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To cite this article: Casiano A. Manrique-de-Lara-Peñate & José J. Déniz-Mayor (2022): The business accounting matrix: a proposal with an application, Economic Systems Research, DOI: [10.1080/09535314.2022.2062302](https://doi.org/10.1080/09535314.2022.2062302)

To link to this article: <https://doi.org/10.1080/09535314.2022.2062302>

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 Published online: 29 May 2022.

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# The business accounting matrix: a proposal with an application

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## ABSTRACT

National accounting matrices (NAM) perfectly describe the economic structure of a national economy, summarising the whole process of generation of primary income and its distribution among the different institutional sectors of the economy. It is not just a way to represent the main economic statistics of an economy but it also serves as the basis for most macroeconomic modelling efforts. The business accounting matrix (BAM) presents the most relevant information for the firm in a similar way, adapted to the descriptive potential of financial accounting, what we believe can be useful both for economic modellers and for decision makers at the firm level. Our intention is not to convince business administrators to change their accounting paradigm but to help analysts and researchers to obtain a comprehensive description of the activity of a firm aligned to well recognised economic statistical standards.

## ARTICLE HISTORY



Received 6 November 2020  
In final form 1 April 2022


## KEYWORDS

National accounts;  
matrix-based accounting of  
firms; enterprise  
input–output

## 1. Introduction

Business models rarely make use of concepts related to national accounting. On the other hand, national accounts, the main basis of information for macroeconomic models, directly use the business accounts to calculate most of the data related to production at the economy-wide level (Viet, 2000). Economic models of firms, however, typically use very limited amount of the information that can be supplied by their financial accounting frameworks. Even if we accept that economic models are necessarily simplifications of reality, we should expect them bring all relevant information to bear upon the purposes for which they are created. This means the combination of economic and financial relationships both in the benchmark data and in the economic modelling structure. Estimating the cost of capital, calculating measures as Tobin's Q, and analysing regulated industries (Chisari et al., 1999; Estache & Grifell-Tatjé, 2013) are undoubtedly exceptions to this general situation.

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This article has been corrected with minor changes. These changes do not impact the academic content of the article.

 Supplemental data for this article can be accessed here. [https://zenodo.org/record/5939986#.YoU\\_d6jMLUQ](https://zenodo.org/record/5939986#.YoU_d6jMLUQ)

A business accounting matrix (BAM) should present information on a firm that is useful both to economic modellers and for the firm's decision makers. It should provide a clear link between the richness of information generated by financial accounting and the analytical capacity of economic accounts and models. It also should offer a structured, panoramic view of all significant economic flows and the relationships among the various agents related to the firm's level of economic activity. A BAM highlights the main aggregates of the economic and financial activity of the firm. It also can be a basis upon which a firm's corporate social responsibility accounting frameworks can be developed and lead to different economic models that can be used by the firm.

In this paper, we present a framework to develop business accounting matrices as a parallel concept to the national accounting matrix (NAM), using the standard financial accounts of the firm. We first show the value added generated by the main operating activity of the firm. We then add other sources of income and the results of the redistributive instruments of the public sector and, subsequently, define aggregates related to the generation, use and distribution of income. We find that incorporating financial and investment flows helps to establish the net financial needs of the firm.

Beyond the use of a BAM as a potentially more complete business economic model, it yields a concise global view of the most important economic variables and flows of a business. This, in turn, facilitates the preparation of easy-to-use scorecards. The structure of BAMs enables the analysis both for a single period as well as comparisons across multiple periods. This same structure facilitates the pattern recognition for classification and prediction purposes via machine-learning techniques like neural networks.

There have been various more or less successful attempts to develop matrix-based financial accounting systems. On the other hand, the input-output (IO) literature contains various efforts in enterprise IO where the scope of the analysis is concentrated at the firm level. Our objective can be viewed as a common framework that satisfies the needs of both firm administrators and economic modellers. We also believe the public sector can use BAMs to better understand activities of public establishments and regulated firms.

In the same way NAMs can be extended to be social accounting matrices (SAMs), BAMs can be transformed into social business accounting matrices (SBAMs). This is generally done by disaggregating information by programmes, departments, types of goods or services, categories of workers, etc. The production, commodities, and operating accounts of SBAMs are equivalent to the information contained in an enterprise IO table (EIOT). A spreadsheet that is available to readers as supplemental material is used to estimate each element of a BAM, which enables ready tracing. It includes a table in which each BAM element incorporates a description of its content. It also contains the example of the complete BAM (SBAM) that was used in the simulation of changes in final demand. Researchers with the financial accounts of a firm at their fingertips can immediately calculate a BAM and, thus, adapt our proposal at their convenience.

The structure of this paper is as follows. Section 2 offers a brief overview of the literature on enterprise input-output. Section 3 shows how the BAM is constructed, explaining the main differences with the NAM, and presenting a practical example. Section 4 proposes a set of potential uses of the BAM, and the last Section proposes some conclusions and future lines of research and potential developments of the BAM.

## 2. Literature review

A somewhat ‘hidden’ area of analysis in the field of enterprise IO (EIO) deserves more attention than it has received to date. Redman (1954) was perhaps the first to acknowledge the significance of IO flows in firms’ decisions. Beringer’s (1956) arguments also highlighted the need to account for relationships between different enterprises when their production functions are not independent. But another author, Farag (1968), was the first to present a micro IO transactions table for a single firm that perfectly relates to the standard IO table and demand model for a single country or region.

Previous models only considered part of the activity of firms, namely that of production, and adapted IO tables and models to firms. Many examples that employed this kind of approach came after. Badi (1979), for example, followed Farag’s approach for a refinery. He constructed the standard IO demand model using the Leontief inverse to calculate the level of production of the different processes needed to satisfy a predefined level of final demand for petroleum products. Li (1981) produced a similar model for a combined iron and steel enterprise and Marangoni and Fezzi (2002) for a pharmaceutical firm. Most, but not all, EIO applications concentrate on manufacturing firms. For example, Liang et al. (2011) examined a mining firm; Correa and Guajardo (2001) a city’s municipal government; Lenzen et al. (2010) a university; Correa and Parker (2005) a hospital administration; Lenzen and Lundie (2012) a dairy; and Correa (2002) societal systems.

Polenske (1997) took a step forward by comparing the IO accounting framework with those that derived from more traditional accounting systems; and concluded by highlighting the advantages of the former. She also briefly details how accounts at different levels – enterprise, regional and national – can be combined for the sake of economic policy. Lin and Polenske (1998) argue that the framework of national accounting may not be well-suited to business accounting and modelling and, thus, propose an alternative that is based on production processes rather than products. They, thereby, derive an equivalent version of the Leontief inverse to obtain total (direct and indirect) IO coefficients. The resulting IO process model (IOPM) can be extended to handle structural and process analysis, and environmental management. In fact, later, Polenske and McMichael (2002) showed how an expanded version of this IOPM can yield an understanding of both energy use and environmental impacts in the coke-making sector.

Many other environmental applications followed. Albino et al. (2003) for a district, and Albino and Kühtz (2004) for a single firm, exemplify the use of EIO models in the evaluation of environmental impacts. Matsumoto and Fujimoto (2008) and Kühtz et al. (2010) demonstrated the use of EIO in environmental and sustainability analysis. The latter used the EIO framework to analyse differences between Chinese and Italian tile manufacturers. They also identified the most polluting production processes and the impact of introducing more sustainable technologies. They prove the usefulness of this framework for public administrators who wish to scrutinise firms’ performance. All these applications confirm the appropriateness of the traditional IO framework at firm level.

At enterprise level, physical data is more accessible, which opens an interesting range of research options. Following an IO approach, Li et al. (2009) prepared both physical and monetary energy consumption matrices. They applied their results to heavy-machinery companies, with the aim of studying different issues, such as the description of energy use, the analysis of energy-saving policies and the impact of energy price changes. Wang

and Jia (2012) applied the extended EIO for sustainability. This model combined process integration with EIO to describe the internal and external relationships of a firm in terms of production processes and related input flows. The process system's engineering models described the mass material flows within the firm and identified where the firm could potentially recover resources or reduce waste.

EIO can be also extended to less traditional areas of analysis such as logistics. In this regard, both Albino et al. (2008) and Li et al. (2008) examine spatial issues using EIO. They model transportation services as another production process, addressing different types of managerial problems via its use (e.g. environmental performance and the impact of transportation on the supply chains). Li et al. (2008) prepared a multi-regional EIO model to explicitly model logistics costs.

The research described demonstrates the versatility of the EIO framework at firm level. However, all these efforts are limited in one way or another to the productive scope of the firm, and sideline many other aspects of it, which are equally relevant.

Although the input–output methodology was created and developed mainly in the field of general economics, various authors soon started to study its adaptation to business accounting. Mattessich (1957) proposed a generalisation of Leontief's model, noting that not only the inter-industrial flows of input–output analysis could be represented by a square matrix, but also any accounting transaction. In an attempt to avoid limitations of conventional accounting, a segment of the business accounting literature proposed the implementation of matrix-based accounting (Babad & Balanchandran, 1989; Bueno Campos, 1970, 1971; Churrua-Arrizabalaga, 1981; Farag, 1968; García-García, 1972; Hicks, 1960; Hughes, 2016; Ijiri, 1965; Leech, 1986; Livingstone, 1969; Mattessich, 1956, 1957, 1958; Mattessich & Galassi, 2000; Mephan, 1988; Pinilla-Monclus, 1975; Richards, 1960; Staubus, 1971).

In general, this line of work assimilated accounting operations into a flow of transactions among the different departments or subsidiaries of a company, and with the remaining economic agents with which it interacts. It is in this light that Mattessich (1956) was the first to suggest linking business accounting with national accounting. Matrix-based accounting goes beyond the mere substitution of the traditional double-entry bookkeeping based on the journal and the ledger. The use of matrices was thought to facilitate the presentation of interrelations between the different elements of the accounting system, allowing predictions to be established about their behaviour, which gave rise to functional accounting. However, the strongly established debit-credit model, used for over 500 years, and the inability to formalise the connection between conventional accounting and the IO framework, almost brought the end of functional accounting.

The two approaches shown, the IO framework and financial accounting are not opposed, but complementary. However, neither has achieved complete integration between the two ways of looking at a firm. The IO framework has not been able to fully and definitively integrate all the information provided by financial accounting, and financial accounting has not been able to move from pure accounting to economic models able to identify the causal factors involved in a firm's activities.

The Business Accounting Matrix (BAM) seeks to establish common ground for both approaches. On the one hand it can incorporate all the information provided by financial accounting. On the other, its structure and matrix format allow the immediate application of IO and Social Accounting Matrix (SAM) related models. This representation enables a

firm to open itself up to the possibility of modelling financial and distributional issues that are important to its stakeholders. Perhaps more importantly, using the accounting framework we propose, modellers might easily prepare static and dynamic models that would be of great interest to firms' managers, as well as for economists interested in more detailed models of firms.

### 3. The Business Accounting Matrix (BAM)

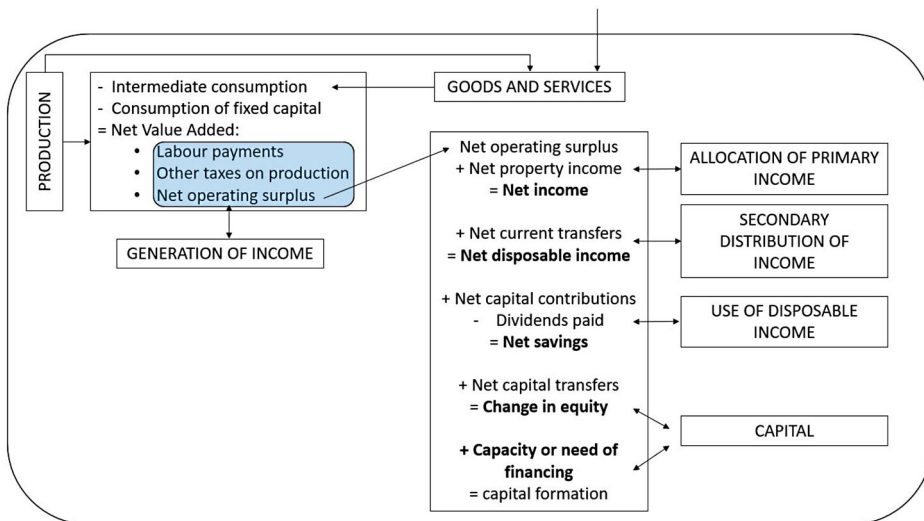
In describing the main aspects of the BAM, we proceed in two steps. First, we compare the basic BAM with an aggregated NAM as described in Kal et al. (2003), see [Supplemental Material](#). The main motivation is the contention that the descriptive and modelling capacity of NAMs can be extended to the firm level. We subsequently describe a more-detailed BAM via a practical example using standard information from a firm's financial accounts.

Figure 1 describes the basic elements incorporated in the BAM. Capital letters are used to name the main BAM accounts. The production of goods and services and the primary income it generates are our starting points. Intermediate goods and services combine with different production factors to generate the goods and services produced and sold by the firm. The firm can also resell previously acquired merchandise. The goods and services account keeps track of all goods, services and merchandise acquired and sold by the firm. Deducting intermediate consumption and the consumption of fixed capital from the firm's production yields the firm's net value added that it generates. Part of this value added is a set of payments to other factors (labour payments) and to the government (other taxes on production). The rest is primary income that stays under the control of the firm. The firm may have or may need to obtain financial assets or pay rent for natural resources.

Allocation of primary income accounts for property income received and paid as the firm generates net income. The account that records the secondary distribution of income allows to obtain the net disposable income by adding current transfers received (e.g. subsidies) and the current transfers paid (e.g. profit tax) to the net income. This concept stands for the accounting results for the period. By adding the net capital contributions from/to stockholders, we end up with the amount of income that the firm can either spend (giving dividends) or keep in the form of net savings for investment or to increase reserves. Net savings plus net noncurrent non-repayable transfers comprise the change in equity, i.e. the firm's 'bottom line'. This result, together with the capacity or need for financing, yields capital formation possibilities (inventories and fixed capital formation). The firm has financing capacity if the balance between the changes in its financial assets and its net borrowing, is positive.

Table 1 highlights a basic aggregate BAM. Its structure is essentially the same as that of a NAM. One important characteristic drives the main differences observed at this level of aggregation. For a national or regional economy, the rest of world (ROW) account are the flows between the local economy and other economies beyond its borders. The domestic flows reflect transactions between many types of agents: producers, consumers, public sector, etc. In the BAM, we consider 'external relations' the transactions between the firm and all other agents, both domestic and foreign. All other flows, those framed with thick lines in Table 1, are purely internal to the firm. Within this area, there is no room for transactions among domestic agents as there is the case in the NAM (e.g.: property income, current

**Figure 1.** Main elements of the business accounting matrix.



**Table 1.** Business accounting matrix (concepts).

ACCOUNT	1. Goods & services (G&S)	2. Production	3. Value added	4. Generation of income	5. Allocation of primary income	6. Secondary distribution of income	7. Use of disposable income	8. Capital	9. Use of change equity	10. Financial	11 & 12. Private & public sectors (current)	13 & 14. Private & public sectors (non-current)	15. Balance	16. Total
1. Goods & services (G&S)	Used Goods and Services (G&S)								Changes in inventories & gross fixed capital formation		Sales (taxes included)	Sales (at book value plus taxes)		
2. Production	Sales (factor prices)													
3. Value added		Net value added (agg.)												
4. Generation of income			Net value added (disagg.)											
5. Allocation of primary income				Net operating surplus							Property income (taxes included)			
6. Secondary distribution of income					Net income						Current non repayable transfers received			
7. Use of disposable income						Net disposable income						Capital contributions		
8. Capital							Net savings	Changes in equity			Adjustments & operative gains	Capital (or non-current) transfers & adjustments & non operative gains	Balance of discontinued operations	
9. Use of change equity		Fixed capital consumption						Changes in inventories & net fixed capital formation & excess or need of financing		Change in borrowing				
10. Financial									Change in financial assets					
11 & 12. Private & public sectors (current)	Acquisitions of current G&S & taxes on current G&S			Labour costs & other production taxes	Property income paid (taxes included)	Current non repayable transfers paid	Dividend paid	Adjustments & operative losses					Balance of current transactions	
13 & 14. Private & public sectors (non-current)	Acquisitions of fixed capital goods & taxes						Returned capital contributions	Capital transfers & adjustments & non operative losses					Balance of non-current transactions	
15. Balance										Balance of changes in financial accounts				
16. Total														

transactions). This is why, instead of talking about industries, we instead refer to departments within the firm and, rather than classify transactions by institution, we identify the corporation as the sole agent. At the same time, the ROW in an EIO is full of agents or stakeholders that a modeller may want to distinguish. Thus, we classify transactions with agents outside of the firm by establishing links to them with the firm.

At the production level, there are other important considerations. A NAM only needs to consider the output produced by the different businesses in an economy. Thus, the logistics



are treated akin to trade margins. Our canonical firm, however, not only can produce but it also can distribute goods and services produced by other firms. So, the BAM refers to sales instead of output, and considers not only commodities used as intermediate consumption but also as finished goods and services acquired for resale.

Another important difference pertains to trade and transport margins. In the BAM, it seems most reasonable to consider them as intermediate consumption. They, therefore, do not appear in [1, 1] in the BAM. This cell only distinguishes between merchandise and other goods and services that are used by the firm in the relevant period. That is, the NAM convention of basic prices is not directly used in the BAM.

The BAM also reflects the firm's complete economic situation, just as a NAM does for an economy; it also covers financial transactions and the firm's financing capacity/requirement. Naturally, the BAM can extend its descriptive capacity by expanding its different accounts further into different components. If the firm has a complete cost accounting, both accounts (1) and (2) can describe the production, cost, and value-added structure at the level of as many goods, services and departments as required by the firm. Our example expands some of the accounts of a fictitious firm to give the reader a better idea of the BAMs' potential. It is based on the standard financial accounts of a real nonfinancial company (a hotel). The [Supplemental Material](#) describes conceptually the contents of each cell of the expanded BAM. The relevant elements for each account are shown by row and column. We next explain the contents of each account of this BAM (Table 2).

### 3.1. The goods and services and production accounts

Table 2 shows one of the most important current accounts of a BAM. The G&S (goods and services) account shows the G&S balances of the business. Its columns display the origins of the G&S and rows their destinations. The account is balanced by construction and is divided into three main groups. The first one (1.1) gathers the G&S that are sold by the firm. Some of them, merchandise, are resold (1.1.1) and the rest, which are finished products and services (sold), are sales of products and services directly produced by the firm (1.1.2). The second group (1.2) consists of goods and services originating outside the firm, some represent flows of current G&S (1.2.1) and others are capital goods (so called fixed assets) (1.2.2). The third group (1.3) includes the cost of the merchandises sold (1.3.1) and the rest of G&S (1.3.2) that are used as intermediate consumption by the firm's departments (2.1) during the period.

Cells [11.1, 1.2.1], [11.2, 1.2.1], [12.1, 1.2.1] and [13.1, 1.2.2] represent invoices for capital goods as well as for current goods and services bought. A portion of these current G&S is acquired from nonfinancial companies [11.1, 1.2.1], yet others from financial entities [11.2, 1.2.1], and the rest is shipped from the public sector (when it operates as a market supplier) [12.1, 1.2.1]. The value of goods and services shipments includes the value added tax (VAT), the 'supported' VAT, which is deducted from the VAT bill. So, the VAT is eliminated from the acquisition price of these goods and services in [12.2, 1.2.1] or in [14.2, 1.2.2]. Services of financial companies are not subject to VAT.

Total current G&S acquired (1.2.1) are classified in used merchandise [1.2.1, 1.3.1], other used goods and services [1.2.1, 1.3.2] and inventories [1.2.1, 9.1]. The first two form the production activity of the firm, which takes these merchandise [1.3.1, 2.1], resells them, and uses the rest of the goods and services [1.3.2, 2.1] as intermediates for its own production



**Table 2.** The business accounting matrix (Part I) and (Part II) (in units of account).

			1, Goods and Services (G & S)						2, Production	3, Value Added	4, Generation of income						5, Allocation of primary income	6, Secondary distribution of income	7, Use of disposable income
			1,1		1,2		1,3		2,1	3,1	4,1				4,2	4,3	5,1	6,1	7,1
			1,1,1	1,1,2	1,2,1	1,2,2	1,3,1	1,3,2			4,1,1	4,1,2	4,1,3	4,1,4					
			Merchandises (sold)	Finished products & services (sold)	Current goods and services (acquisitions)	Fixed capital goods	Merchandises (used)	Rest of goods & services (used)	Departments	Value added	Wages & salaries	Compensations	Employer Social Security	Social benefits	Other production taxes	Net operating surplus	Corporation	Corporation	Corporation
1, Goods and Services (G & S)	1,1	1,1,1	Merchandises (sold)																
		1,1,2	Finished products & services (sold)																
	1,2	1,2,1	Current goods and services (acquisitions)				5,653	2,858,916											
		1,2,2	Fixed capital goods																
	1,3	1,3,1	Merchandises (used)						5,653										
		1,3,2	Rest of goods & services (used)						2,858,916										
2, Production	2,1	Departments	10,520	6,822,799															
3, Value Added	3,1	Value added						3,508,320											
4, Generation of income	4,1	4,1,1	Wages & salaries						2,638,148										
		4,1,2	Compensations						50,005										
		4,1,3	Employer social security						653,523										
		4,1,4	Social benefits						34,790										
	4,2	Other production taxes						204,818											
4,3	Net operating surplus							-72,964											
5, Allocation of primary income	5,1	Corporation												-72,964					
6, Secondary distribution of income	6,1	Corporation													-544,360				
7, Use of disposable income	7,1	Corporation														-585,219			
	8,1	Capital															339,781		
	8,2	Adjusted capital																	
8, Capital	8,3	Change in equity																	
	9,1	Inventories & valuables																	
	9,2	Gross fixed capital formation						460,430											
9, Use of change in equity	9,3	Financing capacity or requirement																	
	10,1	Operating																	
10, Financial	10,2	Non-operating																	
	11,1	Households & non-financial companies			3,078,781				2,638,148	50,005		34,790			69,531	16,000	75,000		
11, Private sector (current)	11,2	Financial companies			11,082										476,438	24,781	0		
	12,1	Market operations			0										0	0	0		
12, Public sector (current)	12,2	Public administration	736	477,246	-201,415					653,523		204,818			-854	78	0		
13, Private sector (capital)	13,1	Households & non-financial companies				150,437											0		
	13,2	Financial companies				0											0		
14, Public sector (capital)	14,1	Market operations				0											0		
	14,2	Public administration				-4,242											0		
15, Balance	15,1	Balance																	
16, Total	16,1	Total	11,256	7,300,045	2,888,448	146,195	5,653	2,858,916	6,833,319	3,508,320	2,638,148	50,005	653,523	34,790	204,818	-72,964	755	-544,360	414,781

Table 2. Continue.

			8. Capital			9. Use of change in equity			10. Financial		11. Private sector (current)		12. Public sector (current)		13. Private sector (capital)		14. Public sector (capital)		15. Balance	16. Total
			8.1	8.2	8.3	9.1	9.2	9.3	10.1	10.2	11.1	11.2	12.1	12.2	13.1	13.2	14.1	14.2	15.1	16.1
			Capital	Adjusted capital	Change in equity	Inventories & valuables	Gross fixed capital formation	Financing capacity or requirement	Operating	Non-operating	Households & non-financial companies	Financial companies	Market operations	Public administration	Households & non-financial companies	Financial companies	Market operations	Public administration	Balance	Total
1. Goods and Services (G & S)	1.1	1.1.1	Merchandises (sold)							11,256	0	0							11,256	
		1.1.2	Finished products & services (sold)			0	5,000			7,295,045	0	0								7,300,045
	1.2	1.2.1	Current goods and services (acquisitions)			23,879														2,888,448
		1.2.2	Fixed capital goods				70,595								75,600	0	0			146,195
	1.3	1.3.1	Merchandises (used)																	5,653
		1.3.2	Rest of goods & services (used)																	2,858,916
2. Production	2.1	Departments																	6,833,319	
3. Value Added	3.1	Value added																	3,508,320	
4. Generation of income	4.1	4.1.1	Wages & salaries																2,638,148	
		4.1.2	Compensations																50,005	
		4.1.3	Employer social security																653,523	
		4.1.4	Social benefits																34,790	
	4.2	Other production taxes																	204,818	
4.3	Net operating surplus																	-72,964		
5. Allocation of primary income	5.1	Corporation							56,487	17,232	0								755	
6. Secondary distribution of income	6.1	Corporation							0	0		0							-544,360	
7. Use of disposable income	7.1	Corporation											1,000,000	0	0				414,781	
8. Capital	8.1	Capital	339,781						0	0	0		10,000	0	0	31,413	0		339,781	
	8.2	Adjusted capital		376,731															381,194	
	8.3	Change in equity			23,879														376,731	
9. Use of change in equity	9.1	Inventories & valuables			23,879														23,879	
	9.2	Gross fixed capital formation			-384,835														75,595	
	9.3	Financing capacity or requirement			737,687			1,973,089	-406,515										2,304,261	
10. Financial	10.1	Operating					-428,007												-428,007	
	10.2	Non-operating					2,732,268												2,732,268	
11. Private sector (current)	11.1	Households & non-financial companies	4,463																1,396,070	
	11.2	Financial companies	0																-496,068	
12. Public sector (current)	12.1	Market operations	0																0	
	12.2	Public administration	0																-1,134,132	
13. Private sector (capital)	13.1	Households & non-financial companies	0	0															935,163	
	13.2	Financial companies	0	0															0	
14. Public sector (capital)	14.1	Market operations	0	0															0	
	14.2	Public administration	0	0															0	
15. Balance	15.1	Balance							-2,401,096	3,138,783									35,655	
16. Total	16.1	Total	339,781	381,194	376,731	23,879	75,595	2,304,261	-428,007	2,732,268	7,362,788	17,232	0	0	1,085,600	0	0	31,413	737,687	
																			41,234,383	

activities. According to cost accounting rules, the costs of sold merchandise [1.3.1, 2.1] and intermediate consumption [1.3.2, 2.1] can be assigned to the different departments of the firm, namely its cost and income centres. Fixed capital goods acquired form part of the firm's gross fixed capital formation [1.2.2, 9.2] or are sold to the private or public sector. In our example, they are only sold to the private sector [1.2.2, 13.1].

Cells [2.1, 1.1.1] and [2.1, 1.1.2] represent the sales of merchandise (10,520 units of account - ua) and own production (6,822,799 ua). Their values include net taxes on products [12.2, 1.1.1] and [12.2, 1.1.2]. These cells include all transport and trade margins paid by the firm, which are considered intermediate goods. For this account to balance, rows and columns must be valued by the same criteria. We, therefore, consider the net taxes on products are registered in [12.2, 1.1.1], and [12.2, 1.1.2] such that these flows are in purchaser prices. These cells, together with [12.2, 1.2.1] and [14.2, 1.2.2], include net taxes (no subsidies exist in our example). The destination of merchandise sales and of own production by institutional sectors are registered in cells [1.1.1, 11.1], [1.1.1, 11.2], [1.1.1, 12.1], [1.1.2, 11.1], [1.1.2, 11.2], [1.1.2, 12.1] and include net taxes on products.

Rows (1.1.1) and (1.1.2), respectively, show destinations of the merchandise resold and of the G&S produced by the firm. In our example both merchandise and own production are sold to households and nonfinancial corporations (11,256 and 7,295,045 ua respectively); another part of the production is devoted to the elaboration of fixed capital goods (5,000 ua in [1.1.2, 9.2]). In the case of own production, the change in inventories (0 ua in our case) is recorded in [1.1.2, 9.1], while the change in inventories of merchandise is in [1.2.1, 9.1].

The uses given to these acquired goods are displayed in rows (1.2.1) and (1.2.2). They consist of using goods and services as well as the merchandise as untransformed goods resold by the corporation [1.2.1, 1.3.1.], intermediate consumption [1.2.1, 1.3.2], increasing inventories [1.2.1, 9.1] and acquired fixed capital goods [1.2.2, 9.2].

When fixed capital goods are acquired from nonfinancial companies, the amount is recorded in [13.1, 1.2.2]; payments made to financial entities are in [13.2, 1.2.2], and the rest, which are bought to the public sector when it operates as a market supplier, are in [14.1, 1.2.2]. In our example, the firm acquires air conditioning equipment for 150,437 ua in [13.1, 1.2.2]. Its sales of fixed capital goods are recorded in [1.2.2, 13.1], [1.2.2, 13.2] and [1.2.2, 14.1], exactly which cell depends on whether the buyer is nonfinancial, financial, or public sector. Used machinery is sold for 80,000 ua and generates VAT of 5,600 ua. But its book value is 70,000 ua, so we register both this book value and the associated VAT in [1.2.2, 13.1]; the profit of 10,000 ua is allocated in [8.2, 13.1]. Obviously, if the prime commercial activity of the firm is that of buying and selling fixed capital goods, the pertinent cell would be that of the commercial activity as previously described. On the other hand, [14.2, 1.2.2] records the indirect taxes charged on sold fixed capital goods (5,600 ua) minus the supported VAT paid (9,842 ua), minus subsidies (0 ua).

One of the most important balances of the BAM is the firm's net value added (3,508,320 ua in [3.1, 2.1]). In this context, value added is the difference between the value of sales of both merchandise and own products (valued at sold prices and excluding any net taxes on products) and the value of all the merchandise acquired together with the intermediates used in the production process (valued at purchase prices, excluding deductible VAT). To obtain net value added, one must also deduct the value of fixed capital consumption [9.2, 2.1].

Value added is the primary income directly generated by the firm. It shows the remuneration of the production factors that enable the primary activities of the firm: either the production or the mere distribution of G&S. It also includes net indirect taxes on production [4.2, 3.1]. The payments to the labour factor not only include wages and salaries [4.1.1, 3.1] but also all other payments related to the labour force like health benefits [4.1.2, 3.1], social security [4.1.3, 3.1] and social benefits [4.1.4, 3.1]. Commissions and bonus payments form part of wages and salaries. The residual of this production account, the net operating surplus, is the income that directly accrues to the firm; in this vein, it is a most critical component of net value added to the firm's management. The rest of value added is out of the firm's locus of control. To obtain net value added and net operating surplus (−72,964 ua [4.3, 3.1]), we deduct fixed capital consumption by departments (460,430 ua, in [9.2, 2.1]).

### ***3.2. Generation and allocation of primary income, secondary distribution of income and the use of disposable income***

We now describe the origin and destination of the primary income generated by the firm. Its origin lies in all elements of net value added (from [4.1.1, 3.1] to [4.3, 3.1]). The destination depends on the institutional sector involved: households for salaries [11.1, 4.1.1], compensations for damage caused like severance payments [11.1, 4.1.2] and social benefits [11.1, 4.1.4]; and the public administration for social security [12.2, 4.1.3] and other indirect taxes on production [12.2, 4.2].

The net operating surplus [5.1, 4.3] is carried forward to the next account, the allocation of primary income, as shown in Table 2. This surplus reflects the income generated (lost in this case) by productive factors directly used in the main activities of the firm. But productive factors owned by the firm can be used by other agents that generate rents (property-type income received) for the firm and that is added to the firm's operating surplus [5.1, 11.1], [5.1, 11.2] and [5.1, 12.1]. On the other hand, the firm also can use productive factors owned by other agents and must pay for them (property-type income paid), thereby reducing its own surplus. This is reported in [11.1, 5.1], [11.2, 5.1] and [12.1, 5.1].

In our example, we add 73,719 ua of property-type income received from different institutions (households, and nonfinancial and financial companies) like rental income, dividends, and interests, to the net operating surplus. We also deduct 545,969 ua of property-type income paid to other agents; so that the difference between the VAT included in the rents received and the VAT included in the rents paid is −854 ua (as shown in [12.2, 5.1]). What remains is the net income of the firm (−544,360 ua in [6.1, 5.1]).

There can be other sources of income and expenses that are not linked to the use of production factors. This is the case of current transfers. The firm could receive a nonrepayable transfer from another private individual or company ([6.1, 11.1] and [6.1, 11.2]), or from the public administration [6.1, 12.2] and must pay a profit tax as well as any related fines and penalties (as is the case at hand) to the public administration (see [12.2, 6.1]). Other payments include grants to households and nonfinancial institutions like nongovernmental organisations [11.1, 6.1] and insurance premiums [11.2, 6.1]. Once the transfers paid (40,859 ua) are deducted from net income and transfers received are added (0 ua), the net disposable income of the firm results (see [7.1, 6.1]).

Disposable income (−585,219 ua) is the income that the firm has available to either distribute among their shareholders or to save. If the firm could have no access to financial markets, disposable income would put a maximum constraint to the fixed capital formation of the firm. However, financial markets allow corporations either to place their own financial resources or to obtain new funding possibilities. The firm can obtain additional funds from its owners by means of an increase in the volume of share available or, contrarily, buy back shares (both cases are types of capital transfers). In our example, households and nonfinancial companies fund the firm to the tune of 1,000,000 ua [7.1, 13.1], but not financial companies [7.1, 13.2] or the government [7.1, 14.2]. Otherwise, the firm does not reimburse its owners during the period (see [13.1, 7.1], [13.2, 7.1], [14.2, 7.1]). Deducting 75,000 ua for the dividends paid (see [11.1, 7.1], [11.2, 7.1] and [12.1, 7.1]) yields the firm's net savings (339,781 ua) in [8.1, 7.1].

### **3.3. Capital, fixed capital formation and financial accounts**

Continuing with Table 2, we can observe the firm's capital, fixed capital formation and financial accounts. In addition to the above-mentioned capital increases, the firm can either obtain capital (noncurrent) transfers (i.e. grants, donations, or bequests) via [8.1, 13.1], [8.1, 13.2] and [8.1, 14.2], or make transfers to other agents, through [13.1, 8.1] [13.2, 8.1] and [14.2, 8.1]. In the example, there are no extra funds to finance investment activities, nor are funds transferred to other agents to finance investments. Therefore, the change in equity [8.2, 8.1] –an aggregate of noncurrent transfers and net savings– equals net savings.

The change in equity can be affected by different operations like the sales of fixed capital goods or financial instruments, impairments, and earnings from holdings. These operations generate non-operating gains and losses, or tax adjustments. The resulting amount defines the adjusted change in equity.

In the example, a change in equity of 339,781 ua, a benefit of 10,000 ua (that was obtained via the sale of a machine as recorded in [8.2, 13.1]), an adjustment due to deferred taxes (31,413 ua in [8.2, 14.2]), and operating losses due to unpaid invoices of households and nonfinancial companies (4,463 ua in [11.1, 8.2]) result in a balance of 376,731 ua as shown in [8.3, 8.2].

Cell [8.2, 15.1] represents the balance for discontinued operations. Due to financial accounting regulations, when a firm divests or shuts down some of its divisions or production lines (or it anticipates the sale or closure in the short term), it should separately record in its income statement all income and expenses (plus profit tax) associated to the pertinent activities. Only the balance (not the item breakdown) of these incomes and expenses is typically displayed in the income statement, however. As there are no discontinued operations in our example, the value of cell [8.2, 15.1] is zero.

The adjusted change in equity is related to two economic variables: the change in inventories and valuables, and the net fixed capital formation. Their balance determines the excess or need for financing, as seen in [9.3, 8.3].

The value of changes in inventories and valuables is 23,879 ua, in [9.1, 8.3], and the net fixed capital formation has a negative balance of 384,835 ua [9.2, 8.3]. If we add the value of consumption of fixed capital, 460,430 ua [9.2, 2.1], the gross fixed capital formation would be 75,595 ua; here 5,000 ua correspond to the fixed capital goods produced by the firm itself [1.1.2, 9.2], while the remaining 70,595 ua represents the balance between the fixed

capital goods it acquires and those sold (at book value) [1.2.2, 9.2]. In the example, the firm has a financing capacity of 737,687 ua.

Financial accounts are divided into two parts: the financial flows related (i) to the firm's operating activities ([10.1, 9.3] and [9.3, 10.1]) and (ii) to its non-operating activities ([10.2, 9.3] and [9.3, 10.2]). In relation to the operating activities, the firm can obtain funds by increasing its liabilities (e.g. increasing payment terms to suppliers) by 1,973,089 ua, while it decreases its acquisition of financial assets (e.g. charging its customers for invoices pending collection) by 428,007 ua. For accounting control, the balance of  $-2,401,096$  ua is displayed in [15.1, 10.1]. In relation to the financial flows affecting non-operating activities, the firm reduces its net financial liabilities by 406,515 ua (e.g. paying off a bank loan), and increases its net financial assets by 2,732,268 ua (e.g. buying stocks or debt securities, lending money to group companies, or obtaining cash by a share capital increase). The balance of 3,138,783 ua is displayed in [15.1, 10.2].

On the other hand, financial accounts displayed in [9.3, 10.1] and [9.3, 10.2] shows the net liabilities that the firm incurs, 1,566,574 ua. While [10.1, 9.3] and [10.2, 9.3] shows its net acquisition of financial assets, i.e. 2,304,261 ua. These financial flows result in an increase in the resources available to finance capital spending in 737,687 ua. (financing capacity).

We can also identify the financing capacity or requirements of the firm with respect to external agents. This we do by examining the firm's external relations accounts (column 15.1) in Table 2, accounts 11 and 12. From these, one can readily see that the firm receives more current flows than it pays from the households and nonfinancial firms (1,396,070 ua, in [11.1, 15.1]), while it pays more than it receives from financial entities ( $-495,069$  ua in [11.2, 15.1]) and public administration ( $-1,134,132$  ua, in [12.2, 15.1]). On the other hand, the firm attains a positive balance with respect to capital operations that originate in both the private and public sector, 935,163 ua [13.1, 15.1] and 35,655 ua [14.2, 15.1], respectively. Adding these balances to capital transfers received and subtracting capital transfers paid results in the firm's global financing capacity/requirement in [16.1, 15.1] and in [15.1, 16.1], which coincides with [9.3, 8.3]: 737,687 ua.

## 4. Applications

### 4.1. Analysis of the results: relation with stakeholders

The firm's performance from the stakeholders' perspective should show the amount of economic and financial flows that it shares with them. Therefore, a first step in this effort should consist of carefully observing the evolution of the firm's balances with other institutions in the BAM.

Data in column (15.1) show the balances of transactions, current and noncurrent, between the firm and households and nonfinancial entities, financial entities, and the public sector (both under its administrative role as well as through its commercial operations). Table 3, a collection of the firm's data for three consecutive years, displays the balances of flows generated between the firm and its stakeholders; it also shows the differences of these balances across the different years. Via this table we can observe the degree to which the firm depends on its relevant interest groups, at least insofar as financial flows are concerned.

**Table 3.** Balance of transactions with stakeholders (in units of account).

	15.1	Year 1	Year 2	Year 3	Year 2–Year 1	Year 3–Year 2	Year 3–Year 1
11.1 Balance of current transactions (households and non-financial companies)		2,903,621	2,159,674	1,396,070	−743,947	−763,604	−1,507,551
11.2 Balance of current transactions (financial companies)		−435,360	−483,207	−495,069	−47,847	−11,862	−59,709
12.1 Balance of current transactions (market operations of public sector)		0	0	0	0	0	0
12.2 Balance of current transactions (public administration)		−1,152,363	−1,081,052	−1,134,132	71,311	−53,080	18,231
13.1 Balance of non-current transactions (households and non-financial companies)		−227,228	−134,050	935,163	93,178	1,069,213	1,162,391
13.2 Balance of non-current transactions (financial companies)		0	0	0	0	0	0
14.1 Balance of non-current transactions (market operations of public sector)		0	0	0	0	0	0
14.2 Balance of non-current transactions (public administration)		55,898	40,005	35,655	−15,893	−4,350	−20,243
15.1 Capacity or need for financing		1,144,568	501,370	737,687	−643,198	236,317	−406,881

In the example, the main surplus relates to households and nonfinancial corporations for current flows and the highest deficit appears to be with the public sector. Current operations with households and nonfinancial entities generate resources (via commercial operations) that meet the demands of financial entities (mainly financial expenses) and public administration (by means of taxes, social security contributions, and fines and penalties, net of current subsidies). The resources also help to satisfy the needs related to noncurrent (or capital) flows of households and nonfinancial entities (in this case, due to the acquisition of fixed assets). The current outflows to the public sector are important as they represent substantial shares of the balance of current transactions with households and nonfinancial companies (40% in year 1 and 81% in year 3). In other words, substantial shares of positive net flows run from the private sector to the public sector.

In year 3, a positive value in noncurrent flows arises mainly due to contributions from households' and nonfinancial firms' capital shares, 1,000,000 ua. (See [7.1, 13.1] of the BAM). These telegraph that the firm can solve potential problems internally. If not for this transaction, the firm, *ceteris paribus*, would have gone from having surplus financing to a deficit position ( $737,687 \text{ ua} - 1,000,000 \text{ ua} = -262,313 \text{ ua}$ ). This would make it very difficult for the firm to keep operating. Bank loans could help, of course, but it could be difficult for the firm to secure them under such conditions.

What stands out most is a change in firm's financing capacity between year 1 and year 2, from 1,144,568 ua to 501,370 ua. This capacity rebounds in year 3, although the balance still lies well below the initial one. Still, all these balances are positive, which shows that



**Table 4.** Balance of current transactions with households and non-financial companies (in units of account).

11.1 Households and non-financial companies (current)	Year 3
(+) Sales of merchandises (net taxes included)	11,256
(+) Sales of finished goods and services (net taxes included)	7,295,045
(+) Property income received (financial investments included) (net taxes included)	56,487
(+) Current non repayable transfers received	0
(+) Adjustments & operating gains	0
(-) Acquisition of goods and services (net taxes included)	-3,078,781
(-) Wages & salaries	-2,638,148
(-) Compensations	-50,005
(-) Social benefits	-34,790
(-) Property income (net taxes included)	-69,531
(-) Current non-repayable paid transfers	-16,000
(-) Adjustments & operating losses	-4,463
<b>= Balance of current transactions (households and non-financial companies)</b>	<b>1,471,070</b>
(-) Dividends paid	-75,000
<b>= Net balance of current transactions (households and non-financial companies)</b>	<b>1,396,070</b>

the firm maintains a solid financing surplus. This evolution is mainly driven by decreases in the firm's balance of current transactions with households and nonfinancial companies over the whole period. That is, the demand for the firm's products and services degraded substantially over the period. Except for that related to capital transactions, other balances do not much alter the firm's financing capacity. The substantial rise of capital transactions in year 3 counteracts the negative tendency of the firm's final balance.

Short-term solvency or working capital also is a very popular indicator of the solvency of a firm (Porter & Norton, 1995). It focuses on the firm's capacity to deal with its core debt. It is usually measured as the difference between current assets and current liabilities. This term is equivalent to the difference between the variations experienced by financial operating [10.1, 9.3] plus financial non-operating [10.2, 9.3] assets; and operating [9.3, 10.1] plus non-operating [9.3, 10.2] liabilities, from one year to the next (see Table 2). Note that this measure is based on financial instruments only, with no consideration for inventories (like merchandise or finished products) or fixed assets; it is, therefore, stricter. The last balance, capacity or need for financing, precisely refers to this concept. It rebounds in year 3 from a precipitous fall in year 2 via mechanisms discussed previously.

This analysis can be broken down by stakeholder. For instance, Table 4 shows the current flows generated with households and nonfinancial companies, recorded in row (11.1) and column (11.1). Sales of finished goods and services represent the main source of incoming flows for the firm, while acquisition of G&S and wages and salaries are main outflows from the firm. These two concepts cover almost 80% of all incoming flows for this stakeholder. Note that this table is not an income statement segmented by interest groups, rather it includes the economic and financial flows generated. Technically, it is akin to a statement of source and application of ordinary funds or potential treasury. That is, if everything sold was collected and everything purchased was paid, it represents the theoretical cash balance of the firm, that is of its operations associated with households and nonfinancial companies.

If one focuses on current operations with the public administration (Table 5, row 12.2 and column 12.2), social security payments are a most important outflow as are net taxes on

**Table 5.** Balance of current transactions with the public administration (in units of account).

12.2. Public sector (public administration) (current)	Year 3
(+) Current non repayable transfers received	0
(-) Net taxes on sold merchandises (output tax minus subsidies)	-736
(-) Net taxes on sold products and services (output tax minus subsidies)	-477,246
(+) Supported & deductible indirect tax (goods and services)	201,415
(+) Supported & deductible indirect tax (property income)	854
(-) Other production taxes	-204,818
(-) Employer social security	-653,523
(-) Current non repayable transfers (included profit tax and fines and penalties)	-78
<b>= Balance of current transactions (public administration)</b>	<b>-1,134,132</b>

**Table 6.** Categories used to disaggregate the BAM.

<b>G&amp;S produced</b>		<b>G&amp;S acquired</b>		<b>Capital goods</b>	
1	Accommodation	1	Advertising	1	Cleaning
2	Atypical	2	Beverages	2	Cutlery
3	Beauty	3	Cleaning	3	Dishes
4	Billiards	4	Communications	4	Glassware
5	Board	5	Community charges	5	Kitchenware
6	Cellar bar salon	6	Customer services	6	Replacement
7	Clothes spa	7	Cutlery	7	Various materials
8	DVD	8	Dishes		
9	Extra ticket	9	Food		
10	Fax	10	Glassware	1	<b>Departments</b> Rentals
11	Forex	11	Hotel uniforms	2	Accommodation
12	Guards	12	Insurance	3	Minibars
13	Health & beauty	13	Kitchenware	4	Check-in and Administration
14	Internet	14	Lingerie	5	Restaurant
15	Light	15	Office supplies	6	Snack Bar
16	Lingerie	16	Other services		
17	Massage	17	Professional services		
18	Massage à la carte	18	Repair and maintenance		
19	Massage rentals	19	Replacement	1	<b>Clients</b> 1 adult no kids
20	Minibar drinks	20	Subcontractors	2	1 adult with kids
21	Minibar food	21	Supplies	3	2 or more adults no kids
22	Parties	22	Temporary works	4	2 or more adults with kids
23	Rest, Beverages	23	Transport	5	Unaccompanied kids
24	Rest, Bodega	24	Various materials	6	Unclassified
25	Rest, Food				
26	Room 'El Vigía'				
27	Safe				
28	Salon bar drinks				
29	Snack bar drinks				
30	Snack bar food				
31	See-sight supplement				
32	Telephone				
33	Tennis court				
34	Tennis rentals				

merchandise and products sold. Fines and penalties as well as tax on profits are irrelevant, and there are no current public grants.

#### 4.2. Modelling exercise: changes in final demand

The previous application does not consider simulation possibilities of the BAM. As mentioned before, the BAM can be expanded into a social business accounting matrix (SBAM)

by disaggregating the information into the firm's departments (equivalent to activities in a national framework), types of goods, categories of value added and final demand, etc. Such extension enables a firm to undertake simulations that are equivalent to those analysts prepare using national or regional SAMs. Just as there is no such a thing as a unique structure for a SAM, we do not insist that our proposed BAM has a canonical SBAM. We propose ours only as a starting point for others. We use hotel information in an EIO table (Manrique-de-Lara-Peñate & Langa-Seva, 2021) to enhance our BAM and adjust it proportionally.

To adapt the hotel information available enabled the disaggregation of many BAM accounts, Table 6 shows the different accounts in our extended BAM. The firm sells 34 categories of goods and services, buys 24 categories of goods and services, and has seven categories of capital/investment goods. Further, the SBAM in Table 6 has seven household types. The first six are clients, and the last is the set of transactions with resident local households. The categories of goods and services produced are used to disaggregate account [1.1.2], the categories of goods and services acquired are used to disaggregate accounts [1.2.1], [1.2.2] and [1.3.2]. The firm's different departments are applied to accounts [2.1] and [3.1], and the household categories are applied to account [11.1]. In summary, the original 35 accounts of the BAM become 136 accounts in the SBAM.

The firm's departments use goods and services (acquired) to supply their own goods and services (produced). Part of this process is displayed in Table 7, which shows intermediate consumption, net value added, fixed capital consumption and total production by department. This table reflects the new disaggregated production accounts [2.1]. IO technical coefficients correspond to the ratios between the intermediate consumption and the value of total production, i.e. the column coefficients of the SBAM.

Since a hotel's Reception (check-in department) invoices very few services to the clients, and its Administration none, the net and gross value added of these two departments, when combined, is negative. This contrasts with the sectors in a national or regional accounting matrix, in which it makes no sense for activities to have negative gross value added (at least in the long run). The most relevant item for the firm is not value added but, rather, operating surplus. Total net operating surplus is negative. That is, while the net operating surplus is positive for the first three departments, it is negative for the rest. In this instance, the firm can bear a negative operating surplus because it receives sufficient capital contributions from its stakeholders during the period considered. The broad picture given by the BAM helps contemplate such circumstances, which are beyond those of simple accounts of the firm's production.

Now that we have the equivalent of a firm's SAM, we can describe how it can be used to simulate changes to the firm's activities. That is, we can alter some elements of the SBAM and see how we should expect its other elements to change as a result. Our description is based on that in Breisinger et al. (2010).

Let  $\mathbf{B}$  be a square  $n \times n$  matrix that records all the transactions  $\{b_{ij}\}$  among the  $n$  accounts of the SBAM. By construction, row and column totals are equivalent:

$$\sum_{j=1}^n b_{ij} = t_i = \sum_{j=1}^n b_{ji} \quad (1)$$

**Table 7.** Disaggregated production account (in units of account).

	Departments (activities)						TOTAL
	RENTALS	ACCOMMODATION	MINIBARS	CHECK-IN & ADMIN	RESTAURANT	SNACK BAR	
<b>Merchandises</b>				5,653			5,653
Advertising		220,528		27,566	22,053	5,513	275,660
Beverages	303		10,074	17,027	144,104	100,045	271,553
Cleaning				52,621	43,382	1,143	97,146
Communications		27,345		3,418	2,735	684	34,182
Community charges		4,202		525	420	105	5,252
Customer services			54	38,937		755	39,746
Cutlery				3,070	92		3,162
Dishes					1,314		1,314
Food	401		915	22,933	838,155	27,009	889,413
Glassware			141	332		1,662	2,135
Hotel uniforms				7,787	101		7,888
Insurance		21,744		2,718	2,174	544	27,180
Kitchenware		1,236		398	384	74	2,092
Lingerie		9,534	15	22,204			31,753
Office supplies				41,493			41,493
Other services		93,836		11,729	9,384	2,346	117,295
Professional services		21,084		2,636	2,108	527	26,355
Repair and Maintenance		246,911		30,864	24,691	6,173	308,639
Replacement				87	6		93
Subcontractors		160,778		582	466	116	161,942
Supplies		346,783		43,348	34,678	8,670	433,479
Temporary works		1,354					1,354
Transport		15,178		1,897	1,518	379	18,972
Various materials			18	7,017	20,870	32,913	60,818
<b>Total intermediate consumption</b>	704	1,170,513	11,217	344,842	1,148,635	188,658	2,864,569
<b>Net Value Added</b>	48,201	2,373,882	17,836	-206,064	1,067,436	207,029	3,508,320
Wages & salaries	7,089	1,017,985	3,703	331,052	1,122,169	156,150	2,638,148
Compensations	134	19,296	70	6,275	21,270	2,960	50,005
Employer social security	1,756	252,176	917	82,008	277,984	38,682	653,523
Social benefits	94	13,424	49	4,366	14,798	2,059	34,790
Other production taxes	550	79,033	288	25,702	87,122	12,123	204,818
Net operating surplus	38,577	991,969	12,809	-655,467	-455,907	-4,945	-72,964
<b>Fixed capital consumption</b>	3,533	256,076	2,099	10,027	160,107	28,588	460,430
<b>Total production</b>	52,438	3,800,471	31,152	148,805	2,376,178	424,275	6,833,319

Goods and services acquired

We can define matrix  $\mathbf{M}$  of column coefficients, each of them calculated as:

$$m_{ij} = \frac{b_{ij}}{t_j} \Rightarrow b_{ij} = t_j m_{ij} \Leftrightarrow \mathbf{M}\mathbf{t} = \mathbf{t}.$$

$$\text{Being } \mathbf{M} = \{m_{ij}\}, (i, j = 1, \dots, n); \text{ and } \mathbf{t} = \begin{bmatrix} t_1 \\ \vdots \\ t_n \end{bmatrix}$$

Without loss of generality, if we define the set of endogenous accounts  $A_e = \{1 \dots k\}$  and the set of exogenous accounts  $A_x = \{k+1 \dots n\}$  as subsets of set  $A$ , we can express Equation 1 as:

$$\sum_{j=1}^k t_j \bar{m}_{ij} + \sum_{j=k+1}^n b_{ij} = t_i \forall i$$

or in matrix notation:

$$\bar{\mathbf{M}}\mathbf{t} + \mathbf{E}\mathbf{u} = \mathbf{t}$$

where  $\bar{m}_{ij} = m$  for  $j \in A_e$ ;  $\bar{m}_{ij} = 0$  for  $j \in A_x$ ;  $\mathbf{E}$  is the  $n \times (n-k)$  matrix of exogenous accounts, and  $\mathbf{u}$  is a vector of ones, here of length  $n-k$ .

Therefore,  $\mathbf{t}$  can be expressed as:

$$\mathbf{t} = (\mathbf{I} - \bar{\mathbf{M}})^{-1} \mathbf{E}\mathbf{u}$$

where  $\mathbf{I}$  is the  $n \times n$  identity matrix.

In other words, by defining the new matrix of exogenous accounts as  $\mathbf{E}'$ , we obtain the corresponding new vector of column totals  $\mathbf{t}'$ , from which we can reconstruct  $\mathbf{B}'$  (the new SBAM), the endogenous columns of the SBAM (in this new matrix the columns for the exogenous accounts are all equal to zero), as follows:

$$\mathbf{B}' = \bar{\mathbf{M}}\hat{\mathbf{t}}$$

where  $\hat{\mathbf{t}}$  is a diagonal matrix constructed from the row vector  $\mathbf{t}$ , which is expressed as  $\mathbf{t}'$ .

Matrix  $(\mathbf{I} - \bar{\mathbf{M}})^{-1}$  is the SBAM multiplier matrix and its  $i^{\text{th}}-j^{\text{th}}$  element can be interpreted as the increase (decrease) in income of account  $i$ , due to an injection (detraction) into exogenous account  $j$ . If the vector of exogeneous accounts consists of the final demand of the clients of the firm, the impact on the production accounts would incorporate not just the direct but also the indirect effects of the changes in final demand. However, this depends on the matrix of intermediate consumption. If none of the firm's own-produced goods and services are also used as intermediates, the total (direct and indirect) requirements do not differ.

In our simulation, it is precisely the expenditures of the firm's clients that are considered exogenous. So, we simulate a 30% increase in the expenditures of each client group separately, see in Table 8. We have chosen three types of impacts of interest to the firm. The first two – the impact on net value added and net operating surplus – could be obtained directly from an EIO accounting model. The third one, the change in equity, can be obtained only from a BAM model.



The final impact depends on the relative importance of each client group in the firm's total expenditures and on the relative composition of the expenditures of each of them. The largest impacts are observed for groups 3 and 6, the two that comprise the two largest shares of expenditures (60% and 25%, respectively). In terms of services consumed, the hotel's accommodation and restaurants count for most payments (60% and 35% respectively) made by all the client groups. Note further that rises in client expenditures on rentals, accommodation and minibars generate increase in the hotel's net operating surplus while those made within all other departments generate a decrease in the hotel's net operating surplus. Total net operating surplus ameliorates but is still negative and the final change in this magnitude depends on the expenditure structure of the different groups of clients. The initial level of net operating surplus can be obtained by subtracting the net operating surplus with the change in net operating surplus.

The change in equity of the firm varies accordingly with the net value added. In part this is because the level of capital contributions from its stakeholders is endogenous; it varies almost directly with changes in activity. In other words, the firm is able to compensate for any difficulties in generating primary income by getting more capital contributions from its stakeholders. When the capital contributions of stakeholders are fixed, however, the change in equity is negative in all cases but simulation 3, in which the rise in net operating surplus facilitates a positive change in equity.

## 5. Conclusions

In this paper, we show the applicability of the national accounts structure to the firm. The different national accounts aggregates are directly relevant to analyses of the progress of firms and, therefore, can be a promising tool for decision-making processes of firms. We contend that managers should supplement their traditional accounting systems with such an economically oriented framework as the BAM and the SBAM. Insofar as firms are increasingly expressing a desire to display their awareness of issues pertaining to social responsibility, the analysis in subsection 'Analysis of the results: relations with stakeholders' can be a good reference point for such displays.

We believe that the BAM framework can be especially useful for the multi-establishment enterprise because the relations among establishments (including, e.g. loans between establishments of the same firm, exchange of goods and services produced by its different establishments, shared use of resources, etc.) is easy to adapt and akin to a multiregional IO (MRIO) framework. Of course, as in an MRIO framework the flows generated by different establishments should be independently registered. Global results can be obtained through aggregation of the cells corresponding to the different establishments or firms.

In broader terms, we believe this framework could be a very useful tool for simulating the potential impacts of regulatory issues. Governments could present effects of the activity on their own establishments as well as on other regulated private establishments, such as utilities.

A BAM is a benchmark representation of the firm that can be used to model its own internal decisions. The main accounting balances would be the basis for the equilibrium identities of simulations of any policies to be implemented by management. Here, ideally, an analyst would use a more disaggregated BAM representation (the SBAM), focusing on more intensively on production and goods and services accounts as well as all accounts



related to the firm's labour. Both frameworks, the BAM and the SBAM, facilitate the use of modelling approaches typically applied to IO tables and SAMs, albeit now at a firm level. On the other hand, this framework could perfectly be used to help the firm optimise its decision-making. We believe that optimisation models, which allow for the imposition of all type of relevant constraints to a firm, are likely to be more useful than are multiplier-based approaches. Further, structural decomposition analysis (SDA) and efficiency measurement of BAMs over time could also prove useful to firms. This would amount to identifying the origins of major changes in each of the main balances of the BAM. Similarly, an SDA that compares the BAM structure across different establishments could also provide insight into the benefits of different management and accounting styles. Incorporating a BAM into a wider national or regional framework also might help to study the best way for big firms to incorporate into the global supply chains.

Financial accounting makes it relatively easy to link the economic flows and funds of a firm across different periods. Doing so with BAMs is tantamount to dynamic economic modelling and performing such modelling for firms could enhance firm-level planning. Future research also could extend this framework to financial companies and to environmental issues.

The matrix structure of the BAM facilitates the mathematical treatment of accounting information. We must bear in mind that most of the relevant machine-learning pattern-identification techniques like neural networks are based on information structured in matrix form. BAMs could be an alternative starting point in this field.

It is obvious that a strict translation of the national accounting framework to the financial accounting model is likely unreasonable. This is due to aspects like valuation criteria as well as the existence of national-level flows that are irrelevant to the firm. In any case, the research reported herein should be considered a preliminary effort that combines both accounting approaches. It attempts to solve several inconsistencies between the two approaches and, we believe, offers a perspective that should help anyone trying to compose a more complete picture of a firm. We hope our effort encourages further research that fully represents the economic flows in a firm's milieu. Online supplemental material that accompanies this paper offers readers the possibility to effortlessly prepare a BAM, as long as the financial accounts of a firm are available. We invite other researchers to use and extend our proposal for preparing BAMs. Naturally, variations will be needed to best serve specific needs of a particular company.

## **Acknowledgements**

We would like to show our gratitude to MUR Hotels for sharing with us the basic necessary data to prepare the EIO table. We would also like to thank the editor and two reviewers for their thoughtful comments and efforts towards improving our manuscript. The Feedback Sessions organised during the 26th International Input–Output Conference in Juiz de Fora, Brasil, where an early version of this paper was presented, turned out to be of great help in improving this work. Satoshi Inomata, organiser of these sessions also greatly contributed with his comments to our work. We also thank Antonio Estache for his valuable suggestions.

## **Disclosure statement**

No potential conflict of interest was reported by the author(s).

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