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Abstract

In 2014, the United Nations published the first International Standard for environmental-economic statistics, known as the System of Environmental-Economic Accounting (SEEA).. As more countries adopt and implement the SEEA, the availability of consistent environmental and economic information increases the need for analytical tools that can use this data to respond to policy relevant questions. In this paper, we present a workflow to develop an environmentally-extended social accounting matrix, which can serve as the basic database for the development of environmentally-extended computable general equilibrium models. To illustrate, and given its comprehensive implementation of the SEEA, we apply this workflow to the Guatemalan case and the Integrated Economic-Environmental Modeling (IEEM) Platform.

Keywords: Environmentally-extended Social Accounting Matrix; System of Environmental-Economic Accounting Central Framework; Guatemala.

JEL Codes: D58 Computable and Other Applied General Equilibrium Models; Q56 Environment and Development • Environment and Trade • Sustainability • Environmental Accounts and Accounting • Environmental Equity • Population Growth.

1.0. Introduction

Nations have recognized the need to extend traditional economic measures in such a way that they reveal the contributions the environment makes to the economy and the influence that economies have on the environment in return (United Nations et al., 2014a)(. Advancements in the development of frameworks to make this link possible have been underway for over two decades, and they have reached maturity with the publication of the System of Environmental-Economic Accounting Central Framework –SEEA– (United Nations et al., 2014a) as the first International Standard for environmental-economic statistics. SEEA provides a connection between physical information about the environment and economic transactions in a way that is consistent with the definitions and classifications of the System of National Accounts(European Commission et al., 2009); a system with which countries traditionally measure economic performance and, among other things, gross domestic product (GDP).

Elsewhere, the authors have taken a dynamic Computable General Equilibrium (CGE) model as a starting point and developed the Integrated Economic-Environmental Modeling (IEEM) Platform that integrates data organized under the SEEA(Banerjee et al., 2016b). We have also demonstrated the application of the framework to the specific case of Guatemala, providing policy analysis related to the forest and fuelwood sector(Banerjee et al., 2019b), as well as Government strategies for achieving the Sustainable Development Goals (Banerjee et al., 2019a).

The latest innovation in integrated economic-environmental analysis links IEEM with spatially explicit ecosystem service modeling (IEEM+ESM) to enable analysis of policy impacts on both market and non-market ecosystem services (Banerjee et al., In review). For example, many regulating ecosystem services such as soil erosion mitigation services provide benefits to people, though they lack a direct market price. Where these services are not quantified or valued, they are not considered in decision making. As renowned environmental economist David Pearce stated: "Economic valuation is always implicit or explicit; it cannot fail to happen at all" (Pearce, 2006), page 4.

The IEEM Platform was conceptualized and designed in such a way that it may be developed for other countries with the required National Accounts data (primarily supply and use tables and integrated economic accounts[1]) and environmental accounts organized according to SEEA principles. Development of IEEM for another country or similar environmentally extended CGE analysis requires the development of a Social Accounting Matrix (SAM) that uses both environmental and economic information. The development of this database, however, may not be altogether clear to researchers. For the interested practitioner, this paper presents a workflow to develop such a matrix that uses information from SEEA, the System of National Accounts (SNA), the Balance of Payments (BoP), and other sources, and which can serve as basic database for IEEM or the development of other environmentally extended CGE modeling. This paper applies this workflow to the Guatemalan case.

This paper proceeds as follows. In section 2 we outline the workflow for the development of an Environmentally-extended Social Accounting Matrix (ESAM) and explain its basic components.

[1] In case integrated economic accounts are not available, government budget and balance of payments data can be used instead. For more insights on how to construct a social accounting matrix in data constrained countries, see: BANERJEE, O., CICOWIEZ, M. & COTTA, J. 2016a. Economics of tourism investment in data scarce countries. *Annals of Tourism Research*, 60**,** 115-138.

Section 3 presents an application of this workflow using data from Guatemala and descriptive statistics that become readily available from the ESAM. Section 4 discusses the outcomes of the exercise and the final section concludes the paper.

2.0. Methodology

In this section, a basic SAM is defined along with the extensions needed to include environmental information within them. Then, an efficient workflow for the development of such an Environmentally-extended SAM (ESAM) is presented from the practitioner's perspective.

2.1. Environmentally-extended SAM definition and schematic representation

A SAM is a matrix representation of the interrelationships existent in an economy at the level of individual productive sectors, factors, and institutions. As stated in Round (2003),

> "...it is a comprehensive, flexible, and disaggregated framework which elaborates and articulates the generation of income by activities of production and the distribution and redistribution of income between social and institutional groups (p. 62)."

A SAM is composed of accounts (Pyatt and Round, 1985, Round, 2003). For each of these accounts, a cell represents a payment column-wise and a receipt row-wise. Hence, columns represent expenditures for each account whereas rows record the matching incomes. Due to the accounting consistency of a SAM, total expenditure of every account must be equal to its total income. In other words, the total of every row must be equal to the corresponding total of the column.

To capture the reciprocal interactions between the economic system and the environment in a manner consistent with the SEEA, the standard construction of the SAM must be extended. Table 1 shows such an extension. Columns and rows one through eight on the upper left corner of the table show the monetary realm of the economy. As an example of an environmental extension that uses available data from the SEEA, the subsequent columns and rows include cells for investments in environmental protection and conservation, two specific types of water, other resources, and two types of outputs from the economy to the environment, namely waste and emissions.

Table 1. Environmentally-extended social accounting matrix schematic representation.

receipts\spending

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
		act	com	factors	hhd	gov	RoW	sav-inv	total mon	enviro	water-reg	water-unreg	other resources	waste	emissions
1	act		dom-prod						inc firms		supply		supply	by-prod	by-prod
2	com	IO			C	G	E	I	demand						
3	factors	VA							inc fac						
4	hhd			VA					inc hhd						by-prod
5	gov	T	T						inc gov						
6	RoW		M	INC-F	TR				out forex				M	imp	
7	sav-inv				SH	SG	SF		sav						
8	total mon	cost firms	supply	spnd fac	spnd hhd	spnd gov	in forex	inv							
9	enviro							enviro invest				source	source		
10	water-reg	int-dem			fin-dem										
11	water-unreg	int-dem													
12	other resources	int-dem			fin-dem		E	fin-dem							
13	waste	int-dem						fin-dem		sink					
14	emissions									sink					

Note: act = activities, com = commodities, dom-prod = domestic production, gov = government, RoW = rest of the world, sav-inv = savings-investment, total-mon = total monetary, enviro = environment, water-reg = water registered, water-unreg = water unregistered, IO = intermediate consumption, VA = value added, T = taxes, M = imports, INC-F = factor income to/from abroad, TR = transfers, C = private consumption, G = government consumption, E = exports, I = investment, SH = households savings, SG = government savings, SF = foreign savings, int-dem = intermediate demand, and fin-dem = final demand.

Source: Authors' own elaboration.

In a SAM, factors of production earn returns from their involvement in domestic and foreign production, and they distribute them, net of taxes, to their owners which are households and enterprises. Institutions (households, enterprises, government, the rest of the country, and the rest of the world) receive income from factors of production and (net) transfers that can be either used to purchase commodities or saved. Savings from households, enterprises, the government and the rest of the world[2] sum to aggregate savings and these, in turn, are equal to the level of investment of the economy.

Gross domestic product (GDP) at factor cost builds as activities remunerate factors of production, in other words, value added. GDP at purchaser prices equals GDP at basic prices plus indirect taxes and tariffs on commodities, which is also equal to total final demand, plus exports, minus imports.

The environmental extension adds accounts for the environment as a source of natural capital and ecosystem service flows, and also quantitatively describes the environment's role as a sink for by-products and waste generated through productive processes following the conventions established in the SEEA. The SEEA is modular and allows for the introduction of new environmental accounts as they are demanded by policy makers and developed by statistical and other government institutions. The IEEM Platform is also structured in this way. This grants a degree of flexibility in which resources to include in the ESAM, depending on research needs and the information that the compilation of the SEEA makes available.

For illustration, the ESAM of Table 1 includes three natural inputs: registered water, un-registered water, and other resources[3]. Registered water (water-reg) is supplied by an industry (act), such as the water distribution utility industry, using unregistered water, water-unreg, from the environment as an input. On the other hand, unregistered water is obtained directly from the environment, and used in various ways including for irrigated agriculture. Lastly, other environmental resources can also be exported and/or imported (row). In addition, industries and households can generate waste (waste) and emissions (emissions) that can be used as intermediate inputs by industries (act) and/or become absorbed by the environment (enviro).

2.2. ESAM Workflow

The implementation of the SEEA facilitates the combination of economic and environmental data, because it extends traditional sources of information, such as Supply and Use Tables in monetary terms, to include environmental inputs and outputs in physical terms, using compatible definitions and classifications for industries, products, institutional sectors of the economy, as well as transactions.

Constructing an ESAM requires the combination of economic information from different sources with environmental accounting information. We propose a workflow based on previous successful experience in the development of an IEEM Platform for Guatemala (Banerjee et al., 2017). Figure 1. shows a diagram of the steps required to construct an ESAM.

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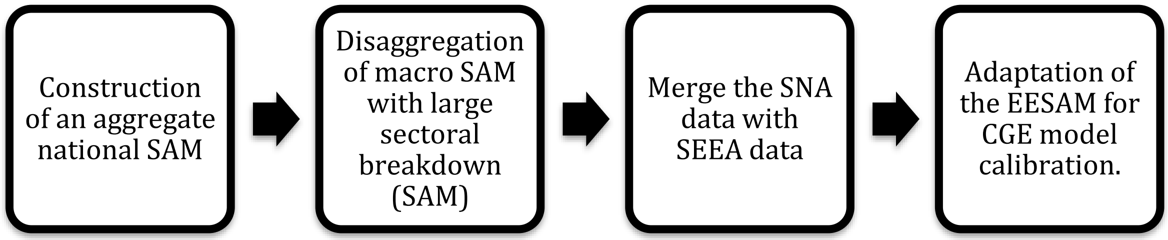
[2] Savings from the government are equal to the difference between its current receipts and spending. Savings from the rest of the world are equal to the current account balance of the balance of payments with the opposite sign.

[3] Other resources might include volumetric information of timber, subsoil resources and any other that are available in environmental accounts of the country of analysis.

Figure 1. Environmentally extended SAM construction workflow



Source: Authors' own elaboration.

The workflow includes (i) construction of an aggregate national SAM; (ii) disaggregation of the macro SAM according to aggregate economic sectors (referred to as the SAM, hereafter); (iii) merging of SNA data with consistent SEEA data, and; (iv) adaptation of the ESAM for calibration of the IEEM Platform.

2.2.1. Macro SAM

Like in the example presented in Table 1, the first step is to construct a highly aggregated or macro SAM which is a schematic representation of the economy with data from the SNA. Data used from the SNA are the Supply and Use Tables and the Integrated Economic Accounts[4]. Supply and Use Tables describe production and consumption (both intermediate and final) in the economy, whereas Integrated Economic Accounts describe the distribution of income between economic institutional sectors including households, enterprises and government, and the rest of the world (European Commission et al., 2009). Depending on the data available for the country of analysis, its thoroughness, as well as compilation choices, balance of payment and fiscal data might be needed to build the Rest of the World and Government accounts, respectively. Other useful information can be found in SNA elements, such as the matrix of bilateral transfers, the matrix of dividends both received and paid, and the matrix of interest received and paid, if available[5].

If data is available, labor payments can be disaggregated into gross operating surplus and mixed income as separate accounts. As such, the macro SAM provides information on the labor income of salaried and non-salaried workers. Income from non-salaried workers is income that is obtained from self-employment and income received from unincorporated enterprises owned by households. Moreover, the activity and commodity tax accounts can be further split into activity and commodity subsidies, if this information is present in the underlying Supply and Use Tables. The household account in the macro SAM can be disaggregated as households, non-profit institutions serving households (NPISH), and enterprises, which are non-financial and financial corporations. Table 2 shows a stylized version of the outcome of this step and Table A.1 in Annex A shows an example for Guatemala.

[4] The interested reader can turn to Banerjee, Cicowiez, & Cotta (2016a) for steps in constructing a macro SAM,
[5] This was the case with Guatemalan data availability.

Table 2. A Schematic Macro SAM.

	Expenditures							
Receipts	Activities	Commodities	Factors	Households	Government	Rest of World	investment	Totals
Activities		Sales						Activity revenue
Commodities	Intermediate inputs			Consump-tion	Consump-tion	Exports	Investment	Commodity demand
Factors	Value added					Wages, rents		Factor income
Households			Wages, rents		Transfers	Transfers		Household income
Government	Taxes	Taxes (incl.	Taxes, rents	Taxes		Transfers		Government income
Rest of World		Imports	Wages, rents	Transfers	Transfers			FOREX outflow
Savings-investmen				Savings	Savings	Savings (cur. acc't		Savings
Totals	Activity spending	Commodity supply	Factor spending	Household	Government	FOREX inflow	Investment	

Source: Authors' own elaboration.

2.2.2 Micro SAM

The macro SAM, once constructed and balanced, provides an overview of the entire economy. The second step builds a more disaggregated SAM, as disaggregated as the data allows. This process uses the information in Supply and Use Tables to disaggregate activities and commodities. Supply and Use Tables describe production and intermediate consumption as commodities in the rows that are either produced (supply) or used (use table) by industries in the columns. The result is identical to that of Table 2, but with a large disaggregation of the rows and columns of industries (act) and commodities (com). In the case of Guatemala, the macro SAM and sectoral information from the SUTs provided by the Central Bank of Guatemala were used as the main inputs in the disaggregation for activities and commodities.

At this stage, it is possible to conduct adjustments to the underlying database that might become obstacles for its implementation in IEEM or environmentally extended CGE analysis. For example, owing to what the researcher aims to model, exports that are larger than domestic production can either be netted out by reducing exports and imports by the same amount, or they can be explicitly considered as re-exports. Following SNA conventions (EC et al., 2009), the data might include "financial intermediation services indirectly measured". If this is not explicitly needed for the analysis, they can be registered as an input to the financial sector. Also, under the assumption that the distribution margins requirements are proportional to the corresponding transactions, trade and transport margins can be split between domestic products, imports, and exports, depending on data availability. In the SNA, the stock variation is a component of the total gross investment; this will be expressed in the SAM as a payment made by the savings-investment account, to the stock variation account (see "sav" and "dstk" in Table A.1 in Appendix A).

It is possible to disaggregate both labor payments and households. In the former, depending on the research questions to be addressed, labor categories (salaried and non-salaried) can be further disaggregated into unskilled, for people under a certain threshold of years of education, and skilled, for people above that threshold. This is possible using a labor and income, or living standards household survey (see Appendix B for the Guatemalan case). In the case of households, these can also be disaggregated into rural and urban, for example, and within each region, into consumption quintiles based on household per capita consumption (see also Appendix B). In both cases, Socio-Economic Database for Latin America and the Caribbean (SEDLAC) guidelines can provide guidance on this process (CEDLAS. and The World Bank., 2014)

2.2.3. Merging the SNA data with consistent SEEA data

In merging the SNA data with consistent SEEA data, the basic structure of Supply and Use Tables as defined by the SNA is extended with information from the SEEA. Monetary information is extended in order to account for environmental inputs to the economy, as well as emissions and effluents returned back from the economy to the environment in physical terms. This is undertaken using industry and product classifications consistent with the SNA.

In practice, the environmentally-extended SAM can follow the tables in the SEEA manual. However, some rearrangement of the data along thematic lines is beneficial to group thematic accounts and similar interactions which will facilitate subsequent implementation in IEEM. Whereas SEEA suggests that inputs are grouped together before transactions within the economy and that effluents and emissions are grouped together after these transactions, we suggest keeping natural inputs and emissions together for specific resources. For example, rows explaining water used for irrigation can be positioned adjacent to rows that describe water waste returns to the environment from the same industries.

Depending on the SEEA accounts available for a specific country, environmental information can include data on water, energy accounting and greenhouse gas emissions, forest accounts, residuals, subsoil accounts, and fisheries. The final output of this step, an environmentally-extended Supply and Use Table, combines monetary information and environmental physical information in a consistent manner. Table 2 depicts such a table; blackened cells indicate those that would be populated.

Table 2. A schematic view of an environmentally-extended supply and use table.

	T01	T02	T03	T04	T05	T06	T07	T08	T09	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21
01. Supply (Monetary)	■		■	■	■	■	■	■	■	■	■	■									
02. Use (Monetary)	■												■	■	■	■	■	■	■	■	■
03. Value Added (Monetary)	■																				
04. Employment	■																				
05. Water supply (Registered/Unregistered)	■	■																			
06. Water use (Registered/Unregistered)	■														■						
07. Cultivated Area (Ha)	■																				
08. Rainfed irrigation use (m3)	■																				
09. Sprinkler irrigation use (m3)	■																				
10. Drip irrigation use (m3)	■																				
11. Gravity use (m3)	■																				
12. Other use (m3)	■																				
13. All irrigation (m3)	■																				
14. Sprinkler irrigation return (m3)	■																				
15. Drip irrigation return (m3)	■																				
16. Gravity return (m3)	■																				
17. Other return (m3)	■																				
18. Energy supply (terajoule)	■	■		■																	
19. Energy use (terajoule)	■													■	■					■	
20. Carbon Dioxide supply (CO2 tonnes)	■														■						
21. Nitrous Oxide supply (CO2 tonnes equivalent)	■														■						
22. Methane supply (CO2 tonnes equivalent)	■														■						
23. Forest products supply (m3)	■			■																	
24. Forest products use (m3)	■													■	■				■	■	
25. Animal species supply (number of individuals)	■			■																	
26. Animal species use (number of individuals)	■													■	■						
27. Residuals supply (tonnes)	■		■												■						
28. Residuals use (tonnes)	■														■						
29. Subsoil resource supply (tonnes)	■		■																		
30. Subsoil resource use (tonnes)	■												■		■					■	
31. Fishery supply (tonnes)	■		■			■	■			■	■										
32. Fishery use (tonnes)	■												■		■					■	

Note: Column names correspond to: T01 Output / Intermediate consumption , T02 Environment , T03 Imports of goods , T04 Imports of services , T05 CIF/FOB adjustment on imports , T06 Value added tax (VAT) , T07 Tariffs exc. VAT on imports , T08 Taxes on products, excluding VAT and Tariffs , T09 Subsidies on products , T10 Trade margins , T11 Transportation margins , T12 Electricity, gas, water margins, T13 Exports of goods , T14 Exports of services , T15 Household final consumption , T16 Non for-profit institutions final consumption , T17 Individual government final consumption , T18 Collective government final consumption , T19 Gross capital formation , T20 Stock variation , T21 Valuable objects.

Source: Authors' own elaboration.

2.2.4. Adaptation of the ESAM for CGE model calibration

In this step, a final check is performed to eliminate common obstacles for implementation of the ESAM in IEEM or extended CGE analysis. In practice, this step is country-specific. However, it usually entails distributing trade and transport margin between domestic sales, exports, and imports. In addition, any re-exports or negative gross operating surpluses should be handled at this stage. Another important adjustment is the distribution of sectoral gross operating surplus among payments to capital, land used in agriculture and forestry, and other natural resources used in fishing and mining including coal, petroleum and gas, metals, and other mining resources.

This step may cause the estimates to deviate slightly from the national or environmental accounts, though is necessary in order to produce an ESAM that is compatible for IEEM calibration. For example, in a case where the Supply and Use Tables records a negative gross operating surplus for a given sector, which is not unusual for publicly operated activities such as utilities, an adjustment is necessary. Without this adjustment, it is not possible to calibrate IEEM's sectoral value-added production function.

3.0. Application

3.1.1. Guatemala's Supply and Use Tables

Guatemalan Supply and Use Tables describe the economic activity of the country for the year 2010, identifying 122 activities and 219 commodities[6] in thousands of quetzales, the local currency (Banco de Guatemala, 2015). Although there are more recent compilations of these tables, we selected 2010 because it is the last year with availability of consistent environmental information from the SEEA.

The supply table presents the output of commodities (rows) by industries (columns) at producer prices. Columns for imports from the rest of the world net of insurance and shipping costs are added to construct supply at basic prices. Columns for trade and transportation margins, along with taxes on products net of subsidies are added to obtain total supply at purchaser prices, which is the monetary value of each commodity that is available to the economy.

Total supply can then be used in the use table as inputs by industries, for final consumption or investment by households, not-for-profits organizations, and the government, it can go to the rest of the world as exports, or it can increase stocks for the following accounting period. Total supply must equal total use for each commodity. Additional complementary adjustments were made to the Supply and Use Tables in order to build the SAM for Guatemala:

- There are six sectors with exports and no domestic production; these are gasoline, liquefied propane and butane, lubricating petroleum oils, plastics in primary form, steam generators except central heating boilers, and office, accounting and computing machinery.
- Similarly, there are 15 sectors with exports larger than domestic production; these are natural rubber, frozen crustaceans and mollusks, flours and meals of fish, flours and meals of oil seeds, raw sugar cane and sugar beet, diesel, fuel oil, essential oils and concentrates, basic metals, general-purpose machinery, special-purpose machinery, electrical machinery and apparatus, radio, television and communication equipment and apparatus, non-metal wastes or scraps, and metal wastes or scraps. Given the requirements for our analysis, re-exports were eliminated by reducing exports and imports in the same amount when constructing the SAM. As discussed earlier, for other analytical purposes, these could have been considered explicitly as re-exports.
- Financial intermediation services indirectly measured were registered as an input for the financial sector.

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[6] The authors gained access to a disaggregated Supply and Use Table data in cooperation with the WAVES initiative and the (Central) Bank of Guatemala within that initiative. Although analysis was conducted with higher levels of disaggregation, the Bank of Guatemala requires that results be presented at higher levels of aggregation. A more aggregated version of the Supply and Use Table is downloadable from www.banguat.gob.gt.

- SEEA and GTAP (Global Trade Analysis Project) data was used to split the sectoral gross operating surplus among payments to capital, land used in agriculture and forestry, and other natural resources used in fishing and mining (coal, petroleum and gas, metals, and other).
- Trade and transport margins were split between domestic products, imports, and exports; we assumed that the distribution margins requirements are proportional to the corresponding transactions.

3.1.2. Integrated Economic Accounts of Guatemala

Integrated economic accounts comprise the full set of accounts for institutional sectors and the rest of the world, together with the accounts for transactions and other flows, and the accounts for assets and liabilities for Guatemala. It includes accounts for the following six institutional sectors: households, non-financial institutions, financial institutions, the government, and the rest of the world. We were also able to use information from the data matrices that record bilateral transactions among institutional sectors, such as current transfers, dividends, and interest payments.

3.1.3. System of Environmental and Economic Accounts of Guatemala

Guatemala's SEEA (Instituto Nacional de Estadistica. et al., 2013) is composed of Asset and Flow accounts in monetary and physical terms for forests, water, land and ecosystems, waste, subsoil resources, fisheries, energy, and environmental expenditures[7] for the period 2001 to 2010.

4.0. Results

This section presents a snapshot of the Guatemalan economy based on the 2010 ESAM. For presentation purposes, the accounts in the final environmentally-extended SAM were aggregated as shown in Table 3.

[7] Detailed information about the Guatemalan SEEA can be found at http://seeagt.github.io

Table 3. Accounts in the aggregated Guatemala 2010 ESAM
Panel (a): Economic accounts

Category - #		Item	Category - #	Item
Sectors (activities and comm) (24)	**Primary (5)**	Agriculture	**Factors (6)**	Labor, non-salaried
		Livestock		Capital
		Forestry		Land
		Fishing		Nat res, forestry
		Mining		Nat res, fishing
	Manufact (12)	Food prod		Nat res, mining
		Beverages and tobacco prod	**Trade and transport margins (3)**	Dist marg, domestic
		Textiles and wearing apparel		Dist marg, imports
		Wood and wood prod		Dist marg, exports
		Paper and paper prod	**Taxes and subsidies (8)**	Social contributions
		Refined petroleum prod		Tax, activities
		Chemicals		Subsidy, activities
		Rubber and plastics		Tax, value added (VAT)
		Non-metallic mineral prod		Tax, imports (tariffs)
		Basic metals and metal prod		Tax, commodities
		Machinery and equipment		Subsidy, commodities
		Other manufactures		Tax, income
	Services (7)	Electricity	**Institutions (12)**	Households
		Water		Non-profit inst serving hhd
		Construction		Enterprises
		Trade		Government
		Hotels and restaurants		Rest of world
		Transport	**Investment**	Savings
		Other services		Investment, private

Panel (b): Environmental accounts

Category - #	Item	Category - #	Item
Water (11)	Registered, supply	**Energy (10) (*)**	Supply, Forestry
	Registered, use		Supply, Mining
	Non-registered, rainfed		Supply, Refined petroleum prod
	Non-registered, sprinkler irrigation		Supply, Recycling
	Non-registered, drip irrigation		Supply, Electricity
	Non-registered, gravity use		Use, Forestry
	Non-registered, other use		Use, Mining
	Return, sprinkler irrigation		Use, Refined petroleum prod
	Return, drip irrigation		Use, Recycling
	Return, gravity use		Use, Electricity
	Return, other use	**Emissions (12)**	Carbon-Diox (CO2), by comm, 4
Forestry Res (14)	Supply by commodity, 7		Nitrous Oxide (N2O), by comm, 4
	Use by commodity, 7		Methane (CH4), by comm, 4
Fishing Res (4) (*)	Supply, Fishing	**Waste (2) (*)**	Total supply
	Supply, Food prod		Total use
	Use, Fishing	**Land use (8)**	Agriculture, 4
	Use, Food prod		Bushes
Mining Res (4) (*)	Total supply		Pastures
	Total use		Forest
	Initial stock		Other
	Final stock		

(*) more disaggregated information is available in Guatemala SEEA.
Source: Authors' own elaboration.

Guatemalan GDP reached 367,215 million quetzales in 2010, based on data from the ESAM (see Table 4). In 2010, the government current account surplus was 0.7% of GDP and government current consumption was 14.6% of GDP (see

Table **5**), with tax collection accounting for 10.1% of GDP. The Guatemala 2010 SAM also reports taxes/subsidies paid/received by institutions, commodity sales, value added, activities, exports, and tariffs. In 2010, remittances from workers abroad accounted for 12% of GDP and remain an important source of income for Guatemalan households and one of the key drivers of private consumption (see Table 6).

Table 4. GDP structure, Guatemala 2010; millions of quetzales and percent.

Item	Nominal (mill quetzales)	GDPshr (%)
Absorption	368,080	110.5
Private consumption	286,760	86.1
Fix investment	49,324	14.8
Stock change	-2,900	-0.9
Government consumption	34,894	10.5
Exports	83,653	25.1
Imports	118,639	35.6
GDP market prices	333,093	100.0
Net Indirect Taxes	22,910	6.9
GDP factor cost	310,183	93.1

Source: Authors' calculations based on Guatemalan ESAM 2010.

Table 5. Government receipts and spending, Guatemala 2010 (million quetzales and shares of GDP)

Item	Nominal (mill quetzales)	GDPshr (%)
Receipts		
Direct tax	10,897	3.3
Activity tax	2,038	0.6
Commodity tax	18,514	5.6
Import tax	2,359	0.7
Domestic transfers	13,504	4.1
Foreign transfers	1,429	0.4
Factor income	44	0.0
Total		
Spending		
Consumption	48,784	14.6
Domestic transfers	34,894	10.5
Foreign transfers	10,609	3.2
Government savings	2,207	0.7
Total	1,074	0.3

Source: Authors' calculations based on Guatemalan ESAM 2010.

Table 6. Current account of balance of payments, Guatemala 2010

Item	Nominal (mill quetzales)	GDPshr (%)
Inflows FOREX		
Exports	83,653	25.1
Transfers to non-gov	40,060	12.0
Transfers to gov	1,429	0.4
Factor income	556	0.2
Foreign savings	5,046	1.5
Total	130,743	39.3
Outflows FOREX		
Imports	118,639	35.6
Transfers from non-gov	9,855	3.0
Transfers from gov	2,207	0.7
Factor income	43	0.0
Total	130,743	39.3

Source: Authors' calculations based on Guatemalan ESAM 2010.

Guatemala's production and trade structure is shown in Table 8. Columns (EXPshr) and (IMPshr) of Table 7 show the share of each sector in total exports and imports, respectively. Columns EXP-OUTshr and IMP-DEMshr of Table 7 present, for each sector, the share of exports in output, and the share of imports in consumption, respectively. For instance, Food products represent a significant share of both export revenue (around 11.4%; see column EXPshr) and value added (9.9%; see column VAshr).

Table 7. Sectoral structure, Guatemala 2010; percent.

Sector	VAshr	PRDshr	EXPshr	EXP-OUTshr	IMPshr	IMP-DEMshr
Agriculture	8.4	6.1	10.7	18.2	27.9	3.3
Livestock	2.4	2.2	2.8	0.1	0.5	0.1
Forestry	0.8	0.8	1.2	2.5	32.7	0.1
Fishing	0.2	0.2	0.1	0.7	41.1	0.1
Mining	2.1	1.5	1.5	7.3	74.1	0.7
Food prod	9.8	12.4	11.4	15.0	15.3	8.7
Beverages and tobacco prod	0.8	1.5	0.6	1.9	15.9	0.8
Textiles and wearing apparel	2.8	4.4	4.1	15.4	45.3	8.2
Wood and wood prod	0.3	0.4	0.4	0.5	14.7	0.3
Paper and paper prod	0.6	0.9	0.5	1.9	30.4	4.2
Refined petroleum prod	0.0	0.0	0.0	0.2	83.3	15.4
Chemicals	1.4	2.3	1.0	8.4	47.3	15.6
Rubber and plastics	0.7	1.2	0.4	2.1	25.0	3.5
Non-metallic mineral prod	0.9	1.4	0.6	1.0	9.8	1.0
Basic metals and metal prod	0.9	1.5	0.7	3.1	29.5	6.1
Machinery and equipment	0.2	0.3	0.2	1.9	83.6	21.7
Other manufactures	0.8	1.2	0.9	1.4	15.0	2.2
Electricity	1.8	2.1	0.9	0.2	1.3	0.3
Water	0.4	0.4	0.2	0.0	0.0	0.0
Construction	4.1	6.5	5.4	0.1	0.3	0.0
Trade	16.9	13.8	17.3	0.0	0.0	0.0
Hotels and restaurants	2.6	3.8	3.0	11.0	45.2	4.0
Transport	3.3	3.5	3.2	5.6	25.1	2.0
Other services	37.8	31.6	33.0	1.7	0.9	1.8
Total	100.0	100.0	100.0	100.0	12.9	100.0

Notes: VAshr = value-added share (%); PRDshr = production share (%); EMPshr = share in total employment (%); EXPshr = sector share in total exports (%); EXP-OUTshr = exports as share in sector output (%); IMPshr = sector share in total imports (%); IMP-DEMshr = imports as share of domestic demand (%). Source: Authors' calculations based on Guatemalan ESAM 2010.

Table 8 shows the factor shares in total sectoral value added. For example, the table shows that agriculture is relatively intensive in the use of non-salaried unskilled labor. In turn, the government sector is relatively intensive in the use of salaried skilled labor. Also, it is worth mentioning that payments to natural resources (i.e., land used in agriculture and forestry, fishing resources, and extractive mineral resources) have their counterpart in the environmental accounts data discussed below. Understanding these structural relationships is important for interpreting the results of public policy and investment analysis implemented in IEEM or extended CGE simulations.

Table 8. Sectoral factor intensity, Guatemala 2010; percent.

Sector	Lab, salaried	Lab, non-salaried	Capital	Nat Res	Total
Agriculture	15.4	56.8	13.1	14.7	100.0
Livestock	16.5	49.5	16.0	17.9	100.0
Forestry	14.2	69.0	7.2	9.6	100.0
Fishing	12.2	18.1	35.2	34.5	100.0
Mining	32.8	6.0	36.3	25.0	100.0
Food prod	26.4	39.2	34.4	0.0	100.0
Beverages and tobacco prod	38.2	1.0	60.8	0.0	100.0
Textiles and wearing apparel	56.5	25.9	17.6	0.0	100.0
Wood and wood prod	28.6	50.8	20.6	0.0	100.0
Paper and paper prod	40.4	9.5	50.1	0.0	100.0
Refined petroleum prod	3.6	0.0	96.4	0.0	100.0
Chemicals	40.1	1.0	58.9	0.0	100.0
Rubber and plastics	30.2	2.0	67.7	0.0	100.0
Non-metallic mineral prod	26.0	10.1	63.8	0.0	100.0
Basic metals and metal prod	40.9	5.8	53.3	0.0	100.0
Machinery and equipment	38.6	7.8	53.7	0.0	100.0
Other manufactures	28.1	34.7	37.1	0.0	100.0
Electricity	23.3	3.2	73.5	0.0	100.0
Water	14.3	3.1	82.7	0.0	100.0
Construction	43.6	30.1	26.3	0.0	100.0
Trade	26.9	31.2	41.9	0.0	100.0
Hotels and restaurants	34.5	31.6	33.9	0.0	100.0
Transport	32.8	23.4	43.8	0.0	100.0
Other services	39.8	9.4	50.9	0.0	100.0
Total	32.7	23.7	41.3	2.3	100.0

Source: Authors' calculations based on Guatemalan ESAM 2010.

From Table 9 to Source: Authors' calculations based on Guatemalan ESAM 2010.

Table 14 shows fishing resources supply and use in tons. Here it is evident that imports of fishery products are quite important relative to domestic production with 44,609 tons produced locally and 22,132 imported. Households and the Food products sector are the main consumers while 17,575 tons of fisheries products are exported.

Table **14** we show aggregated environmental information for water supply and use, land use, emissions, energy supply and use, fishing resources supply and use, as well as waste supply and use, respectively. For example, in Table 10 we see that registered and non-registered water consumption by agricultural activities reached 8,905 and 21,142,765 thousand of m^3, respectively. In addition, Table 9 shows that supply of registered and non-registered water is from the water sector and the environment, respectively. This data reveals, for example, that registered water represented only 1.2 percent of total water use in 2010. Registered water is water that is transacted in the market and in this case, supplied by the water utility.

Table 11 shows land distribution by uses. Of the almost 11 million hectares of land in Guatemala, 28.2% is allocated to agriculture, 34.5% to shrubs, bushes and pastures and 34.2% to forest. Only 3.1% of the country is used for urban areas, infrastructure, or is considered a wetland.

Table 9. Water supply and use; million m3.

	Supply		Use	
Sector	Registered	Non-Regist	Registered	Non-Regist
Agriculture	0	0	8,905	21,142,765
Livestock	0	0	0	26,566
Forestry	0	0	0	501,516
Fishing	0	0	0	514,618
Mining	0	0	829	5,360
Food prod	0	0	36,715	7,368,879
Beverages and tobacco prod	0	0	130,760	11,693
Textiles and wearing apparel	0	0	24,743	11,814
Wood and wood prod	0	0	641	527
Paper and paper prod	0	0	1,273	3,307
Refined petroleum prod	0	0	284	9
Chemicals	0	0	2,020	27,673
Rubber and plastics	0	0	1,113	590
Non-metallic mineral prod	0	0	1,824	8,377
Basic metals and metal prod	0	0	587	7,215
Machinery and equipment	0	0	666	112
Other manufactures	0	0	793	1,553
Electricity	0	0	255	5,057,016
Water	417,679	0	60	0
Construction	0	0	387	75,874
Trade	0	0	41,969	0
Hotels and restaurants	0	0	14,199	0
Transport	0	0	4,348	0
Other services	0	0	57,554	0
Households	0	0	87,753	373,931
Environment	0	35,139,397	0	0
Total	417,679	35,139,397	417,679	35,139,397

Source: Authors' calculations based on Guatemalan ESAM 2010.

Table 10. Land use; hectares.

Use	Hectares	Percent
Land, total	10,888,900	100.0
Land, agriculture	3,071,482	28.2
Land, shrubs and bushes + pastures	3,762,019	34.5
Land, forestry	3,722,595	34.2
Land, urban + infraestructure + wetlands + other	332,803	3.1

Source: Authors' calculations based on Guatemalan ESAM 2010.

In **Error! Not a valid bookmark self-reference.** we show the volume of emissions arising from activities and households; note that the SEEA singles out three different greenhouse gas (GHG) emissions, namely carbon dioxide, nitrous oxide and methane, which are linked to the use, in intermediate and final demand, of specific commodities in the ESAM. For example, households emitted 23.3 million tons of CO_2 through their consumption of fuelwood. In turn, by combining information from the economic and environmental accounts of our ESAM, we see that the industry with greatest emissions per quetzal of output is the Electricity sector. This is due to the fact that much of Guatemala's energy is produced by burning bunker fuel.

Table 11. Emissions; CO_2 thousand of tons and CO^2- equivalent in thousands of tons.

	Carbon-Diox (CO2) (com)				Nitrous Oxide (N2O) (com)				Methane (CH4) (com)			
Sector	For	Min	RefPet	OthMnf	For	Min	RefPet	OthMnf	For	Min	RefPet	OthMnf
Agriculture	0	0	292	0	0	0	1	0	0	0	3	0
Livestock	0	0	79	0	0	0	0	0	0	0	1	0
Forestry	0	0	75	0	0	0	0	0	0	0	1	0
Fishing	0	0	13	0	0	0	0	0	0	0	0	0
Mining	0	15	100	0	0	0	0	0	0	0	0	0
Food prod	3,748	70	730	0	41	0	1	0	72	0	2	0
Beverages and tobacco prod	0	0	376	0	0	0	1	0	0	0	1	0
Textiles and wearing apparel	0	0	112	0	0	0	0	0	0	0	0	0
Wood and wood prod	0	0	40	0	0	0	0	0	0	0	0	0
Paper and paper prod	0	0	25	0	0	0	0	0	0	0	0	0
Refined petroleum prod	0	200	0	0	0	1	0	0	0	1	0	0
Chemicals	81	412	169	0	1	2	0	0	2	1	1	0
Rubber and plastics	0	0	40	0	0	0	0	0	0	0	0	0
Non-metallic mineral prod	428	1,424	484	0	5	7	1	0	8	3	1	0
Basic metals and metal prod	0	14	114	0	0	0	0	0	0	0	0	0
Machinery and equipment	0	47	48	0	0	0	0	0	0	0	0	0
Other manufactures	0	17	115	0	0	0	0	0	0	0	0	0
Electricity	0	1,381	1,382	4,098	0	6	3	51	0	3	4	89
Water	0	0	95	0	0	0	0	0	0	0	1	0
Construction	0	1	255	0	0	0	1	0	0	0	3	0
Trade	71	0	381	0	1	0	1	0	14	0	4	0
Hotels and restaurants	75	0	416	0	1	0	1	0	14	0	4	0
Transport	0	0	1,559	0	0	0	4	0	0	0	15	0
Other services	0	33	916	0	0	0	2	0	0	0	9	0
Households	23,304	0	2,255	0	258	0	5	0	4,494	0	21	0
Total	27,707	3,615	10,072	4,098	307	16	24	51	4,605	8	72	89

Notes: where For = Forestry, Min = Mining, RefPet = Refined petroleum prod, and OthMnf = Other manufactures. Source: Authors' calculations based on Guatemalan ESAM 2010.

Table 12. Energy supply and use (terajoules)

	Energy supply (commodities)						Energy use (commodities)					
Sector	For	Min	RefPet	OthMnf	Ele	Total	For	Min	RefPet	OthMnf	Ele	Total
Agriculture	0	0	0	0	0	0	0	0	3,994	0	142	4,136
Livestock	0	0	0	0	0	0	0	0	1,076	0	273	1,349
Forestry	247,382	0	0	0	0	247,382	0	0	1,019	0	0	1,019
Fishing	0	0	0	0	0	0	0	0	177	0	0	177
Mining	0	25,402	0	0	0	25,402	0	149	1,403	0	279	1,831
Food prod	0	0	0	40,980	4,586	45,566	33,462	698	10,222	0	2,028	46,410
Beverages and tobacco prod	0	0	0	0	0	0	0	1	4,968	0	800	5,770
Textiles and wearing apparel	0	0	0	0	0	0	0	0	1,538	0	1,044	2,582
Wood and wood prod	0	0	0	0	0	0	0	1	551	0	167	719
Paper and paper prod	0	0	0	0	0	0	0	0	352	0	250	602
Refined petroleum prod	0	0	0	0	0	0	0	2,728	1	0	12	2,741
Chemicals	0	0	0	0	0	0	721	4,132	2,322	0	401	7,577
Rubber and plastics	0	0	0	0	0	0	0	0	564	0	468	1,032
Non-metallic mineral prod	0	0	0	0	0	0	3,825	14,310	6,576	0	305	25,016
Basic metals and metal prod	0	0	0	0	0	0	0	142	1,531	0	243	1,917
Machinery and equipment	0	0	0	0	0	0	0	470	673	0	94	1,237
Other manufactures	0	0	0	0	0	0	0	175	1,586	0	284	2,045
Electricity	0	0	0	0	26,859	26,859	0	13,856	18,094	40,980	1,242	74,173
Water	0	0	0	0	0	0	0	0	1,277	0	796	2,072
Construction	0	0	0	0	0	0	0	9	3,474	0	80	3,563
Trade	0	0	0	0	0	0	635	0	5,270	0	6,931	12,836
Hotels and restaurants	0	0	0	0	0	0	669	0	5,721	0	833	7,222
Transport	0	0	0	0	0	0	0	0	21,298	0	342	21,640
Other services	0	0	0	0	0	0	0	335	12,708	0	5,335	18,378
Households	0	0	0	0	0	0	208,070	0	32,957	0	6,649	247,676
Stock change	0	0	0	0	0	0	0	918	3,819	0	0	4,737
Environment	0	0	0	0	-3,277	-3,277	0	0	0	0	0	0
Imports, services	0	34,179	143,172	0	1,304	178,655	0	0	0	0	0	0
Exports, services	0	0	0	0	0	0	0	21,656	0	0	474	22,129
Total	247,382	59,581	143,172	40,980	29,472	520,588	247,382	59,581	143,172	40,980	29,472	520,588

Notes: For = Forestry, Min = Mining cc-for, RefPet = Refined petroleum prod, OthMnf = Other manufactures, and Ele = Electricity. Source: Authors' calculations based on Guatemalan ESAM 2010.

Tables 13 shows energy supply from the economic sectors that produce energetic products, as well as the consumption of those products by each economic sector. Here the importance of fuelwood, produce by the forest sector, is of particular note. Fuelwood according to the ESAM accounts for 71.7% of all domestically produced fuel. The Environment row in the table shows electricity-sector losses of electricity in the process of transmitting electricity to the end-user.

Table 13. Fishing resources supply and use (tons)

	Fishing resources supply			Fishing resources use		
Sector	Fishing	Food prod	Total	Fishing	Food prod	Total
Fishing	44,609	0	44,609	1,110	0	1,110
Food prod	0	12,499	12,499	5,407	0	5,407
Paper and paper prod	0	0	0	0	0	0
Hotels and restaurants	0	0	0	2,331	192	2,524
Other services	34	0	34	0	0	0
Households	0	0	0	18,152	9,332	27,484
Stock change	0	0	0	68	323	391
Imports, goods	0	22,132	22,132	0	0	0
Exports, goods	0	0	0	17,575	24,784	42,358
Total	44,643	34,631	79,274	44,643	34,631	79,274

Source: Authors' calculations based on Guatemalan ESAM 2010.

Table 14 shows fishing resources supply and use in tons. Here it is evident that imports of fishery products are quite important relative to domestic production with 44,609 tons produced locally and 22,132 imported. Households and the Food products sector are the main consumers while 17,575 tons of fisheries products are exported.

Table 14. Waste supply and use; aggregated (tons)

Sector	Supply	Use
Agriculture	19,429,782	1,671,188
Livestock	835,666	0
Forestry	951,341	0
Mining	33,167	0
Food prod	53,640,984	9,237,715
Beverages and tobacco prod	2,525,812	0
Wood and wood prod	28,019	0
Chemicals	20,610,374	498,403
Rubber and plastics	1,097,815	0
Non-metallic mineral prod	12,209,541	0
Other manufactures	282	5,980
Electricity	0	5,512,668
Trade	0	20,607
Transport	2,917	0
Other services	35,342	4,197
Households	1,543,131	27,834
Imports, goods	1,728	0
Total	112,945,902	16,978,592

Notes: the SEEA provides disaggregated information on supply and use by type of waste such as animal organs, hospital waste, among other; considering space, we only show the totals. Source: Authors' calculations based on Guatemalan ESAM 2010.

Finally, Table 15 shows waste supply and use in tons. The food products sector produces the greatest amount of waste, over 53 million tons. The chemicals sector generates less than half of this amount of waste. The agricultural sector generates 19 million tons. Households generate 1.5 million tons of waste.

5.0. Conclusions

In this paper we presented a workflow for the construction of an Environmentally-Extended Social Accounting Matrix and demonstrated an application of this workflow to Guatemala. The ESAM provides researchers with a rich data frame that reveals consistent and comprehensive information on many aspects of the relationship between the economy and the environment that are not evident when the different domains of information are presented separately. Moreover, the ESAM is a foundational resource with which to calibrate and apply environmentally-extended computable general equilibrium models such as the IEEM Platform.

In addition to traditional economic measures of the Guatemalan economy, the ESAM reveals interesting aspects of the use of natural resources. For example, it shows that the economy relies on up to 98.8% of unregistered water which is water that is not transacted in the market or regulated. Guatemala's dependency on the forest sector for fuelwood is also noteworthy and relevant for public policy-making. Furthermore, combining economic and environmental information as implemented in the ESAM, it is possible to observe that electricity generation is the greatest contributor of CO_2 emissions level per monetary unit of output due to the burning of imported bunker fuel.

The development of statistical data frameworks such as the SEEA consistently allows us to measure the contribution of the environment to the economy through time, and as the SEEA standards mature further, particularly with the development of ecosystem service accounting standards (United Nations et al., 2014b), richer environmental information will become available for integrated economic-environmental analysis. It is of utmost importance to reach conventions in the treatment and management of those data sources for use in applied modeling and this paper contributes through its development of a workflow to process SEEA data for use in integrated economic-environmental modeling frameworks such as the IEEM Platform.

Annex A: Macro SAM for Guatemala

Table A.1. Macro SAM for Guatemala 2010 (GDP share, percent)

	act	com	f-lab	f-cap	cssoc	tax-act	tax-imp	tax-com	tax-dir	hhd	gov	row	sav	invng	invg	dstk	total
act		160.6															160.6
com	66.9									86.1	10.5	25.1		11.9	2.9	-0.9	202.5
f-lab	50.0											0.2					50.2
f-cap	40.6																40.6
cssoc	2.5																2.5
tax-act	0.6																0.6
tax-imp		0.7															0.7
tax-com		5.6															5.6
tax-dir										3.3		0.3					3.5
hhd			50.2	40.6	2.5						3.2	12.0					108.5
gov				0.0		0.6	0.7	5.6	3.5	4.1		0.2					14.6
row		35.6	0.0							3.0	0.7						39.3
sav										12.1	0.3	1.5					13.9
invng													11.9				11.9
invg													2.9				2.9
dstk													-0.9				-0.9
total	160.6	202.5	50.2	40.6	2.5	0.6	0.7	5.6	3.5	108.5	14.6	39.3	13.9	11.9	2.9	-0.9	657.1

Note: act = activities; com = commodities; f-lab = labor; f-cap = gross operating surplus + mixed income; tax-act = activity taxes; tax-com = commodity taxes; sub-com = commodity subsidies; tax-imp = import tariffs; tax-dir = direct taxes; hhd = households; gov = government; row = rest of the world; sav = savings; invng = non-government investment; invg = government investment; dstk = stock change. Source: Author’s elaboration.

Annex B. Disaggregation of labor payments and households

Disaggregation of labor payments

In the Guatemalan 2010 ESAM, each labor category (i.e., salaried and non-salaried) in the "standard" micro SAM was disaggregated into two types according to the educational level as follows: (i) unskilled, for workers with incomplete (lower) secondary education (i.e., less than nine years of schooling); and (ii) skilled, for individuals who have completed (lower) secondary education, with or without (incomplete/complete) tertiary education (i.e., nine or more years of schooling). In order to conduct such disaggregation, we used information on labor payments by sector, labor category (salaried/non-salaried) and skill level from the Encuesta Nacional de Condiciones de Vida (ENCOVI) for the year 2011, conducted by the Instituto Nacional de Estadística (INE) (see Table B.1). The ENCOVI 2011 is the closest to 2010 household survey in Guatemala; it covers 66,523 individuals in 13,482 households in all of Guatemala. The ENCOVI 2011 was processed following the SEDLAC (Socio-Economic Database for Latin America and the Caribbean) guidelines (World Bank and CEDLAS, 2012). Not surprisingly, the ENCOVI 2011 does not provide enough information for all labor categories and activities in the SAM. Thus, two or more sectors in the Supply and Use Tables were linked to the same activity in Table B.1.

Table B.1. Share of each labor skill level in total labor payments by sector and labor category; percent.

Sector	Salaried, unskilled	Salaried, skilled	Salaried, total	Non-salaried,	Non-salaried,	Non-salaried,
Agriculture + Forestry	11.9	88.1	100.0	7.9	92.1	100.0
Fishing	14.3	85.7	100.0	3.2	96.8	100.0
Mining	35.7	64.3	100.0	2.1	97.9	100.0
Manufacturing	52.3	47.7	100.0	43.9	56.1	100.0
Electricity + Water	80.0	20.0	100.0	96.4	3.6	100.0
Construction	27.7	72.3	100.0	16.9	83.1	100.0
Trade	68.2	31.8	100.0	38.0	62.0	100.0
Hotels + Restaurants	58.1	41.9	100.0	30.5	69.5	100.0
Transport + Communications	54.8	45.2	100.0	81.6	18.4	100.0
Fiancial Intermediation	88.8	11.2	100.0	.	.	.
Business Services	84.1	15.9	100.0	96.3	3.7	100.0
Public Administration	80.2	19.8	100.0	.	.	.
Education	94.6	5.4	100.0	98.9	1.1	100.0
Health	93.7	6.3	100.0	89.3	10.7	100.0
Other Services	71.7	28.3	100.0	61.7	38.3	100.0
Domestic Service	12.3	87.7	100.0	16.5	83.5	100.0
Total	58.6	41.4	100.0	42.4	57.6	100.0

Source: Authors' elaboration based on ENCOVI 2011.

Disaggregation of households

In the next step, the ENCOVI 2011 was used to disaggregate households into rural and urban, and within each region into consumption quintiles based on their household per capita consumption. To that end, the information in Table B.2 for consumption shares and Table B.3 for income share was used. In addition, the following assumptions were made:

- Direct tax payments are distributed proportional to capital income;
- Rents from natural resources are distributed proportional to capital income;
- Household savings in the SAM were estimated as a residual in order to balance each representative household (current) account. Thus, it is not surprising that some representative households show negative savings. Certainly, an alternative mechanism to estimate household savings could be implemented; for example, by adjusting certain incomes in the ENCOVI 2011 so that savings are non-negative. However, following Deaton (1997), we decided not to alter the household shares in both income and consumption data in the ENCOVI 2011 (Deaton, 1997).

Table B.2. Information used to disaggregate consumption spending by household and commodity; percent.

	Rural					Urban					
Commodity	quint 1	quint 2	quint 3	quint 4	quint 5	quint 1	quint 2	quint 3	quint 4	quint 5	Total
Food	5.0	6.7	7.5	8.5	10.1	8.6	10.9	12.5	14.1	16.1	100.0
Other primaries	11.0	13.1	12.5	12.5	10.7	11.9	9.7	7.2	6.7	4.7	100.0
Textiles	5.0	7.1	7.6	8.9	9.5	8.0	9.9	11.1	14.6	18.3	100.0
Other manufactures	2.5	3.6	4.8	7.0	12.9	5.3	7.7	11.1	16.3	28.8	100.0
Electricity	2.8	4.0	5.0	6.4	10.1	7.7	9.7	12.7	16.1	25.5	100.0
Water and sanitation	1.6	2.8	2.9	6.0	8.3	5.6	10.4	15.2	18.2	28.9	100.0
Hotels and restaurants	0.8	1.8	2.3	3.2	4.2	0.7	0.9	10.1	14.4	61.4	100.0
Transport	2.4	3.6	6.3	7.9	13.0	6.0	8.8	13.9	16.9	21.3	100.0
Communications	1.2	2.2	3.4	5.1	10.6	4.0	7.9	11.8	19.2	34.5	100.0
Education	1.1	1.7	2.8	4.1	7.2	3.8	5.8	13.2	19.4	40.9	100.0
Health	0.9	2.2	2.8	6.0	17.9	3.2	6.7	9.9	15.5	34.9	100.0
Other services	0.3	0.6	0.9	1.9	5.7	3.6	8.5	13.3	16.4	48.7	100.0

Source: Authors' elaboration based on ENCOVI 2011.

Table B.3. Information used to disaggregate income sources by household; percent.

	Rural					Urban					
Income source	quint 1	quint 2	quint 3	quint 4	quint 5	quint 1	quint 2	quint 3	quint 4	quint 5	Total
Salaried, unskilled	9.69	10.49	10.11	9.53	7.23	14.26	14.86	12.47	8.64	2.71	100.00
Salaried, skilled	0.48	0.92	1.47	2.40	5.95	3.56	9.35	12.41	19.82	43.64	100.00
Non-salaried, unskiled	5.96	6.99	8.23	9.79	16.45	7.80	7.73	10.84	14.69	11.52	100.00
Non-salaried, skilled	0.10	0.29	0.60	1.56	10.52	1.39	2.62	5.25	14.90	62.75	100.00
Capital	0.14	1.37	0.66	0.87	6.17	2.25	6.15	7.52	22.47	52.38	100.00
Transfers from Gov	8.86	8.48	7.28	6.24	5.60	7.43	6.90	6.87	14.24	28.11	100.00
Transfers from RoW	2.57	3.65	9.51	9.92	19.98	5.10	5.43	8.87	11.32	23.65	100.00

Source: Authors' elaboration based on ENCOVI 2011.

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