

Panama

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1. Introduction

This document describes the steps behind the creation of the first Input-Output (I-O) table of Panama for the Global Trade Analysis Project (GTAP).¹ The GTAP I-O table for Panama is based on a Social Accounting Matrix (SAM) for the year 1996 built by Sánchez and Vos (2005)². The 1996 SAM was constructed using data from the Supply and Use Tables from the *Contraloría General de Panama* for the study “*Impacto del Tratado de Libre Comercio con los Estados Unidos en el crecimiento, la pobreza y la desigualdad en Panamá: Una evaluación ex-ante usando un modelo de equilibrio general computable dinámico*”.

This technical note is divided into 4 sections. The next section explains the data and the construction of the 1996 SAM, its particular characteristics and its salient economic features. Section 3 describes the process of building the GTAP ready data base, outlining some of the assumptions made about the structure of the source data so it could be consistent with GTAP specifications. Finally, section 4 describes briefly the sectoral aggregation and breakdowns.

2. Source Data

2.1 Data Characteristics

The SAM of Panama has a commodity (product)-by-industry (activity) format, and includes 33 commodities and 13 activities. Its units are denominated in millions of local currency units (*balboas*) in nominal terms at purchasers’ prices of 1996. Table 1A lists the 33 commodity groups of the 1996 SAM whereas Table 2A does the same for activities (or industries). The commodity aggregation of Panama’s SAM sectors to adapt it in compliance with the corresponding GTAP sector breakdown is outlined in Table 3A. The concordance between the Panama I-O commodity data and the GTAP sector

¹ The preparation of the I-O table for GTAP was facilitated by resources from the Economic Commission for Latin America and the Caribbean (ECLAC), the Department of Economic and Social Affairs of the United Nations (UN-DESA) and Germany’s international cooperation agency GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit). The original table and Social Accounting Matrix (SAM) was prepared with the auspices of the agencies mentioned in the text. The inclusion of Panama into GTAP is the result of a collaborative effort of the International Trade and Integration Division of ECLAC and the Development Policy and Analysis Division of UN-DESA to facilitate improved quantitative trade and macroeconomic policy analysis in Central America.

² The authors were affiliated to the Institute of Social Studies in The Hague, The Netherlands, during the elaboration of the referred study.

classification (GSC2) is provided in Table 4A. Finally, Figure 1A provides a summary diagram of the procedures followed to convert the source data to GTAP format.

2.2 Construction of Panama's SAM

The SAM for Panama was built by Sánchez and Vos (2005), following a “top-down approach”. The cells in the SAM were initially determined by a “relatively” aggregated subset of national accounts, to later on estimate a subset of more disaggregated information that allows re-calculating the initial total aggregates, which act as control in the estimation process (Thorbecke, 2003). In other words, Sánchez and Vos first constructed an aggregated matrix with the goal of later estimating a disaggregated matrix, with an important level of disaggregation of factor and institutional income flows.

For the purpose of this technical note for GTAP, we only discuss the steps that we considered relevant in the adaptation of the I-O table for GTAP and omit those aspects of Panama's SAM that were not included in the data for the GTAP Data Base.

Aggregated SAM

Following the format of a conventional SAM, the aggregated SAM for Panama –the column and row totals of which serve as controls in the whole estimation process–, was constructed using a Supply and Use (SU) table for 1996, in millions of *balboas*. All of this information was provided by the *Contraloría General de Panama*.³ The aggregated SAM of Panama was fully consistent with the national accounts for the year 1996. Various modifications to the original data were required to build the aggregated SAM, though, as explained in what follows:

- First, the 33 activities of the aggregated SAM were aggregated into 13 activities in order to facilitate the accounting of intermediate consumption from the Supply-Use tables.
 - o One of these 13 activities separately included the production of transportation and related services from the Panama Canal which is part of the transportation activity in the Supply-Use tables.
 - o The Colon Free Trade Zone was also considered as a separate activity the accounting of which required compiling additional information. Most of the economic activity from the Colon Free Trade Zone actually reflects re-exports..
 - o The aggregated SAM included two activities for agriculture (i.e., “domestic consumption agriculture” and “export agriculture”) and manufacturing (i.e., “manufacturing for the domestic market” and “export-oriented manufacturing”). In both cases, export-oriented activities were those which, according to the 1996 national accounts, were exporting the bulk of its output.

³ More details on the data sources can be found in Appendix A4 of Sánchez and Vos (2005).

- Trade and transportation margins were explicitly accounted for by, row-wise, indicating payments from commodity accounts to the commodity-based account for “trade, lodging and food and beverage serving services”.
- The “Rest of the World” account was divided into two parts to separate all trade that is subject to tax payments (regarded as “local rest of the world”) from that that is exempt from taxes and is channeled through the Colon Free Trade Zone (regarded as “free zone rest of the world”). This adjustment allows differentiating imports that are subject to import tariffs from those that are not.
- Direct purchases from residents, which according to the 1993 UN System of National (1993 SNA) Accounts refer to government and household use of transport services abroad, were considered as imports of “transportation and communication services”. Private consumption of “transportation and communication services” was adjusted accordingly.
- Government transfers to the private sector, savings, and domestic institutions’ transfers to the “local rest of the world” were all adjusted manually in order to gain balance for the domestic private sector and government accounts.
- Exports were adjusted as follows: i) all “production” (that is, imports for re-exportation) from the Colon Free Trade Zone was considered as export services, ii) exports from the Panama Canal and direct purchases were respectively subtracted from and added to exports of “transport and communication services”, iii) to maintain consistency with the 1993 SNA, direct purchases by non residents were not accounted for as government exports and they were rather considered as use of transport services by non residents.
- Income earned by workers of the Department of Defense established in US military bases was considered as a transfer from the rest of the world to (wage) labor.
- Transfers from the rest of the world to the domestic private sector and the government, respectively included: i) direct purchases by non resident households in the domestic market and transfers from foreign workers, and ii) technical assistance and loans. Foreign savings were calculated residually in order to balance the two rest of the world accounts.

Disaggregated SAM

The shift from the aggregated SAM to the final disaggregated SAM entailed performing various disaggregations. Firstly, the labor account was split up into eight accounts as labor was classified by skill level, occupational category, and sex. Secondly, the domestic non-government institution account was broken down into three accounts for enterprises, urban households, and rural households. Thirdly, the two rest of the world accounts (i.e., local and free zone) were both classified by trading partner. The final product of performing these disaggregations was a 1996 SAM with 84 rows and 84 columns. All unbalances that arose during the SAM disaggregation was fixed by solving a constrained

minimization problem based on the Cross Entropy Technique proposed in Robinson et al. (2001).

To include Panama into the GTAP Data Base, we only used the first fully balanced, aggregated SAM. The other accounts breakdown for labor, non-government domestic institutions, and trade by trading partner that led to the construction of the disaggregated SAM was of no use for the purposes of the adaptation to the GTAP setup.

3. I-O Table Construction for GTAP

The information recorded in the 1996 Panamanian SAM constructed by Sánchez and Vos (2005) was transformed in order to set it up in the GTAP format following the guidelines in Huff et al. (2000). The main steps followed for this purpose are explained in this section.

3.1 Make Matrix

Because the GTAP Data Base is set up in a commodity by commodity format, the multi-product (commodity by industry) make matrix for Panama had to be converted into a single-product (commodity by commodity) table. We diagonalized the make matrix by moving values of a commodity j across industries i to industry j . That is, we aggregated the product of each of the various industries which produce the same commodity to yield a sector that produces a single commodity. As a consequence, there was no longer room for secondary production in Panama's matrix.

3.2 Use Matrix

3.2.1 Re-exports

GTAP does not explicitly records re-exports in its data base. For this reason, re-exports that had been recorded in the initial I-O table for Panama –in the accounts for the Colon Free Trade Zone- were eliminated. This adjustment resulted in an imbalance between sales and costs at the commodity-account level that was corrected by adjusting change in stocks by commodity.

3.2.2 Value Added to ORANIG Factors (Labor, Capital and Land)

Value added in the source data accounted for labor and capital. Value added for land was set to zero for all sectors, since the information available did not account for this factor neither would it permit us to calculate shares to separate the portion of the capital factor remuneration (i.e., net operating surplus) that presumably belongs to land rents.

3.2.3 Construction of the tax matrix

There are six tax-related accounts in the 1996 SAM for Panama: a) taxes on sales and consumption (including VAT and special consumption taxes), b) commodity subsidies, c) export subsidies, d) import tariffs, e) net indirect taxes on production activities, and f)

direct income taxes on domestic non-government institutions. For the first four accounts taxes are setup in rows by commodity and these are the taxes needed to construction the tax matrix for the GTAP adaptation. Net indirect taxes on production are used to estimate total output as further explained below (see section 3.7).

Using the data previously described, a tax matrix was created by allocating all tax vectors across intermediate and final demand (excluding the change in stocks and exports), using a coefficients matrix of shares of intermediate and final demand in total demand by commodity. Export subsidies were only allocated to exports. Finally, the row of import tariffs was transformed into a matrix using the coefficients matrix of shares of intermediate and final demand in total demand for commodities. This was later on added to the import component of the Use Matrix including taxes (UP).

3.2.4 Use Matrix with (UP) and without (UF) taxes

Same as the Make Matrix, the Use Matrix was transformed from a commodity-by-industry matrix into a commodity-by-commodity matrix. To perform this change, we applied commodity shares of total output within the same industry j according to the make matrix in order 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, each of the various industries which consumed another given commodity y to yield the intermediate use of that same commodity, 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).

To estimate the Use Matrix including taxes (UP) we first incorporated the values of the column vector for “trade and transportation margins” into the commodity “trade” of the modified commodity-by-commodity Use Matrix. This adjustment captured margins across commodities, and allowed to maintain the balance between sales and costs. To produce the Use Matrix excluding taxes (UF), we subtracted the values of the tax and tariff matrices from the UP matrix. As further indicated in what follows, these two matrices needed to be split up to separate domestic use from import use.

3.2.5 Separating domestic and import uses

GTAP requires the separation between of domestic and import use of both UP and UF matrices. However, for in the 1996 SAM for Panama imports are accounted for only as a row of total imports by commodity. To separate domestic use from import use in the UP and UF matrices, we first estimated a share matrix of intermediate and final demand use by product (excluding exports, allocated entirely into domestic use). In this shares matrix, for each row of the total Use Matrix, we computed the percentage of the row total allocated to each sector. That is, the total use of a commodity by each activity in intermediate and final demand. This procedure implicitly assumes that imports have the same use pattern as domestic commodities. Though not the best approach (particularly when there is a lot of re-exportation), this was deemed to be a good approximation to construct the import matrix considering the data and information available.

The import matrix (including import duties) was estimated using the shares matrix and the vector of imports, by multiplying each commodity total by the appropriate percentage for each sector across intermediate and final demand. That is, an import matrix was created by means of pro-rating the totals across uses by applying the structure implied by the total Use Matrix. Domestic use (tax excluded) was estimated by subtracting the import matrix from the UF matrix. As explained before, all exports were included in the domestic Use Matrix as re-exports are not allowed in the GTAP Data Base.

To estimate tax-inclusive domestic and import use matrices, we first split the matrix of net taxes into domestic and import taxes. For that, we first estimated a share matrix of import use in total use, which was estimated by dividing the values of the import Use Matrix (excluding taxes) by the UF matrix. The use of this share matrix enabled estimation of two tax matrices: one for domestic use and another for import use. These two matrices were subsequently added to the corresponding domestic and import use (tax excluded) to calculate both domestic and import use, tax inclusive.

Finally, the resulting domestic and import tax matrices were finally subtracted from the matrices for domestic and import uses with taxes to obtain those without taxes.

3.2.6 Output (OP) and imports, duty free (MF)

To obtain a vector of output of sector i non-commodity net indirect tax included (vector “OP” in GTAP notation), we added the total sum of domestic and imports intermediate use by commodity (column-wise), total value added by commodity, and other production taxes. Finally, to produce a vector of imports by commodity with import duties excluded (vector “MF” in GTAP notation) we removed import duties from the vector of total imports by commodity (tax excluded).

4. Commodity aggregation and breakdown

Panama’s 33 commodity groups were merged into 26 commodities (Table 3A), while maintaining overall accounting consistency. The main purpose of this new commodity aggregation was to map multiple Panama commodity groups into single GTAP sectors. Finally, the mapping and sectoral split of the 26 aggregated sectors of the derived Panama I-O table into GTAP’s 57 sectors was performed at the GTAP Center, using the cost structure of their “GTAP Representative Table” and the agriculture I-O split procedure (Dimaranan and McDougall, 2002, chapter 13). Table 4A shows the mapping from the 26 aggregated sectors to GTAP 57 sectors.

References

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Appendix

Table 1A. Commodity classification in Panama

No.	Product Name	Product Name (in Spanish)
1	Canal Zone	Canal
2	Colon Free Trade Zone	Zona Libre de Colón
3	Corn	Maíz
4	Paddy Rice	Arroz en cáscara
5	Oil seeds and fruits	Semillas y frutos oleaginosos
6	Pigs	Ganado porcino
7	Poultry	Aves
8	Raw Milk	Leche sin elaborar
9	Other Agriculture for domestic consumption ¹	Otra agricultura para el consumo doméstico
10	Bovine Cattle	Ganado vacuno
11	Bananas	Banano
12	Melon	Melones
13	Watermelon	Sandías
14	Fresh Fish, live or fridge	Pescado fresco, vivo ó refrigerados
15	Shrimp and other crustaceous	Camarón y otros crustáceos
16	Other Agriculture for Exports	Otra agricultura para exportación
17	Common Salt and sodium chloride	Sal común y cloruro de sodio
18	Other Mining	Otra Minería
19	Meat and Meat Products	Carne y productos de carnes
20	Dairy Products	Productos lácteos
21	Milling products and starch	Productos de molinería y almidones
22	Other manufacturing for the domestic market	Otra manufactura para el mercado doméstico
23	Thread and yarn; woven textile fibers, including plush	Hilados e hilos; tejidos de fibras textiles, incluso afelpados
24	Textiles products (except wearing apparel)	Artículos textiles (excepto prendas de vestir)
25	Knitted or crocheted fabrics; Wearing apparel	Tejidos de punto o ganchillo; prendas de vestir
26	Leather and leather products, footwear	Cuero y productos de cuero; calzados
27	Other manufacturing for Exports	Otra manufactura orientada a la exportación
28	Electricity and water	Electricidad y agua
29	Construction	Construcción
30	Trade, Hotel and Restaurants	Comercio, hoteles y restaurantes
31	Transport and communications	Transporte y comunicaciones
32	Financial and Insurance Services	Finanzas y Seguros
33	Public Administration and Social Services	Administración Pública y Servicios sociales

¹ Includes “Vegetables, roots and tubers”, “Beverage crops and spices”, “Raw tobacco”, “Sugar crops”, “Raw vegetable materials”, “Animal Products”, and “Forestry Products”.

² Includes “Fruits (excluding bananas, melon and watermelon) and nuts” and “Live plants, flowers and flower buds.”

³ Includes “Oils and fats and vegetables”, “Beverages”, “Tobacco Products”, “Wood products”, “Wood Pulp, paper and paper products; printing and analogous articles”, “Chemical products”, “Rubber and plastic products”, “Glass and glass products and other non metallic products”, “Furniture” other transportable products nes”, “Waste”, “Common metals”, “Manufactured metallic products, except machinery and equipment”, and “Machinery, equipment and electrical products.”

⁴ Includes “Refined oil products”.

Table 2A. Activity classification in Panama's SAM

No.	Activity	Activity (in Spanish)
1	Canal Zone	Canal
2	Colon Free Trade Zone	Zona Libre de Colón
3	Agriculture for domestic consumption	Agricultura para el consumo doméstico
4	Agriculture for Exports	Agricultura para la exportación
5	Mining	Minería
6	Manufacturing for domestic market	Manufactura para el mercado doméstico
7	Manufacturing for exports	Manufactura orientada a la exportación
8	Electricity and water	Electricidad y agua
9	Construction	Construcción
10	Trade, hotels and restaurants	Comercio, hoteles y restaurantes
11	Transport and communications	Transporte y comunicaciones
12	Financial and Insurance Services	Finanzas y Seguros
13	Public Administration and Social Services	Administración Pública y Servicios sociales

Table 3A. Commodity aggregation of Panama SAM sectors

No.	Aggregated Sectors (27)	Original Sectors (33)	No.
1	Corn	Corn	3
2	Paddy rice	Paddy rice	4
3	Oil seeds and fruits	Oil seeds and fruits	5
4	Fruits and vegetables	Banana Melon Watermelon	11, 12, 13
5	Other Agriculture for domestic consumption	Other Agric. for domestic consumption	9
6	Other Agriculture for Exports	Other Agriculture for Exports	16
7	Bovine Cattle	Bovine Cattle	10
8	Other Cattle	Pigs Poultry	6, 7
9	Raw milk	Raw milk	8
10	Fishing	Fresh Fish, live or fridge Shrimp and other crustaceous	14, 15
11	Mining	Common Salt and sodium chloride Other Mining	17, 18
12	Meat and Meat Products	Meat and Meat Products	19
13	Dairy Products	Dairy Products	20
14	Milling products and starch	Milling products and starch	21
15	Other manuf. for the domestic market	Other manuf. for the domestic market	22
16	Textiles	Thread and yarn; woven textile fibers Textiles products (except wearing apparel)	23, 24
17	Wearing apparel	Knitted or crocheted fabrics; Wearing apparel	25
18	Leather and leather products, footwear	Leather and leather products, footwear	26
19	Other manufacturing for Exports	Other manufacturing for Exports	27
20	Electricity and water	Electricity and water	28
21	Construction	Construction	29
22	Trade, Hotel and Restaurants	Trade, Hotel and Restaurants	30
23	Transport and communications	Transport and communications	31
24	Canal Zone	Canal Zone	1
25	Financial and Insurance Services	Financial and Insurance Services	32
26	Public Administration and Social Services	Public Administration and Social Services	33

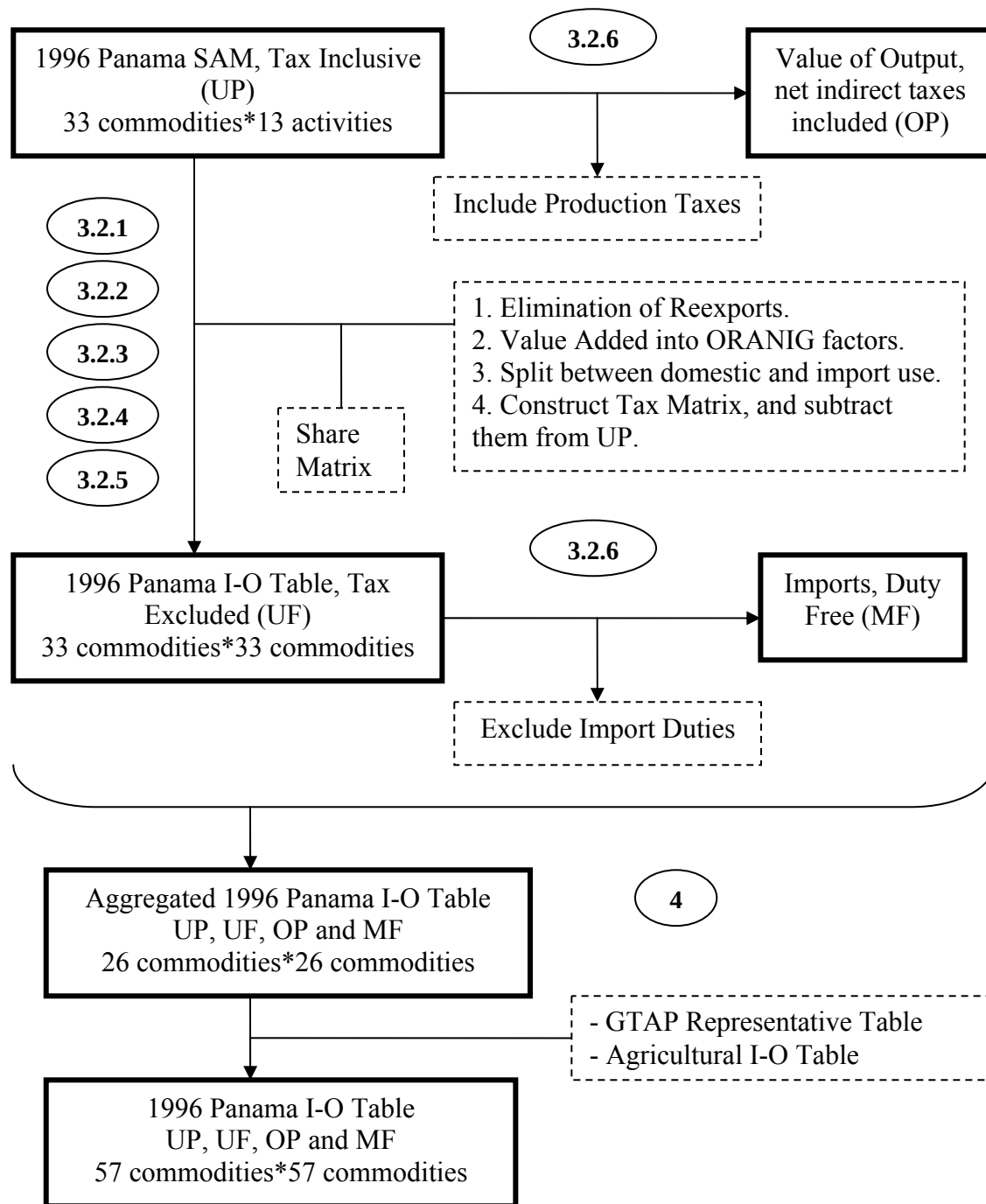
Table 4A. Concordance between GSC2 sectors and Panama's I-O table

GSC2 No.	GSC2 code	GSC2 description	Panama commodity name	Panama commodity No.
1	pdr	Paddy rice	Paddy rice	2
2	wht	Wheat	Other Agric. for domestic consumption	5
3	gro	Cereal grains nec	Corn	1
4	v_f	Vegetables, fruit, nuts	Fruits and vegetables	4
5	osd	Oil seeds	Oil seeds and fruits	3
6	c_b	Sugar cane, sugar beet	Other Agric. for domestic consumption	5
7	pfb	Plant-based fibers	Other Agric. for domestic consumption	5
8	ocr	Crops nec	Other Agriculture for Exports	6
9	ctl	Cattle, sheep, goats, horses	Bovine Cattle	7
10	oap	Animal products nec	Other Cattle	8
11	rmk	Raw milk	Raw milk	9
12	wol	Wool, silk-worm cocoons	Bovine Cattle	10
13	for	Forestry	Other Agric. for domestic consumption	5
14	fsh	Fishing	Fishing	10
15	col	Coal	Mining	11
16	oil	Oil	Mining	11
17	gas	Gas	Mining	11
18	omn	Minerals nec	Mining	11
19	cmt	Meat: cattle, sheep, goats, horse	Meat and Meat Products	12
20	omt	Meat products nec	Meat and Meat Products	12
21	vol	Vegetable oils and fats	Other manuf. for the domestic market	15
22	mil	Dairy products	Dairy products	13
23	pcr	Processed rice	Milling products and starch	14
24	sgr	Sugar	Other manuf. for the domestic market	15
25	ofd	Food products nec	Other manuf. for the domestic market	15
26	b_t	Beverages and tobacco products	Other manuf. for the domestic market	15
27	tex	Textiles	Textiles	16
28	wap	Wearing apparel	Wearing Apparel	17
29	lea	Leather products	Leather and Leather products	18
30	lum	Wood products	Other manuf. for the domestic market	15
31	ppp	Paper products, publishing	Other manuf. for the domestic market	15
32	p_c	Petroleum, coal products	Other manufacturing for Exports	19
33	crp	Chemical, rubber, plastic prods	Other manuf. for the domestic market	15
34	nmn	Mineral products nec	Other manuf. for the domestic market	15
35	i_s	Ferrous metals	Other manuf. for the domestic market	15
36	nfm	Metals nec	Other manuf. for the domestic market	15
37	fmp	Metal products	Other manuf. for the domestic market	15
38	mvh	Motor vehicles and parts	Other manuf. for the domestic market	15
39	otn	Transport equipment nec	Other manuf. for the domestic market	15
40	ele	Electronic equipment	Other manuf. for the domestic market	15
41	ome	Machinery and equipment nec	Other manuf. for the domestic market	15
42	omf	Manufactures nec	Other manuf. for the domestic market	15
43	ely	Electricity	Electricity and water	20
44	gdt	Gas manufacture, distribution	Electricity and water	20
45	wtr	Water	Electricity and water	20

Table 4A. Concordance between GSC2 sectors and Panama's I-O table

GSC2 No.	GSC2 code	GSC2 description	Panama commodity name	Panama commodity No.
46	cns	Construction	Construction	21
47	trd	Trade	Trade, Hotel and Restaurants	22
48	otp	Transport nec	Transport and communications	23
49	wtp	Sea transport	Canal Zone	24
50	atp	Air transport	Transport and communications	23
51	cmn	Communication	Transport and communications	23
52	ofi	Financial services nec	Financial and Insurance Services	25
53	isr	Insurance	Financial and Insurance Services	25
54	obs	Business services nec	Financial and Insurance Services	25
55	ros	Recreation and other services	Public Administration and Social Services	26
56	osg	PubAdmin/Defence/Health/Educ at	Public Administration and Social Services	26
57	dwe	Dwellings	Financial and Insurance Services	25

Figure 1A. Process of creating Panama's I-O table for the GTAP Data Base



Note: Circled numbers represent the number of the section of this technical note where the corresponding procedure is explained in more detail.