

Nota técnica N°2

Social Accounting Matrix and Extended Employ- ment Account for Panama 2022

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DIC 2024

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Cita APA:

Mercatante, J. I. & Ojeda, M. L. (2024). Social Accounting Matrix and Extended Employment Account for Panama 2022. *Serie MESi NT*, 2, 1-30.

Editorial:

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Abstract

This technical note presents the development of a Social Accounting Matrix (SAM) for Panama using 2022 as the base year, complemented by an Extended Account of Employment (EAE). The SAM provides a comprehensive representation of the circular flow of income and expenditures within the Panamanian economy, serving as a foundational tool for the construction of multisectoral simulation models, such as Input-Output (IO) and Computable General Equilibrium (CGE) models. These models enable the evaluation of policy impacts and external shocks, offering valuable insights for decision-making processes.

The construction of the 2022 Panama SAM required the integration of diverse data sources, including:

- The National Accounting System for Panama (2021),
- Household Income and Expenditure Survey (2017/2018),
- The Consolidated Panamanian Government Budget (2021),
- The Balance of Payments (2021),
- Balance sheets from the Panama Canal (2021), and
- Provisional GDP estimates for 2022 from the National Institute of Statistics of Panama (INEC).

Given the challenges of harmonizing information from multiple sources and time periods, the RAS method was employed to ensure data consistency while maintaining alignment with the System of National Accounts (SNA). The resulting SAM includes 28 productive activities, 10 income-differentiated household groups, and accounts for the consolidated government, trade flows, and the rest of the world. Additionally, the EAE provides detailed employment data for each productive sector, linking economic output to labor market dynamics.

1. Introduction

Developing a multisectoral simulation model, such as an Input-Output (IO) or General Equilibrium (CGE) model, requires a substantial amount of detailed information. This information must be systematically structured to ensure consistency across its various components. A Social Accounting Matrix (SAM) fulfills this requirement by representing the circular flow of the economy in a double-entry table. In this framework, the incomes of each sector and agent are recorded in rows, while their expenditures appear in columns.

The first objective of a SAM is to organize in a consistent and comprehensive manner the economic information of a country (or region) during a specific period, normally a stable year for macroeconomic variables. In this regard, the SAM resembles the national accounts and involves data of the System of National Accounts (SNA). In addition, the SAM requires an IO matrix that reflects the inter-industry chains of an economy; i.e., the purchase of an intermediate input by a sector represents the sale of that same input from another sector, generalizing this inter-sector relationship for all transactions within an economy. The income and expenditure budgets of households, the government, and the rest of the world—alongside the sector-level representation of firms within the IO matrix—are additional crucial components required to construct a SAM.

The second objective of the SAM is to provide the statistical basis to create a simulation model that is the tool for the evaluation of different policies or exogenous shocks. Once the information of a specific country within a given year has been organized in the form of a SAM, it represents a static image that reveals the economic structure of the studied country. Considering a SAM as a starting point, an array of different IO and CGE models can be constructed, each with different characteristics.

A SAM is generally composed of 5 types of accounts: goods, factors, agents (households, government) and the rest of the world, and they should all be implicitly or explicitly represented. Disaggregation within each of these accounts is a matter of choice according to the study's conditions and objectives. The structure of the SAM limits the global model and its scope. Therefore, the disaggregation of the matrix is not neutral in terms of future simulations.

As a scheme, Table 1 presents a SAM in a square format: the rows are equal to the columns' accounts. Rows read the different sectors' income, while columns read their expenditures, highlighting the way these sectors relate with each

other. The sum of each row must equal the sum of each column, implying that a sector’s expenditures must equal its income.

Table 1 | Basic Structure of a SAM

		Expenditure							
		Activities	Goods	Factors	Households	Government	Investment	Rest of the world	Total
Income	Activities		Domestic Supply						Activity income
	Goods	Intermediate Demand			Consumers' expenditure	Current expenditure	Demand for Investment	Exports	Total demand
	Factors	Value Added							Factorial income
	Households			Household's factors retribution		Transfers		External Transfers	Household's income
	Government		Import tariffs and other taxes		Direct taxes			External help an loans	Government income
	Savings				Private savings	Fiscal surplus		Current account balance	Total savings
	Rest of the world		Imports						Currency outflows
	Total	Output	Total Supply	Factorial expenditure	Households' expenditure	Public expenditure	Investment expenditure	Currency in-flows	

Source: Own elaboration.

In this technical note, we present the main data sources, assumptions and procedures used to estimate the SAM for Panama using 2022 as a base year. Additionally, said SAM is also complemented with a Extended Account of Employment (EAE) to represent the number of job positions in each productive sector of the country.

To elaborate the 2022 Panama SAM, official data sources and data from the Panama Canal were required. This information has multiple points of origin and often involves multiple periods. In some cases, it is possible to begin with an already existing SAM, which is updated using new information. In other cases, the SAM must be constructed from scratch. In our case, we constructed a completely new SAM.

The main data sources that we have used to construct the 2022 Panama SAM are:

- National Accounting System for Panama (2021)
- Income and expenditure household survey for Panama (2017/2018)
- Consolidated Panamanian Government budget (2021)
- Balance of Payment for Panama (2021)
- Balance sheets for the Panama Canal (2021)

- Provisional estimates of GDP for 2022 elaborated by the National Institute of Statistics of Panama (INEC).

Achieving information consistency can be challenging, particularly when the information comes from different sources and requires efficient harmonization. According to Stone (1978), RAS and Cross-Entropy methods are often used to estimate missing or outdated transactions while minimizing the deviation from the real data and ensuring consistency with the available data, particularly with the data from the SNA (Bacharach, 1970; Stone, 1978). For the construction of the 2022 Panama SAM, the RAS method was employed. This method is presented in Annex A.

In this work, we have successfully estimated a complete SAM and EAE that represents the economy of Panama. Such a matrix is composed of 28 productive activities. In terms of agents, the matrix has 10 households divided by income, the consolidated government, and the rest of the world. The latter is mainly represented through trade variables (exports and imports). The export column represents the expenses of the rest of the world while the import row stores the income of the rest of the world.

This document is divided into four main sections. Section 2 offers a detailed overview of the primary data sources utilized to construct Panama's SAM, along with the most significant findings. Section 3 outlines the procedures and assumptions employed in developing the EAE. Finally, Section 4 presents concluding remarks.

2. Social Accounting Matrix for Panama 2022

2.1. Available Information Sources

In this first subsection, we will detail the primary sources used in the construction of the SAM for Panama in 2022. The creation of a SAM involves the compilation of information from various sources related to the economy, including data on fiscal revenues, sectoral production, foreign trade, public spending, and other key aspects. A detailed description of each of these sources is presented below.

Panama System of National Accounting (SNA) 2021: Among the various sources used for the SAM for Panama, the SNA is the main starting point. INEC provides annual information for the following variables:

- Macroeconomic aggregate values (GDP, private and public consumption, trade balance, aggregate supply and demand).
- Economic activity (production and value added) for each sector.
- Income generation accounts for each production factor.
- Supply and Use Tables (COU) for each sector.

Note that for the year 2022 the national accounts data are still provisional. As of the date of this paper, only an estimate of GDP at market prices for 2022 is available. Thus, the matrix presented for 2022 is an update of the 2021 matrix considering the provisional information presented by the national statistics agencies.

Income and expenditure surveys for Panama: Information from household-level surveys, such as the 2017/2018 “Household Income and Expenditure Survey”, is relevant to identify patterns in household expenditures and income. This information was cross-checked to ensure correspondence with the social structure used in the analysis. Such surveys are particularly useful to exploit detailed microeconomic information to better represent households in Panama.

This specific database was used to estimate the distribution of income and expenditures among 10 deciles of households. It provides information related to the sources of income and expenditures of various households in the country. Although the years surveyed do not coincide with our base years for the SAM, distributional structures are extrapolated. This survey is conducted and published by INEC.

Consolidated State Account: The fiscal analysis is conducted on a consolidated government basis, incorporating national and regional data while excluding intra-regional transactions. Key information was gathered from the Ministry of Economy and Finance (MEF), the General Revenue Directorate (DGI), and INEC. The data distinguishes between economic subsidies and transfers provided by the government to households. Specifically, the MEF supplied public budget details at both regional and national consolidated levels, while the DGI contributed annual statistical data on specific taxes.

Balance of Payments: Data was obtained from INEC's Balance of Payments 2021. This source provides information on transactions

between residents and non-residents, divided between current account, capital account and international reserves. The data were used to analyze the interaction with the rest of the world and to elaborate the rest of the world account.

Panama Canal Information: The Panama SAM for 2022 includes the Panama Canal as a distinct sector. For Canal information, we access the Supply and Use Tables provided by INEC. The Use table provides information on the intermediate and destination of the services produced by the Canal. The Supply table describes the composition of the total supply of goods and services in the economy. The value added was obtained from the Utilization Table. Additionally, to characterize the Canal's activity, we access the Canal's balance sheet for the year under analysis. Regarding employment data, the information related to the total number of jobs was provided by the ACP.

2.2. Step by step elaboration of the Panama's SAM 2022

This subsection presents a methodological and practical analysis of the construction of the SAM for Panama 2022. First, the procedure followed to obtain the macroeconomic aggregates is described. Secondly, the process of elaborating the disaggregated SAM (supply and demand accounts) is detailed. The model presents the following disaggregation: 28 productive sectors, 10 representative households separated by income deciles, the government and the rest of the world.

Macroeconomic Aggregates: Aggregate demand is the value of the quantity of goods and services effectively demanded in a country differentiated into different elements, such as private consumption (C), investment (I), public consumption (G) and exports (X). Aggregate demand is defined as:

$$DA=C+I+G+X$$

Overall supply represents the value of all final goods and services produced by the different sectors of the economy -Gross Domestic Product (GDP)- plus imports (M). Since demand information is generally presented at market prices, net taxes on products (VAT, specific taxes, others) are included in supply to achieve consistency between aggregate supply and demand. Formally:

$$OA=GDP_{pm}+M$$

Finally, aggregate aggregate aggregate demand must be equal to the level of aggregate aggregate aggregate supply. In equilibrium, planned expenditure (target aggregate demand) equals effective output.

$$OA=DA$$

The Supply and Demand Tables are from INEC. The information presented in Table A1.1 shows the values of the macroeconomic aggregates mentioned above. Here it is observed that GDP at market prices for the year 2021 was 91,820 million balboas while for the year 2022 this value was equal to 104,838 million balboas.

The global supply and demand calculated in the MCS should be consistent with the information published by the National Accounts.

Table 2 | Estimated global supply and demand for Panama 2022. In millions of balboas.

Concept	Million Balboas	%
Market Price GDP	76523	73%
Imports	28316	27%
GLOBAL SUPPLY	104838	100%
Household consumption	41072	37%
Public Consumption	9238	10%
Gross Domestic Investment	24292	24%
Exports	30237	30%
GLOBAL DEMAND	104838	100%

Source: Own elaboration. See annex B.

Production: The objective of the production account is to establish the Gross Value Added (GVA), the Gross Value of Production (GVP) and the Intermediate Consumption (IC) generated by each economic sector, determining the GDP of the economy. GVA and GVP for the years of interest were obtained from INEC. The IC is calculated as the difference.

Table 3 | Sectorial Gross Production Value, Gross Value Added and Intermediate Consumption in producer prices for Panama 2022. As percentages of total values.

Sector	GVP	VA	IC	VA Intensity
Agriculture, Forestry and Fishing	2,9%	2,8%	2,8%	0,58
Exploiting of mines and quarries	4,0%	4,2%	3,5%	0,64
Food, beverages, and tobacco	5,4%	3,1%	9,0%	0,35
Textiles and leather	0,2%	0,1%	0,5%	0,18
Wood and paper	0,4%	0,3%	0,7%	0,34

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Chemicals and plastics	0,8%	0,4%	1,3%	0,29
Non-metallic minerals	1,4%	0,9%	2,2%	0,40
Other manufacturing industries	1,4%	0,8%	2,4%	0,32
Electricity and gas supply	1,9%	2,1%	1,7%	0,67
Water treatment and supply	0,3%	0,3%	0,3%	0,60
Construction	15,9%	14,9%	16,0%	0,57
Commerce	17,8%	18,8%	16,9%	0,64
Hotels and restaurants	2,3%	1,6%	3,3%	0,42
Transport by land	2,7%	2,8%	2,3%	0,63
Aquatic transport	0,8%	0,8%	0,8%	0,58
Air transport	1,6%	1,0%	2,5%	0,36
Travel agencies	0,4%	0,4%	0,5%	0,55
Complementary transport activities	1,0%	0,9%	1,3%	0,55
Panama Canal	4,0%	5,9%	0,9%	0,91
Mail and telecommunications	3,1%	2,7%	4,0%	0,53
Financial and insurance activities	6,1%	6,0%	6,7%	0,60
Real estate activities and rentals	7,5%	10,5%	3,1%	0,85
Business services	5,2%	5,5%	5,0%	0,64
Teaching	2,3%	2,8%	1,7%	0,74
Health and social services	4,8%	4,9%	4,7%	0,62
Public administration	4,2%	4,0%	4,6%	0,58
Community services	1,3%	1,4%	1,1%	0,68
Domestic services	0,3%	0,4%	0,1%	0,84
Total	112008	68144	37812	0,61

Source: Own elaboration. See annex B.

Value Added and factor decomposition: This account decomposes GVA according to the remuneration of the factors: labor (L), capital (K), public capital (PK) and Gross Mixed Income (GMI). Formally, total GVA is equal to:

$$GVA=L+K+KPK+GCIM$$

For each year, a factor payment matrix was estimated with data provided by INEC, who published decomposed information for 17 economic activities. However, we must represent 28 sectors in the matrix and to do so the VA decomposition for them maintains that of the 17 activities (data restriction due to the limitation in the sectoral disaggregation of the official data). This implies that many sectors in the matrix will have the same factor distribution depending on the economic activity to which it belongs.

The estimates are presented in Table 4, which also shows the intensity of use of each factor within GVA. The Mining and Quarrying, Construction, and Water

Treatment and Supply sectors are the most capital-intensive activities, with more than 83% of net GVA composed of this factor. The Panama Canal is also a public capital-intensive sector, with a 58% share of public capital in GVA.

The most labor-intensive sector is Domestic Services with a 100% share of net VA. Community Services, Public Administration, Education, and Health and Social Services are other sectors with predominance of labor as the main factor. Finally, Real Estate and Rental Activities is the only sector with IBM as the main factor, accounting for 79% of net VA.

Table 4 | Sectoral labor, capital, public capital and Gross Mixed Income retributions for Panama 2019. In million balboas and percentages.

Sector	%				
	VA net of factor taxes	L	K	PK	GMI
Agriculture, Forestry and Fishing	1886	19%	66%	0%	15%
Exploiting of mines and quarries	2862	6%	92%	1%	0%
Food, beverages, and tobacco	2083	21%	75%	0%	4%
Textiles and leather	42	21%	75%	0%	4%
Wood and paper	171	21%	75%	0%	4%
Chemicals and plastics	266	21%	75%	0%	4%
Non-metallic minerals	628	21%	75%	0%	4%
Other manufacturing industries	518	21%	75%	0%	4%
Electricity and gas supply	1424	16%	78%	5%	0%
Water treatment and supply	198	16%	84%	0%	0%
Construction	10144	13%	83%	0%	4%
Commerce	12793	21%	75%	0%	4%
Hotels and restaurants	1073	22%	74%	0%	3%
Transport by land	1927	27%	64%	0%	8%
Aquatic transport	525	27%	62%	3%	8%
Air transport	668	27%	65%	0%	8%
Travel agencies	249	27%	65%	0%	8%
Complementary transport activities	630	27%	65%	0%	8%
Panama Canal	4033	25%	0%	60%	15%
Mail and telecommunications	1829	27%	64%	1%	8%
Financial and insurance activities	4093	31%	63%	5%	1%
Real estate activities and rentals	7158	4%	16%	0%	79%
Business services	3757	25%	56%	5%	14%
Teaching	1930	87%	12%	0%	1%
Health and social services	3311	78%	13%	0%	10%
Public administration	2709	98%	2%	0%	0%

Community services	963	98%	2%	0%	0%
Domestic services	272	100%	0%	0%	0%
Total	1886	19134	37079	2948	8983

Source: Own elaboration. See annex B.

Imports: Import data were first obtained from INEC. However, given the sectoral disaggregation attempted for Panama's SAM, additional assumptions had to be made. Aggregate import data were separated according to their use. In this paper, four destinations for imports are distinguished: intermediate consumption, private final consumption, exports and investment. The category determined as "exports" corresponds to re-exports. These are imports that are used for a limited time and then returned, or goods imported only as a means of exporting them for use elsewhere. This is particularly important for subtracting import content from total demand to obtain domestic demand.

The distribution of imports by destination of use was constructed using information from INEC's Balance of Payments, as well as the COU 2021. Given the limitation presented by the absence of an official Imports matrix, we had to estimate one. To do so, we used the COU 2021 utilization table. This table contains the total transactions between sectors and the total final demand (domestic + imports). To generate the Imports Table, we updated the Utilization table with a ratio of domestic versus imported supply. This coefficient records, for each sector, how much of its total supply was domestic or foreign (imported). We then used the resulting matrix to distribute the total imports among the destinations we previously defined.

Table 5 | Sector participation on imports by use for Panama 2019. Percentage of total imports.

Sector	Imports
Agriculture, Forestry and Fishing	1,10%
Exploiting of mines and quarries	1,00%
Food, beverages and tobacco	2,00%
Textiles and leather	0,10%
Wood and paper	0,20%
Chemicals and plastics	0,50%
Non-metallic minerals	0,40%
Other manufacturing industries	0,60%
Electricity and gas supply	0,20%
Water treatment and supply	0,10%
Construction	5,90%

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Commerce	2,40%
Hotels and restaurants	0,70%
Transport by land	0,90%
Aquatic transport	0,20%
Air transport	0,90%
Travel agencies	0,10%
Complementary transport activities	0,10%
Panama Canal	0,10%
Mail and telecommunications	0,50%
Financial and insurance activities	0,70%
Real estate activities and rentals	0,20%
Business services	0,70%
Teaching	0,20%
Health and social services	1,00%
Public administration	0,70%
Community services	0,10%
Domestic services	0,00%
Investment	13,40%
Household consumption	25,80%
Exports	39,30%
Total	24413

Source: Own elaboration. See annex B.

Demand: In general terms, the demand for domestic products is obtained by subtracting imports and import taxes from total demands. The following table presents the share of each sector in the different types of domestic demand.

Table 6 | National demand distribution within sectors for Panama 2022. As percentages of the totals and million balboas.

Sector	Intermediate	Households	Government	Investment	Exports	Total
Agriculture, Forestry and Fishing	8%	3%	0%	0%	1%	3%
Exploiting of mines and quarries	4%	0%	0%	0%	19%	5%
Food, beverages, and tobacco	4%	15%	1%	2%	2%	6%
Textiles and leather	0%	0%	0%	0%	0%	0%
Wood and paper	1%	0%	0%	0%	0%	1%
Chemicals and plastics	2%	1%	0%	0%	1%	1%
Non-metallic minerals	6%	0%	0%	0%	0%	2%
Other manufacturing industries	2%	1%	0%	3%	1%	2%
Electricity and gas supply	5%	3%	0%	0%	0%	2%
Water treatment and supply	1%	0%	0%	0%	0%	0%
Construction	4%	0%	0%	93%	0%	18%
Commerce	18%	28%	3%	13%	27%	20%

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Hotels and restaurants	2%	6%	0%	0%	1%	3%
Transport by land	2%	2%	0%	0%	11%	3%
Aquatic transport	1%	1%	0%	0%	3%	1%
Air transport	1%	1%	0%	0%	7%	2%
Travel agencies	0%	0%	0%	0%	2%	0%
Complementary transport activities	1%	1%	0%	0%	4%	1%
Panama Canal	3%	3%	0%	1%	16%	4%
Mail and telecommunications	5%	5%	0%	1%	3%	4%
Financial and insurance activities	15%	5%	0%	0%	7%	7%
Real estate activities and rentals	6%	25%	0%	0%	0%	8%
Business services	19%	1%	0%	0%	3%	6%
Teaching	0%	4%	15%	0%	0%	3%
Health and social services	2%	10%	22%	0%	0%	5%
Public administration	1%	1%	46%	0%	0%	5%
Community services	0%	0%	15%	0%	0%	1%
Domestic services	0%	1%	0%	0%	0%	0%
Total	29.852	33.083	9.238	20.472	19.363	112.009

Source: Own elaboration based on INEC and 2022 SUTs. See annex B.

Households: Households spend on domestic and imported goods and also save. Their income corresponds to returns to factors of production minus net taxes. The result is the net financial position, a financial account used to ensure the consistency of the SAM.

Table 7 | Structure of Household's national consumption in Panama 2019. As percentages of total household consumption.

Sector	Households
Agriculture, Forestry and Fishing	2,5%
Exploiting of mines and quarries	0,2%
Food, beverages, and tobacco	12,6%
Textiles and leather	0,4%
Wood and paper	0,3%
Chemicals and plastics	0,7%
Non-metallic minerals	0,1%
Other manufacturing industries	1,2%
Electricity and gas supply	2,4%
Water treatment and supply	0,4%
Construction	0,0%
Commerce	23,6%
Hotels and restaurants	5,3%
Transport by land	1,6%
Aquatic transport	0,5%

Air transport	1,0%
Travel agencies	0,3%
Complementary transport activities	0,7%
Panama Canal	2,4%
Mail and telecommunications	4,2%
Financial and insurance activities	4,6%
Real estate activities and rentals	20,5%
Business services	1,0%
Teaching	3,7%
Health and social services	8,5%
Public administration	0,5%
Community services	0,1%
Domestic services	1,0%
Total (million balboas)	33.083

Source: Own elaboration. **See annex B.**

Household income from factor remuneration sources (labor, capital and mixed income) is obtained as the difference between total income and net transfers received from the rest of the world and/or the government. Table 8 presents household income and expenditures in the SAM.

Table 8 | Total Households' income and expenditure by concept. In million balboas and percentages.

Concept	Households
Total Income	59.312
Labor	32,4%
Mixed Income	15,1%
Capital	48,1%
Transfers	4,4%
Total Expenditures	59.113
Consumption	69,0%
Investment	29,9%
Direct Taxes	1,1%
Result	199

Source: Own elaboration based on INEC and 2021 SUTs. See annex B.

From the demand side, household consumption is divided according to income deciles. The information required to perform this opening was obtained from the Panama Household Income and Expenditure Survey for 2017/2018. Table 9 presents the income and expenditure structure by income decile.

Table 9 | Total household income and expenditures by per capita income decile. In millions of balboas and percentages.

	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	Total
Incomes	1%	2%	4%	5%	6%	7%	9%	12%	16%	38%	59312
Labor	0%	2%	3%	4%	6%	7%	9%	15%	19%	35%	19201
GMI	0%	1%	1%	1%	2%	3%	5%	7%	14%	66%	8983
Capital	2%	3%	4%	6%	7%	9%	10%	11%	16%	33%	28531
Transfers	4%	5%	5%	7%	7%	9%	9%	15%	15%	24%	2597
Expenses	1%	2%	4%	5%	6%	7%	9%	12%	16%	38%	59113
Consumption	2%	3%	4%	6%	7%	9%	10%	13%	18%	28%	40813
Investment	1%	1%	2%	2%	2%	3%	7%	9%	11%	62%	17674
Taxes	1%	2%	3%	5%	7%	8%	9%	12%	19%	33%	627
Result	-16	-20	-20	-2	16	28	9	39	134	30	199

Source: Own elaboration. See annex B.

Table 10 presents the composition of household income variables by per capita income decile. Said Table particularly interesting to evaluate the distribution of income at the level of the different productive factors and transfers. Likewise, this table is useful to see how the main items of residential expenditure are distributed among the deciles.

Table 10 | Total Households' national consumption by decile of per capita income. In million balboas and percentages.

Sector	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	Total
Agriculture, Forestry and Fishing	5%	5%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Exploiting of mines and quarries	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Food, beverages, and tobacco	27%	26%	19%	17%	19%	15%	15%	15%	9%	6%	13%
Textiles and leather	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%
Wood and paper	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Chemicals and plastics	1%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Non-metallic minerals	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Other manufacturing industries	0%	0%	2%	0%	0%	0%	2%	2%	1%	2%	1%
Electricity and gas supply	5%	4%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Water treatment and supply	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Construction	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Commerce	17%	14%	20%	22%	19%	22%	21%	19%	31%	26%	24%
Hotels and restaurants	5%	6%	4%	5%	6%	5%	5%	6%	4%	6%	5%
Transport by land	2%	3%	2%	2%	3%	2%	2%	2%	1%	1%	2%
Aquatic transport	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%
Air transport	1%	2%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Travel agencies	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

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Complementary transport activities	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	1%
Panama Canal	3%	4%	4%	3%	4%	3%	3%	3%	2%	1%	2%
Mail and telecommunications	2%	5%	4%	5%	5%	5%	6%	6%	3%	3%	4%
Financial and insurance activities	3%	5%	5%	3%	5%	4%	5%	5%	4%	5%	5%
Real estate activities and rentals	15%	12%	18%	19%	16%	19%	18%	16%	27%	23%	21%
Business services	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Teaching	1%	2%	2%	2%	3%	3%	3%	5%	4%	5%	4%
Health and social services	7%	8%	7%	7%	8%	8%	7%	9%	6%	11%	8%
Public administration	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
Community services	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Domestic services	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Total	504	1006	1394	1923	2463	2959	3320	4197	6047	9272	33083

Source: Own elaboration based on INEC and 2022 SUTs. See annex B.

Reasonably, the pattern of household consumption by income decile is in line with expectations. Essential goods such as food and beverages or electricity and gas supply occupy a significant share of the basket of the poorest deciles and this share is decreasing as we move up the deciles. However, the richest deciles allocate more resources to services such as business activities, financial activities and trade.

Investment: Table 11 below presents the composition of the economy's investment 2022. This basket groups the information referred to gross fixed capital formation and stock changes following the standard national accounts literature.

Table 11 | Sectorial private investment. As a percentage of total private investment.

Sector	Private investment
Agriculture, Forestry and Fishing	0%
Exploiting of mines and quarries	0%
Food, beverages and tobacco	1%
Textiles and leather	0%
Wood and paper	0%
Chemicals and plastics	0%
Non-metallic minerals	0%
Other manufacturing industries	2%
Electricity and gas supply	0%
Water treatment and supply	0%
Construction	65%
Commerce	9%
Hotels and restaurants	0%
Transport by land	0%

Aquatic transport	0%
Air transport	0%
Travel agencies	0%
Complementary transport activities	0%
Panama Canal	1%
Mail and telecommunications	1%
Financial and insurance activities	0%
Real estate activities and rentals	0%
Business services	0%
Teaching	0%
Health and social services	0%
Public administration	0%
Community services	0%
Domestic services	0%
Total (million balboas)	17674

Source: Own elaboration based on INEC and 2022 SUTs. See annex B.

As can be seen in the table above, the main investment item is Construction. This is an empirical regularity that is verified for most countries. Trade services also accumulate a significant share of investment.

Government: The resources of the national government come from the collection of taxes, social security contributions and other non-tax revenues. Its expenditures correspond to the acquisition of goods and services for consumption and investment, as well as transfers granted to households. The result is the net financial position, an account used to ensure consistency between revenues and expenditures in the SAM. The general government construction is based on the consolidated government budget.

The SAM considers consolidated general government (central, regional and local). Table 12 shows the details of government revenues and expenditures. Consumption of goods and services was obtained from the 2021 COU. For Public Investment, the information comes from government budgets.

Table 12 | Consolidated public sector for Panama 2019. In million balboas and as a percentage of total GDP.

Concept	Mill. Balboas	% GDP
Income	12,491.1	18.6%
Tax Revenue	5,338.8	8.0%
Social Security	3,574.8	5.3%
Others	3,577.5	5.3%
Expenditure	14,594.4	21.8%

Public Consumption	7,975.1	11.9%
Public Investment	2,742.0	4.1%
Subsidies	272.8	0.4%
Transfers	793.4	1.2%
Other expenses	-843.7	-1.3%
Results	-2,103.3	-3.1%

Source: Own elaboration based on INEC, GID and MEF. See annex B.

Concerning household transfers, these refer both to social aid as well as retirement pensions, tax collection is carried out by the central government, and retirement funds are collected by the Social Security Fund. “Others” category is defined as non-tax income, including benefits from state-owned or licensed companies such as the Panama Canal.

The tax distribution among productive sectors belongs to the cost structure of the economy. For this work, a matrix of taxes was estimated. This matrix assigns a value for each sector that accounts for the sectorial tax payment. In the following paragraphs, we describe those taxes included in the matrix and the corresponding information sources:

- Import taxes: two types of import taxes are included, VAT and tariffs (payment of selective consumption taxes are included on tariffs)
- Sector distribution of the VAT for imported goods is obtained by applying the VAT rate over imports (households’ consumption) in the 2021 SUTs.
- Tariff rates are obtained by dividing the total tariff collection for each sector by the total import of the sector, both obtained from the 2021 SUTs.
- Net VAT is obtained as the difference between total VAT and the estimated VAT on imports for final consumption. Said amount was applied to final household consumption. Sector distribution of the tax comes from the rates applied over final household consumption obtained from the 2021 SUTs.
- Panama has no specific tax placed on exports.
- Other tax income includes other direct taxes, such as the “education insurance”, taxes to capital gains and real estate transfers, among others. Information from these taxes comes from the GID and is distributed according to production value.

Additionally, the SAM also specifies income taxes and social contributions. While income tax information is also provided by the GID, social contributions information comes from the MEF based on SSF information.

Table 13 shows detailed information on tax collection for 2022. Factor taxes are the most important sources of income for the government, followed by the national VAT. These taxes collected 7.584 million balboas in 2022.

Table 13 | Detailed Tax Collection for Panama 2022. In million balboas and as a percentage of total GDP.

Tax	Mill. Balboas	% GDP
Tariffs	384	0,5%
National VAT	1549	2,0%
Production	857	1,1%
Factors	6035	7,9%
Direct	368	0,5%
Total	9193	12,0%

Source: Own elaboration based on INEC, GID and MEF. See annex B.

Table 14 shows how subsidies are distributed at the activity level.

Table 14 | Detailed Subsidy structure for Panama 2022. In million balboas and as a percentage of total GDP.

Sector	Mill. Balboas	% GDP
Industries	102	0,1%
Electricity, gas, and water supply	127	0,2%
Panama Canal	77	0,1%
Rest	140	0,2%
Total	447	0,6%

Source: Own elaboration based on INEC, GID and MEF. See annex B.

Rest of the world: The import and export data can be seen in Table 15. While imports have already been presented, export data are obtained from INEC and the balance of payments. Inward and outward transfers due to remuneration (capital benefits and remittances) are also obtained from this source.

Table 15 | Foreign accounts for Panama 2022. In million balboas and as a percentage of total GDP.

Type	Mill. Balboas	% GDP
Credit	30237	39,5%
Exports	30237	39,5%
Goods	4342	5,7%

Services	25895	33,8%
Debit	33238	43,4%
Imports	28316	37,0%
Goods	23717	31,0%
Services	4599	6,0%
Net Remunerations	-67	-0,1%
Net returns from investment	4990	6,5%
Results	-3001	-3,9%

Source: Own elaboration based on INEC. See annex B.

Compatibilization: Table 16 presents the composition in terms of activities of the 28 sectors represented in this SAM. For this work, we considered the 70 sectors that are being considered in the national accounts of Panama.

Table 16 | Compatibilization between activities in the Supply and Use Tables and SAM.

Nation Accounts Activity	SAM Sector
Cultivation of cereals	Agriculture, Forestry and Fishing
Cultivation of legumes, roots, and tubers	Agriculture, Forestry and Fishing
Banana Cultivation	Agriculture, Forestry and Fishing
Growing other fruits and nuts	Agriculture, Forestry and Fishing
Other crops, n.e.c.	Agriculture, Forestry and Fishing
Animal husbandry and ordinary hunting	Agriculture, Forestry and Fishing
Agricultural service activities	Agriculture, Forestry and Fishing
Forestry, timber harvesting and related service activities	Agriculture, Forestry and Fishing
Sea and freshwater fisheries	Agriculture, Forestry and Fishing
Marine and freshwater aquaculture and fisheries-related service activities	Agriculture, Forestry and Fishing
Mining and quarrying	Exploiting of mines and quarries
Production, processing and preservation of meat and fish	Food, beverages and tobacco
Processing and preservation of fruits, legumes, and vegetables; Manufacture of oils and fat of vegetable or animal origin	Food, beverages and tobacco
Milk products	Food, beverages and tobacco
Other food products	Food, beverages and tobacco
Beverage and tobacco	Food, beverages and tobacco
Textiles and clothing products	Textiles and leather
Tanning and marinating of leather, leather products; footwear	Textiles and leather

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Food and food products	Wood and paper
Paper and paper products	Wood and paper
Substances and chemicals	Chemicals and plastics
Manufacture of pharmaceuticals, medicinal chemicals, and botanicals	Chemicals and plastics
Manufacture of rubber and plastic products.	Chemicals and plastics
Manufacture of cement, lime, and gypsum	Non-metallic minerals
Manufacture of other non-metallic mineral products n.e.c.	Non-metallic minerals
Manufacture of base metals.	Other manufacturing industries
Other manufacturing industries	Other manufacturing industries
Electricity, gas, steam, and air conditioning supply	Electricity and gas supply
Water collection, distribution, and purification	Water treatment and supply
Construction	Construction
Wholesale trade in free zone	Commerce
Wholesale and commission trade	Commerce
Retail trade	Commerce
Repair and maintenance service activities for motor vehicles and motorcycles	Commerce
Hotels	Hotels and restaurants
Restaurants	Hotels and restaurants
Ground transportation; Pipeline transport	Transport by land
Water transport	Aquatic transport
Air transport	Air transport
Secondary air transport activities: airports	Air transport
Activities of travel agencies, tour operators and related booking services	Travel agencies
Complementary and transport-aiding storage and storage	Complementary transport activities
Other complementary and ancillary activities to transport	Complementary transport activities
Panama Canal	Panama Canal
Other secondary water transport activities	Aquatic transport

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Postal, courier and telecommunications activities	Mail and telecommunications
Financial activities, except insurance and pension funds	Financial and insurance activities
Insurance, Reinsurance and Pension Funds, except compulsory social security schemes	Financial and insurance activities
Activities ancillary to financial services, insurance, and pension funds	Financial and insurance activities
Rental housing	Real estate activities and rentals
Other real estate activities	Real estate activities and rentals
Rental of machinery and equipment without operators, household effects and appliances and licensing	Real estate activities and rentals
Informatics and related activities	Business services
Legal and Accounting Activities	Business services
Research and development, business advice and market research activities	Business services
Advertising	Business services
Other business activities	Business services
Teaching	Teaching
Health and Social Services Activities	Health and social services
Other social and personal service activities	Health and social services
Construction	Construction
Rental housing	Real estate activities and rentals
Private households with domestic service	Domestic services
Research and development, business advice and market research activities	Business services
State administration and implementation of the Community's economic and social policy	Public administration
Provision of services to the community at large	Community services
Activities of Social Security Plans of Compulsory Affiliation	Community services
Teaching	Teaching
Health and Social Services Activities	Health and social services
Other social and personal service activities	Health and social services

Source: Own elaboration. See annex B.

3. Extended Account of Employment for Panama 2022

To capture the impact of the Canal on employment, it is necessary to complement the SAM with an Extended Account of Employment. This additional matrix must be consistent with the MCS in terms of sectoral disaggregation and base year. To construct these vectors, we have used various databases, summarized in the following figure.

Table 16 | Databases used for the construction of the Panama Employment Satellite Account 2022.

Database	Source	Year
Labor Market Survey		2022
National Economic Census	INEC	2011
Panama Canal	ACP	2022

Source: own elaboration.

As can be seen, the 2022 Multiple Use Survey (21 main activities) and the 2011 National Economic Census (employment information at 4 digits of activity to reach the breakdown of 28 sectors of the SAM to open the sectors of Manufacturing Industry, Transportation and Warehousing, and Administrative and Support Services Activities) were considered. Additionally, the Panama Canal Authority provided valuable information on employment in the Canal, pertaining mainly to the public sector, composed of male employees over 24 years of age and with university or vocational training.

In addition to the number of jobs by sector, the EAE also contains qualitative information on professional categories, gender, age, and educational level. Figure A3 indicates the employment categories of the Panama 2022 EAE.

Table 17 | Employment categories included in the CSE 2022 for Panama.

Occupational Category	Gender	Age	Educational Background
Public Sector Worker	Male	Less than 24 years	No education
Private Sector Worker	Female	More than 24 years	Only Primary education ¹ (complete or incomplete)
Independent Worker			Only Secondary ¹ (complete or incomplete)
Manager			Tertiary education ²
Family Worker			University education
			Vocational

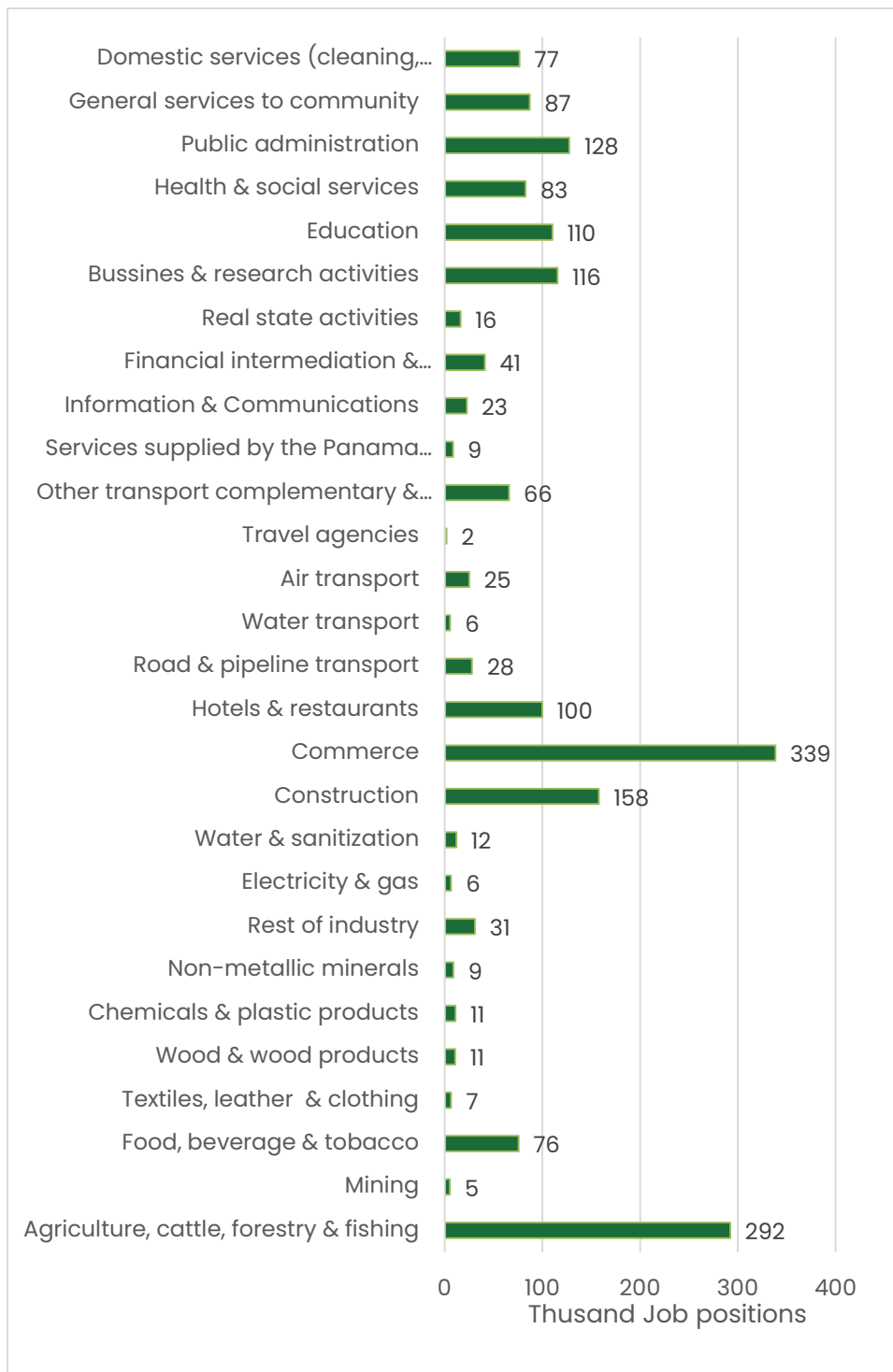
Note: The available database did not provide sufficient information to distinguish between complete and incomplete primary and secondary education. ² This type of education refers to persons who received technical skills such as carpentry, plumbing, culinary arts, etc.

Source: Own elaboration.

Some methodological issues should be noted. First, the methodology employed combines data from different years. Specifically, we combine the 2011 National Economic Census (NEC) with the 2022 Multiple Use Survey to disaggregate employment in the Manufacturing Industries, as well as in Transportation and Warehousing. One of the main disadvantages of this approach is to rely on outdated information. Since the 2011 EAE does not provide data disaggregated by occupational category, age and educational level, the aggregated sector structures were applied to construct the final version of the EAE for each year.

Based on the estimates made, it was possible to evaluate the weight of each sector in relation to the total economy. Figure 1 shows how jobs are distributed among the 28 productive sectors considered in this study. More specifically, as shown in Figure 1, the Commerce sector leads with 18% of employment, followed by Agriculture, Forestry and Fishing with 16%. In contrast, sectors such as Travel Agencies (0.1%), Mining (0.3%), Water Transportation (0.3%), and Electricity and Gas Supply (0.3%) have a smaller share of total employment.

Figure 1 | Sectoral participation in overall employment. Year 2022.



Source: Own elaboration

4. Final Remarks

The 2022 Panama SAM, complemented by an EAE, offers a comprehensive representation of the country's economic structure, highlighting its inter-sectoral relationships and employment dynamics. Constructed using official and sector-specific data, this SAM not only provides a static snapshot of Panama's economy but also serves as a robust foundation for developing multisectoral simulation models such as IO or CGE models. These models enable the evaluation of policy impacts and external shocks, making them invaluable tools for policymakers and researchers alike.

The construction of this SAM required meticulous harmonization of diverse data sources to ensure consistency and reliability. By applying the RAS method, we addressed data gaps and ensured alignment with the System of National Accounts. The resulting matrix, with its detailed disaggregation of 28 productive activities, income-differentiated households, and key economic agents, underscores the critical role of SAMs in bridging data systems and simulation modeling.

This technical note outlines the methodology, assumptions, and data sources used to construct the 2022 Panama SAM and EAE. It provides a foundation for future analyses of Panama's economy and demonstrates the importance of integrating high-quality data into economic modeling efforts.

References

Bacharach, M., (1970). *Biproportional Matrices & Input-Output Change*. Cambridge: Cambridge University Press.

Stone, R. (1978). "Forward" to G. Pyatt, A. Roe, et al, *Social accounting for Development Planning*. Cambridge: Cambridge University Press.

Annex A: RAS methodology

In some cases, the absence of information or its incompleteness may require some procedures to face this challenge. RAS is a method that allows estimating a complete and update matrix when having an initial (outdated) matrix and only the (new) sums of the columns and rows. This method also allows including restrictions when there are some

known elements for the new matrix. As we can see, this is a powerful method to conciliate or update data. According to Mastronardi et al. (2018), this method is widely used for the estimation of IO matrices and SAMs.

More technically, the RAS methodology is an algorithm which starts with an initial matrix (A), which is composed by elements a_{ij} , and vectors that contain the total sums (y^*) required for rows and columns. By using an iterative process, the RAS method looks for a new matrix A^* , whose elements are a_{ij}^* , that respects those totals (Stone, 1978). Mathematically, the iterative process searches for vectors r_i and s_j to meet the following condition:

$$a_{ij}^* = r_i a_{ij} s_j$$

The problem with the estimation of a $N \times N$ SAM consists in identifying N^2 non-negative parameters only counting with $2 \times N - 1$ independent restrictions of rows and columns. The RAS procedure imposes bi-proportional conditions in order to reduce the problem by finding $2 \times N - 1$ coefficients for r_i and s_j , arriving at a single solution. The procedure is an iterative algorithm that alternately complies (on each iteration) with rows or columns totals, changing the a_{ij} coefficients.

The minimum information required by this method is the total of rows and columns of the new matrix. This requirement is restrictive. If only partial information is available in both the vectors y^* or the Matrix A , the RAS method will not be able to estimate the new matrix, since the minimum requirement is to know all the borders of the coefficient matrix.

Annex B: Main Data Sources

1. Macroeconomic indicators (INEI): Panamá recently changed its base year so national accounts were updated.
 - o GDP and Gross Value of Production (GVP) (frequency: yearly and quarter. Aggregate and sectoral. Current and constant prices). (i)
https://www.inec.gob.pa/publicaciones/Default3.aspx?ID_PU

BLICACION=1270&ID_CATEGORIA=4&ID_SUBCATEGORIA=77

and (ii)

https://www.inec.gob.pa/publicaciones/Default2.aspx?ID_CATEGORIA=4&ID_SUBCATEGORIA=26

- Global demand and supply (frequency: yearly). https://www.inec.gob.pa/publicaciones/Default3.aspx?ID_PUBLICACION=1270&ID_CATEGORIA=4&ID_SUBCATEGORIA=77
- General Government Account (Yearly data: 2018–2022): https://www.inec.gob.pa/publicaciones/Default3.aspx?ID_PUBLICACION=1270&ID_CATEGORIA=4&ID_SUBCATEGORIA=77 (Check: Complementary Tables)
- Balance of Payments (BOP): it presents the complete balance of payment both yearly and quarterly. Time frame: until 2024 (Q2). https://www.inec.gob.pa/publicaciones/Default2.aspx?ID_CATEGORIA=4&ID_SUBCATEGORIA=24
- Income Generation Account (IGA): Yearly. Time frame: 2018–202. https://www.inec.gob.pa/publicaciones/Default3.aspx?ID_PUBLICACION=1270&ID_CATEGORIA=4&ID_SUBCATEGORIA=77
- GDP components per sector: Yearly. Time frame (2018–2022). https://www.inec.gob.pa/publicaciones/Default3.aspx?ID_PUBLICACION=1270&ID_CATEGORIA=4&ID_SUBCATEGORIA=77
- GDP per province: Frequency: yearly. 2018–2022. https://www.inec.gob.pa/publicaciones/Default2.aspx?ID_CATEGORIA=4&ID_SUBCATEGORIA=76

2. Household Surveys (INEC):

- Household Expenditure Survey 2017–18 (INEC, ENGHO): Available only for the year 2018. https://www.inec.gob.pa/aplicaciones/Default2.aspx?ID_CATEGORIA_APLICACIONES=1&ID_IDIOMA=1

- Household Income Survey 2024 (INEC): Frequency: mainly yearly. https://www.inec.gob.pa/publicaciones/Default2.aspx?ID_CATEGORIA=5&ID_SUBCATEGORIA=38
3. Input-Output (INEC) and SAM information (MESi):
- Supply and Use Tables (frequency: Yearly): 2018-2022. https://www.inec.gob.pa/publicaciones/Default3.aspx?ID_PUBLICACION=1270&ID_CATEGORIA=4&ID_SUBCATEGORIA=77
 - Social Accounting Matrix for Panama, 2021 (MESi-IIEP)
 - Social Accounting Matrix for Panama, 2019 (MESi-IIEP)
 - Employment Satellite Account (by gender, formality and age) 2021-22 (MESi-IIEP)
4. Government accounts
- National government budget execution (National Ministry of Economics and Finance):
 - National report of budget execution (Frequency: Yearly). 2014-2021. <https://www.mef.gob.pa/ejecucion-presupuestaria/>
 - Fiscal budget (frequency: quarterly). <https://www.mef.gob.pa/balance-agosto-2024/>
 - National taxes information (MEF - DGI):
 - National tax report (Frequency: yearly – For the last year monthly). 2009-2021. <https://www.mef.gob.pa/recaudacion-de-ingresos-dgi/>
 - Yearbook of National Tax Collection (Frequency: Yearly). 2015-2022. <https://dgi.mef.gob.pa/Transparencia/Boletin>