Inter-American Development Bank

An Input-Output Table of Paraguay for the GTAP Database

Climate Change and Sustainability Division

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TECHNICAL NOTE Nº 880

November 2015

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November 2015

IDB
Inter-American Development Bank

Cataloging-in-Publication data provided by the
Inter-American Development Bank
Felipe Herrera Library

Cicowiez, Martin.
An input-output table of Paraguay for the GTAP database / Martin Cicowiez, Horacio Santander, Carlos E. Ludena.

p. cm. — (IDB Technical Note ; 880)
Includes bibliographic references.
1. Computable general equilibrium models—Paraguay. I. Santander, Horacio. II. Ludena, Carlos E. III. Inter-American Development Bank. Climate Change and Sustainability Division. IV. Title. V. Series.
IDB-TN-880

JEL Code: C67, C68
Key words: input-output, supply-use tables, economic modeling, computable general equilibrium, Paraguay

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The update of the input-output table from Paraguay for the Global Trade Analysis Project (GTAP) database was funded by the Inter-American Development Bank (IDB), under coordination from Carlos Ludena at the Climate Change and Sustainability Division of the IDB, and the technical support of Martin Cicowiez from CEDLAS-UNLP, Argentina. Horacio Santander from the Ministry of Finance in Paraguay provided invaluable access to national data. The authors are grateful to Angel Aguiar for his support during the process of building the Paraguay input-output table for the GTAP data base.

Please cite as:

Cicowiez, M., H. Santander, C.E. Ludena. 2015. An Input-Output Table of Paraguay for the GTAP Database. Inter-American Development Bank, Technical Paper No. 880, Washington, DC.

An Input-Output Table of Paraguay for the GTAP Database

In the interest of updating the input-output data of Paraguay in the Global Trade Analysis Project (GTAP) database to support economic analysis in this country, the Inter-American Development Bank commissioned the update of these data using the data from a 2009 social accounting matrix (SAM) developed by Cicowiez and Santander (2015). The document describes the process of transforming the 2009 SAM of Paraguay into the GTAP format. Further details on the GTAP database may be found at www.gtap.org.

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INDEX

INDEX OF TABLES

1. Introduction

In order to promote the economic analysis of economic and environmental issues for Paraguay, the Inter-American Development Bank (IDB) commissioned the update of the input-output data of Paraguay in the Global Trade Analysis Project (GTAP) database. The GTAP database is a global database which contains complete bilateral trade information, transport and protection linkages, covering more than 140 countries and 57 sectors. The GTAP Data Base represents the world economy and is used by economists around the world as a key input into contemporary applied general equilibrium analysis of global economic issues.

The aim of this technical note is to document in detail the steps followed to transform the 2009 Social Accounting Matrix of Paraguay (see Cicowiez and Santander, 2015) into the Global Trade Analysis Project (GTAP) input-output format (Huff, McDougall and Walmsley, 2000). This document is structured as follows. The data requirements to construct the GTAP input-output (I-O) table for Paraguay are identified and described in Section 2. The next section describes the steps followed to construct the I-O table. In Section 3 the concordance between the I-O table and the GTAP sectoral classification is presented. Finally, the resulting I-O table and some final remarks regarding it are presented.

2. Data Sources

The main sources of information when constructing an I-O table for GTAP - or a Social Accounting Matrix (SAM) - tend to be supply and use tables, and other standard databases such as national accounts, fiscal data, and the balance of payments. The supply and use tables provide information on production, intermediate consumption, final demand (i.e., household and government consumption), exports, and value added.

The GTAP I-O table for Paraguay is based on the 1997 Supply and Use matrices compiled by the Central Bank of Paraguay. However, this information was updated using national accounts data for the year 2009, the more recent year for which a complete set of information was available.

The 1997 supply and use tables of Paraguay have a commodity/product by industry/activity format. The units are in thousands of guaraníes in nominal terms at purchasers' prices, and include 46 commodities and 33 activities (see Appendix 1 for details). As usual, the supply table shows the total outputs of 46 domestic commodities, total imports, transport and

trade margins, and taxes on goods, by commodity. The use table shows the demand for those commodities, valued at purchasers' prices, by industries, private households, government, investment, changes in inventories, and exports.

In addition, we used the following data from the Central Bank and the Ministry of Finance[1] for the year 2009:

- GDP by income source (i.e., compensation of employees, taxes on production, consumption of fixed capital, gross operating surplus, and mixed income) and activity in the IO tables
- Gross output value by activity;
- (total) intermediate consumption by activity;
- Taxes (i.e., value-added tax, excise taxes, and tariffs) by product;
- Exports and imports by product;
- Re-exports by product. The total value of re-exports (i.e., US$ 2,699 million according to BCP estimates; equivalent to 46% of total exports) was distributed among commodities in the input-output table: alcoholic beverages, perfumes, sporting goods, sunglasses, electronics, and toys.[2]

3. Construction of the Input-Output Table for GTAP

As a first step, we built the 2009 social accounting matrix documented in Cicowiez and Santander (2015). The 2009 SAM was built using the data described above in combination with the 1997 supply and use tables. The resulting imbalances were eliminated using the cross-entropy method (Robinson et al., 2001). As a second step, we adapted the 2009 SAM to fit the GTAP I-O table format. To that end, we proceeded as follows.

(1) We expanded the make table contained in the SAM from the original commodity by industry (46x33) format to the commodity by commodity (46x46) format; a "pure" industry technology assumption was followed, which assumes that all commodities produced by an industry are produced using an identical input structure.

[1] Taxes, exports and imports and reexports information were provided by prepared by the "Unidad del Sistema de Información Económico Financiera" of the Ministry of Finance of Paraguay.
[2] The procedure is explained in detail in Cicowiez and Santander (2015).

(2) As the GTAP database does not support re-exports, re-exports were eliminated from the input-output table for GTAP. Specifically, re-exports were subtracted from total exports and from total imports. Thus, the balance between supply and demand was maintained.

(3) Imports in the supply and use tables correspond to a column vector that reports total imports by commodity. Thus, following Huff et al. (2000), we created an import matrix by prorating the totals across uses by applying the structure implied by the total use matrix; that is, for each row of the (total) use matrix we computed the percentage of the row total allocated to each sector. Then, we filled in the import matrix by multiplying each commodity total by the appropriate share for each sector. Finally, we subtracted the new import matrix from the total use matrix to obtain the domestic use matrix.

(4) The trade and transport margins were subtracted from the use matrix and registered as consumption of the "Wholesale and retail trade" commodity. This adjustment allowed maintaining the balance between supply and demand.

(5) The (domestic) commodity taxes were allocated across intermediate and final demand (excluding exports) using the corresponding share matrix of product consumption. The value-added tax was allocated to intermediate and final demand, because (similar to Ludena, 2008) it was found that not all value-added tax collection was included in final private consumption.

(6) Tariffs were allocated across intermediate and final demand using the import share matrix.

(7) The previous steps resulted in the tax inclusive use matrix (UP), separating between domestic and import use. To produce the use matrix tax excluded (UF), we subtracted the tax matrix and the estimated tariff matrix from the UP matrix.

4. Commodity Aggregation and Splits

The 46 sectors of the Paraguay input-output table developed were aggregated to a set of 36 sectors that best correspond to elements of GTAP's standard 57 commodities. The mappings from 46 sectors to these 36 sectors are reported in Table 1.

Table 1: Concordance between Paraguay I-O sectors and GTAP (GSC2) sectors

Paraguay 36 Aggregated Sectors (46 sectors into 36 sectors)		GTAP (GSC2) Sectors (57)	
No.	Description	No.	Code
1	Cotton wool	7	pbf
2	Sugarcane	6	c_b
3, 4	Other industrial crops; Soy	5, 8	ocr, osd
5	Other cereals	1, 2, 3	pdr, wht, gro
6, 7	Tubers; Fruits and other agricultural prods	4	v_f
8, 9, 10	Cattle; Other livestock; Other livestock prods	9, 10,10, 11, 12	ctl, oap, rmk, wol
11	Forestry Products	13	for
12	Fishery products	14	fsh
13	Mining Products	15, 16, 17, 18	col, oil, gas, omn
14, 15	Beef; Other meats	19, 20	cmt, omt
16	Vegetable oils and fats	21	vol
17	Milk products	22	mil
18	Sugar	24	sgr
19, 20	Milling and bakery products; Other food products	23, 25	pcr, ofd
21	Beverages and tobacco	26	b_t
22	Textiles and clothing	27, 28	tex, wap
23	Leather and leather products	29	lea
25	Paper and cardboard products	31	ppp
26	Fuels and lubricants	32	p_c
27, 28, 29	Chemicals, Pharmaceuticals; Tires & rubber prods	33	crp
30	Non-metallic mineral products	34	nmm
31	Products of iron and non-ferrous	35, 36	i_s, nfm
32	Structural metal products	37	fmp
33	Machinery and equipment, household appliances	40, 41	ele, ome
34	Motor vehicles	38, 39	mvh
24, 35	Wood and wood products; Other manufactures	30, 42	lum, omf
36	Electricity and water	43, 45	ely, wtr
37	Construction	46	cns
38, 39	Wholesale and retail trade; Restaurants and hotels	47, 44	trd, gdt
40	Transportation	48, 49, 50	otp, wtp, atp
41	Post and telecommunications	51	cmn
42	Financial services and insurance	52, 53	ofi, isr
43	Rental services	57	dwe
44	Services to enterprises	54	obs
45	Services to households	55	ros
46	Government services	56	osg

Source: Author's elaboration.

5. Input-Output Table Description

In what follows, some basic statistics that were obtained from the Paraguay input-output table for GTAP are presented. Paraguay GDP reached 70,980,409 million guaraníes in 2009 (see Table 2). In 2009, the government current savings were around 4.3% of GDP and government current consumption was 12.2% of GDP. The Paraguay 2009 input-output table for GTAP reports taxes paid by institutions, commodity sales, activities, and tariffs; total tax revenue reached 15.3% of GDP in 2009 – this figure includes social security receipts.

Table 2: Gross Domestic Product (GDP) structure in Paraguay (2009) (million guaraníes and percent)

Macro Aggregate	Guaraníes (million)	Share of GDP (percentage)
Demand		
Private Consumption	53,985,590	76.1
Investment	10,684,753	15.1
Stock Change	226,745	0.3
Government Consumption	8,641,801	12.2
Exports	21,672,343	30.5
Total Demand	95,211,232	134.1
Supply		
GDP (market prices)	70,980,409	100.0
Imports	24,230,823	34.1
Total Supply	95,211,232	

Source: Author's elaboration.

The production and trade structure of Paraguay is presented in Table 3. The first column shows the share of each sector in the total gross value of production. About 33% of total value is agriculture and food processing, and 56% is services, while only 11% corresponds to manufactures (excluding food processing). Regarding exports, 60% comes from agriculture and agroindustry. Some sectors are more export oriented than others. For instance, "Other industrial crops; Soybeans" are exported at a rate of 76% of total production, while at the same time representing a significant share of export revenue (17.8%). For imports, more than 60% are concentrated on manufactured products like Fuels & lubricants, chemicals, pharmaceuticals & rubber products, machinery & equipment and motor vehicles. Almost the same sectors represent a large share (70-90%) of final consumption.

Finally, Table 4 shows the sectoral composition of value-added, and its distribution between labor and capital.

Table 3: Sectoral structure of production and trade in Paraguay (2009) (percent)

Sector	Share per sector in total production	Exports		Imports	
		Share of total exports (%)	Share of production per sector (%)	Share of total imports (%)	Share of consumption per sector (%)
Cotton wool	0.3	0.4	27.2	0.1	4.8
Sugarcane	0.3	0.0	0.0	0.0	0.0
Other industrial crops; Soybeans	3.8	17.8	75.7	2.6	33.4
Other cereals	2.0	9.1	75.4	0.5	16.4
Tubers; Fruits and other agric. prods	2.2	2.0	15.1	0.6	5.5
Cattle; Other livestock products	5.4	0.1	0.3	0.3	1.1
Forestry Products	1.0	0.9	14.5	0.0	0.0
Fishery products	0.1	0.0	0.3	0.1	23.2
Mining Products	0.2	0.1	10.2	0.2	22.1
Beef; Other meats	7.9	12.9	26.5	0.1	0.3
Vegetable oils and fats	2.8	13.6	78.1	0.3	7.9
Milk products	0.6	0.1	2.5	0.2	7.3
Sugar	2.0	1.7	13.8	4.5	30.9
Milling, bakery; Other food products	0.7	0.7	18.4	0.0	0.5
Beverages and tobacco	3.7	0.6	2.6	0.6	3.3
Textiles and clothing	2.0	1.3	10.8	4.1	29.8
Leather and leather products	0.4	1.3	48.3	0.3	25.4
Paper and cardboard products	1.1	0.1	1.2	3.5	34.5
Fuels and lubricants	0.0	0.0	0.0	19.9	80.2
Chemicals, pharma.; Rubber prod.	1.5	3.0	31.7	21.0	72.3
Non-metallic mineral products	1.2	0.2	2.1	1.8	22.3
Products of iron and non-ferrous	0.5	0.5	14.9	2.9	51.5
Structural metal products	1.3	0.0	0.6	0.6	8.7
Machinery and equipment	0.2	0.4	27.9	10.4	76.8
Motor vehicles	0.2	0.2	19.2	11.6	87.6
Wood and wood prods; Other manuf.	2.2	1.4	10.5	2.2	18.8
Electricity and water	1.6	0.5	5.2	0.0	0.0
Construction	7.6	0.0	0.0	0.0	0.0
Wholesale & retail trade; Rest. & hotels	19.5	4.4	3.7	2.8	2.6
Transportation	5.7	3.5	10.1	6.8	19.4
Post and telecommunications	2.7	0.4	2.2	0.1	0.6
Financial services and insurance	2.5	0.6	3.8	1.2	7.7
Rental services	0.7	0.0	0.0	0.0	0.0
Services to enterprises	4.1	18.6	74.3	0.2	3.3
Services to households	5.0	0.0	0.0	0.0	0.0
Government services	6.9	3.5	8.3	0.6	1.6
Total	100.0	100.0		100.0	

Source: Author's elaboration.

Table 4: Sectoral composition of value added in Paraguay (2009)

(percent)

Sector	Share of total value added (%)	Share of total value added per sector (%)		
		Labor	Capital	Total
Cotton wool	0.4	75.1	24.9	100
Sugarcane	0.5	75.1	24.9	100
Other industrial crops; Soy	5.9	75.1	24.9	100
Other cereals	3.0	75.1	24.9	100
Tubers; Fruits and other agr. Products	3.3	75.1	24.9	100
Cattle; Other livestock products	6.4	29.3	70.7	100
Forestry Products	1.8	4.9	95.1	100
Fishery products	0.1	100.0	0.0	100
Mining Products	0.2	46.8	53.2	100
Beef; Other meats	3.5	5.4	94.6	100
Vegetable oils and fats	0.4	19.0	81.0	100
Milk products	0.1	45.4	54.6	100
Sugar	0.2	61.1	38.9	100
Milling, bakery; Other food products	0.8	53.4	46.6	100
Beverages and tobacco	1.9	28.7	71.3	100
Textiles and clothing	1.3	86.7	13.3	100
Leather and leather products	0.3	84.0	16.0	100
Paper and cardboard products	0.7	79.2	20.8	100
Fuels and lubricants	0.0	0.0	0.0	100
Chemicals, pharmaceuticals; Rubber prod.	0.6	66.2	33.8	100
Non-metallic mineral products	1.0	46.2	53.8	100
Products of iron and non-ferrous	0.4	65.0	35.0	100
Structural metal products	0.5	76.2	23.8	100
Machinery and equipment	0.1	76.2	23.8	100
Motor vehicles	0.1	76.2	23.8	100
Wood and wood products; Other manuf.	1.3	67.9	32.1	100
Electricity and water	1.7	27.3	72.7	100
Construction	7.3	66.4	33.6	100
Wholesale & retail trade; Rest. & hotels	4.1	73.2	26.8	100
Transportation	3.2	33.4	66.6	100
Post and telecommunications	3.5	24.5	75.5	100
Financial services and insurance	1.2	0.0	100.0	100
Rental services	4.6	46.4	53.6	100
Services to enterprises	22.6	56.8	43.2	100
Services to households	6.6	79.4	20.6	100
Government services	10.3	100.0	0.0	100
Total	100.0			

Source: Author's elaboration.

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Appendix 1: Activities and Products in the Paraguay Supply and Use Tables

No.	Products (46)	Activities (33)
1	Cotton wool	Agriculture
2	Sugarcane	Livestock
3	Other industrial crops	Forestry
4	Soybeans	Fishing
5	Other cereals	Mining
6	Tubers	Meat products
7	Fruits and other agricultural products	Oils and fats
8	Cattle	Dairy
9	Other livestock	Milling
10	Other livestock products	Sugar
11	Forestry Products	Other food
12	Fishery products	Beverages and tobacco
13	Mining Products	Textiles
14	Beef	Leather
15	Other meats	Wood
16	Vegetable oils and fats	Paper
17	Milk products	Refined Petroleum
18	Sugar	Chemicals; Rubber; Plastics
19	Milling and bakery products	Non-metallic minerals
20	Other food products	Metals
21	Beverages and tobacco	Machinery and equipment
22	Textiles and clothing	Other manufactured goods
23	Leather and leather products	Electricity and water
24	Wood and wood products	Construction
25	Paper and cardboard products	Wholesale and retail trade
26	Fuels and lubricants	Transport
27	Chemicals products	Communications
28	Pharmaceuticals and toiletry products	Financial Intermediation
29	Tires, tubes and other rubber products	Renting
30	Non-metallic mineral products	Business activities
31	Products of iron and non-ferrous	Hotels and restaurants
32	Structural metal products	Services to households
33	Machinery and equipment, household appliances	Government Services
34	Motor vehicles	
35	Other manufactured goods	
36	Electricity and water	
37	Construction	
38	Wholesale and retail trade;	
39	Restaurants and hotels	
40	Transportation	
41	Post and telecommunications	
42	Financial services and insurance	
43	Rental services	
44	Services to enterprises	
45	Services to households	
46	Government services	