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Impact Assessment of Infrastructure Projects. An approach based on a Social Accounting Matrix (SAM), developed within the framework of the 2025 version of the System of National Accounts (SNA)

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Impact Assessment of Infrastructure Projects.

An approach based on a Social Accounting Matrix (SAM), developed within the framework of the 2025 version of the System of National Accounts (SNA).

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Abstract

We analyse the effects of changes in infrastructures investment on a country's economic activity, through an approach based on a Social Accounting Matrix (SAM). This is an approach developed within the framework of the 2025 version of the System of National Accounts (SNA), illustrated by its numerical example, with characteristics and specificities that can be adopted and adapted to concrete realities.

Covering all the transactions measured by the national accounts, the SAM is a square matrix, in which the sum of the rows is equal to the sum of the corresponding columns. The entries made in rows represent revenues or changes in liabilities and net worth. The entries made in columns represent expenditures or changes in assets.

Through numerical and algebraic versions, the SAM assumes the role of a tool for measuring and modelling a country's economic activity. The numerical version describes empirically the country's economic activity, with a specific numerical value in each cell. The algebraic version describes theoretically that same activity, being each cell filled with algebraic expressions that, together with those of all the other cells, form a SAM-based model, the calibration of which involves a replication of the numerical version.

With rows and columns representing accounts, besides the rest of the world, here completely aggregated, the (domestic) economy is disaggregated in production and institutions. Within production accounts, factors of production, activities (industries) and products (goods and services) are identified. Within institutions accounts, current, capital, and financial accounts are identified, each of which identifying the main institutional sectors - non-financial and financial corporations, general government, households, and non-profit institutions serving households.

The assessment of the impact of infrastructure projects is made through the quantification of multiplier effects of changes in the capital formation of non-financial corporations in constructions and construction services, on the one hand, and in the output of constructions and construction services by the construction activity (industry), on the other.

Key words:

Social accounting matrix; National accounts; Macroeconomic modelling

JEL Codes

E01; E16; E17

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ACRONYMS AND ABBREVIATIONS

CPC … Central Product Classification

DI … Disposable Income, gross

GDP … Gross Domestic Product

GNI … Gross National Income

ISIC ... International Standard Industrial Classification of All Economic Activities

ISWGNA … Intersecretariat Working Group on National Accounts

NPISHs … Non-Profit Institutions Serving Households

S … Saving, gross

SAM … Social Accounting Matrix

SNA … System of National Accounts

2025 SNA … 2025 version of the System of National Accounts

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[2] The numbering of tables and figures is preceded by the number of the section or subsection in which they are inserted, starting with each one.

1. Introduction

This working paper is part of a research project in progress, entitled: "Empirical Economics - economics based on statistical evidence, with emphasis on the national accounts". This project is, in turn, being developed within the scope of another one entitled: "Measuring and Modelling the Activity of a Society".

The SAM is a tool with specific features that allows the study of the economic activity of a country. Within the framework of the 2025 version of the SNA (ISWGNA, 2025) – for short, 2025 SNA, and covering all the transactions measured by the national accounts, in Section 2, numerical and algebraic versions of a SAM are constructed allowing, respectively, empirical and theoretical approaches to the economic activity of the country of our interest and to which these accounts relate.

Among the references in which the approach here presented had its origin, the following can be highlighted: Stone (1986); Pyatt and Round (1985); Pyatt (1988, 1991); Drud et al. (1986). It is an approach that has been progressively applied and experimented by the author, through the adoption and adaptation of national accounts – data and systems.

Illustrated by the numerical example of the 2025 SNA (Annex 3[3]), in Subsection 2.1, a numerical version of a SAM is presented following a top-down method of construction. An aggregated structure is firstly presented as a summary of the national accounts, from which the consistency of the entire system is ensured, and a set of controlling totals is identified for other levels of disaggregation, being worked one. To simplify, that numerical example is presented without any reference to the source of information, assuming but not mentioning that it refers to a fictious country in a fictious year and sometimes mentioning that it is expressed in currency units. Associated SNA codes, almost always, in parenthesis, accompany the description. In Subsection 2.2, the accounting multipliers model is presented as a possible algebraic version to be used in our SAM-based approach.

In Section 3, by applying that model to the disaggregated version presented in Section 2, two scenarios involving changes associated to possible infrastructure projects are constructed and some of the corresponding results are compared and assessed.

All the work is illustrated in gross terms, that is, before deducting the values attributed to depreciation and depletion.

A summary and some concluding remarks, in Section 4, emphasize aspects considered important in the exercise carried out.

[3] All the data here presented was compiled or worked from: 2025SNASeqAccts.xlsx. In the construction of the disaggregated SAM, the from-whom-to-whom transactions were estimated by using the methodology described in Santos (2023 and 2024).

2. A SAM-based approach to measure and model the economic activity of a country

The SAM we are working with, independently of its level of disaggregation, is a square matrix, in which each column-row pair represents an account with the outflows represented in column and the inflows in row. In turn, reflecting the existence of equilibrium in the accounts, the sum of each column is equal to the sum of the corresponding row. In terms of the 2025 SNA terminology for transactions, we say that the entries made in columns represent expenditures (or outflows, outgoings, uses, outlays) and changes in assets and that the entries made in rows represent revenues (or inflows, incomings, resources, receipts, incomes) and changes in liabilities and net worth. Two readings for each cell are, therefore, possible, according to its row and column.

2.1. SAM numerical versions constructed from the SNA

In a SAM numerical version, each cell is filled with numerical values.

The transactions of the national accounts associated with the generation, distribution (allocation), redistribution (transfer), use, and accumulation of income, are represented through the interconnection of two main groups of the SAM accounts: the (domestic) economy, and the rest of the world.

In our SAM, the economy comprises, on the one hand of factors of production, activities (industries), and products (goods and services, produced non-financial assets) accounts that are integrated in the (process of) "production" (subgroup of) accounts. When disaggregated, factors of production comprise labour (employees) and others (employers and own-account workers, capital), activities comprise the ten main ISIC categories of industries, and products comprise the goods and services of the eleven main CPC sections.

In turn, current, capital, and financial accounts are integrated in the "institutions" (subgroup of) accounts of the economy. When disaggregated, five institutional sectors are identified in each of these accounts: non-financial and financial corporations, general government, households, and non-profit institutions serving households (NPISH).

The rest of the world comprises (here) a single account with the same name.

2.1.1. The aggregated SAM

Table 2.1.1-1 represents the aggregated SAM, which is a summary of all the transactions measured by the national accounts and the controlling totals for other levels of disaggregation, as can be seen in Subsection 2.1.2.

Table 2.1.1-1. Aggregated SAM, in gross terms.

Expenditures/Changes in assets / Revenues/ Changes in liabilities and net worth			Economy						Rest of the world account	Total
			Production accounts			Institutions accounts				
			Factors of production	Activities (industries)	Products (goods and services)	Current	Capital	Financial		
Economy	Production accounts	Factors of production	0	*Value added, gross* (excluding taxes on production and imports less subsidies) = 1 678	0	0	0	0	Remuneration of employees + property income = 50	Factor income originating = 1728
		Activities (industries)	0	0	Output = 3 617	0	0	0	0	Production value = 3617
		Products (goods and services)	0	Intermediate consumption = 1881		Final consumption = 1414	Capital formation = 414	0	Exports = 540	Aggregate demand = 4249
	Institutions accounts	Current	*National income, gross* (excluding taxes on production and imports less subsidies) = 1 688	Other taxes less subsidies on production = 58	Taxes less subsidies on products = 133	Current transactions = 1 168	0	0	Current transfers = 17	Total income received (resources) = 3064
		Capital	0	0	0	*Saving, gross* = 427	Capital transfers = 61	0	Capital transfers = 1	Investment funds = 489
		Financial	0	0	0	0	*Net lending (+) / net borrowing (–)* = 10	Net acquisition of financial assets/liabilities = 379	Net acquisition of liabilities = 48	Total changes in liabilities and net worth = 437
Rest of the world account			Remuneration of employees + property income = 40		Imports = 499	Current transfers = 55	Capital transfers = 4	Net acquisition of financial assets = 58		Total revenues and changes in liabilities and net worth from transactions with the rest of the world = 656
Total			Factor income retained = 1 728	Total costs = 3 617	Aggregate supply = 4 249	Total income expended (uses) = 3 064	Aggregate investment = 489	Total changes in financial assets = 437	Total expenditures and changes in assets from transactions with the rest of the world = 656	

By linking SAM accounts with national accounts that record transactions, namely, current, capital, financial and goods and services accounts, and associating abbreviated identifiers with them to facilitate reading, Table 2.1.1-2 summarizes the corresponding descriptions. This form of systematization has been adopted and adapted by the author in previous works, the last of which was Santos (2022).

Table 2.1.1-2. Correspondence between the SAM and the national accounts, and accounts description.

SAM accounts				National accounts	Accounts description
Economy	Production	f	Factors of production	Earned income	Distribution of income arising from involvement in production processes or from ownership of assets, which may be needed for production purposes, among institutions and activities
		a	Activities	Production	Transactions that constitute the production process
		p	Products	Goods and services	Use of available products
	Institutions	dic	Current	Transfer of income	Transformation of the balance of earned income (national income) into disposable income, through the receipt and payment of current transfers
				Use of income	Distribution of disposable income between final consumption and saving
		dik	Capital	Capital	Transactions linked to acquisitions of non-financial assets and capital transfers involving the redistribution of wealth
		dif	Financial	Financial	Transactions in financial assets and liabilities between institutional units, and between these and the rest of the world
Rest of the world		rw	Rest of the world	Rest of the world	Transactions between resident and non-resident units

Considering the non-null transactions represented in the SAM cells represented by "T" followed by the abbreviated identifiers of the accounts in row and column in parentheses, Table 2.1.1-3 represents the structure of the aggregated SAM and Table 2.1.1-4 completes its description.

Representing schematically the transactions between accounts, with the direction of the arrows representing the direction of the transactions, Figure 2.1.1-1 shows the network of linkages provided by the SAM, whose complexity increases with its disaggregation, according to the various objectives of the analysis and the availability of statistical information.

Table 2.1.1-3. Structure of the aggregated SAM.

	f	a	p	dic	dik	dif	rw	Total
f		T(f,a)					T(f,rw)	f.
a			T(a,p)					a.
p		T(p,a)	T(p,p)	T(p,dic)	T(p,dik)		T(p,rw)	p.
dic	T(dic,f)	T(dic,a)	T(dic,p)	T(dic,dic)			T(dic,rw)	dic.
dik				T(dik,dic)	T(dik,dik)		T(dik,rw)	dik.
dif					T(dif,dik)	T(dif,dif)	T(dif,rw)	dif.
rw	T(rw,f)	T(rw,a)	T(rw,p)	T(rw,dic)	T(rw,dik)	T(rw,dif)		rw.
Total	.f	.a	.p	.dic	.dik	.dif	.rw	

Figure 2.1.1-1. Network of linkages provided by the aggregated SAM.

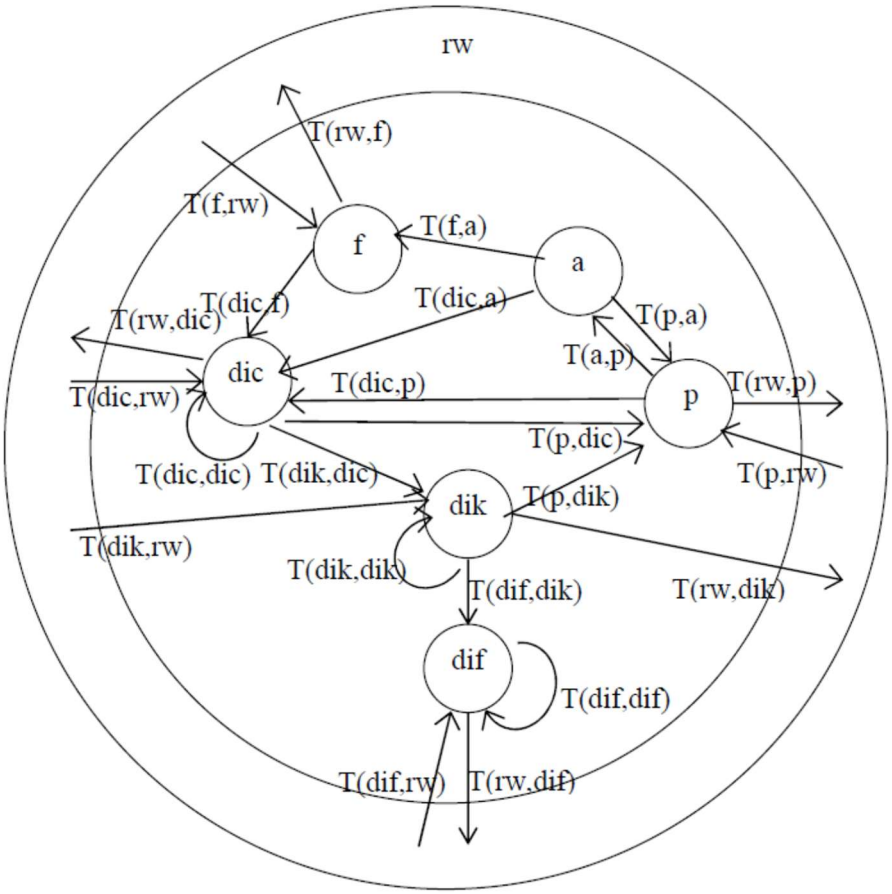


Table 2.1.1-4. Description of the cells of the aggregated SAM[4]. [part 1 of 2]

SAM cells	National accounts transactions	
	descriptions	SNA codes
T(f,a)	Remuneration of factors of production [part expended by domestic institutions]	
	- income of the institutional sectors originating from the remuneration of employees	D1
	- remuneration of employers and own-account (or self-employed) workers (gross mixed income)	B3g
	- property income	D4
	- remuneration of capital (gross operating surplus)	B2g
T(f,rw)	Remuneration of factors of production [part expended by the rest of the world]	
	- income of the institutional sectors originating from the remuneration of employees	D1
	- property income	D4
T(p,a)	Intermediate consumption (basic prices) – value of the goods and services consumed as inputs of the process of production, excluding those fixed assets whose consumption is recorded as depreciation	P2
T(a,p)	Output (basic prices)	P1
T(p,dic)	Final consumption (purchasers' prices) – expenditure incurred by resident institutional units on goods or services which are used for the direct satisfaction of individual needs or wants, or the collective needs of members of the community	P3
T(p,dik)	Capital formation (purchasers' prices) – gross fixed capital formation, changes in inventories, and acquisitions less disposals of valuables	P5
T(p,rw)	Exports (purchasers' prices) - transactions in goods and services from residents to non-residents institutional units	P6
T(rw,p)	Imports (purchasers' prices) - transactions in goods and services from non-residents to residents institutional units	P7
T(dic,dic)	Current transfers	
T(rw,dic)	- current taxes on income, wealth, etc.	D5
T(dic,rw)	- social contributions less service charges	D61
	- social benefits other than social transfers in kind	D62
	- other current transfers	D7
	Adjustment for the change in pension and non-pension entitlements	D8
T(dik,dik)	capital transfers	
T(rw,dik)	- capital taxes	D91
T(dik,rw)	- investment grants	D92
	- other capital transfers	D99
	acquisitions less disposals of non-produced non-financial assets	NF2,34,35

[4] In some cases, it is also possible for the rest of the world to have revenues from other taxes less subsidies on production - T(rw,a) and taxes less subsidies on products -T(rw,p), which is not the case of our numerical example and therefore these descriptions do not appear in this table. On the other hand, because this description is of the cells of the aggregated SAM, although the transposition to the aggregated SAM is straightforward, as will be seen below, the trade and transport margins – T(p,p), whose sum is zero, are not described here, but appear in the disaggregated SAM.

Table 2.1.1-4. Description of the cells of the aggregated SAM. [part 2 of 2]

SAM cells	National accounts transactions	
	descriptions	SNA codes
T(dif,dif)	financial transactions	
T(rw,dif)	- monetary gold and special drawing rights	F1
T(dif,rw)	- currency and deposits	F2
	- debt securities	F3
	- loans	F4
	- equity and investment fund shares/units	F5
	- insurance, pension and standardized guarantee schemes	F6
	- financial derivatives and employee stock options	F7
	- other accounts receivable/payable	F8
T(dif,dik)	net lending(+) /borrowing(-) – (respectively) the net revenues that the total economy makes available to the rest of the world or the net expenditures, covered by funds received from the rest of the world in order to finance the corresponding needs of investment	B9
T(dik,dic)	gross saving - portion of aggregate income that is not used for final consumption expenditure and current transfers to domestic institutions or to the rest of the world	B8g
T(dic,a)	other taxes less subsidies on production	D29-D39
T(dic,p)	taxes less subsidies on products	D21-D31
T(dic,f)	remuneration of factors of production [part received by domestic institutions]	
	- income of the institutional sectors originating from the remuneration of employees	D1
	- remuneration of employers and own-account (or self-employed) workers (gross mixed income)	B3g
	- property income (revenues less expenditures)	D4
	- remuneration of capital (gross operating surplus)	B2g
T(rw,f)	remuneration of factors of production [part received by the rest of the world]	
	- income of the institutional sectors originating from the compensation of remuneration	D1
	- property income	D4
Totals		
f.	(row) factor income originating	
.f	(column) factor income retained	
a.	(row) production value	
.a	(column) total costs	
p.	(row) aggregate demand	
.p	(column) aggregate supply	
dic.	(row) total income received (resources)	
.dic	(column) total income expended (uses)	
dik.	(row) investment funds	
.dik	(column) aggregate investment	
dif.	(row) total changes in liabilities and net worth	
.dif	(column) total changes in financial assets	
rw.	(row) total revenues and changes in liabilities and net worth from transactions with the rest of the world	
.rw	(column) total expenditures and changes in assets from transactions with the rest of the world	

2.1.2. Disaggregation and extension

Also with abbreviated identifiers, the above-mentioned disaggregation is systematized in Table 2.1.2-1, and the numerical version of the disaggregated SAM is presented in Table 2.1.2-2. This version was constructed from the same parts of the aggregated version and the corresponding disaggregation and extension, allowed by the national accounts and estimates of the author for from-whom-to-whom distributive and financial transactions of institutional sectors, following some previous work with institutional interrelations, namely Santos (2023 and 2024).

Table 2.1.2-1. Description of the accounts of the disaggregated SAM.

Economy	Production	f	Factors of production	l	Labour (employees)
				o	Others (employers and own-account workers, capital)
		a	Activities (industries, by ISIC categories)	a01	Agriculture, forestry and fishing (A)
				a02	Manufacturing and other industry (B-E)
				a03	Construction (F)
				a04	Trade, transport, accommodation and food (G-I)
				a05	Information and communication (J)
				a06	Finance and insurance activities (K)
				a07	Real estate activities (L)
				a08	Business services (M-N)
				a09	Education, human health and social work (P-Q)
				a10	Other services (R-T,U)
		p	Products (goods and services by CPC sections)	p01	Agriculture, forestry and fishery products (0)
				p02	Ores and minerals; electricity, gas and water (1)
				p03	Manufacturing and other industrial products (2-4)
				p04	Constructions and construction services (5)
				p05	Trade, accommodation, food and beverages servicing services; transport services (6)
				p06	Finance and related services (7 less 72-73)
				p07	Real estate services; and rental and leasing services (72-73)
				p08	Business and production services (8)
				p09	Education, human health and social care services (92-93)
				p10	Other services (94-99)
				p11	Public administration and related services (91)
	Institutions (institutional sectors by SNA codes)	dic	Current	nfc	Non-financial corporations (S11)
				fc	Financial corporations (S12)
				g	General government (S13)
				h	Households (S14)
				npi	Non-profit institutions serving households (S15)
		dik	Capital	nfc	Non-financial corporations (S11)
				fc	Financial corporations (S12)
				g	General government (S13)
				h	Households (S14)
				npi	Non-profit institutions serving households (S15)
		dif	Financial	nfc	Non-financial corporations (S11)
				fc	Financial corporations (S12)
				g	General government (S13)
				h	Households (S14)
				npi	Non-profit institutions serving households (S15)
Rest of the world (SNA code for institutional sector)				rw	Rest of the world (S2)

Table 2.1.2-2. Disaggregated SAM, in gross terms. [part 1 of 5]

			f			a						
			l	o	*total*	a01	a02	a03	a04	a05	a06	a07
			1	*2*		*3*	*4*	*5*	*6*	*7*	*8*	*9*
f	l	*1*	0	0	*0*	19	547	79	102	32	44	49
	o	*2*	0	0	*0*	25	138	46	42	30	46	91
	total		*0*	*0*	*0*	*44*	*685*	*125*	*144*	*62*	*90*	*140*
a	a01	*3*	0	0	*0*	0	0	0	0	0	0	0
	a02	*4*	0	0	*0*	0	0	0	0	0	0	0
	a03	*5*	0	0	*0*	0	0	0	0	0	0	0
	a04	*6*	0	0	*0*	0	0	0	0	0	0	0
	a05	*7*	0	0	*0*	0	0	0	0	0	0	0
	a06	*8*	0	0	*0*	0	0	0	0	0	0	0
	a07	*9*	0	0	*0*	0	0	0	0	0	0	0
	a08	*10*	0	0	*0*	0	0	0	0	0	0	0
	a09	*11*	0	0	*0*	0	0	0	0	0	0	0
	a10	*12*	0	0	*0*	0	0	0	0	0	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
p	p01	*13*	0	0	*0*	3	71	0	3	1	2	1
	p02	*14*	0	0	*0*	3	190	1	6	3	2	1
	p03	*15*	0	0	*0*	32	675	80	44	16	16	19
	p04	*16*	0	0	*0*	1	9	5	3	1	1	1
	p05	*17*	0	0	*0*	3	65	3	25	4	4	2
	p06	*18*	0	0	*0*	1	36	7	18	1	3	6
	p07	*19*	0	0	*0*	1	15	1	8	2	5	2
	p08	*20*	0	0	*0*	2	70	17	15	10	18	16
	p09	*21*	0	0	*0*	0	1	0	0	0	0	0
	p10	*22*	0	0	*0*	1	1	0	1	1	1	0
	p11	*23*	0	0	*0*	0	0	0	0	0	0	0
	total		*0*	*0*	*0*	*47*	*1 133*	*114*	*123*	*39*	*52*	*48*
dic	nfc	*24*	0	248	*248*	0	0	0	0	0	0	0
	fc	*25*	0	27	*27*	0	0	0	0	0	0	0
	g	*26*	0	25	*25*	- 2	43	5	- 5	- 1	4	6
	h	*27*	1 154	227	*1 381*	0	0	0	0	0	0	0
	npi	*28*	0	7	*7*	0	0	0	0	0	0	0
	total		*1 154*	*534*	*1 688*	*- 2*	*43*	*5*	*- 5*	*- 1*	*4*	*6*
dik	nfc	*29*	0	0	*0*	0	0	0	0	0	0	0
	fc	*30*	0	0	*0*	0	0	0	0	0	0	0
	g	*31*	0	0	*0*	0	0	0	0	0	0	0
	h	*32*	0	0	*0*	0	0	0	0	0	0	0
	npi	*33*	0	0	*0*	0	0	0	0	0	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
dif	nfc	*34*	0	0	*0*	0	0	0	0	0	0	0
	fc	*35*	0	0	*0*	0	0	0	0	0	0	0
	g	*36*	0	0	*0*	0	0	0	0	0	0	0
	h	*37*	0	0	*0*	0	0	0	0	0	0	0
	npi	*38*	0	0	*0*	0	0	0	0	0	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
rw		*39*	2	38	*40*	0	0	0	0	0	0	0
Total			*1 156*	*572*	*1 728*	*89*	*1 861*	*244*	*262*	*100*	*146*	*194*

Table 2.1.2-2. Disaggregated SAM, in gross terms. [part 2 of 5]

			a				p				
			a08	a09	a10	*total*	p01	p02	p03	p04	p05
			10	*11*	*12*		*13*	*14*	*15*	*16*	*17*
f	l	*1*	79	113	86	*1 150*	0	0	0	0	0
	o	*2*	40	30	40	*528*	0	0	0	0	0
	total		*119*	*143*	*126*	*1 678*	*0*	*0*	*0*	*0*	*0*
a	a01	*3*	0	0	0	*0*	87	0	2	0	0
	a02	*4*	0	0	0	*0*	0	195	1 650	7	6
	a03	*5*	0	0	0	*0*	0	0	11	232	1
	a04	*6*	0	0	0	*0*	0	0	24	3	226
	a05	*7*	0	0	0	*0*	0	0	18	2	0
	a06	*8*	0	0	0	*0*	0	0	0	0	0
	a07	*9*	0	0	0	*0*	0	0	0	0	0
	a08	*10*	0	0	0	*0*	0	0	9	0	0
	a09	*11*	0	0	0	*0*	0	0	0	0	0
	a10	*12*	0	0	0	*0*	0	0	0	0	0
	total		*0*	*0*	*0*	*0*	*87*	*195*	*1 714*	*244*	*233*
p	p01	*13*	2	3	2	*88*	2	0	0	0	- 2
	p02	*14*	2	5	4	*217*	0	2	0	0	- 2
	p03	*15*	19	46	43	*990*	0	0	74	0	- 74
	p04	*16*	1	11	7	*40*	0	0	0	0	0
	p05	*17*	4	4	5	*119*	0	0	0	0	0
	p06	*18*	7	7	16	*102*	0	0	0	0	0
	p07	*19*	4	8	11	*57*	0	0	0	0	0
	p08	*20*	19	22	33	*222*	0	0	0	0	0
	p09	*21*	1	24	8	*34*	0	0	0	0	0
	p10	*22*	1	2	2	*10*	0	0	0	0	0
	p11	*23*	0	1	1	*2*	0	0	0	0	0
	total		*60*	*133*	*132*	*1 881*	*2*	*2*	*74*	*0*	*- 78*
dic	nfc	*24*	0	0	0	*0*	0	0	0	0	0
	fc	*25*	0	0	0	*0*	0	0	0	0	0
	g	*26*	4	2	2	*58*	2	5	89	17	5
	h	*27*	0	0	0	*0*	0	0	0	0	0
	npi	*28*	0	0	0	*0*	0	0	0	0	0
	total		*4*	*2*	*2*	*58*	*2*	*5*	*89*	*17*	*5*
dik	nfc	*29*	0	0	0	*0*	0	0	0	0	0
	fc	*30*	0	0	0	*0*	0	0	0	0	0
	g	*31*	0	0	0	*0*	0	0	0	0	0
	h	*32*	0	0	0	*0*	0	0	0	0	0
	npi	*33*	0	0	0	*0*	0	0	0	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
dif	nfc	*34*	0	0	0	*0*	0	0	0	0	0
	fc	*35*	0	0	0	*0*	0	0	0	0	0
	g	*36*	0	0	0	*0*	0	0	0	0	0
	h	*37*	0	0	0	*0*	0	0	0	0	0
	npi	*38*	0	0	0	*0*	0	0	0	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
rw		*39*	0	0	0	*0*	37	61	284	0	99
Total			*183*	*278*	*260*	*3 617*	*128*	*263*	*2 161*	*261*	*259*

Table 2.1.2-2. Disaggregated SAM, in gross terms. [part 3 of 5]

			p							dic	
			p06	p07	p08	p09	p10	p11	*total*	nfc	fc
			18	*19*	*20*	*21*	*22*	*23*		*24*	*25*
f	l	*1*	0	0	0	0	0	0	*0*	0	0
	o	*2*	0	0	0	0	0	0	*0*	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
a	a01	*3*	0	0	0	0	0	0	*89*	0	0
	a02	*4*	0	2	1	0	0	0	*1 861*	0	0
	a03	*5*	0	0	0	0	0	0	*244*	0	0
	a04	*6*	0	4	3	0	2	0	*262*	0	0
	a05	*7*	0	0	80	0	0	0	*100*	0	0
	a06	*8*	146	0	0	0	0	0	*146*	0	0
	a07	*9*	0	189	0	0	5	0	*194*	0	0
	a08	*10*	0	0	172	0	2	0	*183*	0	0
	a09	*11*	0	0	0	278	0	0	*278*	0	0
	a10	*12*	0	0	0	0	82	178	*260*	0	0
	total		*146*	*195*	*256*	*278*	*91*	*178*	*3 617*	*0*	*0*
p	p01	*13*	0	0	0	0	0	0	*0*	0	0
	p02	*14*	0	0	0	0	0	0	*0*	0	0
	p03	*15*	0	0	0	0	0	0	*0*	0	0
	p04	*16*	0	0	0	0	0	0	*0*	0	0
	p05	*17*	0	0	0	0	0	0	*0*	0	0
	p06	*18*	0	0	0	0	0	0	*0*	0	2
	p07	*19*	0	0	0	0	0	0	*0*	0	0
	p08	*20*	0	0	0	0	0	0	*0*	0	0
	p09	*21*	0	0	0	0	0	0	*0*	0	0
	p10	*22*	0	0	0	0	0	0	*0*	0	0
	p11	*23*	0	0	0	0	0	0	*0*	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*2*
dic	nfc	*24*	0	0	0	0	0	0	*0*	0	3
	fc	*25*	0	0	0	0	0	0	*0*	5	11
	g	*26*	0	0	11	0	4	0	*133*	25	11
	h	*27*	0	0	0	0	0	0	*0*	62	251
	npi	*28*	0	0	0	0	0	0	*0*	2	0
	total		*0*	*0*	*11*	*0*	*4*	*0*	*133*	*94*	*276*
dik	nfc	*29*	0	0	0	0	0	0	*0*	222	0
	fc	*30*	0	0	0	0	0	0	*0*	0	12
	g	*31*	0	0	0	0	0	0	*0*	0	0
	h	*32*	0	0	0	0	0	0	*37*	0	0
	npi	*33*	0	0	0	0	0	0	*0*	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*222*	*12*
dif	nfc	*34*	0	0	0	0	0	0	*0*	0	0
	fc	*35*	0	0	0	0	0	0	*0*	0	0
	g	*36*	0	0	0	0	0	0	*0*	0	0
	h	*37*	0	0	0	0	0	0	*0*	0	0
	npi	*38*	0	0	0	0	0	0	*0*	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
rw		*39*	13	0	5	0	0	0	*499*	4	12
Total			*159*	*195*	*272*	*278*	*95*	*178*	*4 249*	*320*	*302*

Table 2.1.2-2. Disaggregated SAM, in gross terms. [part 4 of 5]

			dic				dik				
			g	h	npi	*total*	nfc	fc	g	h	npi
			26	*27*	*28*		*29*	*30*	*31*	*32*	*33*
f	l	*1*	0	0	0	*0*	0	0	0	0	0
	o	*2*	0	0	0	*0*	0	0	0	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
a	a01	*3*	0	0	0	*0*	0	0	0	0	0
	a02	*4*	0	0	0	*0*	0	0	0	0	0
	a03	*5*	0	0	0	*0*	0	0	0	0	0
	a04	*6*	0	0	0	*0*	0	0	0	0	0
	a05	*7*	0	0	0	*0*	0	0	0	0	0
	a06	*8*	0	0	0	*0*	0	0	0	0	0
	a07	*9*	0	0	0	*0*	0	0	0	0	0
	a08	*10*	0	0	0	*0*	0	0	0	0	0
	a09	*11*	0	0	0	*0*	0	0	0	0	0
	a10	*12*	0	0	0	*0*	0	0	0	0	0
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
p	p01	*13*	2	28	0	*30*	2	0	0	1	0
	p02	*14*	0	40	0	*40*	- 1	0	0	0	0
	p03	*15*	3	570	0	*573*	127	3	18	26	2
	p04	*16*	0	2	0	*2*	163	4	18	25	3
	p05	*17*	0	56	0	*56*	0	0	0	0	0
	p06	*18*	0	53	0	*55*	0	0	0	0	0
	p07	*19*	0	115	0	*115*	16	1	2	3	0
	p08	*20*	0	40	0	*40*	1	0	0	0	0
	p09	*21*	188	21	33	*242*	0	0	0	0	0
	p10	*22*	0	85	0	*85*	0	0	0	0	0
	p11	*23*	169	5	2	*176*	0	0	0	0	0
	total		*362*	*1 015*	*35*	*1 414*	*308*	*8*	*38*	*55*	*5*
dic	nfc	*24*	0	66	0	*69*	0	0	0	0	0
	fc	*25*	4	244	0	*264*	0	0	0	0	0
	g	*26*	96	232	1	*365*	0	0	0	0	0
	h	*27*	112	1	5	*431*	0	0	0	0	0
	npi	*28*	4	32	1	*39*	0	0	0	0	0
	total		*216*	*575*	*7*	*1 168*	*0*	*0*	*0*	*0*	*0*
dik	nfc	*29*	0	0	0	*222*	0	2	30	0	0
	fc	*30*	0	0	0	*12*	0	0	0	0	0
	g	*31*	- 27	0	0	*- 27*	1	1	0	3	1
	h	*32*	0	215	0	*215*	15	4	0	2	2
	npi	*33*	0	0	5	*5*	0	0	0	0	0
	total		*- 27*	*215*	*5*	*427*	16	7	30	5	3
dif	nfc	*34*	0	0	0	*0*	- 80	0	0	0	0
	fc	*35*	0	0	0	*0*	0	- 3	0	0	0
	g	*36*	0	0	0	*0*	0	0	- 77	0	0
	h	*37*	0	0	0	*0*	0	0	0	174	0
	npi	*38*	0	0	0	*0*	0	0	0	0	- 4
	total		*0*	*0*	*0*	*0*	*- 80*	*- 3*	*- 77*	*174*	*- 4*
rw		*39*	32	7	0	*55*	11	0	- 12	4	1
Total			*583*	*1 812*	*47*	*3 064*	*255*	*12*	*- 21*	*238*	*5*

Table 2.1.2-2. Disaggregated SAM, in gross terms. [part 5 of 5]

			dik	dif						rw	*Total*
			total	nfc	fc	g	h	npi	*total*		
				34	*35*	*36*	*37*	*38*		*39*	
f	l	*1*	*0*	0	0	0	0	0	0	6	*1 156*
	o	*2*	*0*	0	0	0	0	0	0	44	*572*
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*50*	*1 728*
a	a01	*3*	*0*	0	0	0	0	0	*0*	0	*89*
	a02	*4*	*0*	0	0	0	0	0	*0*	0	*1 861*
	a03	*5*	*0*	0	0	0	0	0	*0*	0	*244*
	a04	*6*	*0*	0	0	0	0	0	*0*	0	*262*
	a05	*7*	*0*	0	0	0	0	0	*0*	0	*100*
	a06	*8*	*0*	0	0	0	0	0	*0*	0	*146*
	a07	*9*	*0*	0	0	0	0	0	*0*	0	*194*
	a08	*10*	*0*	0	0	0	0	0	*0*	0	*183*
	a09	*11*	*0*	0	0	0	0	0	*0*	0	*278*
	a10	*12*	*0*	0	0	0	0	0	*0*	0	*260*
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*3 617*
p	p01	*13*	*3*	0	0	0	0	0	*0*	7	*128*
	p02	*14*	*- 1*	0	0	0	0	0	*0*	7	*263*
	p03	*15*	*176*	0	0	0	0	0	*0*	422	*2 161*
	p04	*16*	*213*	0	0	0	0	0	*0*	6	*261*
	p05	*17*	*0*	0	0	0	0	0	*0*	84	*259*
	p06	*18*	*0*	0	0	0	0	0	*0*	2	*159*
	p07	*19*	*22*	0	0	0	0	0	*0*	1	*195*
	p08	*20*	*1*	0	0	0	0	0	*0*	9	*272*
	p09	*21*	*0*	0	0	0	0	0	*0*	2	*278*
	p10	*22*	*0*	0	0	0	0	0	*0*	0	*95*
	p11	*23*	*0*	0	0	0	0	0	*0*	0	*178*
	total		*414*	*0*	*0*	*0*	*0*	*0*	*0*	540	*4 249*
dic	nfc	*24*	*0*	0	0	0	0	0	*0*	3	*320*
	fc	*25*	*0*	0	0	0	0	0	*0*	11	*302*
	g	*26*	*0*	0	0	0	0	0	*0*	2	*583*
	h	*27*	*0*	0	0	0	0	0	*0*	0	*1 812*
	npi	*28*	*0*	0	0	0	0	0	*0*	1	*47*
	total		*0*	*0*	*0*	*0*	*0*	*0*	*0*	*17*	*3 064*
dik	nfc	*29*	*32*	0	0	0	0	0	*0*	1	*255*
	fc	*30*	*0*	0	0	0	0	0	*0*	0	*12*
	g	*31*	*6*	0	0	0	0	0	*0*	0	*- 21*
	h	*32*	*23*	0	0	0	0	0	*0*	0	*238*
	npi	*33*	*0*	0	0	0	0	0	*0*	0	*5*
	total		*61*	*0*	*0*	*0*	*0*	*0*	*0*	*1*	*489*
dif	nfc	*34*	*- 80*	17	42	15	46	3	*123*	17	*60*
	fc	*35*	*- 3*	20	24	1	114	1	*160*	13	*170*
	g	*36*	*- 77*	10	49	4	15	1	*79*	14	*16*
	h	*37*	*174*	2	8	0	3	0	*13*	2	*189*
	npi	*38*	*- 4*	1	3	0	0	0	*4*	2	*2*
	total		*10*	*50*	*126*	*20*	*178*	*5*	*379*	*48*	*437*
rw		*39*	*4*	10	44	- 4	11	- 3	*58*		*656*
Total			*489*	*60*	*170*	*16*	*189*	*2*	*437*	*656*	

2.1.3. Macroeconomic aggregates

From each level of disaggregation of the SAM, constructed from the national accounts and/or other sources of information, we can study facts of interest for what we want to work on.

For instance, the main macroeconomic aggregates are provided directly or can be calculated from the data provided by the SAM, as shown in Table 2.1.3-1.

Depending on its level of disaggregation, specific structural features can be identified from the SAM, as we will see in Section 3.

Table 2.1.3-1. Calculation of macroeconomic aggregates, in gross terms.

SAM cells	National accounts transactions		algebraic operation	Amounts		
	description	SNA code		National accounts (sequence)	Aggregated SAM	Disaggregated SAM
---	***Value added, gross*** *(excluding taxes on production and imports less subsidies)*			1 736	1 736	1 736
T(a,p)	Output of goods and services	P1	+	3 617	3 617	3617
T(p,a)	Intermediate Consumption	P2	-	1 881	1 881	1881
	Gross domestic product	*B1g*		1 869		1 869
---	Production Approach			1 869	1 869	1 869
T(a,p)	Output	P1	+	3 617	3 617	3617
T(dic,p)	Taxes less subsidies on products	D.21-D.31	+	133	133	133
T(p,a)	Intermediate consumption	P2	-	1 881	1 881	1881
---	Expenditure Approach			1 869	1 869	1 869
T(p,dic)	Final consumption expenditure	P3	+	1 414	1 414	1414
T(p,dik)	Capital formation	P5	+	414	414	414
T(p,rw)	Exports of goods and services	P6	+	540	540	540
T(rw,p)	Imports of goods and services	P7	-	499	499	499
---	Income Approach			1 869	1 869	1 869
T(f,a)	Remuneration of employees (domestic institutions' expenditures)	D1	+	1 150	1 678	1150
	Operating surplus, gross	B2g	+	467		
	Mixed income, gross	B3g	+	61		528
T(dic,p)	Taxes on production and imports less subsidies (domestic institutions'expenditures)	D2-D3	+	191	133	133
T(dic,a)					58	58
---	***National income, gross***	B5g		1 879	1 879	1879
T(dic,f)	Remuneration of employees (domestic institutions' revenues)	D1	+	1 154	1 688	1154
	Operating surplus, gross	B2g	+	467		
	Mixed income, gross	B3g	+	61		534
	Property income (domestic institutions' revenues less expenditures)	D4	+	6		
T(dic,a)	Other taxes on production less other subsidies on production	D29-D39	+	58	58	58
T(dic,p)	Taxes less subsidies on products	D21-D31	+	133	133	133
---	***Disposable income, gross***	B6g		1 841	1 841	1841
T(dic,f)	Remuneration of employees (domestic institutions' revenues)	D1	+	1 154	1 688	1154
	Operating surplus, gross	B2g	+	467		
	Mixed income, gross	B3g	+	61		534
	Property income (domestic institutions' revenues less expenditures)	D4	+	6		
T(dic,a)	Other taxes on production less other subsidies on production	D29-D39	+	58	58	58
T(dic,p)	Taxes less subsidies on products	D21-D31	+	133	133	133
T(dic,rw)	Current transfers from the rest of the world	D5;D61;	+	17	17	17
T(rw,dic)	Current transfers to the rest of the world	D62;D7	-	55	55	55
T(dik,dic)	***Saving, gross***	B8g		427	427	427
T(dif,dik)	***Net lending (+) /borrowing (-)***	B9		10	10	10

2.2. SAM algebraic version - the accounting multipliers model

In a SAM algebraic version, each cell is filled with algebraic expressions that, together with those of all the other cells, form a SAM-based model, the calibration of which involves a replication of the corresponding numerical version.

To exemplify and considering the aspects chosen for study in Section 3, the algebraic version of the SAM worked here, from the above-presented disaggregated (numerical) SAM, is also be defined as an accounting multipliers model. This model provides a theoretical description of the country's economic activity and enables, the construction of scenarios resulting from experiments of changes in its cells. In a simplified form, the whole mathematical and analytical study will be made at the level of value, that is, prices will not be separated from quantities, and at current prices. The analysis will be static, assuming that production technology and resources' endowment are provided, there is no full employment, the relevant transactions are those measured by the national accounts and the structural features of the numerical version do not change.

According to their definition inside or outside the modelling process, SAM accounts are grouped respectively into endogenous and exogenous, as shown in Table 2.2-1. This is a version adapted from Pyatt and Round (1985), maintaining the above-mentioned principles of equilibrium of the accounts and of the entries made in rows and columns - referred to in simplified form as revenues and expenditures, respectively.

Table 2.2-1. SAM algebraic version.

Expenditures / Revenues	Endogenous accounts	Exogenous accounts	Total
Endogenous accounts	$N = A_n.\hat{y}_n$ $[A_n = N.\hat{y}_n^{-1}]$	X	$y_n = n + x = A_n.y_n + x = (I-A_n)^{-1}.x = M_a.x$
Exogenous accounts	$L = A_l.\hat{y}_n$ $[A_l = L.\hat{y}_n^{-1}]$	R	$y_x = l + r = A_l.y_n + r$ $[l = A_l.M_a.x]$
Total	y'_n	y'_x	

Note: Multiplications are identified by ".", if they are not at the end of a sentence.

Legend:

N = matrix of transactions between endogenous accounts; n = vector of the (corresponding) row sums.

X = matrix of transactions between exogenous and endogenous accounts (injections from first into second); x = vector of the (corresponding) row sums.

L = matrix of transactions between endogenous and exogenous accounts (leakages from first into second); l = vector of the (corresponding) row sums.

R = matrix of transactions between exogenous accounts; r = vector of the (corresponding) row sums.

y_n = (column) vector of the receipts of the endogenous accounts (diagonal, $\hat{y}_n$; inverse, $\hat{y}_n^{-1}$); y_n' = (row) vector of the expenditures of the same accounts.

y_x = (column) vector of the receipts of the exogenous accounts; y_x' = (row) vector of the expenditures of the same accounts.

A = average propensities to expend of endogenous accounts, in: endogenous accounts, A_n, in exogenous accounts, A_l.

M_a = matrix of the accounting multipliers.

"X" is the matrix where experiments can be performed.

With accounting multipliers (M_a), the impact or global effect of changes in revenues of endogenous accounts is analysed at the moment they occur, with the above-mentioned assumptions. They can be decomposed in several different ways, as described and exemplified, for instance, in Santos (2004). In turn, we can work with transposed matrices, that is, exchanging expenditures by revenues and work with average propensities to receive, instead of average propensities to expend. On the other hand, the work with more than one SAM, also allows the calculation of marginal, instead of average, propensities and fixed-price multipliers, as described and exemplified, for instance, in Santos (2007). Other SAM algebraic versions can also be explored and experimented, as is the case, for instance, of Santos (2009 and 2013).

3. Scenarios on the effects of infrastructure projects

The above-described accounting multipliers model is now applied to the SAM presented in Subsection 2.1.2 with the financial account (dif) aggregated, that is to a SAM with 35 rows and columns.

Two scenarios involving changes in SAM's cells are constructed and the results taken from the recalculated SAMs. These results reflect the multiplier effects of these changes in SAMs in which the expenditures of the exogenous accounts do not change, except those that are the starting point of each scenario.

Let's assume that an enterprise (or firm) or group of enterprises, resident in the country in study or part of a domestic multinational enterprise group (engaged in production activity on the economic territory on a long-term basis), whose principal activity is the construction, intends to implement a large housing complex.

For the approval of such a project, the local authorities require that it be accompanied, within its territorial limits, by the infrastructures necessary for its operation, regarding sewage, water, gas, electricity and telecommunications networks, in addition to the corresponding road accesses and green areas. To satisfy this requirement an infrastructures project is also required.

We are, therefore, thinking in an investment project of a large housing complex in which is implicit another one in infrastructures. To show to the authorities the economic importance of that part of the intended investment, we are going to assess the macroeconomic impact of the involved infrastructures, through the SAM-based approach, with the methodological details presented in Section 2. Thus, transactions in products, involving institutional sectors and activities (industries) are going to be considered, through the capital formation of non-financial corporations in constructions and construction services, on the one hand, and through the output of constructions and construction services by the construction activity (industry), on the other. In the former, we are looking to the demand of products for capital formation by the non-financial corporations. In the latter, we are looking to the supply of products by the construction activity (or industry), which has the capacity to meet the demand, given that there is not full employment.

The same absolute changes, that is, increases of 15 monetary units, involving transactions in products supposedly affected by the implementation of the above-mentioned infrastructures project or others, are going to be experimented.

3.1. Changes in the capital formation of non-financial corporations in constructions and construction services.

Let's centre our attention in transactions in products associated to capital formation (SNA code P5), which can be firstly identified in the cell with the same description in the aggregated SAM - Table 2.1.1-1. We have, thus, within the production accounts, the products account in row and, within the institutions accounts, the capital account in column.

Following the accounts description of the disaggregated SAM, in Table 2.1.2-1, to the definition of this scenario, "constructions and construction services", the SAM account "p04", and "capital account of non-financial corporations", the SAM account "dik-nfc", are, respectively, the row and the column of our interest.

Regarding the account "p04", as the name suggests and is specified in last versions of *CPC,* it is organised in constructions, involving buildings and civil engineering works, and in construction services, involving general construction services of buildings and civil engineering works, site preparation services, assembly and erection of prefabricated constructions, special trade construction services, installation services and building completion and finishing services.

In turn, with "dik" described in Table 2.1.1-2, "nfc"- non-financial corporations, are organized in public, national private and foreign-controlled (see SNA 2025, Chap. 28).

Thus, extracted from the disaggregated SAM – Table 2.1.2-2, Table 3.1-1 represents the submatrix of interest for this scenario.

Table 3.1-1. Capital formation of institutional sectors in products.

	dik-nfc	dik-fc	dik-g	dik-h	dik-npi	*total*
p01	2	0	0	1	0	*3*
p02	- 1	0	0	0	0	*- 1*
p03	127	3	18	26	2	*176*
p04	163	4	18	25	3	*213*
p05	0	0	0	0	0	*0*
p06	0	0	0	0	0	*0*
p07	16	1	2	3	0	*22*
p08	1	0	0	0	0	*1*
p09	0	0	0	0	0	*0*
p10	0	0	0	0	0	*0*
p11	0	0	0	0	0	*0*
total	*308*	*8*	*38*	*55*	*5*	*414*

From the reading of Table 3.1-1 we can see that transactions in products (SNA codes in parentheses) related with capital formation (P5) represent an amount of 414 currency units in the (total) economy. From the use table (see SNA 2025, Chap.15), we know that this amount is decomposed in 376 of gross fixed capital formation (P51g), 28 of changes in inventories (P52) and 10 of acquisitions less disposals of valuables (P53).

The capital formation of non-financial corporations (dik-nfc), amounting 308 currency units, represents 74% of the above-mentioned total. In turn, the capital formation in constructions and construction services (p04), amounting 213 currency units, represents 51% of that same total. Thus, the capital formation of non-financial corporations in constructions and construction services (p04, dik-nfc), in the amount of 163 currency units, is our focus of interest.

In the definition of this scenario, we assume an absolute increase of 15 currency units, or 9.2%, regarding the latter amount.

The following accounts were set as exogenous: non-financial corporations' capital (dik-nfc), institutions' financial (dif); and rest of the world (rw).

3.2. Changes in the output of constructions and construction services by the construction activity (industry).

This time, our focus are the transactions in products related with output (SNA code P1), which can be firstly identified in the cell with the same description in the aggregated SAM - Table 2.1.1-1. We have, thus, the activities account in row and the products account in column.

From the description of the accounts of the disaggregated SAM, in Table 2.1.2-1, to the definition of this scenario, within the production accounts, "construction", the SAM account "a03", and

"constructions and construction services", the SAM account "p04", are, respectively, the row and the column of interest.

As is specified in last versions of *ISIC,* the account "a03" is organised in construction of residential and non-residential buildings; civil engineering, involving construction of roads and railways works, of utility projects, and of other civil engineering projects; and specialized construction activities, involving demolition and site preparation, electrical, plumbing and other construction installation activities, building completion and finishing, intermediation service activities for specialized construction services, and other specialized construction activities.

In turn, the specification of the account "p04" is that made in Subsection 3.1.

The submatrix represented in Table 3.2-1, extracted from the disaggregated SAM – Table 2.1.2-2, shows the part of interest for this scenario.

Table 3.2-1. Output of products by activities.

	p01	p02	p03	p04	p05	p06	p07	p08	p09	p10	p11	*total*
a01	87	0	2	0	0	0	0	0	0	0	0	*89*
a02	0	195	1 650	7	6	0	2	1	0	0	0	*1 861*
a03	0	0	11	232	1	0	0	0	0	0	0	*244*
a04	0	0	24	3	226	0	4	3	0	2	0	*262*
a05	0	0	18	2	0	0	0	80	0	0	0	*100*
a06	0	0	0	0	0	146	0	0	0	0	0	*146*
a07	0	0	0	0	0	0	189	0	0	5	0	*194*
a08	0	0	9	0	0	0	0	172	0	2	0	*183*
a09	0	0	0	0	0	0	0	0	278	0	0	*278*
a10	0	0	0	0	0	0	0	0	0	82	178	*260*
total	*87*	*195*	*1 714*	*244*	*233*	*146*	*195*	*256*	*278*	*91*	*178*	*3 617*

From the reading of Table 3.2-1 we can say that transactions in products related with output (SNA code P1) represent an amount of 3 617 currency units in the (total) economy. In turn, the output of constructions and construction services (p04), and the output by the construction activity (a03), amounting 244 currency units, only represent 7% of that total. In this scenario, our focus of interest is, thus, the output of constructions and construction services by construction (a03, p04), in the amount of 232 currency units, which is 95% of the output of the corresponding products and activity.

In the definition of this scenario, we assume an absolute increase of 15 currency units, or 6.5%, regarding the latter amount.

The following accounts were set as exogenous: constructions and construction services (p04), institutions' financial (dif); and rest of the world (rw).

3.3. Results assessment

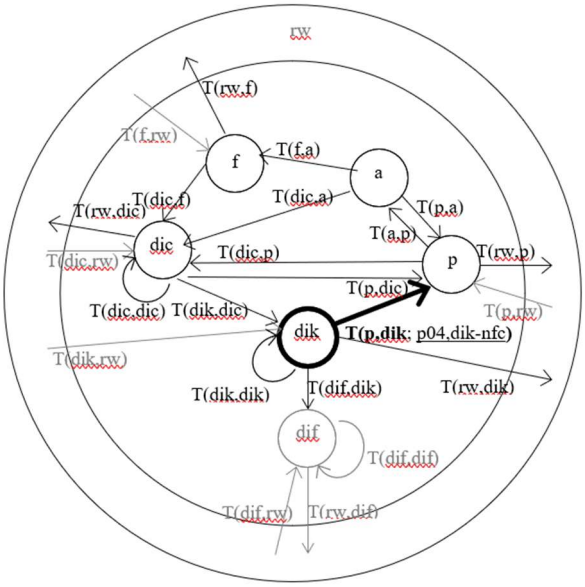
The scenarios defined in Subsections 3.1 and 3.2, within the scope of the SAM-based approach presented in Section 2, reflect the multiplier effects of absolute increases of 15 currency units,

respectively, in the capital formation of non-financial corporations in constructions and construction services and in the output of constructions and construction services by the construction activity (industry), which represent relative increases of 9.2% and 6.5%, respectively.

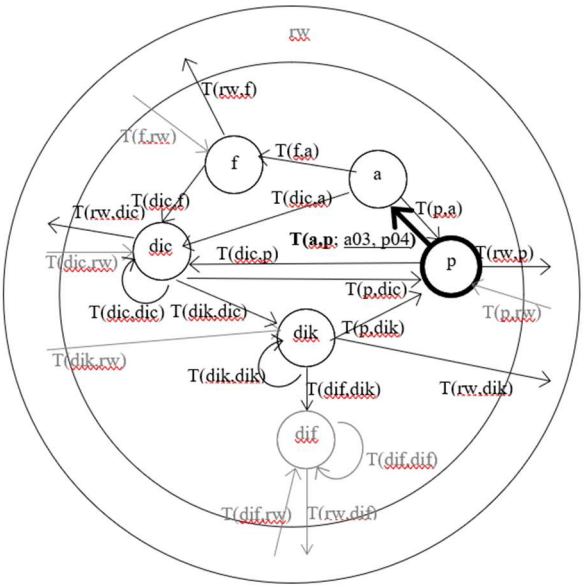
With these initial changes, the following accounts were set as exogenous: institutions' financial account (dif) and rest of the world account (rw), in both scenarios; non-financial corporations' capital account (dik-nfc) in the former scenario, and constructions and construction services (products) account (p04), in the latter scenario.

We are, therefore, dealing with transactions in products (capital formation and output) which position in the aggregated version of the network of linkages provided by the SAM, schematically represented in Figure 2.1.1-1, are identified in the following Figure 3.3-1.

Figure 3.3-1. Network of linkages provided by the aggregated SAM, with thicker lines identifying the accounts and the transactions firstly affected by the changes defined in Subsections 3.1 and 3.2.



Changes in the capital formation of non-financial corporations in constructions and construction services (Subsection 3.1)



Changes in the output of constructions and construction services by the construction activity (Subsection 3.2)

The rest of the world (rw) and the financial (dif) accounts and the associated flows are represented in gray to identify their exogeneity.

The results in each scenario are reflected from a more complex network of linkages with the above represented arrows multiplied by the number of accounts of the disaggregated SAM, as identified in Table 2.1.2-1, except in the case of financial account (dif), worked in an aggregated form. On the other hand, we must not forget that they are conditioned by the assumptions of the adopted model, as specified in Subsection 2.2.

The assessment of the effects of infrastructure projects resulting from the initial changes of the two types described above is made from the recalculated SAMs in the corresponding scenarios. Given the

numerous possibilities for assessing these results, let us consider the effects in terms of final percentual changes in the macroeconomic aggregates, systematized in Subsection 2.1.3. Net lending (+) / borrowing (–) is excluded because it has the financial account in row, which exogeneity can distort the analysis.

Table 3.3.-1. Effects of the constructed scenarios at the level the macroeconomic aggregates.

Macroeconomic aggregates, gross terms	Changes (%)	
	Subsection 3.1	Subsection 3.2
Domestic product [GDP]	1.99	2.00
National income [GNI]	1.94	1.94
Disposable income [DI]	1.92	1.93
Saving [S]	1.90	1.96

Thus, the macroeconomic effects of absolute increases of 15 currency units corresponding to a relative increase of 9.2% in the capital formation of non-financial corporations in constructions and construction services, in Subsection 3.1, and to a relative increase of 6.5% in the output of construction in constructions and construction services, in Subsection 3.2, are not very different, although a slight relevance of the positive effects of the latter can be identified.

It could be quite interesting if we also had regional data, which could be a possibility for countries that, along with national accounts, also have regional accounts.

As shown in Table 3.3-2, except for the GDP, the adopted SAM-based approach also allows to identify the structure of the distribution by institutional sectors of the macroeconomic aggregates, represented in Table 3.3-1, as well as effects of the constructed scenarios.

Table 3.3-2. Structure of the distribution of GNI, DI and S by institutional sectors and effects of the constructed scenarios.

		GNI			DI			S		
		Structure (%)	Scenarios (% change)		Structure (%)	Scenarios (% change)		Structure (%)	Scenarios (% change)	
			Subsection 3.1	Subsection 3.2		Subsection 3.1	Subsection 3.2		Subsection 3.1	Subsection 3.2
S11	Non-financial corporations	13.2	1.92	1.97	13.4	1.89	1.95	52.0	1.90	1.95
S12	Financial corporations	1.4	1.92	1.97	1.4	1.14	1.18	2.8	1.84	1.88
S13	General government	11.5	2.08	1.68	10.1	2.07	1.64	-6.3	1.97	1.82
S14	Households	73.5	1.92	1.98	74.6	1.92	1.98	50.4	1.91	1.95
S15	NPISHs	0.4	1.92	1.97	0.4	1.68	1.73	1.2	1.88	1.90
S1	All domestic sectors (total economy)	100.0	1.94	1.94	100.0	1.92	1.93	100.0	1.90	1.96

Like for the total economy, the relevance of the effects of the scenario constructed in Subsection 3.2 for institutional sectors is evidenced, except for the general government. Indeed, for the latter, the relevance of the effects of the scenario constructed in Subsection 3.1, especially in the case of GNI and DI, possibly has to do with its better ability to capture the generation of taxes on production and imports.

Although the non-financial corporations are directly involved in the first scenario, through an increase in capital formation, and indirectly involved in the second scenario, through an increase in the output, the effects felt by them are very similar to those felt by the other institutional sectors.

4. Summary and concluding remarks

Within the scope of a research project entitled "Empirical Economics - economics based on statistical evidence, with emphasis on the national accounts", this working paper illustrates a SAM-based approach to the impact of infrastructure projects on a country's economic activity.

Developed within the framework of the 2025 SNA and illustrated by its numerical example, numerical and algebraic versions of a SAM, covering all the transactions supposedly measured by national accounts, are presented as possibilities to be adopted and adapted to concrete realities. Considering the above-mentioned research project, the numerical version is better specified, whereas the presented algebraic version – the accounting multipliers model, is only a simple and illustrative possibility for the intended approach.

Thus, acknowledging the importance of the national accounts as the main source of information for any study that intends to measure and model (total or partially) the economic activity of a country, we applied the principles of the input-output analysis to a SAM, that is, to a square matrix in which, production and institutions accounts allow the work with transactions in products, as well as, distributive and financial transactions, involving the processes of production, distribution and redistribution of income.

In the form of guidelines for a SAM-based approach to the impact assessment of infrastructure projects, under the assumptions of the adopted multipliers model, we constructed two scenarios involving changes in the capital formation of non-financial corporations in constructions and construction services and in the output of constructions and construction services by the construction activity (industry). We therefore adopt, respectively, a demand perspective and a supply perspective of the transactions in products associated with the implementation of infrastructures projects, within the framework described. Among the countless possibilities provided by the SAMs recalculated after running that model with the mentioned changes, the assessment of the corresponding impacts was made at the level of the main macroeconomic aggregates as well has the parts of the five institutional sectors in each of which. Although without a significant difference, the impact of latter was more relevant in the total and at the level of the institutional sectors, except the general government.

Other experiments could be performed, with other models, or with the same model, but other organization of the exogenous accounts, or changes.

All this work could also be interesting at a regional level.

Other approaches, replacing or complementing the one we have just presented, should also be considered, such as the matrix and I/O model and many of its variants/possibilities.

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