

Bolivia

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1. Introduction

This document describes the steps behind the creation of the first Bolivian Input-Output (IO) table for the Global Trade Analysis Project (GTAP). The GTAP Input-Output table for Bolivia is based on the 2000 Supply and Use matrices compiled by the National Institute of Statistics of Bolivia. The National Institute of Statistics of Bolivia is the only official provider of these data in Bolivia, and is in charge of collecting and processing data on National Accounts.

This document is divided in 4 sections. The next section explains the data, their particular characteristics and its salient economic features. Section 3 describes the process of building the database, outlining some of the assumptions made about the structure of the source data so it can be consistent with GTAP specifications. Section 4 describes briefly the sectorial aggregation and splits. Finally, section 5 describes source data missed in the process of moving to the GTAP specification.

2. Source Data

2.1 Characteristics

The 2000 Supply and Use tables of Bolivia have a commodity by industry format. The units are in thousands of local currency (bolivianos) in nominal terms at purchasers' prices, and include 35 commodities and 35 industries. Appendix 1A provides a list of commodities with descriptions and concordances between the Bolivia IO commodity classification and the SIC rev.3 (ISICr3). Similarly, Appendix 1B provides the concordance between the Bolivia IO commodity data and GTAP sector classification (GSC2). The Use matrix includes an additional industry (36 in total) called Banking Imputation ("Imputación Bancaria" in Spanish) which we discuss more in detail in section 2.2.

2.2 Main Economic Features

In Bolivia, the National Institute of Statistics constructs Supply and Use matrices or input-output tables. This institution is in charge of preparing the Bolivian system of National Accounts. Input output tables are part or sub-product of this system. The National Institute of Statistics of Bolivia not only follows the United Nations methodology on national accounts but also makes an effort to suit IO tables to the reality of the productive system of Bolivia.

The Use table in Bolivia can be seen as one matrix with four sub-matrices:

- I. The total supply of goods and services sub-matrix, which includes column data for domestic production, imports, taxes, tariffs, and margins. Row totals of these columns yield total supply. (Total supply is therefore measured at purchasers' prices).
- II. Intermediate demand sub-matrix, representing industry's consumptions of goods and services, valued at purchasers' prices.
- III. Final demand or final utilization sub-matrix, which represents consumption of households, consumption of government, gross fixed capital formation, changes in stock, and exports. Final demand is valued at purchasers' prices.
- IV. Output sub-matrix, a matrix that registers gross production by industry and value added generated by these industries.

There is a complementary table to the Use matrix available from the National Institute of Statistics of Bolivia: the Supply or Make matrix. This is a matrix of 35 commodities and 35 industries that describes the origin of domestic supply of goods and services. Additionally, there is a matrix with the distribution of taxes and margins between intermediate and final demand.

There are some particular features of the IO tables of Bolivia. These features include a fictitious financial industry (*Imputación Bancaria*), and direct purchases of other goods and services.

As mentioned before, the Use table of Bolivia presents a fictitious financial industry (*Imputación Bancaria*). This is a fictitious industry included in the source data to treat the value generated by financial intermediation. The National Institute of Statistics avoids the difficult task of dealing with distributing financial services production into intermediate industry's consumption by creating a fictitious industry that "consumes" all imputed financial services production. In the use matrix, the production of this sector corresponds to the intermediate consumption of a fictitious sector with negative value added and intermediate consumption with the same value but opposite sign to value added. Section 3.3 below explains how this sector was treated to match the GTAP sectorial classification.

The IO table also includes data for "direct purchases of other goods and services." By including these data the National Institute of Statistics tries to distinguish "final consumption in the domestic territory" from "national consumption." Direct purchases register then, purchases that Bolivian nationals make from foreign sources and purchases that non-residents make in Bolivia. Accounting for data on direct purchases makes it possible to calculate final consumption and gross savings of household residents, and measure the input in intermediate goods of Public Administration.

3. Preparing the Bolivian Data Base

3.1 Make Matrix

Because the GTAP model and its database are commodity by commodity, the multi-product (commodity by industry) Supply or Make table of Bolivia had to be converted to a single-product (commodity by commodity) database. Since the Make table was already a square matrix (35x35) we diagonalize it, by moving values of a commodity j across industries i to industry j , to produce a diagonal matrix. For example, tables 2 and 3 denote the make matrix before and after diagonalization. The commodity "Non-Industrial Agricultural Products" is produced in two industries, "Non-Industrial Agricultural Products" and "Industrial Agricultural Products". The

diagonalization eliminates the multi-product nature of the make matrix, moving what is produced of “Non-Industrial Agricultural Products” in industry “Industrial Agricultural Products” into a sector “Non-Industrial Agricultural Products”.

This means that if we started with a Non-Industrial Agricultural Products industry that produced “Non-Industrial Agricultural Products” commodities as well as “Industrial Agricultural Products” commodities we ended up with a sector “Non-Industrial Agricultural Products” that produced wheat, maize, and others, and a sector “Industrial Agricultural Products” that produced only industrial agricultural products (soybeans, tobacco, sugarcane, etc.)

To end up with a diagonal make matrix, we applied commodity shares of total output within the same industry j in the make matrix to distribute values by commodity from industry i to industry j in this matrix. We aggregated the product of each of the various industries which produce the same commodity to yield a sector that produces a single commodity.

Table 1. Selected Production of Commodity i by Industry j - Original Make Matrix
-In thousands of Bolivianos

Commodity \ Industry		1	2	3	... 35
		Non-Industrial Agricultural Products	Industrial Agricultural Products	Coca	Total 3+4+5
1	Non-Industrial Agricultural Products	3,424,303	158,969	0	3,583,272
2	Industrial Agricultural Products	21,185	1,502,841	0	1,523,999
3	Coca	5,819	0	434,724	440,543
⋮					
35					
Total 1+2+3		3,451,307	1,661,810	434,724	5,547,814

Table 2. Selected Production of Commodity i by Commodity j - Diagonal Make Matrix
-In thousands of Bolivianos

Commodity \ Industry		1	2	3	... 35
		Non-Industrial Agricultural Products	Industrial Agricultural Products	Coca	Total 3+4+5
1	Non-Industrial Agricultural Products	3,583,272	0	0	3,583,272
2	Industrial Agricultural Products	0	1,523,999	0	1,523,999
3	Coca	0	0	440,543	440,543
⋮					
35					
Total 1+2+3		3,583,272	1,523,999	440,543	5,547,814

3.2 Value Added

Value added in the source data of 2000 is not disaggregated into factor remunerations and tax components. To distribute value added into its components we use the 1996 Social Accounting Matrix (SAM) of Bolivia which has value added disaggregated. An initial step was to map the sectors in the SAM (41) to the sectors in the Use matrix (35). Two sectors were mapped to Financial Services, three sectors to Social Services and four sectors to Public Administration Services. We aggregated these sectors to the corresponding 35 industries in the Use Matrix and estimated each component shares in value added. Value added in the 1996 SAM accounted for labor and capital (wages and salaries, income from owner-operator, and capital income), and net indirect taxes. These shares we multiplied by the valued added share in the 2000 Use Matrix to distribute value added into its components.

After this initial estimation of value added we added the vector called Direct Purchases or *Compras Directas* in Intermediate Consumption to value added (see section 2.2 for an explanation of this account). This was necessary, since direct purchases affected the balance between sales and costs. The only sector affected by this procedure was Public Administration (*Servicios de la Administración Pública*). All other sectors had zero values in the vector of Direct Purchases. We allocated the value of \$107,242 corresponding to direct purchases in Public Administration into the value added of this sector.

After this initial transformation and estimation we assigned value added amongst different factors of production in the source data (land, labor and capital) according to the shares in Table 3 to do both, account for land and, distribute income from owner-operator to labor, land and capital. We use these shares differently, depending on whether the industry used or not natural resources.

For manufacturing and service –sectors for which we assumed no use of natural resources– the process of obtaining factors of production categories consisted of adding to labor (wages and salaries) and capital the assumed fraction of owner-operators’ income imputed to labor and capital, respectively. By definition, value added for land was set to zero in these sectors. For those sectors that used natural resources such as primary agriculture, forestry, fish, oil, and mining, we followed the same procedure as in the sectors discussed before, except that the fraction assigned to land was positive. To distribute ownership of Dwellings, we applied the following shares across factors: a) 10% to labor, b) 10% to Land, and c) 80% to Capital.

Table 3. Shares of Factor Endowment in Value Added

Description	Factor Share ¹
Non-agricultural owner-operator income given to labor	0.6
Non-agricultural owner-operator income given to capital	0.4
Agricultural owner-operator income given to labor	0.6
Agricultural owner-operator income given to land	0.2
Agricultural owner-operator income given to capital	0.2
Gross fixed capital formation given to land	0.3
Gross fixed capital formation given to capital	0.7

¹. Source: Mark Horridge, Center of Policy Studies, Monash University.

Finally, to maintain the commodity by commodity structure of the make matrix we multiplied value added by the cost shares of the make matrix.

3.3 Use Matrix (UP)

We made the following three corrections to the source Use matrix to meet GTAP specifications:

1. As explained in section 2.1, the Use matrix included a fictitious financial industry called Banking Imputation (*Imputación Bancaria*). In the Use table, this industry consumed only a Financial Intermediation commodity. We removed the fictitious sector from intermediate consumption of the Use table and assigned this value to households' final demands. In other words, the cell in the Use matrix that corresponded to the Financial Intermediation commodity and the Banking Imputation was set to zero, and the amount of that cell was placed into final demand of Households for Financial Intermediation.
2. We transformed the Use matrix from a commodity-by-industry to a commodity-by-commodity matrix. To perform this change, we applied commodity shares of total output within the same industry j in the Make table to distribute values by commodity from industry i to industry j in the Use matrix. We aggregated each of the various industries which consumed a given commodity x to yield the intermediate use of that commodity x , each of the various industries which consumed another given commodity y to yield the intermediate use of that commodity y , and so on. These new sectors have a cost structure that is a share-weighted sum of the cost structure of the parent industries that produce these commodities (in the Make matrix).
3. We included the values of the column vector called "Marketing and Transport Margins (*Márgenes de Comercialización y Transporte*)" of the Make matrix into the commodity "Comercio" of the modified commodity-by-commodity Use matrix. This vector has a negative value in 'Comercio' equal to sum of all the other commodities. This negative value was set to zero as we included these values into the Use matrix. This adjustment captured margins across commodities and allowed to maintain the balance between sales and costs.

To separate the Use matrix into Domestic and Imports use, we used a vector of imports to distribute and extract import use by commodity. This vector of imports included imports, tariffs and taxes on imports (estimated by multiplying taxes on "Other Products and Imports" by the share of imports in the Use matrix). The resulting vector of imports was multiplied by row shares of each commodity i in industry j , to estimate and extract imports use.

The GTAP specification does not allow re-exports, so we distributed all exports to the Domestic Use matrix, allocating zeros into these columns in the Import Use matrix. This procedure produced both domestic and import tables commodity tax inclusive (matrix "UP" in GTAP notation).

3.4 Domestic and Import Use Free of Taxes (UF)

Both domestic and import Use matrices included taxes. To produce tax-free matrices ("UF" in GTAP notation), we obtained the amount of taxes corresponding to both imports and domestic intermediate and final demands (except from "Change in Stocks") and subtracted these taxes from the corresponding demands.

There were two types of taxes: sales (domestic and imports) and production taxes. These taxes were included in the Value Added tax (*Impuestos al valor agregado*) and Transaction and other Production and Import taxes (TOCIT) (*Impuesto a las transacciones y otros impuestos a los productos y las importaciones*).

The source data had values of the distribution of these taxes between intermediate (as an aggregate) and final demand (household and government demand, net capital formation, change in stocks, and exports). Using this distribution, we obtained two matrices of the shares of taxes in intermediate and final demand that were applied to distribute the tax vectors into intermediate and final demand. We distributed taxes within intermediate demand (all 35 industries) by using the Use matrix's shares. Once we obtained the portion of other import taxes from the TOCIT taxes we subtracted this portion from TOCIT to get production taxes.

Using the share of imports in the use matrix, we split sales taxes into domestic and import taxes. To obtain a matrix of import taxes we added the import portion of value added tax and the import portion of TOCIT. Domestic sales taxes include domestic value added taxes only.

The resulting domestic and import tax matrices were finally subtracted from both domestic and import use (tax inclusive) to obtain both domestic and import use free of taxes.

3.5 Output (OP) and Imports Free of Tariffs (MF)

To obtain a vector of output of sector i non-commodity net indirect tax included (vector "OP" in GTAP notation), we added together the sum of domestic and imports intermediate use, value added, and production taxes (other domestic taxes). The Bolivia source data had production taxes mixed with other taxes on imports. We separated out production taxes from other import taxes as explained in section 3.4 above, and added these production taxes to intermediate use (domestic and imports) and value added to obtain the OP vector.

Finally, to produce a vector of imports by commodities with import duties excluded (vector "MF" in GTAP notation) we removed tariffs from the totals of free-of-consumption-tax Imports Use table.

4. Commodity Aggregation and Splits

According to the sectorial concordance between GSC2 sectors and the Bolivia IO table (Appendix 1B) we aggregated the 35 sectors from Bolivia into 32 sectors, assuring balance was maintained. For example, "beverages" and "Processed Tobacco" were aggregated to the GSC2 sector "Beverages and tobacco products".

The only split that we performed was of "Textiles" into the three corresponding GTAP sectors (tex, wap, lea) using shares of Gross Value of Output. The shares were tex (10.91%), wap (54.96%) and lea (34.13%)¹. We use these shares to split Textiles across commodities and industries in intermediate use, final demand (UP and UF), output (OP) and imports (MF). The rest of the sectoral split to map the Bolivian sectors in the aggregated IO to the 57 GSC2 sectors was performed at the GTAP Center, using the cost structure of their "GTAP Representative Table" (chapters 13 and 14, Dimaranan and McDougall, 2002).

¹ Source: Hugo Alba Braun, National Accounts, National Statistics Institute, Bolivia

5. Final Comments

The only data lost as a result of moving between the source data and the GTAP format were the data of direct purchases in both: final demand (Household Consumption and Exports) and imports (of services). The negative value added in the fictitious financial sector was also excluded. Appendix 2 provides a summary diagram of the procedures applied to the source data to bring it into the GTAP format.

References

- Dimaranan, B.V. and R.A. McDougall, 2002. *Global Trade, Assistance, and Production: The GTAP 5 Data Base*, Center for Global Trade Analysis, Purdue University
- Huff, K., R. McDougall, and T. Walmsley, 2000. *Contributing Input-Output Tables to the GTAP Data Base*, GTAP Technical Paper No. 1, January 2000.
- National Institute of Statistics of Bolivia, 2004. *Tablas de Oferta y Utilización de Bolivia, 2000*, Electronic File in Excel.

APPENDIX 1A. Commodity classification and Concordance between Bolivia IO Table and ISICr3

Commodity No.	Description	ISICr3
1	Agricultural Products – Non-Industrial	0111-0113
2	Agricultural Products – Industrial	0111-0113
3	Coca	0111
4	Livestock Products	0121-0123
5	Forestry, Hunting and Fishing	0150, 0200, 0500
6	Oil and Natural Gas	1110, 1120
7	Metallic and Non-Metallic Minerals	1200-1429
8	Fresh and Processed Meat	1511-1514
9	Dairy Products	1520
10	Milling and Bakery Products	1531, 1533, 1541, 1544
11	Sugar and Candy Products	1542-1543
12	Other Food Products	1514-1532, 1549
13	Beverages	1551-1554
14	Processed Tobacco Products	1600
15	Textiles, Apparel and Leather Products	1711-1712, 1721-1723, 1729-1730, 1810, 1820, 1911-1912, 1920
16	Wood Products	2021-2022, 2029
17	Paper Products	2101-2102, 2109, 2211-2212, 2219, 2221-2222, 2230
18	Chemical Products	2411, 2413, 2421-2424, 2429-2430 , 2511, 2519, 2520
19	Petroleum Products	2320
20	Non-Metallic Mineral Products	2610, 2691-2696
21	Basic Metal Products	2710, 2720, 2731-2732
22	Metal Products, Machinery, and Equipment	2811-2812, 2892-2893, 2899, 2913-2914, 2919, 2921-2922, 2924-2925, 2929-2930, 3110, 3120, 3130, 3140, 3150, 3190, 3311, 3320, 3420, 3430, 3512, 3520, 3592
23	Other Manufactured Products	3610, 3691-3692, 3694, 3699
24	Electricity, Gas and Water	4010, 4020, 4100
25	Construction	4510, 4520, 4530, 4540, 4550
26	Trade	5110-5260
27	Transport and Storage	6010-6023, 6030, 6110, 6120, 6210-6220, 6301-6309
28	Communication	6411-6412, 6420,
29	Financial Services	6511, 6519, 6601, 6603, 6720
30	Business Services	70, 71, 72, 73, 74, 7020-7499
31	Dwellings	7010
32	Community, Social and Personal Services	80, 90
33	Restaurants and Hotels	5510, 5520
34	Domestic Services	9500
35	Public Administration Services	7511-7514, 7521-7523, 7530

APPENDIX 1B. Concordance between GSC2 Sectors and Bolivia IO table

GSC2 No.	GSC2 Code	GSC2 Description	Bolivia Commodity Name	Bolivia Commodity No.
1	pdr	Paddy rice	Agricultural Products – Non-Industrial	1
2	wht	Wheat	Agricultural Products – Non-Industrial	1
3	gro	Cereal grains nec	Agricultural Products – Non-Industrial	1
4	v_f	Vegetables, fruit, nuts	Agricultural Products – Non-Industrial	1
5	osd	Oil seeds	Agricultural Products – Industrial	2
6	c_b	Sugar cane, sugar beet	Agricultural Products – Industrial	2
7	pfb	Plant-based fibers	Agricultural Products – Industrial	2
8	ocr	Crops nec	Coca	3
9	ctl	Cattle, sheep, goats, horses	Livestock Products	4
10	oap	Animal products nec	Livestock Products	4
11	rmk	Raw milk	Livestock Products	4
12	wol	Wool, silk-worm cocoons	Livestock Products	4
13	for	Forestry	Forestry, Hunting and Fishing	5
14	fsh	Fishing	Forestry, Hunting and Fishing	5
15	col	Coal	Oil and Natural Gas	6
16	oil	Oil	Oil and Natural Gas	6
17	gas	Gas	Oil and Natural Gas	6
18	omn	Minerals nec	Metallic and Non-Metallic Minerals	7
19	cmt	Meat: cattle, sheep, goats, horse	Fresh and Processed Meat	8
20	omt	Meat products nec	Fresh and Processed Meat	8
21	vol	Vegetable oils and fats	Other Food Products	12
22	mil	Dairy products	Dairy Products	9
23	pcr	Processed rice	Milling and Bakery Products	10
24	sgr	Sugar	Sugar and Candy Products	11
25	ofd	Food products nec	Other Food Products	12
26	b_t	Beverages and tobacco products	Beverages	13
			Processed Tobacco Products	14
27	tex	Textiles	Textiles, Apparel and Leather Products	15
28	wap	Wearing apparel	Textiles, Apparel and Leather Products	15
29	lea	Leather products	Textiles, Apparel and Leather Products	15
30	lum	Wood products	Wood Products	16
31	ppp	Paper products, publishing	Paper Products	17
32	p_c	Petroleum, coal products	Petroleum Products	19
33	crp	Chemical, rubber, plastic prods	Chemical Products	18
34	nmm	Mineral products nec	Non-Metallic Mineral Products	20
35	i_s	Ferrous metals	Basic Metal Products	21
36	nfm	Metals nec	Basic Metal Products	21
37	fmp	Metal products	Metal Products, Machinery, and Equipment	22
38	mvh	Motor vehicles and parts	Metal Products, Machinery, and Equipment	22
39	otn	Transport equipment nec	Metal Products, Machinery, and Equipment	22
40	ele	Electronic equipment	Metal Products, Machinery, and Equipment	22

APPENDIX 1B. Concordance between GSC2 Sectors and Bolivia IO table (Continued)

GSC2 No.	GSC2 Code	GSC2 Description	Bolivia Commodity Name	Bolivia Commodity No.
41	ome	Machinery and equipment nec	Metal Products, Machinery, and Equipment	22
42	omf	Manufactures nec	Other Manufactured Products	23
43	ely	Electricity	Electricity, Gas and Water	24
44	gdt	Gas manufacture, distribution	Electricity, Gas and Water	24
45	wtr	Water	Electricity, Gas and Water	24
46	cns	Construction	Construction	25
47	trd	Trade	Trade	26
			Hotels and Restaurants	33
48	otp	Transport nec	Transport and Storage	27
49	wtp	Sea transport	Transport and Storage	27
50	atp	Air transport	Transport and Storage	27
51	cmn	Communication	Communication	28
52	ofi	Financial services nec	Financial Services	29
53	isr	Insurance	Business Services	30
54	obs	Business services nec	Business Services	30
55	ros	Recreation and other services	Community, Social and Personal Services	32
			Domestic Services	34
56	osg	PubAdmin/Defence/Health/Ed	Public Administration Services	35
	ucat			
57	dwe	Dwellings	Dwellings	31

APPENDIX 2. Process of creating the Bolivian database for the GTAP database

