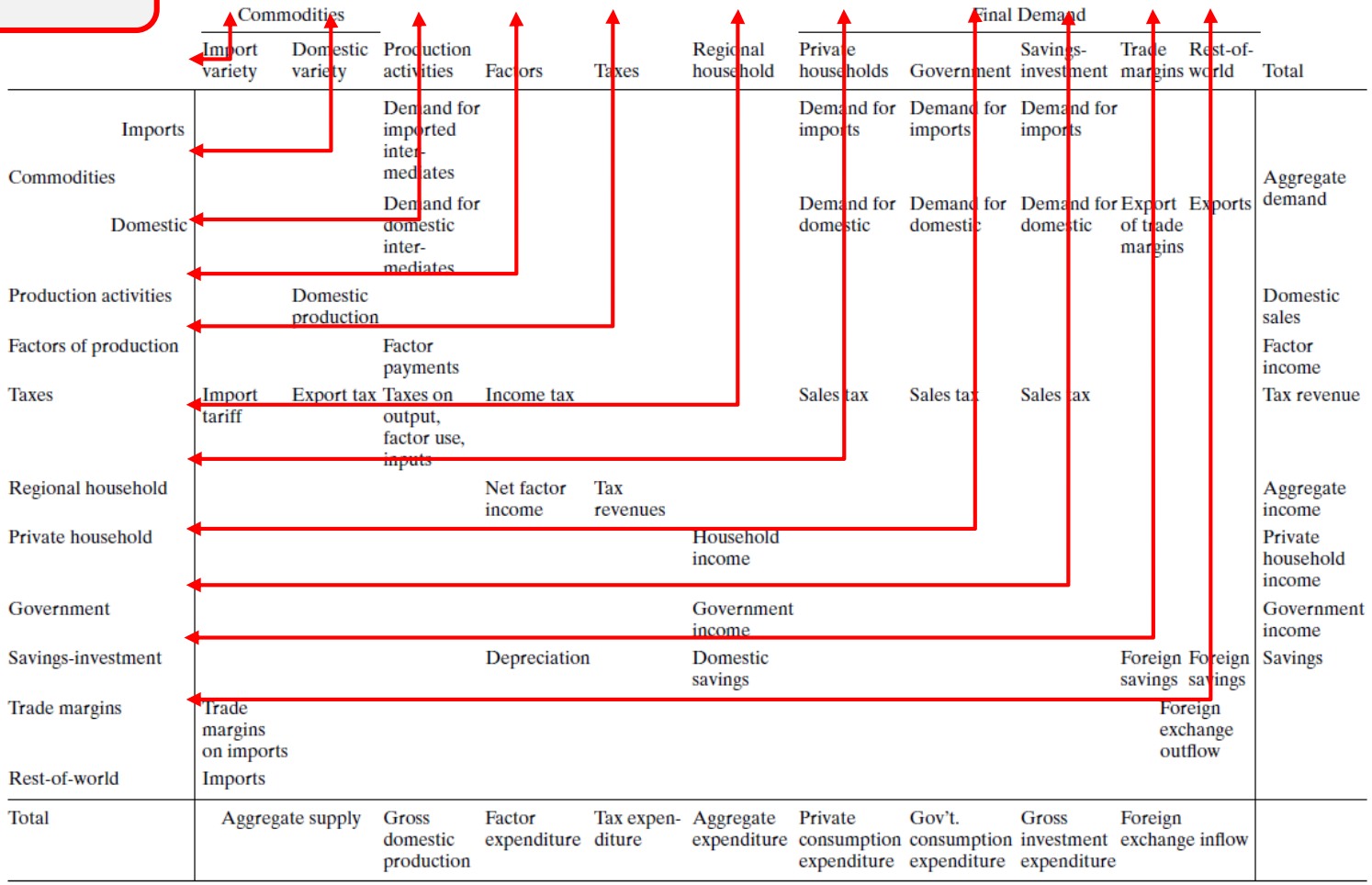
	Commodities						Final Demand					
	Import variety	Domestic variety	Production activities	Factors	Taxes	Regional household	Private households	Government	Savings-investment	Trade margins	Rest-of-world	Total
Imports			Demand for imported inter-mediates				Demand for imports	Demand for imports	Demand for imports			
Commodities												Aggregate demand
Domestic			Demand for domestic inter-mediates				Demand for domestic	Demand for domestic	Demand for domestic	Export of trade margins	Exports	
Production activities		Domestic production										Domestic sales
Factors of production			Factor payments									Factor income
Taxes	Import tariff	Export tax	Taxes on output, factor use, inputs	Income tax			Sales tax	Sales tax	Sales tax			Tax revenue
Regional household				Net factor income	Tax revenues							Aggregate income
Private household						Household income						Private household income
Government						Government income						Government income
Savings-investment				Depreciation		Domestic savings				Foreign savings	Foreign savings	Savings
Trade margins	Trade margins on imports									Foreign exchange outflow		
Rest-of-world	Imports											
Total	Aggregate supply		Gross domestic production	Factor expenditure	Tax expen-diture	Aggregate expenditure	Private consumption expenditure	Gov't. consumption expenditure	Gross investment expenditure	Foreign exchange inflow		

Source: Burfisher (2016).

Matriz de Contabilidade Social

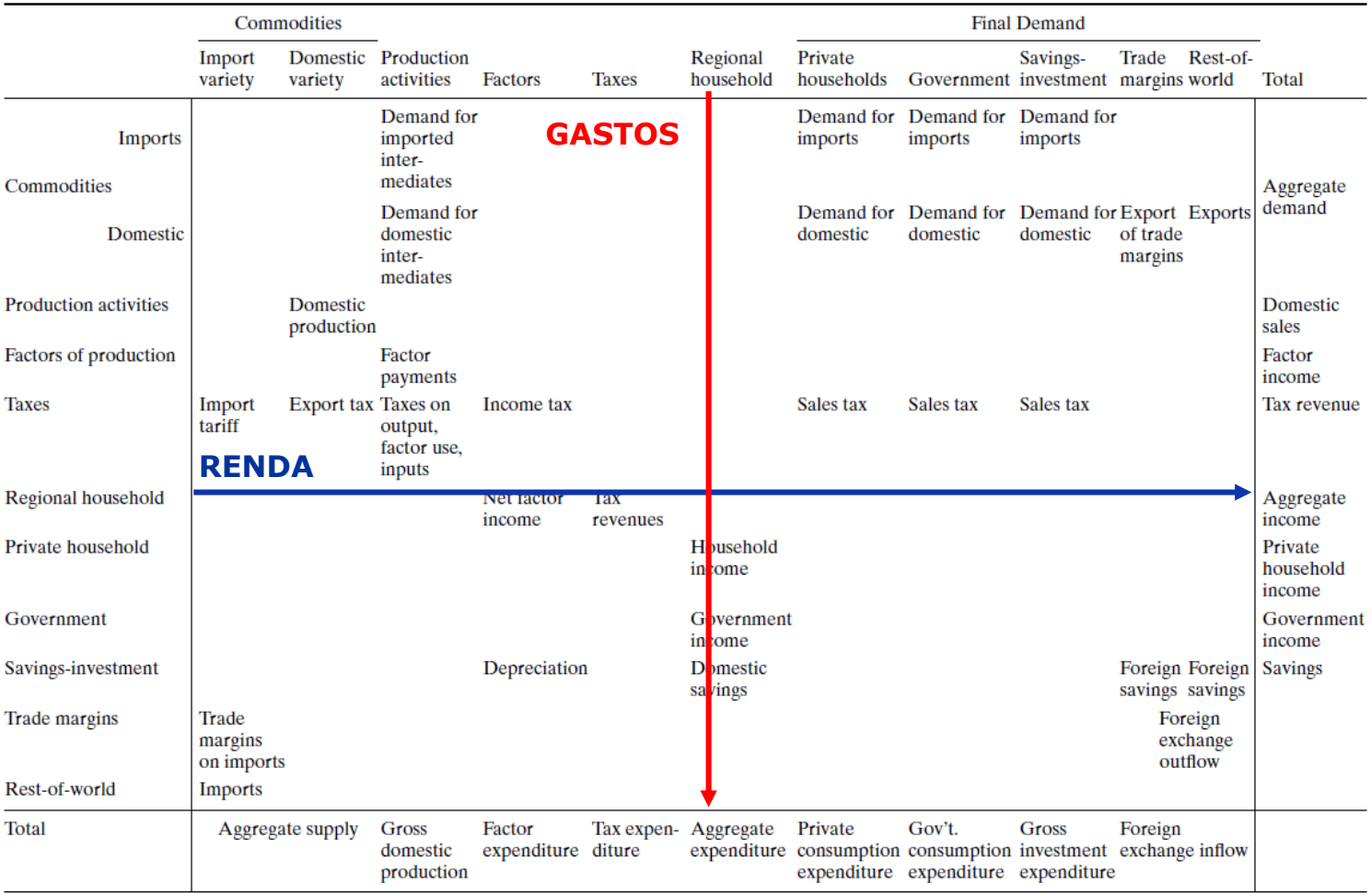
A **MCS** é uma matriz quadrada de dados

Accounts in a Social Accounting Matrix with a Regional Household



Source: Burfisher (2016).

Matriz de Contabilidade Social



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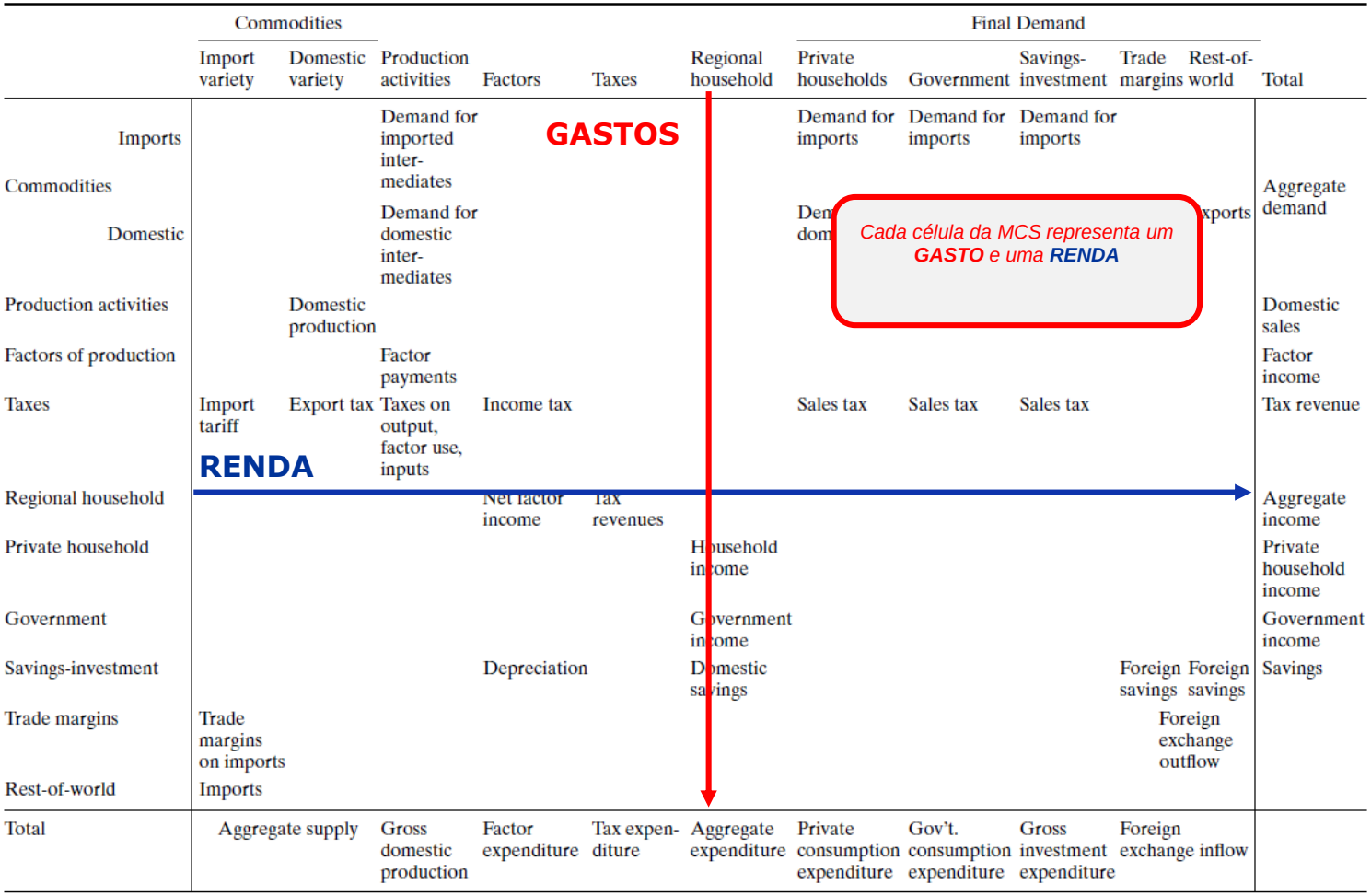
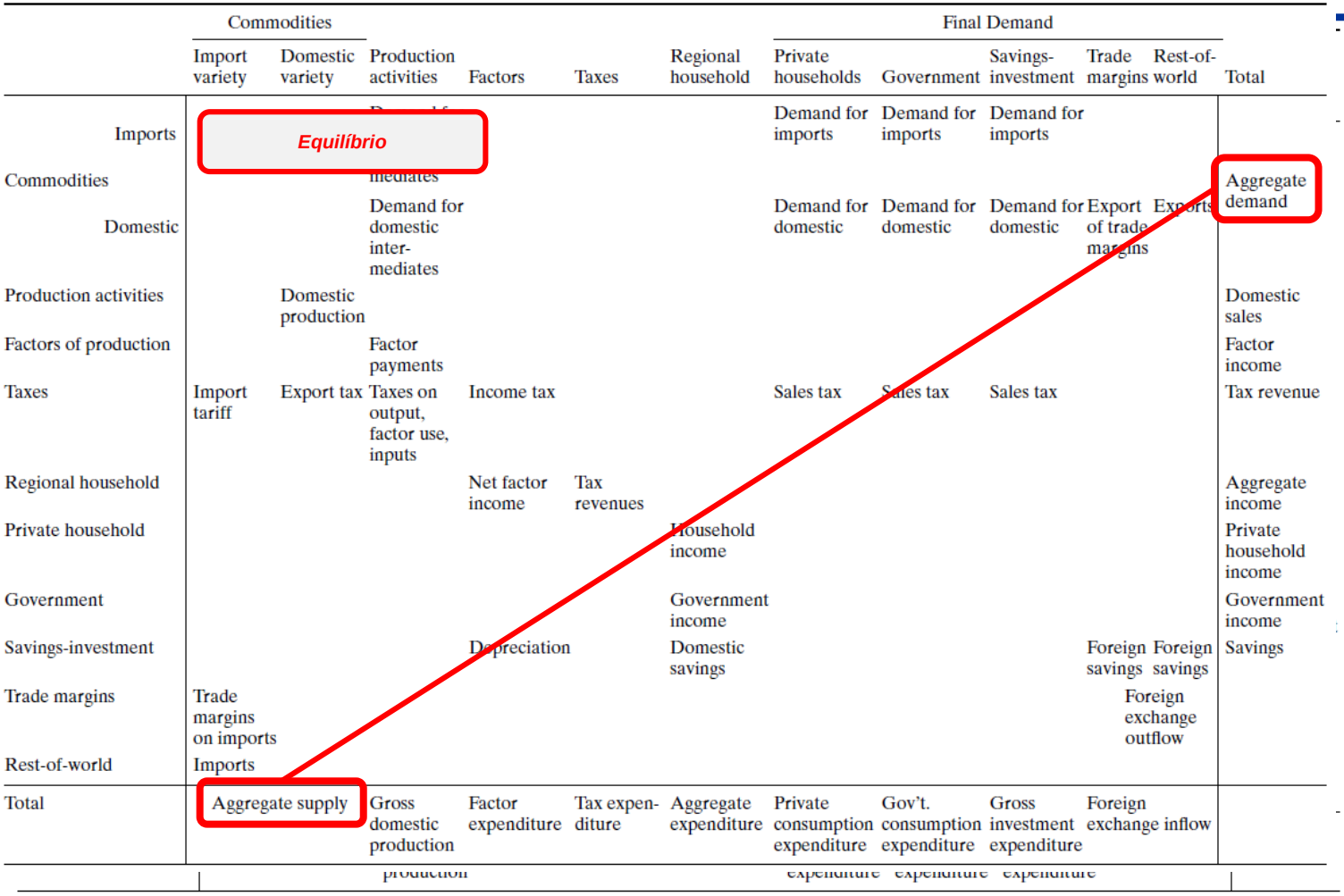
Matriz de Contabilidade Social



Matriz de Contabilidade Social



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Equilíbrio

Estrutura de GTAP

Estrutura do GTAP

Coding Conventions

Sets and Indices

REG	Regions	r
COMM	Commodities	c
MARG	Margin Commodities	m
NMRG	Non-margin commodities	n
ACTS	Activities	a
ENDW	Endowments	e
DEMD	Commodities & endowments	d
ENDWS	Sluggish endowment	e
ENDWM	Mobile endowment	e
ENDWC	Capital endowment	e
ENDWF	Sector-specific endowment	e
ENDWMS	Mobile & sluggish endowments	e

Prices (ending in)

P	Producer prices (e.g., VDFP: domestic purchases, by firms, at producer prices)
B	Basic prices (e.g., VDFB: domestic purchases, by firms, at basic prices)
S	Supply prices (e.g., EVOS: primary factor sales, at supply (post-income tax) prices)
VCIF	CIF prices (e.g., Imports, at CIF prices)
VFOB	FOB prices (e.g., non-margin exports, at FOB prices)

Source: Standard GTAP Model v7 - Quick Reference Card.

Estrutura do GTAP

Agents

Households, Firms, Government, Investment

VDPP	domestic purchases, by households, at producer prices
VDFP	domestic purchases, by firms, at producer prices
VDGP	domestic purchases, by government, at producer prices
VDIP	domestic purchases, by investment, at producer prices

Key Parameters

ESBD	Armington CES domestic/imported allocation
ESBM	Armington CES for regional allocation of imports
ESBT	CES between primary factors and intermediate inputs
ESBV	CES between primary factors in production
ETRE	CET between sectors for sluggish primary factors
INCP	CDE expansion parameter
SUBP	CDE substitution parameter

Source: Standard GTAP Model v7 - Quick Reference Card.

Estrutura do GTAP

Simplified view of the GTAP Data Base Structure (excluding commodity taxes)

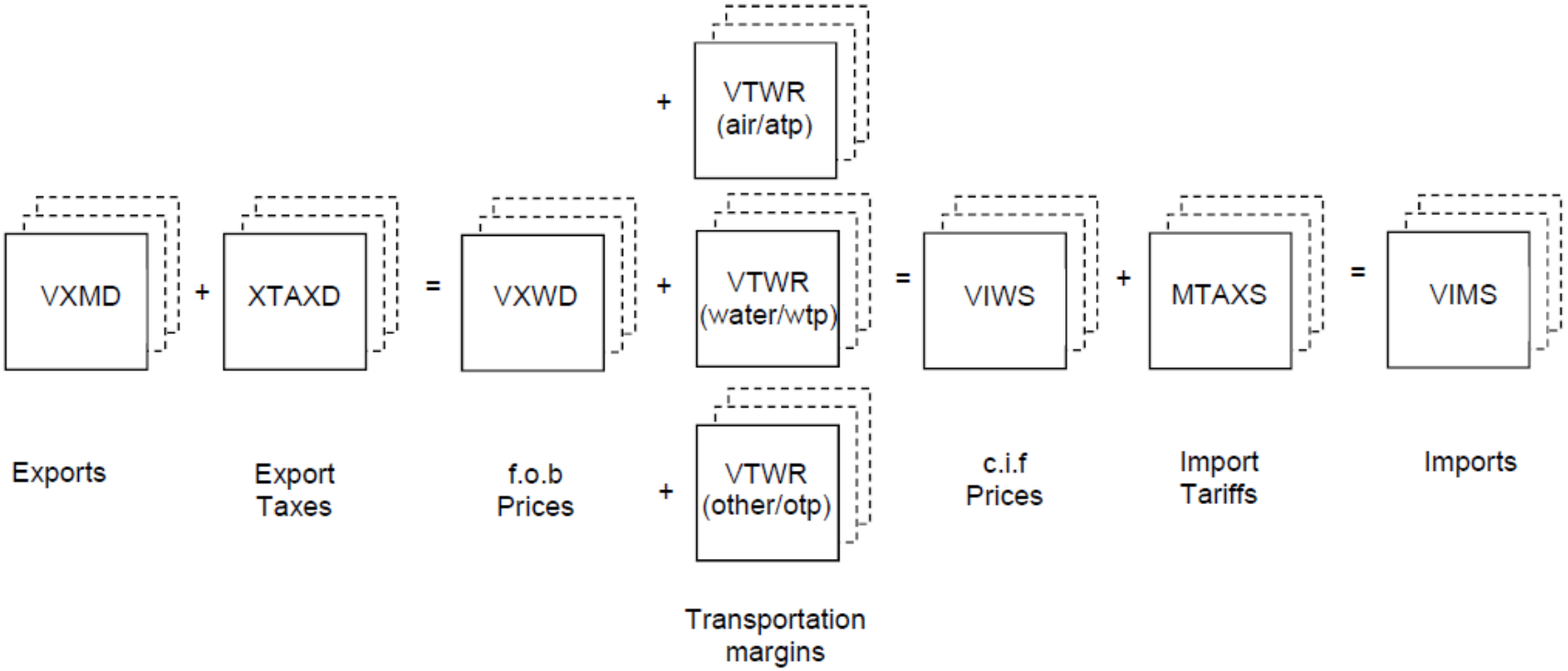
	Domestic activities (57)	Other countries (129)	Global Transport (1)	Investment (cgds) (1)	Private Consumption (1)	Government (1)
Domestic Commodities (57)	VDFM	VXMD	VST	VDFM	VDPM	VDGM
Imported Commodities (57)	VIFM			VIFM	VIPM	VIGM
Factors (5)	VFM					

Note: N.B Commodity taxes are applied to all values except exports (VXMD and VST).
Values inclusive of taxes end in “A” for agent prices instead of “M” for market prices.
Source: Walmsley, Aguiar e Narayanan (2012).

"V" = Value; "D" = Domestic; "I" = Import; "F" = Firms;
"X" = Exportação; "P" = Private Consumption (Household);
"G" = Government; "M" = Market Prices.

Estrutura do GTAP

Link between Exports and Imports



Source: Walmsley, Aguiar e Narayanan (2012).

Estrutura do GTAP

```
Coefficient (ge 0)(all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    VXMD(i,r,s) # exports of i from r to s valued at mkt prices (tradeables only) #;

Coefficient (all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    XTAXD(i,r,s) # tax on exports of good i from source r to destination s #;

Coefficient (ge 0)(all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    VXWD(i,r,s) # exports of i from r to s valued FOB (tradeables only) #;

Coefficient (ge 0) (all,m,MARG_COMM)(all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    VTMFSD(m,i,r,s)
    # int'l margin usage, by margin, freight, source, and destination #;

Coefficient (ge 0)(all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    VIWS(i,r,s) # imports of i from r to s valued CIF (tradeables only) #;

Coefficient (all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    MTAX(i,r,s) # tax on imports of good i from source r in destination s #;

Coefficient (ge 0)(all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    VIMS(i,r,s) # imports of i from r to s valued at domestic mkt prices #;
```

Estrutura do GTAP

```
Coefficient (ge 0)(all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    VXMD(i,r,s) # exports of i from r to s valued at mkt prices (tradeables only) #;

Coefficient (all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
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Coefficient (all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
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Coefficient (ge 0)(all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    VIMS(i,r,s) # imports of i from r to s valued at domestic mkt prices #;
```
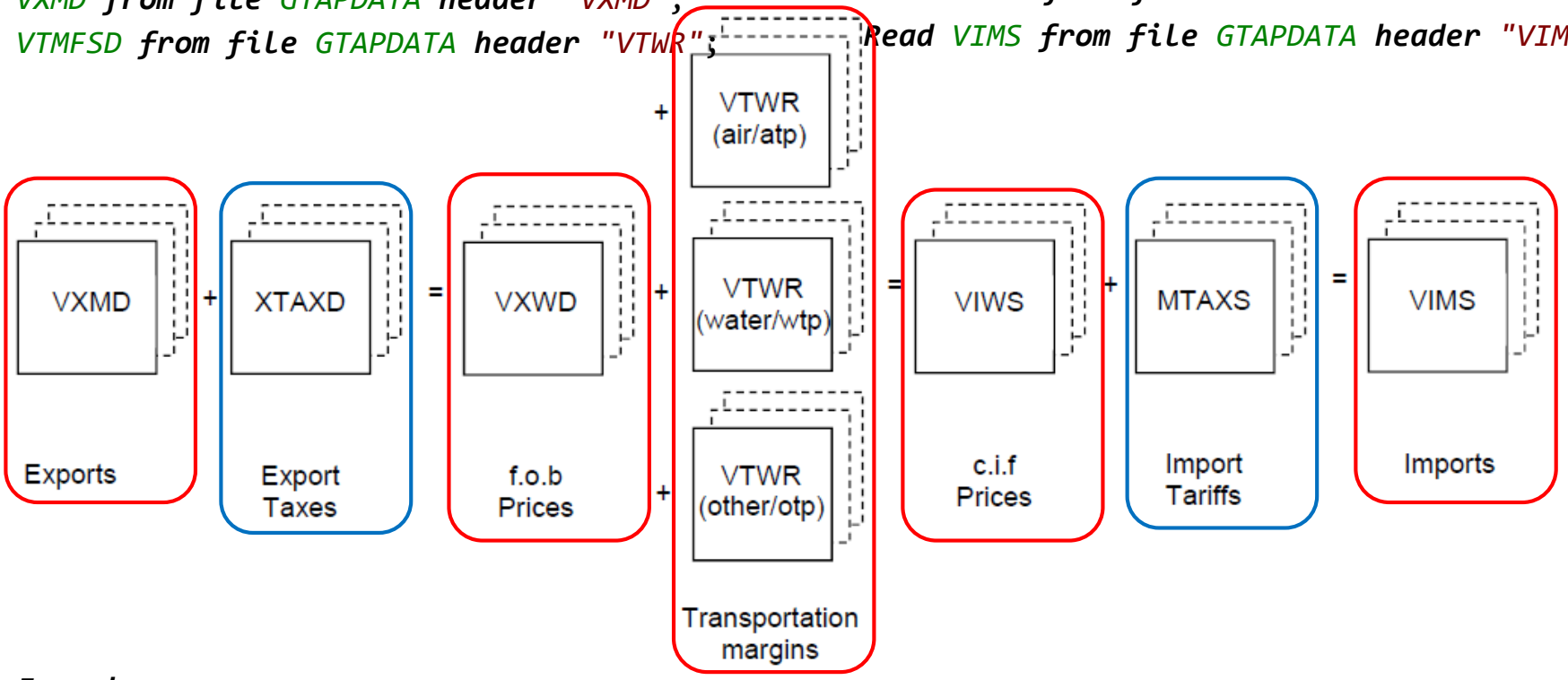

Estrutura do GTAP

```
Read VXMD from file GTAPDATA header "VXMD";
Read VXMD from file GTAPDATA header "VXMD";
Read VTMFSD from file GTAPDATA header "VTWR";
```

```
Read VIWS from file GTAPDATA header "VIWS";
Read VIMS from file GTAPDATA header "VIMS";
```




```
Formula
(all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    XTAXD(i,r,s) = VXWD(i,r,s) - VXMD(i,r,s);
```

```
Formula
(all,i,TRAD_COMM)(all,r,REG)(all,s,REG)
    MTAX(i,r,s) = VIMS(i,r,s) - VIWS(i,r,s);
```

Estrutura do GTAP

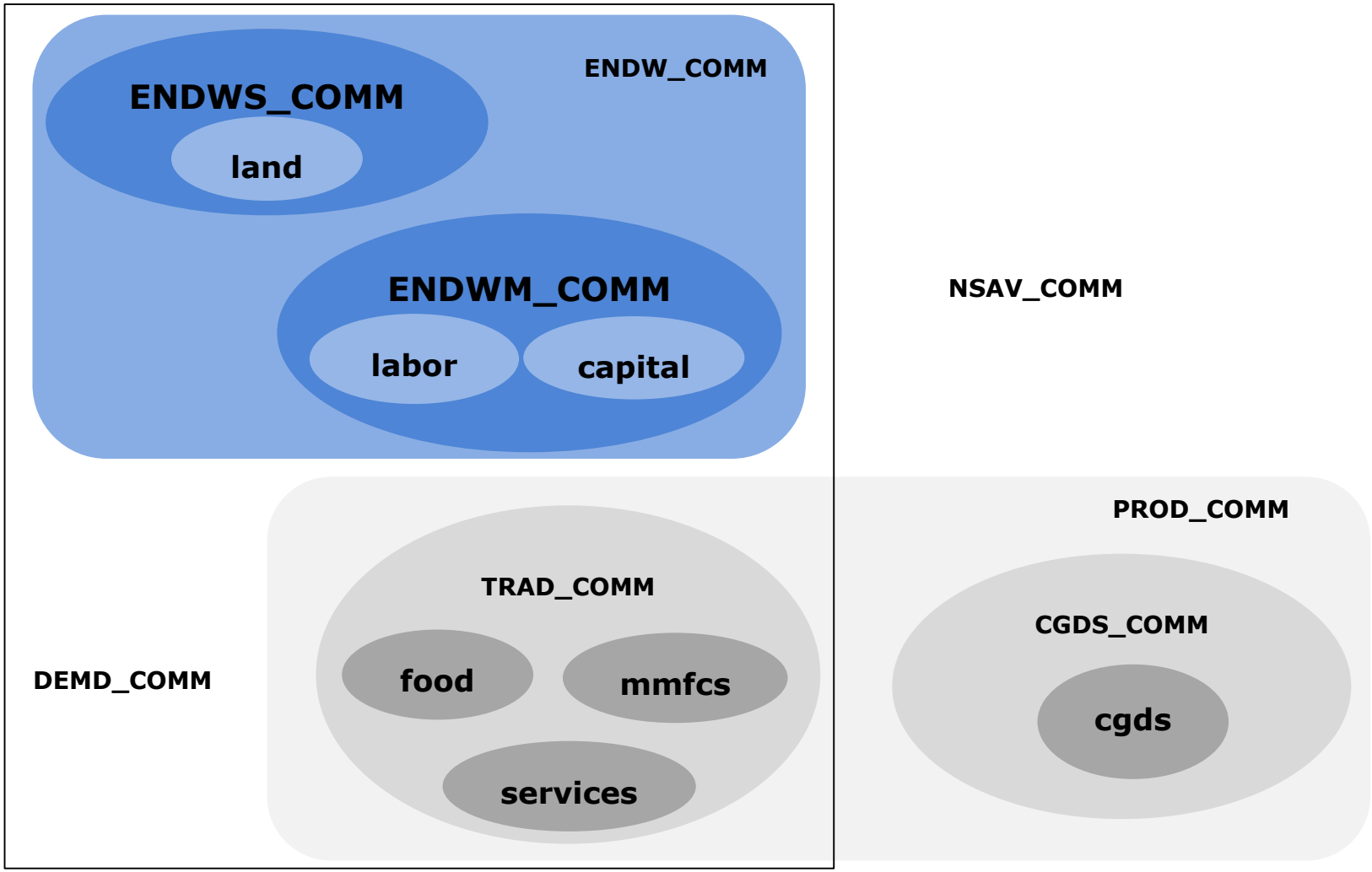
Preliminaries: FILES; SETS; READ statements of Base Data; Common VARIABLES; Common COEFFICIENTS.

Modules:

1. Government Consumption
2. Private Consumption
3. Firms
4. Investment, Global Bank, and Savings
5. International Trade
6. International Transport Services
7. Regional Household
8. Equilibrium Conditions

Appendices: A. Summary Indices; B. Equivalent Variation; C. Welfare Decomposition; D. Terms of Trade Decomposition.

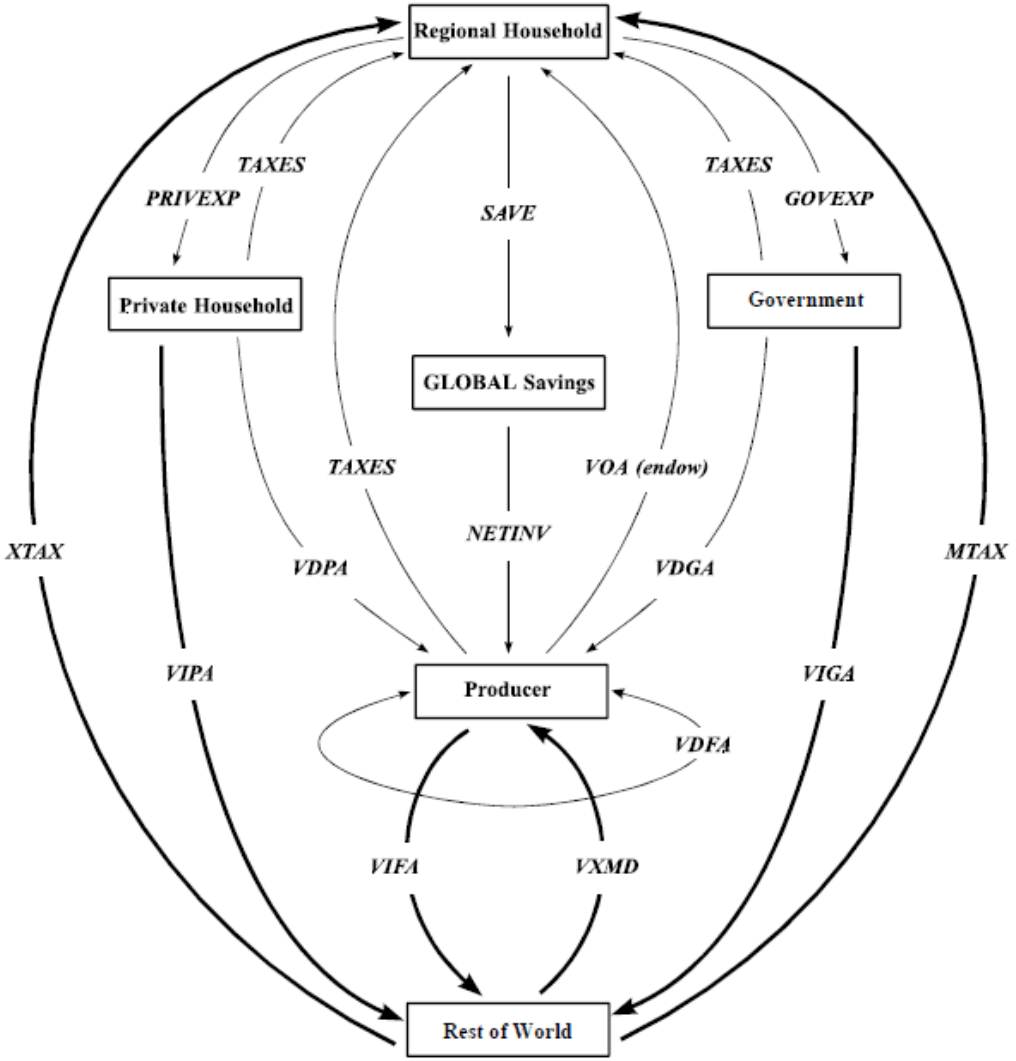
Conjuntos


ENDW_COMM
ENDWS_COMM
land
ENDWM_COMM
labor
capital
NSAV_COMM
PROD_COMM
TRAD_COMM
CGDS_COMM
DEMD_COMM
food
mmfcs
cgds
services

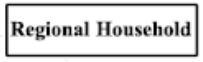
Conjuntos

```
Set TRAD_COMM # traded commodities #
    maximum size 10 read elements from file GTAPSETS header "H2";

Set MARG_COMM # margin commodities #
    maximum size 10 read elements from file GTAPSETS header "MARG";

Subset MARG_COMM is subset of TRAD_COMM;

Set NMRG_COMM # non-margin commodities # = TRAD_COMM - MARG_COMM;

Set CGDS_COMM # capital goods commodities #
    maximum size 1 read elements from file GTAPSETS header "H9";

Set ENDW_COMM # endowment commodities #
    maximum size 5 read elements from file GTAPSETS header "H6";

Set PROD_COMM # produced commodities # = TRAD_COMM union CGDS_COMM;

Set DEMD_COMM # demanded commodities # = ENDW_COMM union TRAD_COMM;

Set NSAV_COMM # non-savings commodities # = DEMD_COMM union CGDS_COMM;

Subset PROD_COMM is subset of NSAV_COMM;
```

Economia Multiregional Aberta



Economia Multiregional Aberta

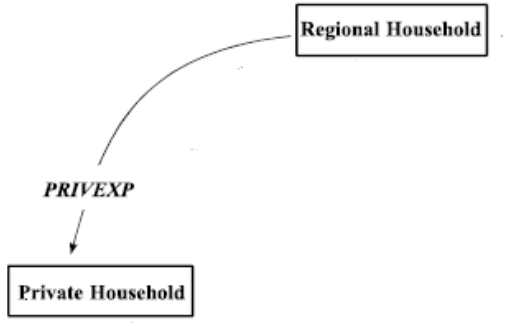


A ***Família Regional*** está associada, por questões estruturais do modelo, a cada uma das regiões.

É responsável por coletar toda a renda que é gerada dentro da economia (impostos e pagamentos aos fatores de produção).

A renda regional é exaurida entre os componentes da demanda final por meio de uma função de utilidade do tipo **Cobb-Douglas**.

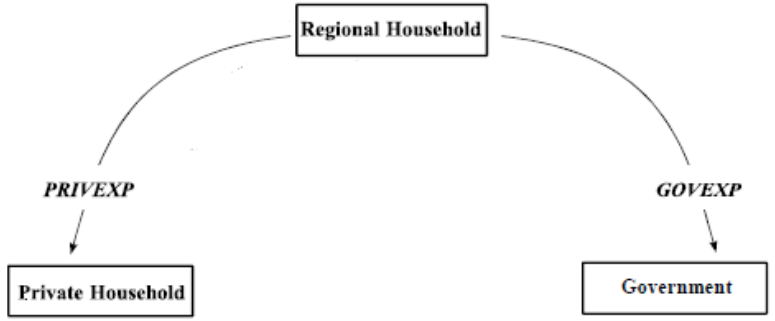
Economia Multiregional Aberta



A **renda regional** é distribuída em:

Gastos das Famílias
PRIVEXP
PRIVate household **EXP**enditure

Economia Multiregional Aberta

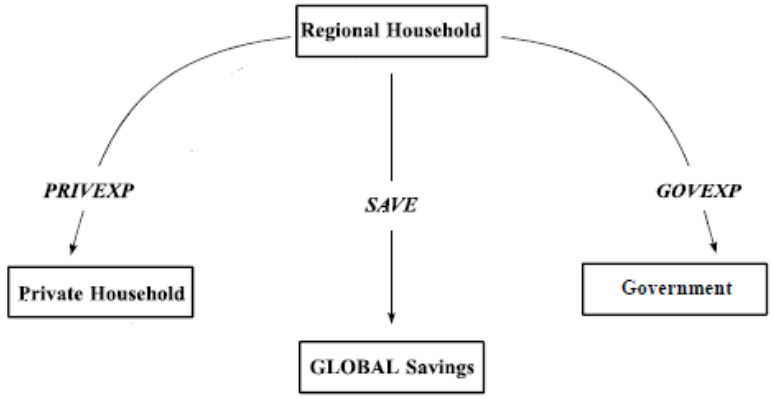


A **renda regional** é distribuída em:

Gastos das Famílias
PRIVEXP
PRIVate household **EXP**enditure

Gastos do Governo
GOVEXP
GOVernment **EXP**enditure

Economia Multiregional Aberta



A **renda regional** é distribuída em:

Gastos das Famílias
PRIVEXP
PRIVate household **EXP**enditure

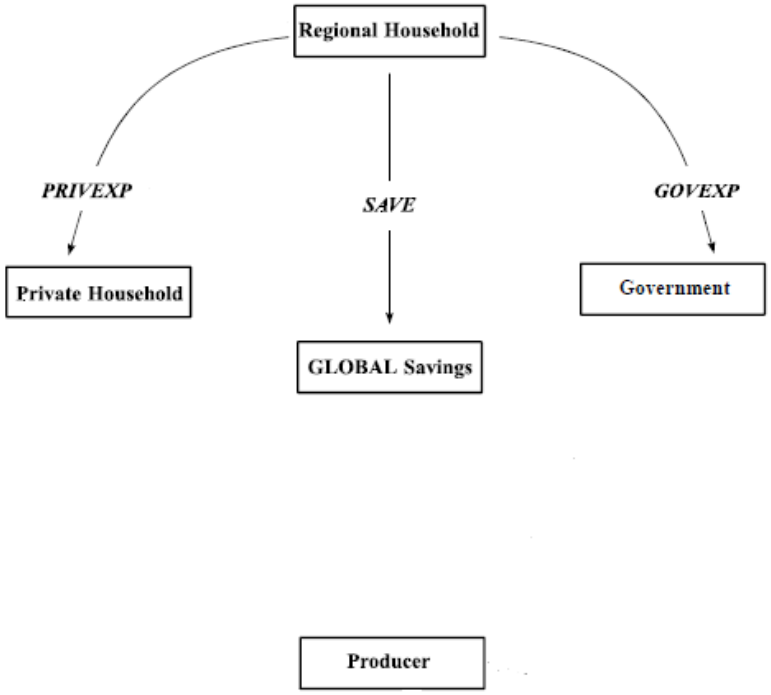
Gastos do Governo
GOVEXP
GOVernment **EXP**enditure

Poupança
SAVE
SAVings

Cada componente da demanda final mantém uma **participação constante** da renda regional total*.

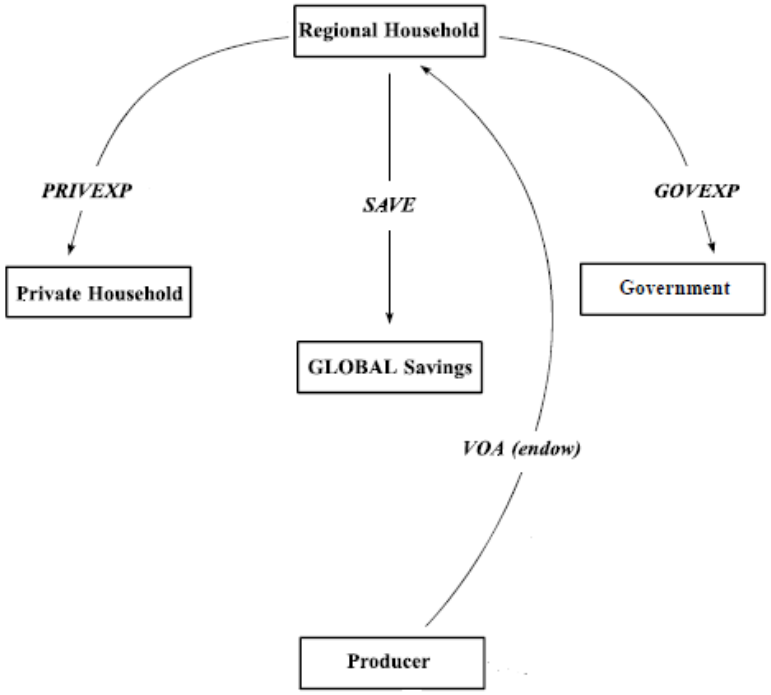
* ***Standard closure of GTAP***

Economia Multiregional Aberta



Os **Produtores** interagem com a **Família Regional** da seguinte maneira:

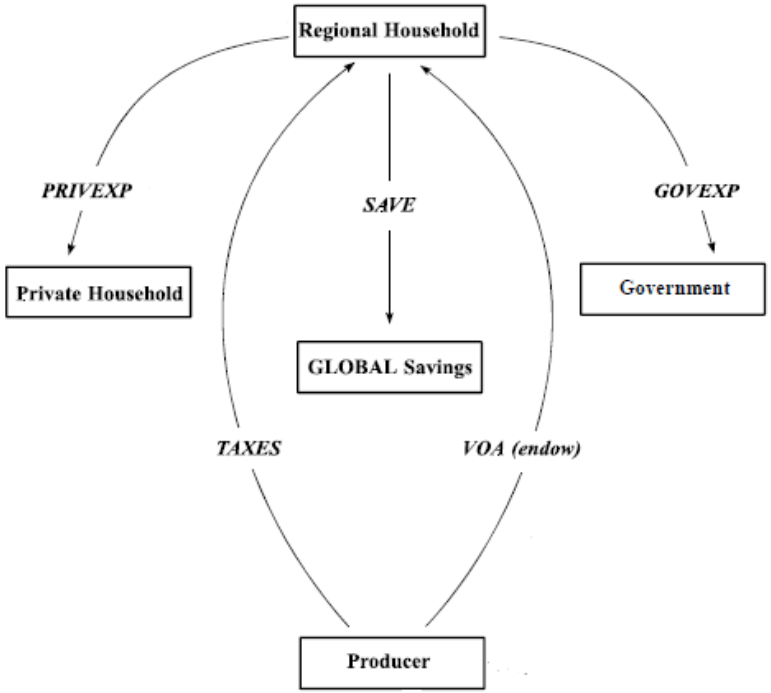
Economia Multiregional Aberta



Os **Produtores** interagem com a **Família Regional** da seguinte maneira:

Pagam pelo uso dos fatores primários de produção
VOA
Value of **O**utput at **A**gents' prices

Economia Multiregional Aberta

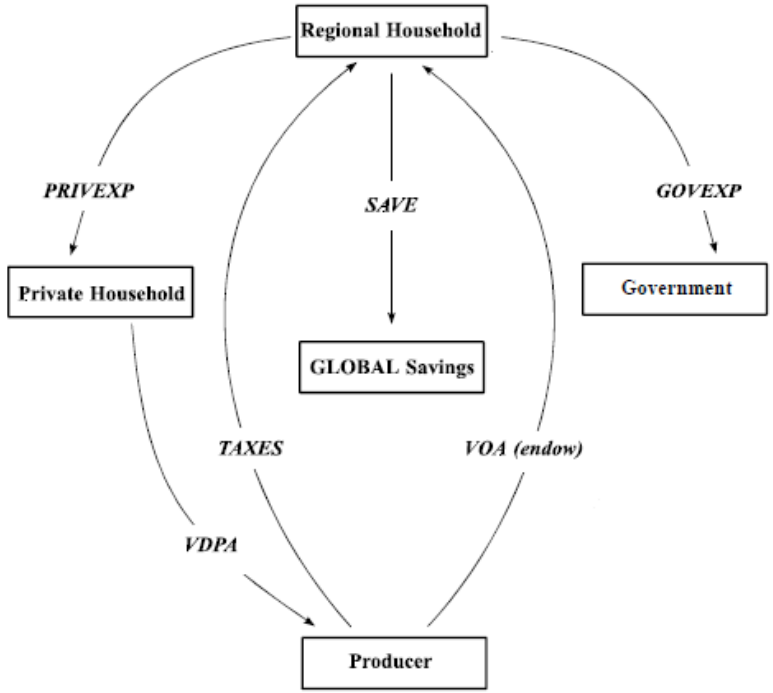


Os **Produtores** interagem com a **Família Regional** da seguinte maneira:

Pagam pelo uso dos fatores primários de produção
VOA
Value of **O**utput at **A**gents' prices

Pagam impostos
TAXES

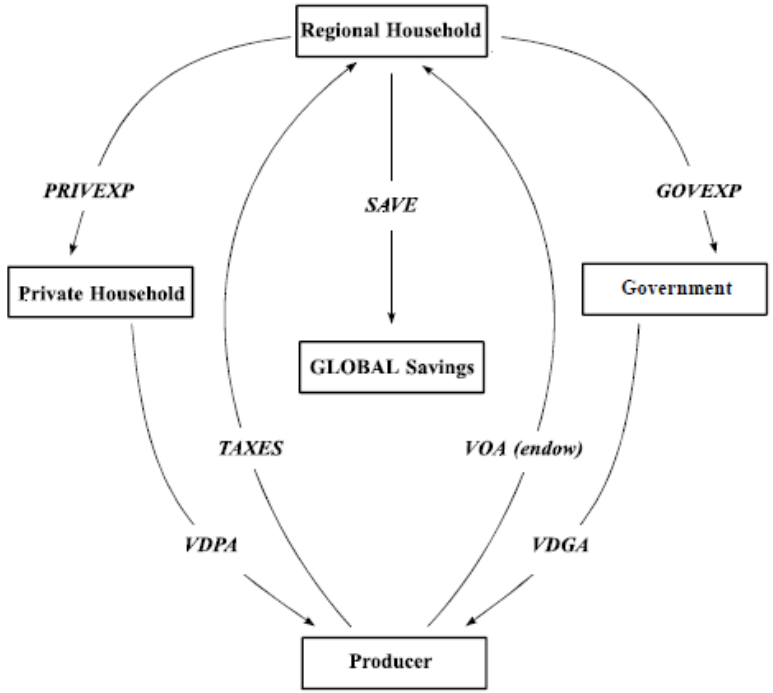
Economia Multiregional Aberta



Os **Produtores** recebem pela venda de bens de consumo para:

Famílias Privadas
VDPA
Value of **D**omestic **P**rivate household purchases, evalueted at **A**gents' prices

Economia Multiregional Aberta

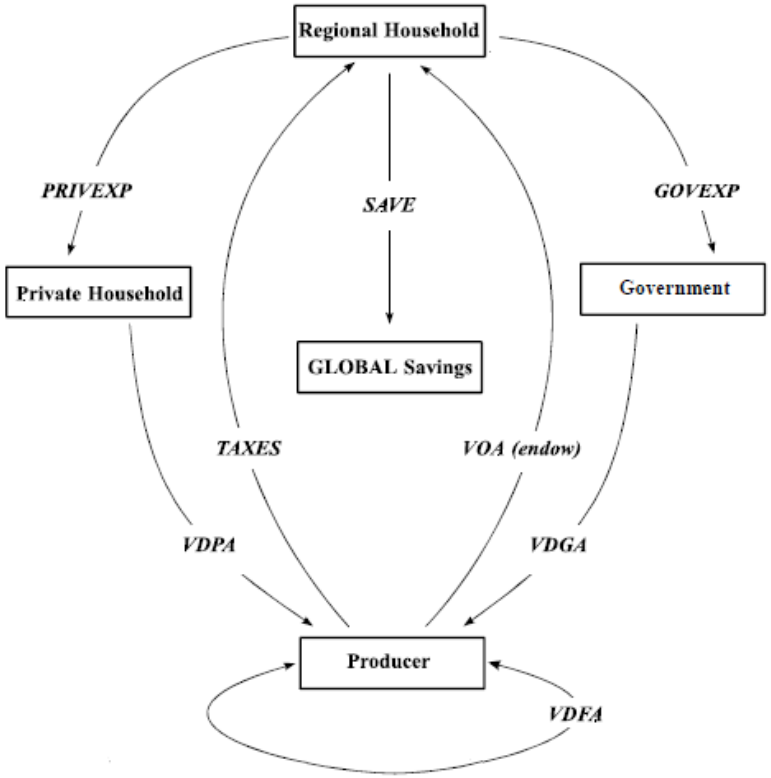


Os **Produtores** recebem pela venda de bens de consumo para:

Famílias Privadas
VDPA
Value of **D**omestic **P**rivate household purchases, evalueted at **A**gents' prices

Governo
VDGA
Value of **D**omestic **G**overnment purchases, evaluated at **A**gents' prices

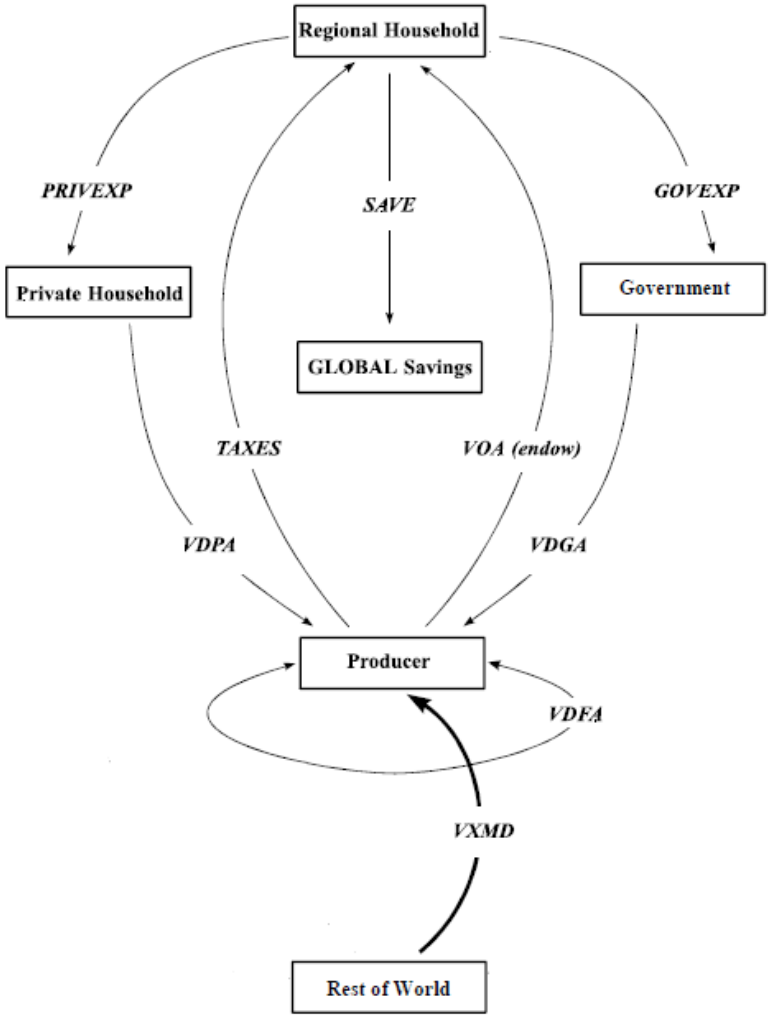
Economia Multiregional Aberta



Os **Produtores** recebem também pela venda de insumos intermediários para:

Outros Produtores
VDFA
Value of **D**omestic **F**irm Purchases, evaluates at **A**gents' prices

Economia Multiregional Aberta

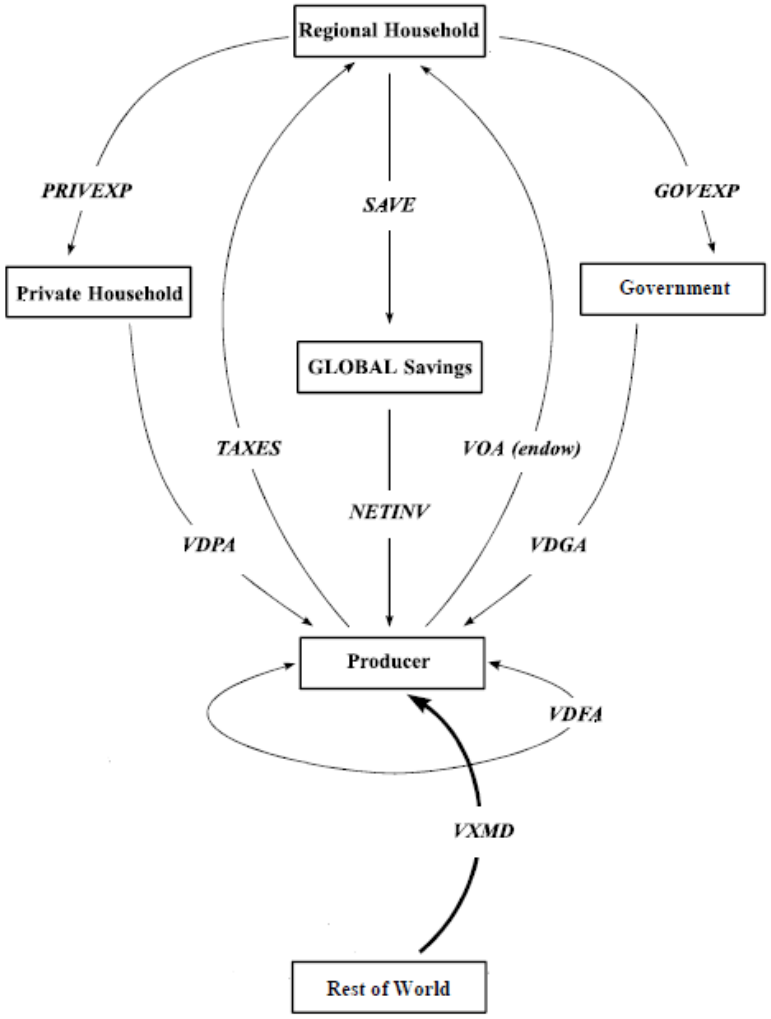


Os **Produtores** recebem também pela venda de insumos intermediários para:

Outros Produtores
VDFA
Value of **D**omestic **F**irm Purchases, evaluates at **A**gents' prices

Restante do Mundo
VXMD
Value of e**X**ports at **M**arket prices, by **D**estination

Economia Multiregional Aberta



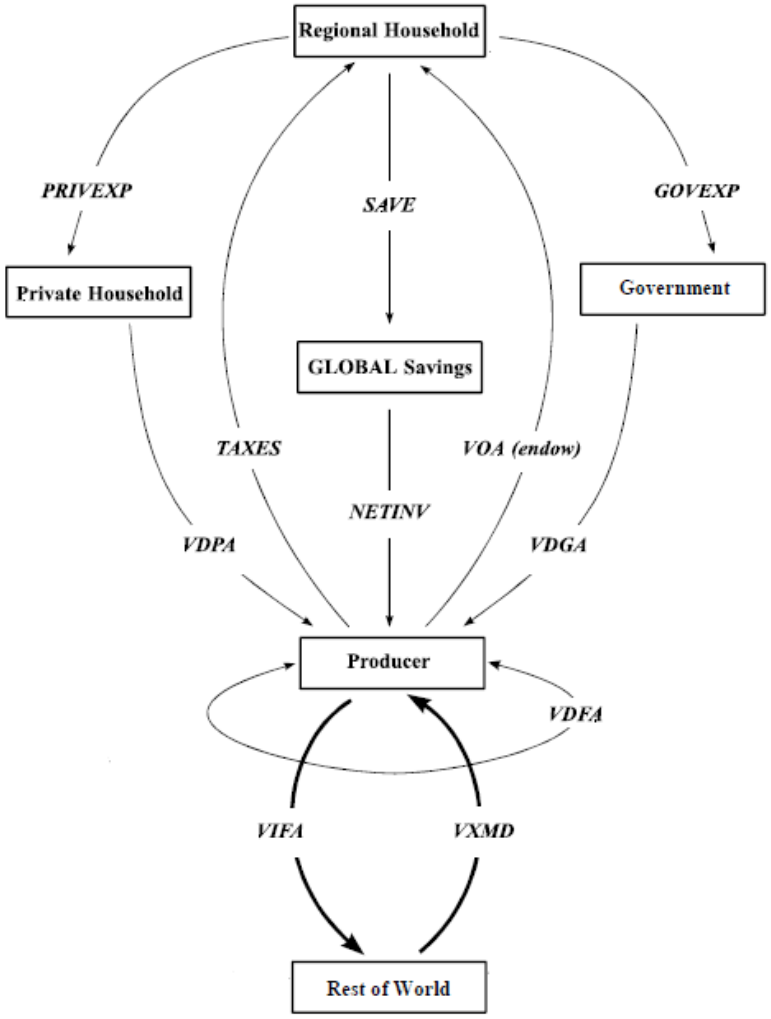
Os **Produtores** recebem investimento provenientes da Poupança Global
NETINV

Observação:

Modelo Estático

Savings-driven
Investimento não afeta a capacidade produtiva, mas afeta a atividade total.

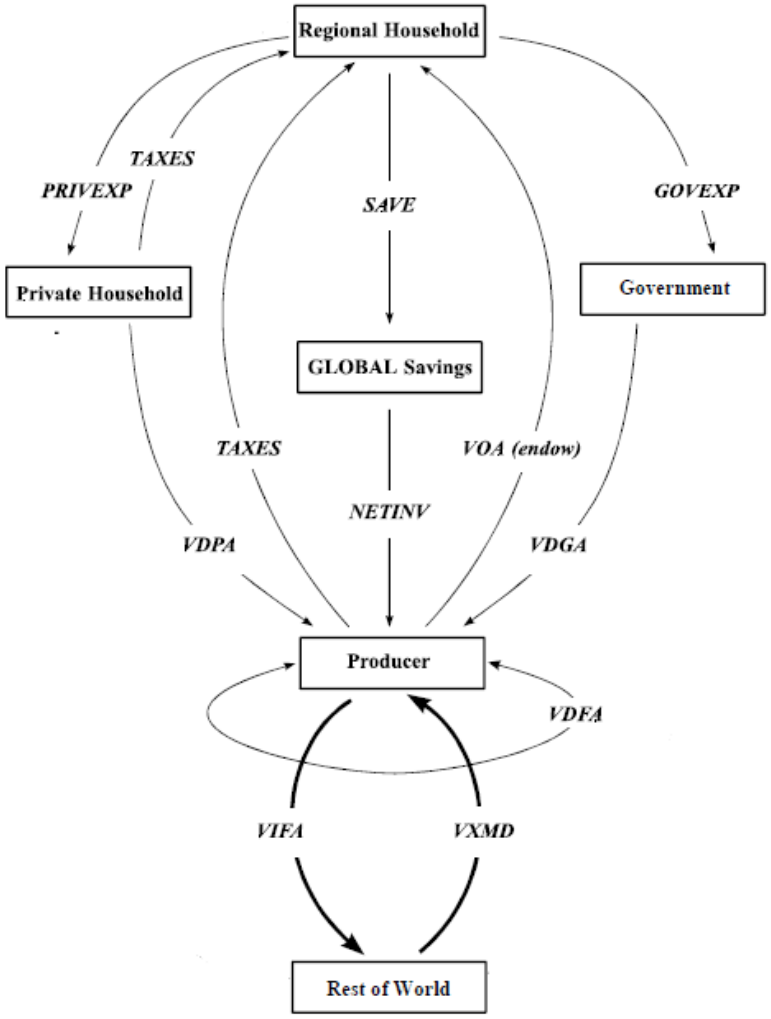
Economia Multiregional Aberta



Os **Produtores** pagam pelo uso de insumos intermediários do Restante do Mundo

VIFA
Value of **I**mports by **F**irm, evaluates at **A**gents' prices

Economia Multiregional Aberta



As **Famílias "Privadas"**:

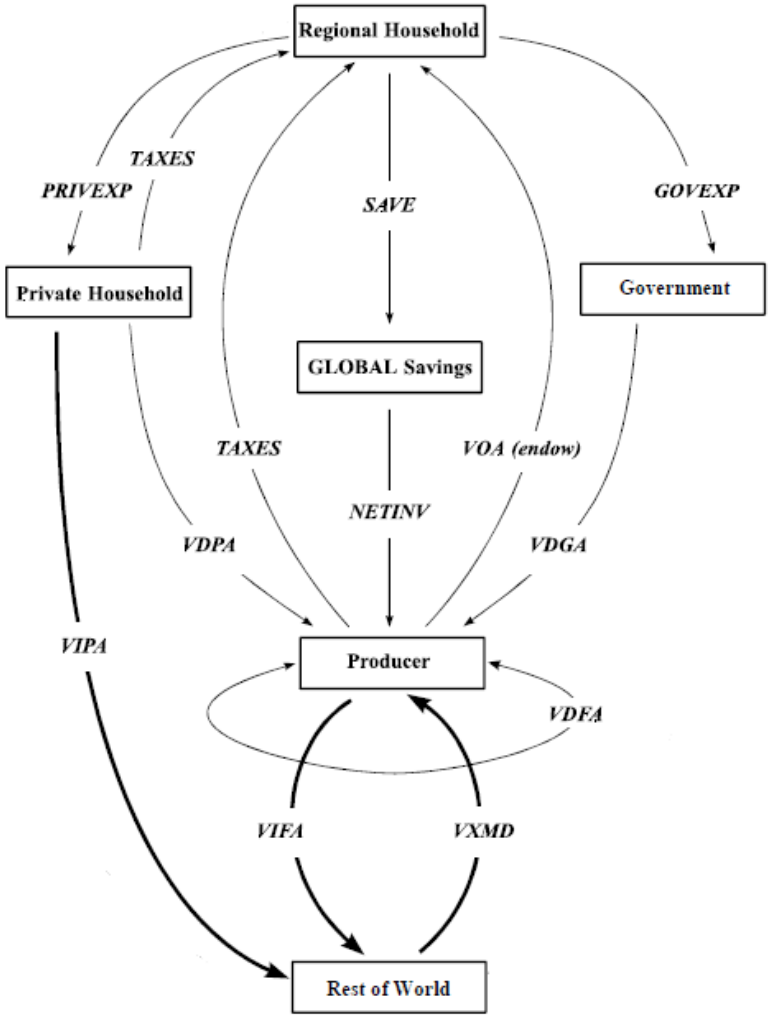
Pagam impostos para
a Família Regional
TAXES

Compram bens de consumo dos Produtores
VDPA

e

Recebem parte da renda da economia acumulada pela Família Regional
PRIVEXP

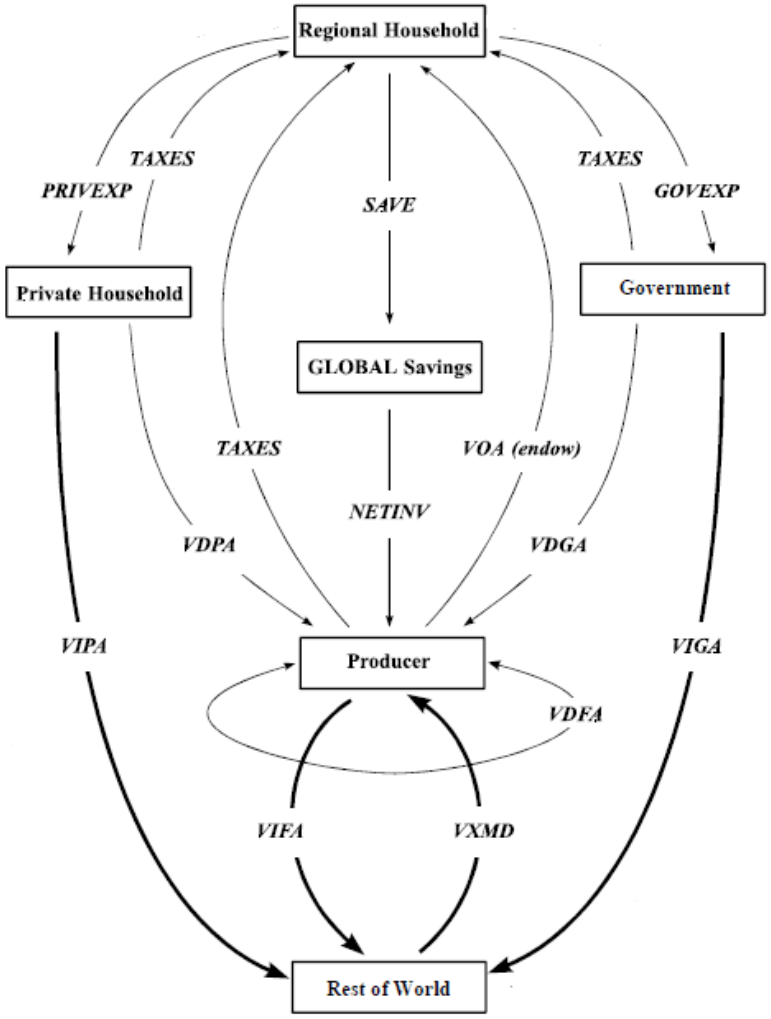
Economia Multiregional Aberta



As **Famílias "Privadas"** também compram bens de consumo do Restante do Mundo

VIPA
Value of expenditure on **I**mports by **P**rivate household, evaluates at **A**gents' prices

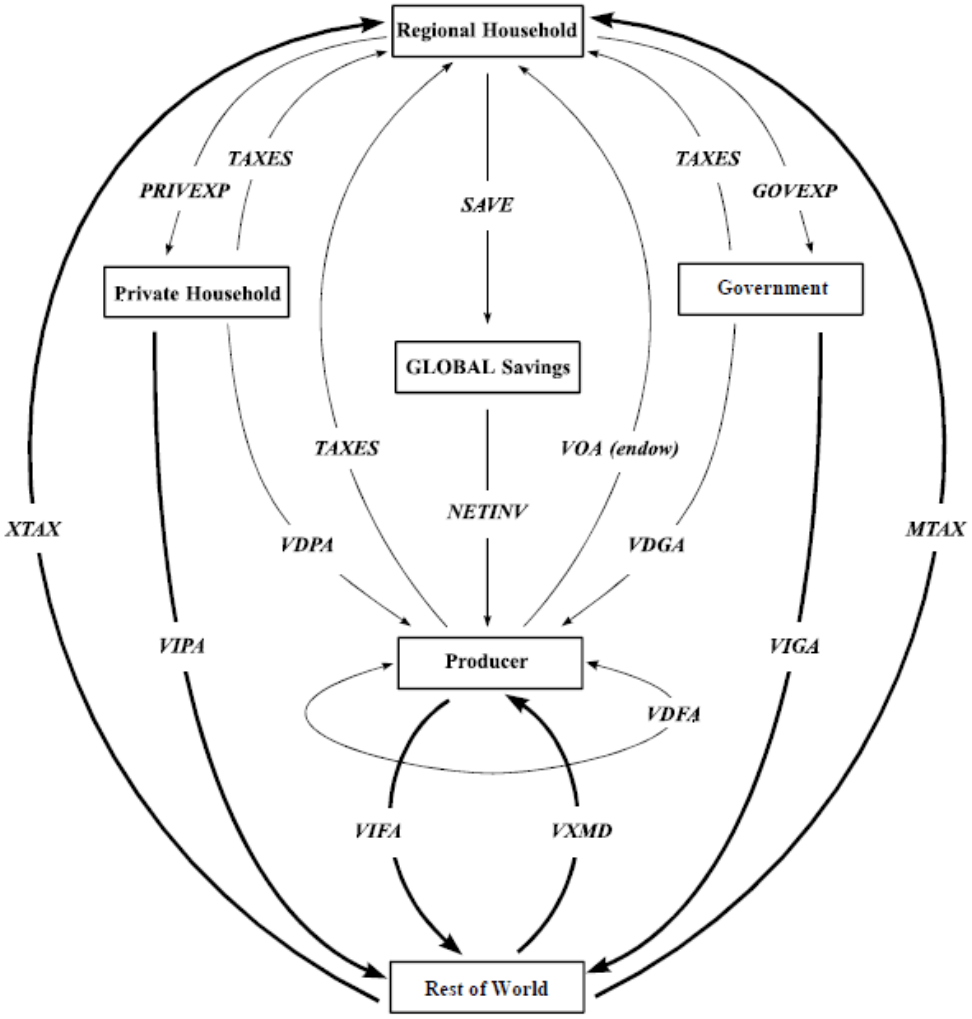
Economia Multiregional Aberta



O **Governo** também compra bens de consumo importados do Restante do Mundo

VIGA
Value of expenditure on **I**mports by **G**overnment, evaluates at **A**gents' prices

Economia Multiregional Aberta



O **Restante do Mundo**:

Paga para a Família Regional impostos de importação (**MTAX**) e exportação (**XTAX**)

Recebe pela venda de bens de consumo para:

Famílias Privadas
VIPA

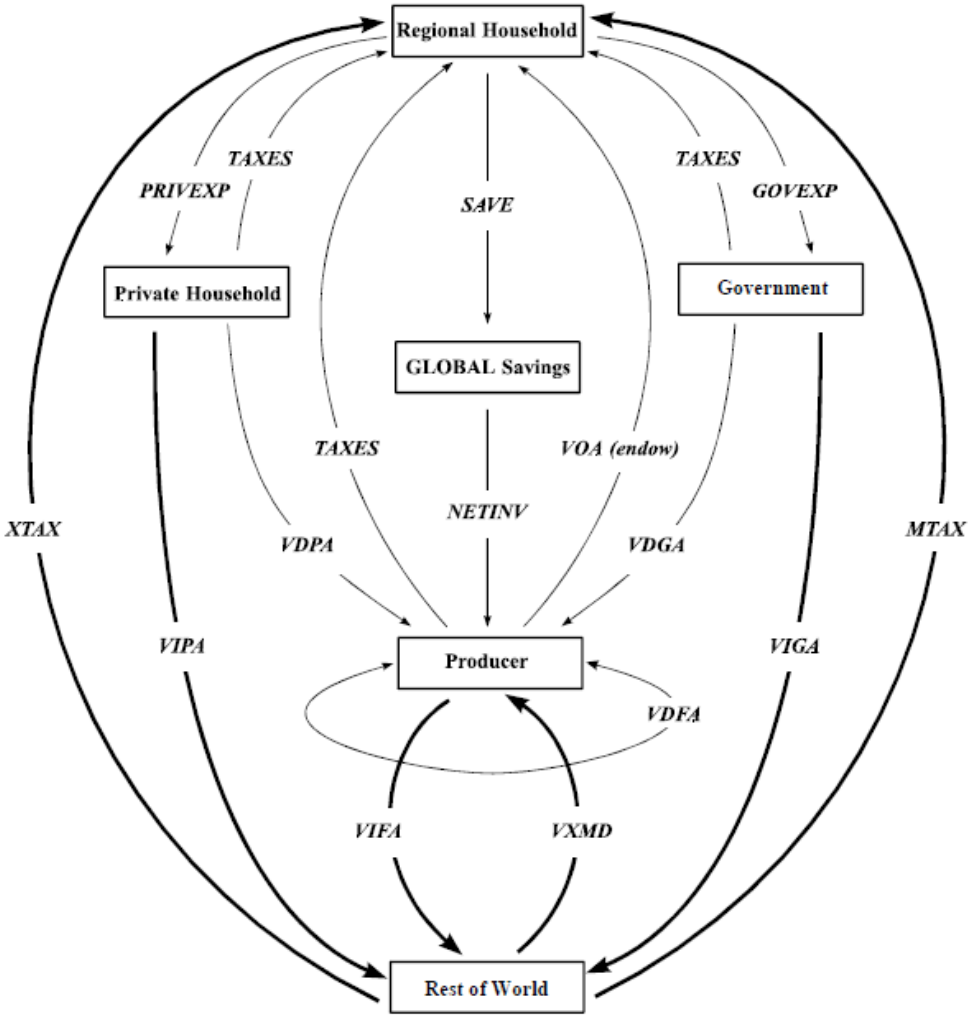
e

para o Governo
VIGA

Recebe pela venda de insumos intermediários para os Produtores
VIFA

Paga pelo uso de insumos intermediários dos Produtores de outra região
VXMD

Economia Multiregional Aberta



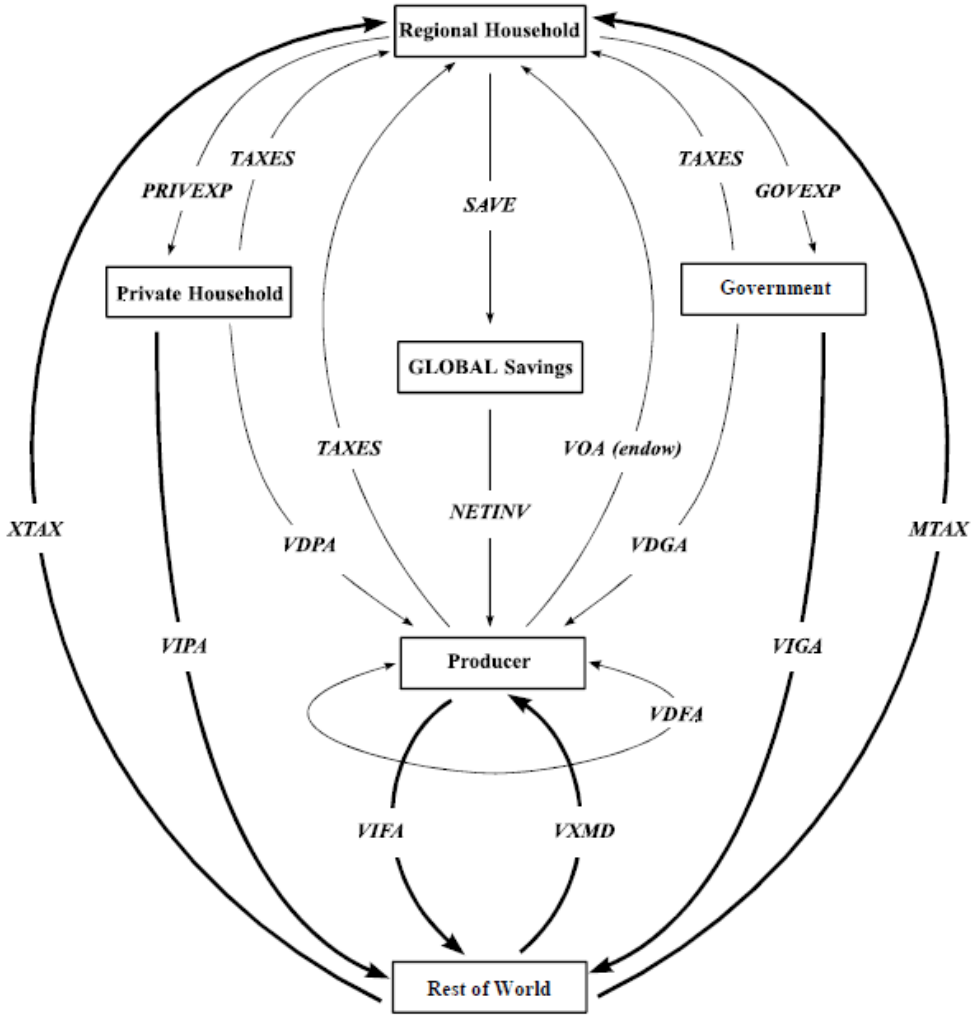
O GTAP descreve a economia global que consiste em muitas economias.

O GTAP assume a mesma estrutura para cada economia.

É um modelo **bottom-up**.

As economias são ligadas por meio do **comércio internacional** e **fluxos de investimento**.

Economia Multiregional Aberta



Todas as regiões estão em equilíbrio:

S - I = X - M

O Mundo está em equilíbrio:

Poupança Global	Investimento Global
Exportações Totais	Importações Totais

Referências

Básica:

BURFISHER, M. E. ***Introduction to computable general equilibrium models****. Cambridge University Press, 2016.*
CORONG, E. L.; HERTEL, T. W.; MCDOUGALL, R. A.; TSIGAS, M. E.; MENSBRUGGHE, D. V. D. The standard GTAP model, version 7. ***Journal of Global Economic Analysis****, v. 2, n. 1, p. 1–119, 2017.*

HERTEL, T. W. ***Global trade analysis: modeling and applications****. New York: Cambridge University Press, 1997.*
WALMSLEY, T. L.; AGUIAR, A. H.; NARAYANAN, B. ***Introduction to the Global Trade Analysis Project and the GTAP data base****. GTAP Working paper, No. 67, Global Trade Analysis Project, West Lafayette: GTAP, 2012.*

Referências

Complementar:

HERTEL, T. W. ***Global Applies General Equilibrium Analysis Using the Global Trade Analysis Project Framework****. In: DIXON, P. B.; JORGENSON, D. W. Handbook of Computable General Equilibrium Modeling. Elsevier, 2013.*

Material cedido e elaborado pelo Prof. Vinicius de Almeida Vale – UFPR e customizado pelo Prof. Fernando Salgueiro Perobelli para uso nas disciplinas Métodos de Análise Regional – PPGE – UFJF e Modelos de equilíbrio Geral Computável - USP