**The SAM as a tool of economic data base architectural design.**

**The case of Chile: 2008-2011**

by

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**Abstract**

The SAM primarily is an accounting framework. If SAM microdata base is exhaustive then SAM is a map of the economy. The practical consequence of these two assumptions is that the SAM gives the best approach to design economic multidimensional data bases. In this paper we demonstrate that the two assumptions are realistic and prove that SAM is a robust data base model design. Demonstrations are based on the SAM for Chilean economy for the years 2008 to 2011. Those SAMs replicate in a matrix way all of the Chilean national accounts officially published. In order to present the full data and the architectural design a Microsoft Access data base is used. This tool is easy to apply for any SAM or national accounts of every country. Besides the approach is equally relevant to apply on national accounts extensions like satellite and regional accounts.

**Introduction**

Every cell in a SAM expresses an economic fact

$$\text{Economic fact} = f(x,i,j)$$

Where $x$ is an operation, $i$ is an object and $j$ is an agent. This expression reflects a simple entry in an accounting framework. Double entry is a combination of two simply entries and quadruple entry is a combination of two double entries. The national accounts rules established the quadruple entry as the essential of every economic fact registration. The practical issues in national accounts compilations hides this essential point. It is not possible to build national accounts using quadruple entries in an exhaustive and integral way. But, for economic data base design is necessary to define the entire domain of the economic facts.

That simple expression has many implications. The two more relevant are:

- The function f(*x,i,j*) allows to register all of the economic facts without exceptions. Even considering value or physical measurements. At the same time it's possible to locate the fact in a matrix like Social Accounting Matrix (SAM) or Input- Output Table (IOT). In this sense the function provide an authentic map of the economy.
- The function follows the same organization of REA (resource, event, agents) models used in relational data base design (Chang, Ingraham, p.1). From this viewpoint is possible to integrate in one data base design every economic data base.

In this paper the model is explained, in the first section with the implications in terms of data base organization. In the second section the concept of the matrix as map is developed, considering data in SAM and off SAM fully articulated. In the third section the annual Chilean national SAM is obtained starting from the data base and economic concepts established in the previous sections.

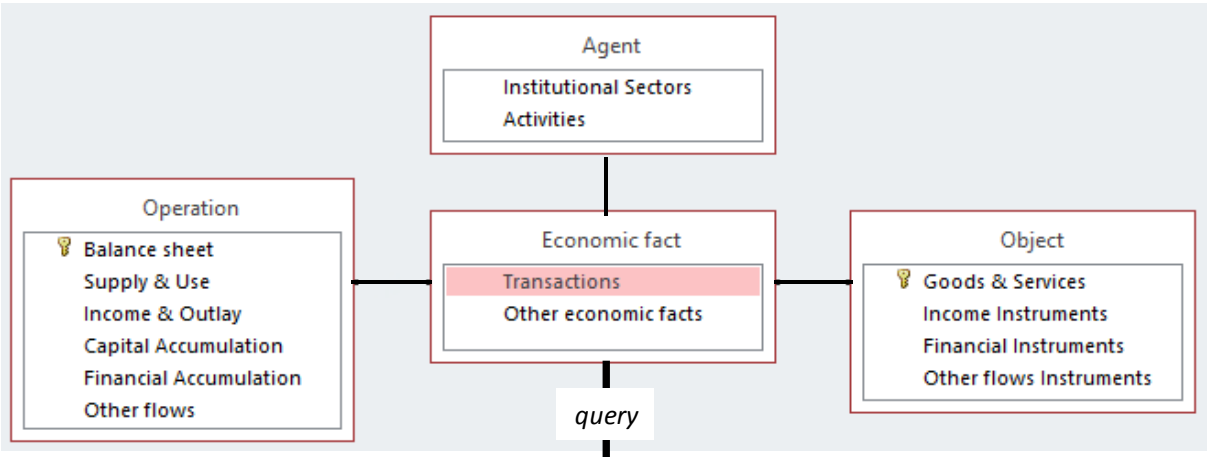
**The SAM in a relational data base design**

First of all, it is necessary to point out that a relational or a multidimensional data base manages the data as objects (tables, queries, forms and reports). The distinction between basic tables and queries is essential (see figure 1). National or satellite accounts, SAMs, IOTs, and every analytical statements or framework are queries. That is very relevant, because analysts as users of data bases introduce bias in the data base organization, starting from the specialized field where they work. Any of those fields do not give the best approach to design a data base.

What is the normal design that ensures the optimal use of a data base?

An economic fact origins data. The design of an economic data base must be neutral regarding the diversity of analytic uses it might have. Thus, a first distinction between structure and analytic use of the data can be established.

Figure 1. Essential components of a relational data base economic model




SAM /SNA 2008

| | | | | Balance inicio | Flujos | | | | | | | | Total flujos | Otros flujos | Balance cierre |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cuenta Corriente | | | | Cuenta de Acumulación | | | Resto del mundo | | | |
| | | | | | Rentas | S.Instituc. | Bs.y ss. | Actividad | Capital | I.Financ. | S.Instituc. | | | | |
| | | | | Sa | A | B | C | D | E | F | G | H | T | R | Sc |
| Balance de apertura | | | Sa | | | | | | 9.922 | | 6.792 | 573 | | | |
| Flujos | Cuenta Corriente | Rentas | A | | | 1.526 | | 1.441 | | | | 79 | 3.046 | | |
| | | Sectores institucionales | B | | 2.967 | | 133 | 58 | | | | | 3.158 | | |
| | | Bienes y servicios | C | | | 1.399 | | 1.883 | 414 | | | 540 | 4.236 | | |
| | | Actividades | D | | | | 3.604 | | | | | | 3.604 | | |
| | Cta. de Acumu-lación | Capital | E | | | 233 | | 222 | | -3 | | | 452 | | 452 |
| | | Instrumentos financieros | F | | | | | | 38 | | 603 | 47 | 688 | 384 | 1.072 |
| | | Sectores institucionales | G | 16.714 | | | | | | 603 | | | 603 | | 17.317 |
| | Resto del Mundo | | H | 573 | 79 | | 499 | | | 88 | | | 666 | 7 | 1.246 |
| Total flujos | | | T | | 3.046 | 3.158 | 4.236 | 3.604 | 452 | 688 | 603 | 666 | 16.453 | | |
| Otros flujos | | | R | | | | | | 290 | | | 7 | | | 297 |
| Balance de cierre | | | Sc | | | | | | 10.664 | 688 | 7.395 | 1.246 | | 391 | 20.384 |

The structure of the economic data

The structure of the data can be understood starting from the rules of grammar. An economic fact can be identified as a grammatical phrase. The proper and common nouns define the agent (*j*) and the economic object (*i*). The verb defines the economic operation (*x*).

If the transaction is interpreted as a grammatical sentence, it would have: subject (agent), verb (operation) and predicate (object) and adjectives or attributes.

The adjectives or attributes determine the agent and object noun. Two big categories of attributes can be established: Adjectives that refer to the context of the economic fact and to the object's quantification.

Attributes of context refer to time (*t*) and space (*s*) which determine the three basic elements: agent, operation and object.

Quantification attributes define the position (*p*) or topology of the object, considering its placement in the agent's net worth, whether they would be assets, liabilities or net worth. On other aspect, they refer to the many ways of measurement of the object (*m*), where the component of measurement or quantification can be distinguished, of which the basic elements are quantity, prices or values. From this components arise three entities. When referring to quantity, certain units of volume measurement must be established, such as kilos, liters, hectares, etc. When referring to price and values other two entities arise: the measure unit, in monetary terms, and the valuation. Valuation (*v*) allows distinguishing several prices or values of an object, depending on the time, space and the services that increase those values. Finally, the register type (*r*) identifies the component and format of the data. The data can be defined by price, volume or value and take the form of a basic amount, index, indicator or parameter.

The position of the object can be modified by increasing or diminishing the net worth. Accounting gathers this phenomenon by entry (e). In the asset position, the debit registers increase and credit registers decrease. In the liability position, the entry is the opposite. In any case, there is always a resource in debits and a use in credits.

From the previously stated, in functional terms it can be defined as:

$$\text{Economic fact} = f(x, t, s, e, f, i, b, m, v, j)$$

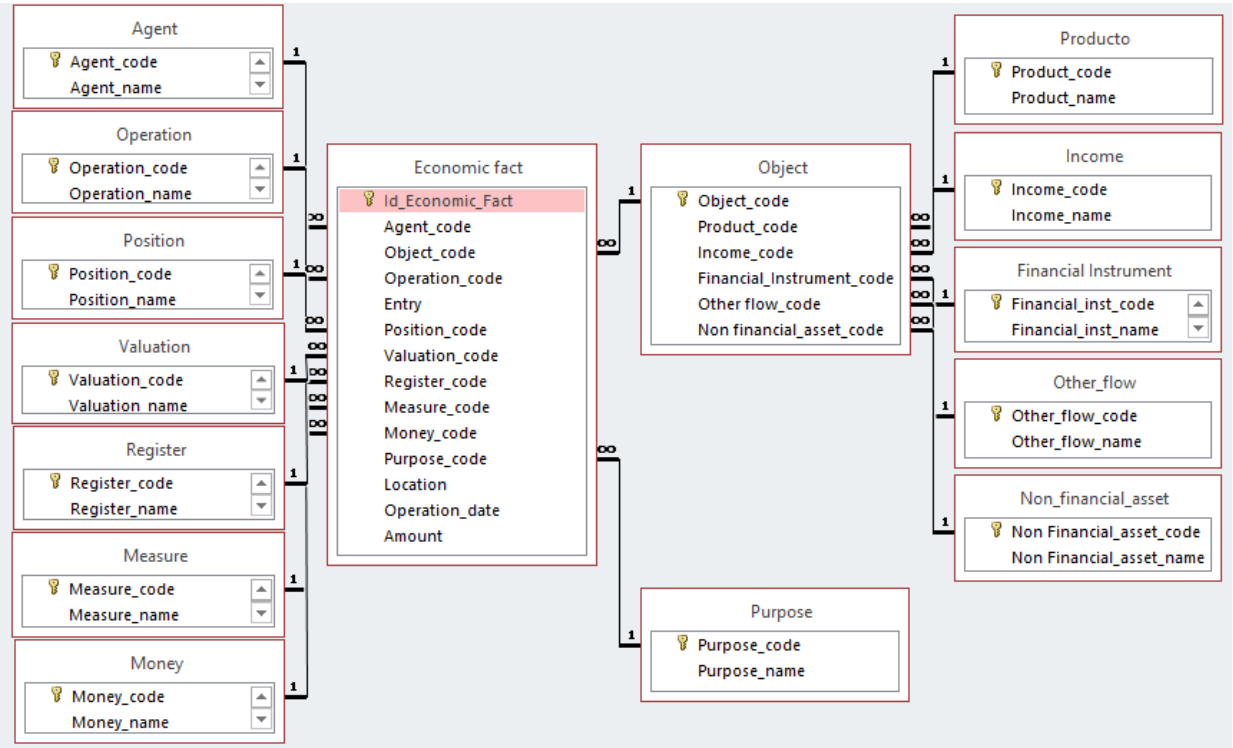
Which in terms of an explicatory matrix would be as it follows:

Table 1. The structure of the economic data

| | | Agent ( *j* ) | Object ( *i* ) | Operation ( *x* ) |
|---|---|---|---|---|
| Time | ( *t* ) | *jt* | *it* | *xt* |
| Space | ( *s* ) | *js* | *is* | *xs* |
| Entry | ( *e* ) | | | *xe* |
| Position | ( *b* ) | | *ib* | |
| Measurement | ( *m* ) | | *im* | |
| Valuation | ( *v* ) | | *iv* | |
| Registry | ( *r* ) | | *ir* | |

Considering the dimensions thus defined, the star schema (Adamson, 2010), with a bigger level of data specificity, would be as shown in figure 2.

Figure 2. Data star schema. Definition of accounting




The analytic use of the data

The dimensional model previously described corresponds with the definition of "pure" entities. As it can be deduced, there is not a plan or system of financial accounts, statistics or reports that are incorporated to the model in an explicit way. As it will be shown next, all those specific variations of information are situated in a less abstract level, therefore more concrete that the enunciated model. In practical terms, they constitute different queries for the data system.

The analytic use is supported on big accounting systems, and in charts, tables, reports and any arrangement oriented to an objective of special analysis or economic policies. Among those big accounting systems we have:

- System of National Accounts (SNA)

- Balance of Payments and International Investment Position (BPM)
- Monetary and Financial Statistics (MFS)
- Public Finances Statistics (FPS)
- Satellite account systems: health, tourism, culture, nonprofit institutions among others.

The SNA fulfills the role of axis to all the macroeconomic accounting systems and provides an adequate framework to incorporate any specific analytic approach, whether it would be sectorial, regional or any kind of other dimensions.

Among the analytic arrangements we can distinguish by importance:

- The social accounting matrix (SAM) and its extensions
- The input-output table (IOT)
- The flow of funds statements

In general terms, an analytic arrangement is a table that complements or crosses the big systems previously mentioned. For example, the analytic tables of foreign debt that are extensions of the BPM and FPS.

The concept of functionality is key to define an analytic use of data. All the analytic uses previously mentioned are characterized by defining functional classifications or purpose of an economic fact. That is the case of the classification of the functions of government (COFOG), classification of individual consumption according to purpose (COICOP) or the socioeconomic classifications typically present in the SAMs: rural, urban and categories of the labor factor.

**The SAM as an economy MAP**

From the third manual of national accounts (SNA 1968 or Revision 3), a thorough set of registries has been completed, including all the economic facts. The system as a set of accounts has quite a complex structure. Whether in its “T” accounts format presented in the

different chapters of the manuals or the panoramic table format (tables 2.13 and 2.14, SNA 2008, pages 31-32), it isn't accessible without a specialized knowledge in national accounts. In that context, the SAM as a matrix format presents the system in an articulate way, considering all the relations of agents and economic objects in the different economic facts. Therefore the SAM as a double entry table can effectively provide a map of the economy. For this property, the SAM has to conceptually include all the SNA registries. In other words, it has to fulfill the exhaustiveness principle of the SNA.

The best proof can be obtained by recurring to the numeric exercise that goes with the last three versions of the national accounts manual (1968, 1993 y 2008). Figure 3 shows the SAM from the SNA's numeric exercise on its most added data.

Figure 3. Integrated Macro SAM of stocks and flows

| | | | | Opening balance | Flows | | | | | | | | Total flows | Other flows | Closing balance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Current Accounts | | | | Accumulation Accounts | | | Rest of the world | | | |
| | | | | | I&O | Instit.S | Prod | Activit | Capital | Financ.I | Instit.S | | | | |
| | | | | Ob | A | B | C | D | E | F | G | H | T | R | Cb |
| Opening balance sheet | | | Ob | | | | | | 9.922 | | 6.792 | 573 | | | |
| Flows | Current Accounts | Income-Outlay | A | | | 1.526 | | 1.441 | | | | 79 | 3.046 | | |
| | | Institutional Sectors | B | | 2.967 | | 133 | 58 | | | | | 3.158 | | |
| | | Products | C | | | 1.399 | | 1.883 | 414 | | | 540 | 4.236 | | |
| | | Activities | D | | | | 3.604 | | | | | | 3.604 | | |
| | Accumu-lation Accounts | Capital | E | | | 233 | | 222 | | -3 | | | 452 | | 452 |
| | | Financial Instruments | F | | | | | | 38 | | 603 | 47 | 688 | 384 | 1.072 |
| | | Institutional Sectors | G | 16.714 | | | | | | 603 | | | 603 | | 17.317 |
| | Rest of the world | | H | 573 | 79 | | 499 | | | 88 | | | 666 | 7 | 1.246 |
| Total flows | | | T | | 3.046 | 3.158 | 4.236 | 3.604 | 452 | 688 | 603 | 666 | 16.453 | | |
| Other flows | | | R | | | | | | 290 | | | 7 | | | 297 |
| Closing balance sheet | | | Cb | | | | | | 10.664 | 688 | 7.395 | 1.246 | | 391 | 20.384 |

Source: Self elaboration based on the numeric exercise of the SNA 2008. Figure 2.1.

The macro SAM presented above must be considered a matrix of matrices. Each module, represented by a figure, can be opened on a two dimensional matrix considering the row and column data. The column data are always a debit and the row data a credit. There's five major interrelated blocks.

a) Current accounts that are divided in goods and services (C) and income distribution (A and B). The agents are economic activities (D) or institutional sectors (B)
b) Accumulation accounts divided in capital account, considering stock variation (E) and fixed capital formation (Ea) and accumulation of financial assets and liabililities (F).
c) Other changes of volume and prices that register all the several kinds of capital gains and losses.
d) Opening (Ob) and closing (Cb) balance accounts: assets and liabilities.
e) Rest of the World (H) that register all the country's transactions with other countries.

In b), c) and d) the agents are institutional sectors (G).

How do the requirements of this account system appear, starting from the hypercube on table 1 and the star schema on figure 2? There must be observed that every cell from the matrix (or the detail from the sub matrix that summarizes the cell) is a $x_{ij}$ registry, where $x$ is the operation, $i$ the object and $j$ the agent. The distinctive features in the agent's definition on SNA explain the existence of two classifications: one for institutional sectors and another one for branches of economic activity. Regarding the objects, there are four kinds: goods and services, income, financial instruments and those contained in other flows (row and column R). Operations are goods and services and incomes and outlays, as explained on a); capital and financial accumulation, as explained on b). Operations of capital reconciliation and stocks are respectively described on c) and d).

The other dimensions registered on table 1 and figure 2 are implicit in the SAM's registries. The position defines that transactions on current accounts are changes of the net worth in the debit (row) or credit (column). Likewise, if the transactions are about accumulation, other flows or balance sheets, the assets are placed on the columns, while the liabilities and net worth are on the rows.

The valuation dimension defines the basic registries of stocks and flows. For example, the production is defined to basic values, and the stock to user values. The registry dimensions, measuring and currency are defined on the volumes, prices, values in which the transaction is done and registered on its more atomic level. The time and spatial data are enclosed by the range of the SAM that refers to a specific time period and country.

**The core of the SAM and its extensions**

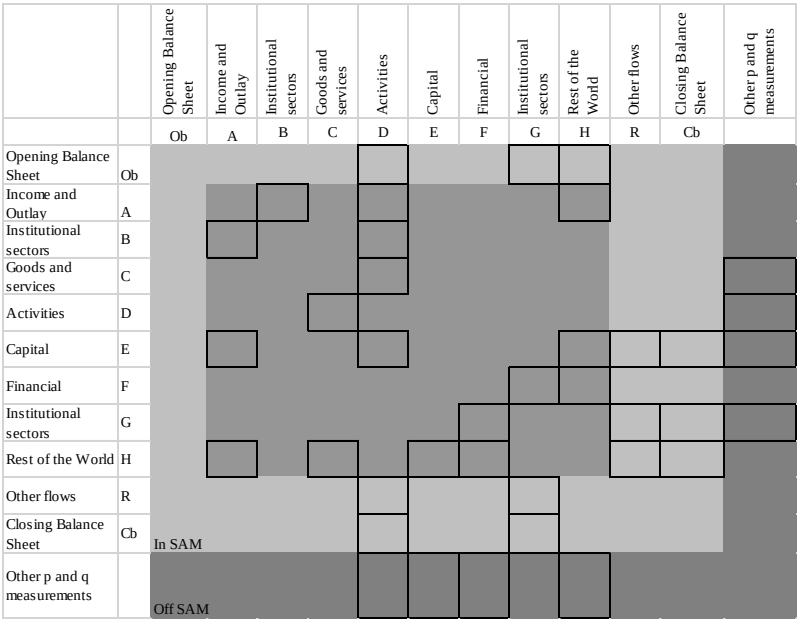
Three main objections can be raised to the affirmation that the SAM delivers an exhaustive picture of the economic facts.

- The inclusion of stocks
- The inclusion of satellite measurements
- The inclusion of counter agents

Inclusion of stocks

The SAMs, from their appearance on the 60's, are mostly about flows. In effect, the symmetric balance of rows and columns exists only for flows. However, this situation would limit the possibilities of articulation between flows and stocks that the SAM has. This articulation is a fundamental part of SNA. This difficulty is overcome when considering three data zones, as shown by the figure 4.

Figure 4. SAM zones in a broad sense



As shown in the figure above, the inner zone from A to H is the traditional área of the SAM. Then the data zone from other flows or reconciliation (R) and balance items (Ob and Cb). Both zones can be considered in SAM, since they register values from balanced economic accounts. The third external zone corresponds to all kinds of information about prices, indicators or volumes that can be labeled as off SAM. However, those measurements are related to rows or columns in SAM. That's the case, for example, in the environmental data included in NAMEA matrices (Basina, et al, 2012, for example).

Inclusion of satellite measurements

The satellite measurements imply the introduction of functional classifications to the agents and the objects included in the SAM.

In practice, from a matrix point of view, first there is a separation between the agent and the satellite and non-satellite object, then a crossing or a bridge between the core tables and functional or by purpose tables is needed.

Figure 5. The extended SAM to satellite measurements

| | | | Object | | Agent | |
|---|---|---|---|---|---|---|
| | | | Satellite | Non satellite | Satellite | Non satellite |
| | | | S O | nS O | S A | nS A |
| Object | Satellite | S O | | | | |
| | Non satellite | nS O | | | | |
| Agent | Satellite | S A | | | | |
| | Non satellite | nS A | | | | |

Inclusion of the counter agents

By definition, the SAM doesn't include counter agents. In fact, its components are ordered pairs *i,j*, as exposed at the beginning of this paper.

The inclusion of the counter agent in matrix form adheres to the who to whom matrices. The SAM's format might eventually open some row/column component to consider the counter agent, but it would be too trying and of little significance.

If there's data about the counter agent, these should be registered on the data base. Here arises the importance of the distinction between the data base (structure) regarding the SAM, which, as previously stated, is one of the many queries than can be formulated. In effect, if the counter agents would exist, as in the case of the resources and uses of funds, from the same base would come out the SAM and each of the who to whom matrices in a partial but balanced way.

**The Chilean 2008-2011 SAMs**

The close relationship between national accounts and the SAM exposed in previous sections can be demonstrated in practice taking the Chilean case as example.

The full version of Chile's national accounts has a two year delay. As of March, 2014, the tables of supply and use (SUT) had been published and in April, 2014, the institutional accounts were published, including stocks and flows. Both chapters was in the digital version in the website of Central Bank of Chile (Banco Central de Chile, 2014).

For the first time SAMs have been provided for a 4 consecutive years period based on the official information from national accounts. To Chile, there are two precedents: the 1986 SAM (Venegas, 1995) and the 2008 SAM (Venegas, 2011). The goal is to start a publishing period of annual SAMs, which will provide information of great analytic value for the analysis of the multipliers' evolution and several economic parameters or indicators of great value to be used in economic models. The SAMs containing input-product tables for discrete periods of 5 to 10 years are traditionally used to perform an analysis of structural change. The possibility of annual SAMs allows moving forward to a structural drift concept that permits examining how the structural change happens in time.

In previous sections the SAM treatment has been based on macrodata. When applying it to Chile, the entire link between macro and microdata will be examined. Considering the total of the published data, the referential SAM provided in this study would be a "virtual" matrix with 663 rows by 636 columns. By the way, there is no sense in printing or spreading out this

matrix, and not only because of the physical difficulties that a printed or digital archive with those features involves.

The 633x636 matrix isn't a functional instrument for any specialized stock, flow or institutional sectors or flow analysis that normally uses SAMs. However, starting from the entire detail it's possible to consider the maximum detail for stocks or flows from an institutional sector or economic activity wanted for study, and to add the rest of the data in an adequate way considering the traits of the specific study.

Taking those considerations in account, in the annexed file the data base to construct the 633x636 matrix are presented (*BDatos_SAM_633x636.mdb*), with a complete identification of the respective rows and columns.

The SAM that will be presented in the next sections considers in the first place a macro SAM format of 10x10, to explain in general terms the order of the matrix. Based on this Macro SAM the numbers for years 2008 to 2011 are presented, showing in some way how the economy has changed on that period of time.

On a second point, the SAM's architecture and the relation of its data with the sources of national accounts is addressed. For this effect a 633x636 maximum detail matrix and a 140x136 matrix (*BDatos_SAM_140x136.mdb*), were considered. The objective in this point is to allow the user to locate each account, row, column or cell of the matrix, in the SAM itself and on the original public sources of the data.

A third point explains the Microsoft Access archive that served as a platform for the data registry on relational base. This data base design is, on itself, of great interest for the conceptual modeling of economic data bases. The SAM's design on rows and columns establishes a certain "geo-reference" of any economic data, providing a true coordinate system. Thus proving the concept of the SAM as an economic map, in which it's possible to go from the macro to the microdata with any level of detail needed according to different analytic requirements.

## 5.1 SAM's structure for Chile 2008-2011

Table 2 presents the macro SAMs 2008-2011 for national economy.

Table 2. Macro SAMs. 2008 to 2001
(thousands millions of chilean pesos)

**2008**

| | | | | Opening balance sheet | Flows: Current account: Income& outlay | Flows: Current account: Institutional sectors | Flows: Current account: Goods & services | Flows: Current account: Activities | Flows: Acumulation Account: Capital | Flows: Acumulation Account: Activities | Flows: Acumulation Account: Financial instruments | Flows: Acumulation Account: Institutional sectors | Flows: Rest of the world | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sa | A | B | C | D | E | Ea | F | G | H | T |
| Opening balance sheet | | | Sa | | | | | | | | | 621.287 | | 621.287 |
| Flows | Current account | Income and outlay | A | | | 73.981 | | 83.492 | | | | | 5.367 | 162.841 |
| | | Institutional sectors | B | | 152.251 | | 8.911 | 1.445 | | | | | | 162.607 |
| | | Goods and services | C | | | 67.635 | | 98.641 | 1.184 | 23.179 | | | 38.953 | 229.591 |
| | | Activities | D | | | | 183.578 | | | | | | | 183.578 |
| | Acumu-lation Account | Capital | E | | | 20.990 | | | | | | 20.992 | 6.742 | 48.724 |
| | | Activities | Ea | | | | | | 23.179 | | | | | 23.179 |
| | | Financial instruments | F | | | | | | | | | 45.406 | 16.174 | 61.580 |
| | | Institutional sectors | G | 621.287 | | | | | 17.622 | | 48.776 | | | 687.684 |
| Rest of the world | | | H | | 10.590 | | 37.102 | | 6.740 | | 12.804 | | | 67.237 |
| | | | T | 621.287 | 162.841 | 162.607 | 229.591 | 183.578 | 48.724 | 23.179 | 61.580 | 687.684 | 67.237 | 2.248.306 |

**2009**

| | | | | Sa | A | B | C | D | E | Ea | F | G | H | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Opening balance sheet | | | Sa | | | | | | | | | 666.037 | | 666.037 |
| Flows | Current account | Income and outlay | A | | | 60.623 | | 86.531 | | | | | 5.041 | 152.195 |
| | | Institutional sectors | B | | 141.824 | | 8.704 | 1.209 | | | | | | 151.736 |
| | | Goods and services | C | | | 69.578 | | 89.066 | - 1.465 | 21.027 | | | 35.849 | 214.054 |
| | | Activities | D | | | | 176.805 | | | | | | | 176.805 |
| | Acumu-lation Account | Capital | E | | | 21.536 | | | | | | 21.544 | - 3.956 | 39.124 |
| | | Activities | Ea | | | | | | 21.027 | | | | | 21.027 |
| | | Financial instruments | F | | | | | | | | | 26.217 | 8.933 | 35.150 |
| | | Institutional sectors | G | 666.037 | | | | | 23.526 | | 24.235 | | | 713.798 |
| Rest of the world | | | H | | 10.371 | | 28.545 | | - 3.964 | | 10.915 | | | 45.868 |
| | | | T | 666.037 | 152.195 | 151.736 | 214.054 | 176.805 | 39.124 | 21.027 | 35.150 | 713.798 | 45.868 | 2.215.794 |

**2010**

| | | | | Sa | A | B | C | D | E | Ea | F | G | H | T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Opening balance sheet | | | Sa | | | | | | | | | 754.853 | | 754.853 |
| Flows | Current account | Income and outlay | A | | | 75.042 | | 99.765 | | | | | 7.511 | 182.318 |
| | | Institutional sectors | B | | 169.653 | | 10.080 | 1.163 | | | | | | 180.896 |
| | | Goods and services | C | | | 79.168 | | 97.170 | 1.441 | 23.407 | | | 42.246 | 243.432 |
| | | Activities | D | | | | 198.099 | | | | | | | 198.099 |
| | Acumu-lation Account | Capital | E | | | 26.686 | | | | | | 29.923 | - 6.913 | 49.696 |
| | | Activities | Ea | | | | | | 23.407 | | | | | 23.407 |
| | | Financial instruments | F | | | | | | | | | 42.659 | 7.670 | 50.328 |
| | | Institutional sectors | G | 754.853 | | | | | 34.998 | | 37.584 | | | 827.435 |
| Rest of the world | | | H | | 12.665 | | 35.254 | | - 10.150 | | 12.744 | | | 50.514 |
| | | | T | 754.853 | 182.318 | 180.896 | 243.432 | 198.099 | 49.696 | 23.407 | 50.328 | 827.435 | 50.514 | 2.560.978 |

| 2011 | | | | Opening balance sheet | Flows: Current account: Income& outlay | Flows: Current account: Institutional sectors | Flows: Current account: Goods & services | Flows: Current account: Activities | Flows: Acumulation Account: Capital | Flows: Acumulation Account: Activities | Flows: Acumulation Account: Financial instruments | Flows: Acumulation Account: Institutional sectors | Flows: Rest of the world | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sa | A | B | C | D | E | Ea | F | G | H | T |
| Opening balance sheet | | | Sa | | | | | | | | | 825.308 | | 825.308 |
| Flows | Current account | Income and outlay | A | | | 87.234 | | 108.461 | | | | | 5.906 | 201.601 |
| | | Institutional sectors | B | | 190.510 | | 11.473 | 1.468 | | | | | | 203.452 |
| | | Goods and services | C | | | 88.782 | | 111.625 | 1.653 | 27.132 | | | 46.163 | 275.354 |
| | | Activities | D | | | | 221.554 | | | | | | | 221.554 |
| | Acumu-lation Account | Capital | E | | | 27.108 | | | | | | 27.114 | 2.836 | 57.058 |
| | | Activities | Ea | | | | | | 27.132 | | | | | 27.132 |
| | | Financial instruments | F | | | | | | | | | 54.274 | 19.333 | 73.607 |
| | | Institutional sectors | G | 825.308 | | | | | 25.700 | | 55.688 | | | 906.695 |
| | Rest of the world | | H | | 11.310 | | 42.327 | | 2.829 | | 17.918 | | | 74.385 |
| Adjustment for different versions | | | | | 219 | - 328 | | | 256 | | | | - 147 | - |
| | | | T | 825.308 | 201.820 | 203.124 | 275.354 | 221.554 | 57.314 | 27.132 | 73.607 | 906.695 | 74.238 | 2.866.145 |

Nota: 2011 row adjustment come from de 2014 version of SUT and 2013 version of institutional accounts (IA) up to march, 2014. 2014 version of IA was published after of this paper was prepared

In order to perform a brief analysis of the data, it's convenient to examine some of the Chilean economy's indicators of context, as shown on table 3.

Table 3. Global indicators for macro SAMs comparative analysis

| | Indicators | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|
| 1) | Population (estimated), june 30 of each year. Thousands of people | 16.763 | 16.929 | 17.094 | 17.248 |
| 2) | Labour force (yearly average).Thousands of people | 7.561 | 7.667 | 7.749 | 8.043 |
| 3) | Employment (yearly average). Thousands of people | 6.896 | 6.849 | 7.102 | 7.463 |
| 4) | Stock of non financial capital. Thousands of millions of pesos | 205.668 | 221.930 | 229.504 | 249.588 |
| 5) | Gross Domestic Product (GDP). Thousands of millions of pesos | 93.848 | 96.444 | 111.008 | 121.403 |
| 6) | Rate of exchange. Pesos per U.S.A. dollar | 521,79 | 559,67 | 510,38 | 483,36 |

Sources: 1) a 3). Institute of National Statistics. Taken from Central Bank of Chile. Statistics Database
4) Henriquez (2008), Tabla 5.
5 y 6) Central Bank of Chile. Statistics Database

Using the previously presented terminology, 1, 2, 3 indicators and 5 are off SAM. Data 4 and 5 are in SAM. Since the measurement in Chilean pesos shows significant jumps on the numbers as an effect of the price variations, and in order to facilitate the international compares, a simple conversion from the macro SAM to U.S.A dollars has been included on table 4. Each element was converted at the same average rate exchange of observed dollar for each year (table 3, row 6).

Chilean economy's assets[1] (row 1) reached during 2008 US$ 1.584 billions (US$mm), $700 billions at the end of 2008, which equals US$1.341 billions (m.m). As a consequence of the crisis that started the second semester of that year, the assets diminished in 2009, but they recovered in the following years. This recovery was helped by a depreciated dollar and by a bigger relative growth of production in relation to the countries directly affected by the crisis. If we consider the liabilities as a generic debt, the relation debt/capital of the institutional sectors of the national economy by the end of 2008 is 2,8, slightly increasing during the year (an increase of 1,7%). The net assets or non-residents net worth on national economy amounts to $4,6 billion (US$8,8 m.m) at the beginning of 2008 and $17 billions (US$32,6 m.m) by the end of 2008.

Table 4. Some significant values from macro SAMs
(millions of U.S.A. dollars)

| | Aggregates | SAM Index File | Col | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|
| 1 | Assets | | | 1.584.843 | 1.586.597 | 1.928.688 | 2.223.780 |
| 2 | - Non financial assets | OB | Ea | 394.159 | 396.539 | 449.676 | 516.356 |
| 3 | - Financial assets | OB | G | 1.190.684 | 1.190.058 | 1.479.012 | 1.707.424 |
| 4 | Gross Domestic Product | (1) | | 179.858 | 172.323 | 217.502 | 251.162 |
| 5 | Output (basic value) | D | C | 351.824 | 315.912 | 388.142 | 458.359 |
| 6 | Exports | C | H | 74.653 | 64.054 | 82.774 | 95.503 |
| 7 | Imports | H | C | 71.106 | 51.003 | 69.075 | 87.567 |
| 8 | Gross investment in fixed capital | C | Ea | 44.421 | 37.570 | 45.862 | 56.132 |
| 9 | Factors payments | A | D | 160.012 | 154.612 | 195.474 | 224.388 |
| 10 | Taxes on production and products | B | C, D | 19.846 | 17.712 | 22.028 | 26.774 |
| 11 | Final consumption | C | B | 129.622 | 124.320 | 155.117 | 183.676 |
| 12 | Saving | E | B | 40.227 | 38.480 | 52.286 | 56.081 |

(1) (C,B) + (C,E) + (C,Ea) + (C,H) - (H,C)

In fact, the GDP increased relevantly (in nominal terms) between 2008 and 2011 (from US$mm 179 to US$mm 251) despite a slight decrease in 2009.

The imported supply in relation to the domestic one (row 7/row 5) in 2008 was 20.2%, after a strong decrease in 2009 it has been recovering its participation. The incidence of the exports (row 6/row 5) has remained steady, with some volatility, around 21%.

[1] It doesn't consider the value of the product existences, not included in the study of capital's stock (Henríquez, 2005), base of the data about non-financial assets.

The gross capital formation in fixed capital (row 8/row 4) has decreased from 24,7% in 2008 to 22,3% in 2010, but with a tendency to rise. The final consumption for years 2008 and 2009 represents a 72,1% of the GDP (row 11/row 4), then there's a decrease followed by a strong increase in 2011. The saving rate (row 11/row 4) presents a more stable participation on that period, except for a very strong increase in 2010. These values are evidence that the period of adjust of demand post crisis happens in 2010. The tax charge on production and products also reaches its smaller value in 2010 (10,1%), and goes back to increase in 2011.

The description shows some notion of the analysis that can be extracted from the values of the macro SAM. Despite of being very global values, interesting conclusions can be reached. When more macro SAM cells are opened with a zoom effect, the conclusions are richer in analytic elements. Aspects of the income distribution (rows and columns A and B) and flow of funds (rows and columns G and F) can also be incorporated.

The observations made on the macro SAM include a wide variety of relevant economic indicators. As it has been shown, when considering the data from table 4, several indicators of per capita, productivity, participation and variations can be deduced.

In general, the analyses made from SAM are focused on the participation or distribution the components in flows and stocks. Nevertheless, in the production and good and services cells (rows and columns C and D), it's possible to arrange in a complementary way, values at constant prices that allows to incorporate analyses of growth and structural change.

All the analyses that can be potentially made require establishing assumptions and hypothesis that are outside the objective of this paper. The purpose on this work was to try and illustrate in an elementary way the contents and utility of the macro SAM, a concise and relatively simple instrument.

### 5.3 Data base organization for SAM 2008-2011

If we admit that the SAM presents an exhaustive vision of stocks and economic flows, then it can also provide guidelines to organize any economic data system. This is a very relevant subject for the modern government management oriented to public policies in different social

and economic areas. Implementing innovative Information Technology (IT) is a fundamental tool to accomplish efficient solutions that consider the sectorial and geographic interrelation as a whole. From this point of view, the data model presented at the beginning of this paper can contribute to integrate solutions, to make the most of the synergies and to facilitate the analysis of the practical implementation of state policies.

This final part of the paper demonstrates how to apply the data model to the 2008-2011 SAMs for the Chilean economy.

Obviously, The SAM/IT subject regarding the organization of data bases can't be found on literature about SAMs[2] that come in a big part from the work of economists that are users of the economic data. However, this gains relevance when the SAMs include a wide level of detail as products of the national accounts work. In the different countries, the national accounts can be found on the national offices of statistics or in central banks and therefore they are part of vast information systems. In these cases, the SAM/IT subject could be very important as an axis for the corporative or institutional data model. By this way, the SNA purpose of full articulation of economic data can be achieved (SNA 2008, paragraphs 1.57 to 1.62).

The data model presented here suffers from several simplifications, even in data standardization requisites, from the systems engineering's point of view. In practice, it's a conceptual model that supports the logical and physical model that the computer engineers have to implement. This work opted for a less rigorous approach to ease the search and queries from possible non-technological users, and attends to the fact that the SAM is a product that refers to a period of time and space. This property allows omitting all explicit references to dates, periods, countries or other geographical localizations typical on most of the economic data bases.

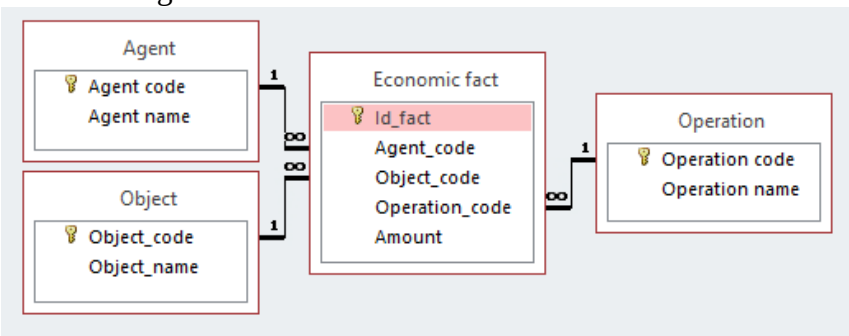
[2] The valuable existence of software such as AISHA (Geschke, et al, 2011) and SIMSIP (Parra & Wodon, 2009), is acknowledged, but those are solutions of optimization procedures or analytic processing of data. In any case, the relational data base platform here presented can be integrated to these analytical software proposing a solution of processing problems from the micro to the macrodata

In any case, along with the SAM data base presentation, comments will be included to widen the vision on a more integral way, emphasizing the simplifications previously mentioned.

For this paper, the data model was implemented on an Access relational data base (Microsoft Office), a tool with enough resources to process the almost 23.000 registers of the virtual SAM's 633x636 rows and columns. As previously mentioned, this universe of data can be expanded to tens of thousands economic objects and hundreds of thousands of agents, in works involving microdata. In this scenario, an Access data base will clearly be insufficient. However, the model implemented on it can be easily migrated to relational data bases on a corporative or world class level (Oracle, SQL Server, Sybase, among other), where the basic microdata can be uploaded on a data warehouse. On this base, to perform the following analytic process of the data, there are very sophisticated technological tools, for example, in the solutions of Bussiness Intelligence (BI) (Howson, 2008). That's the case with OLAP (*On Line Analytical Processing*) tools or others based on the dynamic tables principle that ease the whole elaboration process of the SAM type matrices and their regional and satellite extensions mentioned on a past section of this paper. In a nutshell, it's necessary to remember that the model (structure and its relations) here exposed for the SAM it's extendable to applications with a high data density.

The model starts from the most abstract vision of the SAM, presented at the beginning of this paper. A cell of the SAM is an economic fact $x_{ij,}$ where $x$ is an economic operation, $i$ is an object and $j$ is an agent. This atomic data can be entered on a 4-table data base, where the central table corresponds to the economic facts being registered. The table and its relations (from 1 (1) to various (∞)) are presented on figure 6.

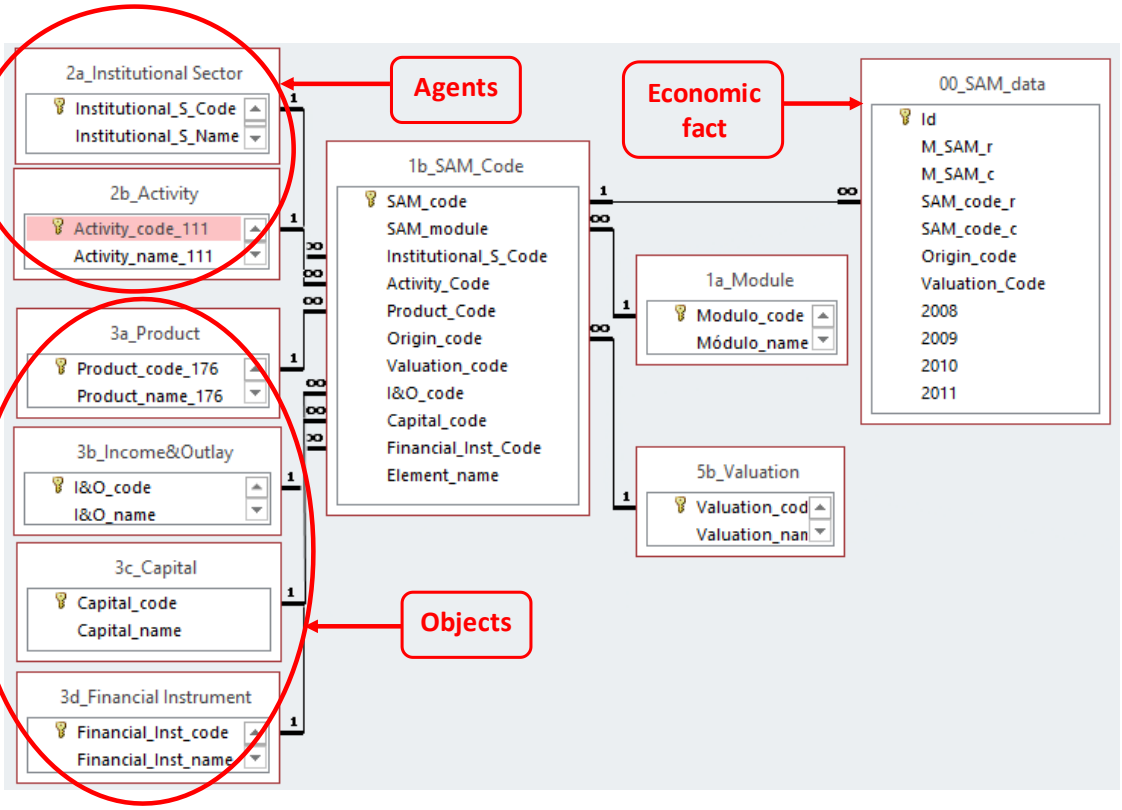
Figure 6. Basic data model for economic facts



When progressing from the abstract model to the concrete data, it must be considered that the three elements of the economic fact present a series of attributes that define their specific class. As it was previously exposed on table 1, the details of space, time, value, measurement, position, purpose, must be distinguished. For the specific needs of the 2008-2011 SAM data base it's only necessary to specify the origin and valuation of the object, with two additional tables besides the model in figure 6. This simplification doesn't hold against a microdata base for national accounts, sectorial or regional statistics, or others like them.

Taking in consideration these aspects, figure 7 shows the practical model of the SAM's data. Above all it can be noticed that the entities from the elemental model on figure 6 are decomposed in two types of agents and four types of objects, which in fact are the national account's coordinates.

Figure 7. SAM data model. Simple entry: row or column




As a way to make the identification and query of the SAM's base easier, a table of the SAM's code has been created, that in essence has the codes for the agent and object, adding two

identification fields of the row/column of the SAM. This table is dispensable on the definition of any economic information system that doesn't have the SAM as a product or result. On this situation, the object and agent tables are on direct relation with the economic fact table, as in the elemental model on figure 6.

The two fields of identification of the SAM on the "Code_SAM" table are:

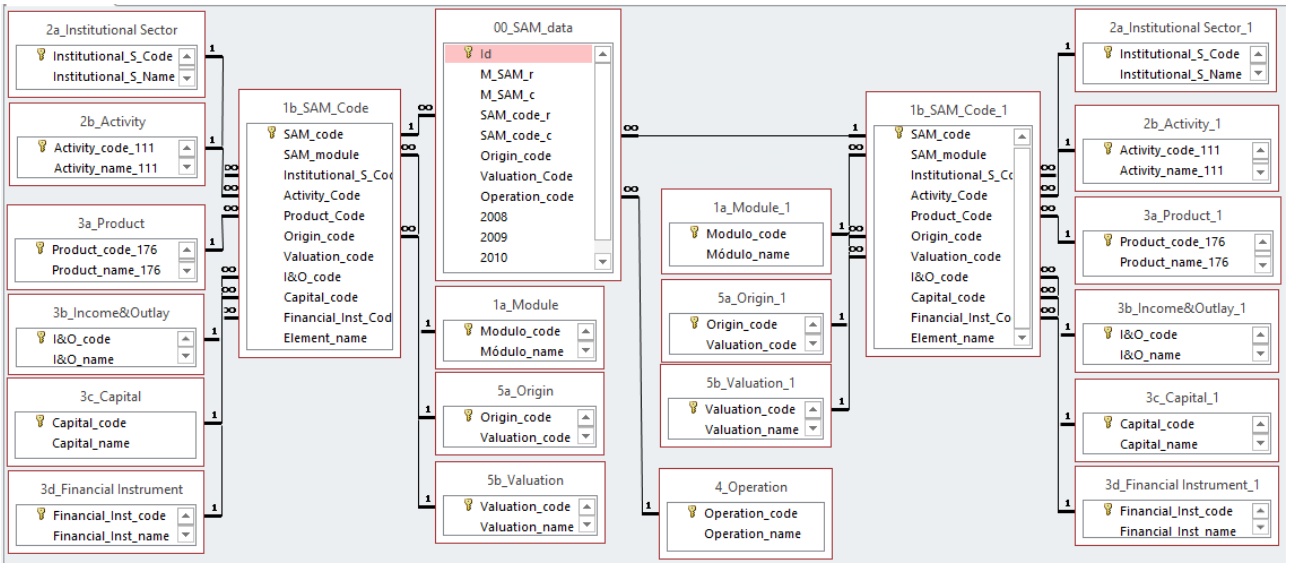
- Identification of the module of the macro SAM (module code)
- Identification of the code of the economic fact (SAM code)

This last Code SAM complies with the different identification codes for the 2008 SNA's transactions.

With those entities any simple entry element of the SAM can be identified by a row or a column. Since the total identification of each cell supposes both entries, then the tables defined on figure 6 are duplicated. Thus, there's a group of tables that identifies the row and other group that identifies the column, as shown on figure 8.

The duplication of the tables doesn't mean redundancy on the data base, since the tables are defined only once and a mirror is created for the queries.

Figure 8. SAM data model. Double entry: row and column



The detail of figure 8's table used on the implementing of the data base, both in Microsoft Access, can be found on the files annexed to this document.

The previous presentation is based on the 633x636 SAM file. The same definitions and relations are present on the 140x136 SAM file, only the more detailed level has been eliminated from the activities and products table. Both matrices are not completely symmetric. As a matter of fact, the data presentation does not allow a full relation between rows and columns, for conceptual reasons (non financial assets for example) or Chilean accounts presentation, (fixed capital consumption highly aggregated).

From the previous description it can be concluded that the SAM, as such, is a query to the data base. Additionally, the SAM is one of many possible queries. The supply and use tables and the institutional accounts implicit on the SAM's rows and columns can also be subject of other kinds of queries. The queries can be even more specific, when referring to a data subgroup, or to specific objects and agents defined on the ordered trio agent-object-operation.

The queries can include different levels of classification and aggregation of the agents and objects. A practical way of doing it is presented on the activities and product tables on figure 8. As it can be seen, there's an added option of four institutional sectors and two aggregation options of ten activities. These options are also present on the product, income and financial instruments, as it can be confirmed on the data base, even if they're not visible on figure 8. With this solution it's possible to enter the level of data aggregation required for several works that can center their interest on certain classifications that mix details and several aggregations. It's only a matter of entering those classifications on the respective tables, as it was done here for the cases described by figure 8 and concretely, on the data base. So, for example, if the SAM is wanted for a study about energy, the classification will consider the maximum detail of activities and products existing about that subject, and maybe defining only one activity or product for the rest of the economy.

The solution thus provided isn't the more efficient from the logical and physical point of view of a well-designed data base. On that case, each classification level should be on a

separated table that relates to the maximum detail table. Thus a table will exist with 10 activities and another table with 111 separated activities, both related between them. That way, the solution could be even simpler for professionals with knowledge of relational data bases. On this paper the previous solution was preferred even with it violates the attributes of data normalization, introducing non desirable redundancies. The solution was adopted to avoid the multiplication of tables and to facilitate the identification of data to professionals non familiarized with relational data bases.

Specifically, the query of the SAM as a matrix was obtained on this work from queries on the Access base named SAM 140x136. The selection of the data base thus determined was transferred to the Excel worksheet, where a dynamic table was designed, that provided as a result the respective SAMs, the macro SAM included.

The previous clarifications are enough to use the data bases provided. The rest of the details for the tables and their relations are enough self-documented on the data bases themselves.

**Conclusions**

The SAM appropriately reflects the entire economic stocks and flows present on the national accounts system. Therefore it inherits its properties of exhaustiveness and full articulation.

With a proper relation between functional classifications (households and socioeconomic stratas referred to income and consumption) and the SNA's central classifications, the SAM expands its domain to the area of the socioeconomic accounts. The first part of the SAMs' history is based on this domain.

By incorporating physical measurements linked to the economic flows and functional classifications of purpose or finality, the SAM can expand its domain to satellite measurements of all kinds, going further than the environment accounts (NAMEA) or tourism, as it already happened in the past.

Considering this wide domain, there's no doubt that the SAM provides a map for all kind of environmental, social and economic measurements.

Taking advantage of these features, the SAM can constitute a synthetic and integrated diagram to design all kinds of economic data bases on line with the modern relational or multidimensional data base systems.

This paper provided the proof of part of these attributes of the SAM, by applying them to the experience of the Chilean economy for the 2008-2011 period.

The making of annual SAMs that even opens up the possibility of making quarterly SAMs, allows advancing on the analysis of the economy, going from the old structural measurements between discreet periods to structural drifts measurements on continued periods.

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