**Susana Santos**

# Using a SAM-based model to measure the distributional Impacts of government policies

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A scenario will be defined and analysed from an experiment carried out in relation to the distributional impact of a reduction in the direct tax rate paid by households.

**Keywords:** Social accounting matrix (SAM); System of national accounts (SNA); Computable general equilibrium model; Portugal.

**Archives:** Social Accounting Matrices

**Correspondence addresses:**

Susana Santos, ISEG (School of Economics and Management)/TULisboa - Technical University of Lisbon; UECE – Research Unit on Complexity and Economics
Rua Miguel Lupi, 20, 1249-078 Lisboa, Portugal

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# USING A SAM-BASED MODEL TO MEASURE THE DISTRIBUTIONAL IMPACTS OF GOVERNMENT POLICIES

BY SUSANA SANTOS[*]

ISEG (School of Economics and Management)/TULisboa – Technical University of Lisbon; UECE – Research Unit on Complexity and Economics and DE – Department of Economics

## Abstract

A Social Accounting Matrix (SAM) will be proposed as a working instrument for studying the (macro-)impacts of government policy on the distribution of income.

A numerical version of the SAM, constructed from the System of National Accounts (SNA), will serve as the basis for the construction of an algebraic version of the same matrix for Portugal.

To this end, a computable (numerically solvable) general (economy-wide) equilibrium (macroeconomic balance) approach will be adopted.

A SAM-based model will be constructed, in which each cell is defined with a linear equation or system of equations, whose components are all the known and quantified transactions of the SNA, using parameters deduced from the numerical SAM that served as the basis for this model.

A scenario will be defined and analysed from an experiment carried out in relation to the distributional impact of a reduction in the direct tax rate paid by households.

# 1. INTRODUCTION

The main purpose of this paper is to study the impacts of government policy on the distribution of income, paying close attention to the corresponding response of the different macroeconomic aggregates and balances.

Because of this aim, the author was obliged to work with data that were more than a decade out of date, since 1995 was the only year for which there existed workable data. However, the task to be carried out in this study is nonetheless an experiment that has never previously been undertaken for Portugal, while, furthermore, it seeks to demonstrate the importance and potentialities of the working instrument used.

The Social Accounting Matrix (SAM) is the working instrument, i.e. a square matrix in which, by convention, the entries made in rows represent resources, incomes, receipts or changes in assets, whilst the entries made in columns represent uses, outlays, expenditures or changes in liabilities and net worth. Therefore, for each row there is a corresponding column, with the totals of each of these (row and column) being equal. These figures will include both production and trade, as well as institutional accounts, which are subdivided into yet other accounts.

A numerical version of the SAM, constructed from the System of National Accounts (SNA), will serve as the basis for the construction of an algebraic version of the same matrix.

This methodological choice was linked to the fact that, underlying the SAM, there are interrelated subsystems that, in the numerical version of the matrix, provide an analytical picture of the circular flow or the general equilibrium interactions of the market economy, when studied during a particular accounting period. On the other hand, in the algebraic version of the SAM, it is possible to measure and quantify the economy-wide effects of changes in the particular nominal flows represented by the numerical version (injections into and leakages from the system), which might be the result of policy measures.

Section 2 provides the presentation of the numerical version of the SAM, constructed in perfect consonance with the System of National Accounts (SNA) through a top-down approach.

In turn, Section 3 presents an algebraic version of the above-mentioned SAM, within a static short-term framework, adopting a computable (numerically solvable) general (economy-wide) equilibrium (macroeconomic balance) approach.

Like the numerical version, this algebraic version of the SAM, which will also be referred to as a SAM-based model, is constructed in perfect consonance with the SNA, with each cell being defined through a linear equation or system of equations, whose components

are all the known and quantified transactions of that system. This model will be calibrated using parameters and exogenous variables calculated from the database, i.e. the numerical version of the SAM, presented in Section 2.

Section 4 defines and analyses a scenario arising from an experiment carried out into the distributional impact caused by a reduction in the direct tax rate paid by households. For this purpose, some parameters and the exogenous variables used to calibrate the model will be subjected to a shock, the SAM-based model will then be processed and the impacts will be studied by considering the relative differences between the aggregates, balances and indicators presented in Section 3, both after and before the experiment.

Section 5 ends the paper with some concluding remarks designed to emphasise the importance of the SAM as a working instrument.


## 2. THE NUMERICAL VERSION OF THE SAM

Both the purpose of this paper and the available information dictated the classification adopted for the accounts of the numerical and, consequently, the algebraic versions of the SAM. Thus, in the case of the domestic economy, "Production and Trade" was divided into factors of production, activities and products, and "Institutions" into current, capital and financial accounts. Besides these accounts, we also have an aggregate account for the "rest of the world".

The criterion used by the author for ordering the accounts was the one underlying the basic SAM represented in Table 1.

Nowadays, the SNA in general and the Portuguese National Accounts in particular provide several (mutually exclusive) possibilities for the disaggregation of products and activities, but only a few possibilities for the institutional accounts, and even fewer possibilities for the factors of production.

The SNA that has been used in Portugal since 1995 has been the European System of National and Regional Accounts in the European Community of 1995 – ESA 95 (Eurostat, 1996), which is based on the 1993 version of the International United Nations System of National Accounts – SNA 93, prepared by the Inter-Secretariat Working Group and published by the United Nations Statistical Office (ISWG, 1993).

Table 2 shows the Portuguese SAM that could be constructed from the SNA for the particular purpose described in the introduction, and which will be broken down even further, albeit using other sources of information.

**Table 1**. Portuguese basic SAM (Social Accounting Matrix) for 1995 (in millions of euros)

| Incomes (receipts) \ Outlays (expenditures) | | Production and Trade | | | Institutions | | | Rest of the World (RW) (7) | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| | | Factors (1) | Activities (2) | Products (3) | Current A. (4) | Capital A. (5) | Financial A. (6) | | |
| Production and Trade | Factors (1) | 0 | Gross Added Value, at factor cost (70 725) | 0 | 0 | 0 | 0 | Compensation of Factors from the RW (3 243) | Aggregate Factors Income (73 968) |
| | Activities (2) | 0 | 0 | Production (154 394) | 0 | 0 | 0 | 0 | Production Value (154 394) |
| | Products (3) | 0 | Intermediate Consumption (84 102) | Trade and Transport Margins (0) | Final Consumption (64 898) | Gross Capital Formation (19 623) | 0 | Exports (24 433) | Aggregate Demand (193 056) |
| Institutions | Current A. (4) | Gross National Income, at factor cost (70 542) | Net taxes on production (-346) | Net taxes on products (10 283 ) | Current Transfers (42 145) | 0 | 0 | Current Transfers from the RW (3 960) | Aggregate Income (126 583) |
| | Capital A. (5) | 0 | 0 | 0 | Gross Saving (17 291) | Capital Transfers (4930) | Net borrowing (40) | Capital Transfers from the RW (2 320) | Investment Funds (24 582) |
| | Financial A. (6) | 0 | 0 | 0 | 0 | 0 | Financial Transactions (35 030) | Financial Transactions from the RW (9 257) | Total financial transactions (44 287) |
| Rest of the World (RW) (7) | | Compensation of Factors to the RW (3 426) | Net taxes on production (-87) | Imports + net taxes on products (28 127 + 252) | Current Transfers to the RW (2 249) | Capital Transfers to the RW (29) | Financial Transactions to the RW (9 217) | | Transactions Value to the RW (43 213) |
| TOTAL | | Aggregate Factors Income (73 968) | Total Costs (154 394) | Aggregate Supply (193 056) | Aggregate Income (126 583) | Aggregate Investment (24 582) | Total financial transactions (44 287) | Transactions Value from the RW (43 213) | |

Source: *Instituto Nacional de Estatística* (Portuguese National Accounts for 1995)

**Table 2**. Portuguese macro-SAM (Social Accounting Matrix) for 1995 (in millions of euros)

| Outlays (expenditures) / Incomes (receipts) | | | FACTORS | | | ACTIVITIES | | | | | | | PRODUCTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Labour - employees | Own assets | Total | Agriculture, hunting and foresty… | Industry, including energy | Construction | Wholesale and retail trade… | Financial, real-estate, renting… | Other service activities | Total | Products of agriculture, hunting, forestry… | Products from mining and quarrying… | Construction work | Wholesale and retail trade services… | Financial intermediation services, real estate… | Other services | Total |
| | | | 1 | 2 | | 3 | 4 | 5 | 6 | 7 | 8 | | 9 | 10 | 11 | 12 | 13 | 14 | |
| FACTORS | Labour - employees | 1 | 0 | 0 | 0 | 652 | 9 258 | 2 589 | 8 222 | 4 212 | 13 630 | 38 563 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Own assets | 2 | 0 | 0 | 0 | 3 327 | 8 054 | 2 303 | 9 478 | 5 583 | 3 417 | 32 161 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 0 | 0 | 0 | 3 979 | 17 313 | 4 892 | 17 700 | 9 794 | 17 047 | 70 725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ACTIVITIES | Agriculture, hunting and foresty… | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 060 | 379 | 2 | 0 | 19 | 0 | 6 460 |
| | Industry, including energy | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 321 | 69 | 2 | 413 | 48 | 55 852 |
| | Construction | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 14 191 | 0 | 0 | 0 | 14 204 |
| | Wholesale and retail trade… | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 | 13 | 31 749 | 683 | 0 | 32 469 |
| | Financial, real-estate, renting.. | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 14 | 0 | 20 967 | 0 | 20 987 |
| | Other service activities | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 81 | 28 | 78 | 852 | 23 379 | 24 421 |
| | Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 064 | 55 823 | 14 317 | 31 829 | 22 934 | 23 427 | 154 394 |
| PRODUCTS | Products of agriculture … | 9 | 0 | 0 | 0 | 606 | 4 640 | 0 | 369 | 0 | 78 | 5 693 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Products from mining and … | 10 | 0 | 0 | 0 | 1 756 | 29 158 | 5 096 | 6 608 | 1 559 | 3 346 | 47 524 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Construction work | 11 | 0 | 0 | 0 | 30 | 250 | 3 394 | 280 | 525 | 128 | 4 606 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Wholesale and retail trade… | 12 | 0 | 0 | 0 | 121 | 1 198 | 247 | 4 193 | 897 | 896 | 7 552 | 1 236 | 13 886 | 0 | - 15 122 | 0 | 0 | 0 |
| | Financial intermediation… | 13 | 0 | 0 | 0 | 112 | 3 019 | 563 | 3 092 | 7 514 | 2 365 | 16 666 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Other services | 14 | 0 | 0 | 0 | 26 | 315 | 38 | 347 | 713 | 623 | 2 062 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 0 | 0 | 0 | 2 651 | 38 579 | 9 337 | 14 889 | 11 209 | 7 437 | 84 102 | 1 236 | 13 886 | 0 | - 15 122 | 0 | 0 | 0 |
| INSTITUTIONS — CURRENT ACCOUNT | Households | 15 | 38 620 | 20 994 | 59 614 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Enterprises (nonfinancial corporations) | 16 | 0 | 11 561 | 11 561 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Financial corporations | 17 | 0 | 1 787 | 1 787 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Government | 18 | 0 | - 2 558 | - 2 558 | - 135 | - 31 | - 20 | - 96 | - 13 | - 50 | - 346 | - 1 | 7 108 | 405 | 1 046 | 1 347 | 378 | 10 283 |
| | Non Profit Institutions Serving Households (NPISH) | 19 | 0 | 137 | 137 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 38 620 | 31 922 | 70 542 | - 135 | - 31 | - 20 | - 96 | - 13 | - 50 | - 346 | - 1 | 7 108 | 405 | 1 046 | 1 347 | 378 | 10 283 |
| INSTITUTIONS — CAPITAL ACCOUNT | Households | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Enterprises (nonfinancial corporations) | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Financial corporations | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Government | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Non Profit Institutions Serving Households (NPISH) | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| FINANCIAL ACCOUNT | | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| REST OF THE WORLD | | 26 | 64 | 3 363 | 3 426 | - 34 | - 8 | - 5 | - 24 | - 3 | - 13 | - 87 | 1 481 | 24 689 | 32 | 840 | 1 181 | 156 | 28 379 |
| TOTAL | | | 38 683 | 35 285 | 73 968 | 6 460 | 55 852 | 14 204 | 32 469 | 20 987 | 24 421 | 154 394 | 8 781 | 101 506 | 14 754 | 18 592 | 25 462 | 23 961 | 193 056 |

Source: *Instituto Nacional de Estatística* (Portuguese National Accounts for 1995)

# Table 2 (continued). Portuguese macro-SAM (Social Accounting Matrix) for 1995 (in millions of euros)

| | | | | | INSTITUTIONS | | | | | | | | | | FINANCIAL ACCOUNT | REST OF THE WORLD | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Outlays (expenditures) / Incomes (receipts) | | CURRENT ACCOUNT | | | | | | CAPITAL ACCOUNT | | | | | | | | | |
| | | Households | Enterprises (nonfinancial corporations) | Financial corporations | Government | Non Profit Institutions Serving Households (NPISH) | Total | Households | Enterprises (nonfinancial corporations) | Financial corporations | Government | Non Profit Institutions Serving Households (NPISH) | Total | | | |
| | | 15 | 16 | 17 | 18 | 19 | | 20 | 21 | 22 | 23 | 24 | | 25 | 26 | |
| **PRODUCTION and TRADE — FACTORS** | | | | | | | | | | | | | | | | |
| Labour - employees | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 | 38 683 |
| Own assets | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 123 | 35 285 |
| Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 243 | 73 968 |
| **ACTIVITIES** | | | | | | | | | | | | | | | | |
| Agriculture, hunting and foresty... | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 460 |
| Industry, including energy | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 852 |
| Construction | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 204 |
| Wholesale and retail trade... | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 469 |
| Financial, real-estate, renting .. | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 987 |
| Other service activities | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 421 |
| Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 154 394 |
| **PRODUCTS** | | | | | | | | | | | | | | | | |
| Products of agriculture ... | 9 | 2 546 | 0 | 0 | 18 | 0 | 2 564 | 185 | 130 | 0 | 3 | 0 | 318 | 0 | 205 | 8 781 |
| Products from mining and ... | 10 | 27 967 | 0 | 0 | 628 | 0 | 28 595 | 768 | 5 282 | 347 | 452 | 246 | 7 095 | 0 | 18 292 | 101 506 |
| Construction work | 11 | 74 | 0 | 0 | 0 | 0 | 74 | 4 148 | 2 816 | 437 | 2 552 | 120 | 10 072 | 0 | 1 | 14 754 |
| Wholesale and retail trade... | 12 | 5 467 | 0 | 0 | 37 | 0 | 5 504 | 91 | 194 | 19 | 1 | 0 | 305 | 0 | 5 231 | 18 592 |
| Financial intermediation... | 13 | 6 388 | 0 | 0 | 77 | 43 | 6 508 | 505 | 1 049 | 110 | 8 | 0 | 1 671 | 0 | 617 | 25 462 |
| Other services | 14 | 6 136 | 0 | 0 | 14 272 | 1 245 | 21 653 | 58 | 91 | 10 | 1 | 1 | 160 | 0 | 87 | 23 961 |
| Total | | 48 578 | 0 | 0 | 15 032 | 1 288 | 64 898 | 5 755 | 9 562 | 922 | 3 018 | 366 | 19 623 | 0 | 24 433 | 193 056 |
| **INSTITUTIONS — CURRENT ACCOUNT** | | | | | | | | | | | | | | | | |
| Households | 15 | 470 | 1 349 | 2 051 | 9 623 | 13 | 13 506 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 293 | 76 413 |
| Enterprises (nonfinancial corporations) | 16 | 1 339 | 58 | 363 | 0 | 0 | 1 759 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 13 344 |
| Financial corporations | 17 | 2 125 | 329 | 29 | 4 | 14 | 2 501 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 4 323 |
| Government | 18 | 13 883 | 2 108 | 229 | 6 866 | 7 | 23 092 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 609 | 31 081 |
| Non Profit Institutions Serving Households (NPISH) | 19 | 323 | 50 | 34 | 878 | 0 | 1 286 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 423 |
| Total | | 18 141 | 3 894 | 2 705 | 17 371 | 35 | 42 145 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 960 | 126 583 |
| **CAPITAL ACCOUNT** | | | | | | | | | | | | | | | | |
| Households | 20 | 7 952 | 0 | 0 | 0 | 0 | 7 952 | 0 | 0 | 812 | 206 | 0 | 1 018 | - 4 023 | 147 | 5 095 |
| Enterprises (nonfinancial corporations) | 21 | 0 | 9 342 | 0 | 0 | 0 | 9 342 | 0 | 0 | 0 | 707 | 0 | 707 | - 49 | 896 | 10 896 |
| Financial corporations | 22 | 0 | 0 | 1 558 | 0 | 0 | 1 558 | 0 | 484 | 328 | 2 | 0 | 814 | - 287 | 0 | 2 085 |
| Government | 23 | 0 | 0 | 0 | - 1 661 | 0 | - 1 661 | 63 | 161 | 3 | 1 870 | 4 | 2 100 | 4 423 | 1 275 | 6 136 |
| Non Profit Institutions Serving Households (NPISH) | 24 | 0 | 0 | 0 | 0 | 100 | 100 | 0 | 0 | 0 | 291 | 0 | 291 | - 23 | 1 | 370 |
| Total | | 7 952 | 9 342 | 1 558 | - 1 661 | 100 | 17 291 | 63 | 645 | 1 143 | 3 075 | 4 | 4 930 | 40 | 2 320 | 24 582 |
| FINANCIAL ACCOUNT | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 030 | 9 257 | 44 287 |
| REST OF THE WORLD | 26 | 1 743 | 108 | 60 | 339 | 0 | 2 249 | - 723 | 689 | 20 | 43 | 0 | 29 | 9 217 | X | 43 213 |
| TOTAL | | 76 413 | 13 344 | 4 323 | 31 081 | 1 423 | 126 583 | 5 095 | 10 896 | 2 085 | 6 136 | 370 | 24 581 | 44 287 | 43 213 | X |

Source: *Instituto Nacional de Estatística* (Portuguese National Accounts for 1995)

This macro-SAM was constructed from blocks of sub-matrices or sets of sub-matrices, whose transactions have common characteristics. These blocks can be specified by identifying the transactions involved in the National Accounts, a task that is undertaken in Section 3. A systematised description of the sources of information and the method of calculation used is provided by Santos in "SAMs and SNA: An Application" (2005) and "Constructing a Database for Economic Modelling from the SNA: a SAM for Portugal" (2006). The first of these also includes a description of the SAM cell contents, although this relates to a SAM calculated for 1999.

As can be seen from its totals, Table 2, which represents the so-called macro-SAM, is a possible disaggregation of Table 1, which in turn represents the so-called basic SAM (the completely aggregated macro-SAM).

If we look at the world around us, it is easy to agree with the statement that "the determinants of the distribution of income and the mechanisms by which it changes represent one of the most difficult theoretical and empirical problems facing the science of economics" (Dervis et al., 1982). If it were an easy task, then certainly the world today would be a fairer place.

Working on the empirical side, the author believes that "SAMs provide an invaluable statistical framework for the analysis of the mapping between the different kinds of distributions one may want to consider" (Dervis et al., 1982).

Perhaps in a rather simplistic way, but at least to begin with, the author accepts that the study of income distribution in a society involves the study of how the national pie is divided up and how it can then be sliced. The first aspect can be analysed from one or more snapshots of the economy, provided by a suitably disaggregated SAM, and the second from the modelling of that same SAM. Therefore, of crucial importance here is the way in which the primary and secondary distribution of income, as well as the use that is made of it, are dealt with. The factors of production account and the current account of the institutions are the accounts that cover such issues.

"In the SAM, the institution entitled 'households' really represents all the people in society" (Dervis et al., 1982). It therefore needs to be disaggregated. On the other hand, the distribution of the (primary) incomes that accrue as a result of involvement in either the processes of production or the ownership of assets among institutions (and activities) is covered by the factors of production account, so that this must also be disaggregated.

The question thus arises "how should these disaggregations be performed?" This will not be discussed here, however, because our dependence on the available data is total. Even so, despite the fact that the information is not up-to-date, it is nonetheless sufficient for us to be able to at least study some aspects of the distribution of income.

The workable data made available to the author for studying and modelling income distribution in Portugal consisted of an incomplete disaggregated National Accounting Matrix (NAM) and a previous (provisional) version for 1995, constructed as a result of the collaboration of the Portuguese Statistical Institute (Instituto Nacional de Estatística) in the work undertaken by the Leadership Group on Social Accounting Matrices, under the coordination of Statistics Netherlands (LEG, 2003).

In that NAM, labour was broken down into six types, according to the gender and education level of workers, and households were broken down into four types, according to their main source of income. Such disaggregation was performed using specific data sources, such as household budget surveys, the labour force survey and administrative data (employment records, income tax and social security files, etc.).

Thus, in this paper, the factors of production will be disaggregated into two main groups: labour (or employees) and own assets; the latter being further disaggregated into labour (employers and own-account workers) and capital. In turn, households were disaggregated into four types according to their main source of income.

Thus, one of the many advantages of the SAM approach could be referred to here. To use the words of Pyatt (1991), by "reducing the social accounts to the essential", the SAM approach "provides a useful starting point for understanding the assumptions and manipulations that have been built into the secondary source material which is typically employed by the majority of analysts".

This top-down approach made it possible to compile a numerical version of the SAM with 34 rows and 34 columns, which has the particularity of being balanced and perfectly consonant with the national accounts when aggregated at the level of 26 rows and columns – the case of the macro-SAM represented by Table 2. However the disaggregation into 34 rows and columns was also performed from credible sources, with its differences from the aggregated level (26 x 26) not being very significant, generally speaking.

The non-adjusted submatrices were adjusted one by one, using the RAS (Richard A. Stone) method, and the balanced SAM was obtained, as represented in Table 3 – the numerical version, or the database, of the algebraic version, or the model, to be defined and worked with in the next section.

**Table 3**. Portuguese SAM (Social Accounting Matrix) for 1995 (in millions of euros)

| Outlays (expenditures) / Incomes (receipts) | | # | PRODUCTION and TRADE — FACTORS — Labour (employees) Lower | Medium | Higher | Total | Own Assets — Labour (employers and/or own-account work.) Lower | Medium | Higher | Total | Capital | Total | Total | ACTIVITIES — Agriculture, hunting and foresty; fishing ... | Industry, including energy | Constru-ction | Wholesale and retail trade, repair of .. motor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | | 4 | 5 | 6 | | 7 | | | 8 | 9 | 10 | 11 |
| PRODUCTION and TRADE / FACTORS / Labour (employees) / Lower | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 473 | 5 113 | 2 244 | 4 846 |
| Medium | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 159 | 3 112 | 144 | 2 290 |
| Higher | | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 1 034 | 201 | 1 086 |
| Total | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 652 | 9 258 | 2 589 | 8 222 |
| Own Assets / Labour (employers and/or own-) / Lower | | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 509 | 181 | 89 | 685 |
| Medium | | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 874 | 78 | 5 | 271 |
| Higher | | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 47 | 7 | 180 |
| Total | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 442 | 305 | 100 | 1 136 |
| Capital | | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 884 | 7 749 | 2 203 | 8 342 |
| Total | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 3 327 | 8 054 | 2 303 | 9 478 |
| Total | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 3 979 | 17 313 | 4 892 | 17 700 |
| ACTIVITIES / Agriculture, hunting and foresty.. | | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Industry, including energy | | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wholesale and retail trade, repair .. | | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Financial, real-estate, renting and.. | | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Other service activities | | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| PRODUCTS / Products of agriculture, hunting .. | | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 606 | 4 640 | 0 | 369 |
| Products from mining and quarry.. | | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 756 | 29 158 | 5 096 | 6 608 |
| Construction work | | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 250 | 3 394 | 280 |
| Wholesale & retail trade services.. | | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 121 | 1 198 | 247 | 4 193 |
| Financ.intermediation serv, real . | | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 112 | 3 019 | 563 | 3 092 |
| Other services | | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 26 | 315 | 38 | 347 |
| Total | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 651 | 38 579 | 9 337 | 14 889 |
| INSTITUTIONS / CURRENT ACCOUNT / Households (by main source of income) / employees | | 20 | 17 699 | 11 719 | 7 029 | 36 446 | 313 | 322 | 205 | 840 | 6 548 | 7 388 | 43 834 | 0 | 0 | 0 | 0 |
| employers and/or o.a. work. | | 21 | 576 | 584 | 98 | 1 258 | 2 586 | 1 365 | 371 | 4 322 | 7 520 | 11 842 | 13 100 | 0 | 0 | 0 | 0 |
| recipients of pensions | | 22 | 223 | 234 | 61 | 518 | 37 | 54 | 7 | 98 | 1 205 | 1 302 | 1 820 | 0 | 0 | 0 | 0 |
| others | | 23 | 208 | 145 | 45 | 398 | 25 | 30 | 4 | 59 | 402 | 461 | 859 | 0 | 0 | 0 | 0 |
| Total | | | 18 705 | 12 682 | 7 233 | 38 620 | 2 961 | 1 771 | 587 | 5 319 | 15 675 | 20 994 | 59 614 | 0 | 0 | 0 | 0 |
| Enterprises (non financial corporations) | | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 561 | 11 561 | 11 561 | 0 | 0 | 0 | 0 |
| Financial corporations | | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 787 | 1 787 | 1 787 | 0 | 0 | 0 | 0 |
| Government | | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - 2 558 | - 2 558 | - 2 558 | - 135 | - 31 | - 20 | - 96 |
| Non Profit Inst.Serv.Househ. (NPISH) | | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 137 | 137 | 137 | 0 | 0 | 0 | 0 |
| Total | | | 18 705 | 12 682 | 7 233 | 38 620 | 2 961 | 1 771 | 587 | 5 319 | 26 603 | 31 922 | 70 542 | - 135 | - 31 | - 20 | - 96 |
| CAPITAL A. / Households | | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Enterprises (non financial corporations) | | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Financial corporations | | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Government | | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Non Profit Inst.Serv.Househ. (NPISH) | | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| FINANCIAL ACCOUNT | | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| REST OF THE WORLD | | 34 | 2 | 60 | 1 | 64 | 0 | 0 | 0 | 0 | 3 363 | 3 363 | 3 426 | - 34 | - 8 | - 5 | - 24 |
| TOTAL | | | 18 708 | 12 742 | 7 234 | 38 683 | 2 961 | 1 771 | 587 | 5 319 | 29 965 | 35 285 | 73 968 | 6 460 | 55 852 | 14 204 | 32 469 |

Source: *Instituto Nacional de Estatística* (Portuguese National Accounts and Portuguese Pilot - National Accounting Matrix, for 1995)

# Table 3 (continued). Portuguese SAM (Social Accounting Matrix) for 1995 (in millions of euros)

| Outlays (expenditures) / Incomes (receipts) | | | Financial, real-estate, renting and busin..activi 12 | Other service activities 13 | Total | Products of agriculture, hunting, forest.. 14 | Products from mining and quarrying 15 | Construction work 16 | Wholesale and retail trade services; 17 | Financial intermediation services, real estate, renting 18 | Other services 19 | Total | employees 20 | employers and/or o.a. work 21 | recipients of pens. 22 | others 23 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FACTORS — Labour (employees) | Lower | 1 | 1 441 | 4 513 | 18 629 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Medium | 2 | 1 466 | 5 568 | 12 739 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Higher | 3 | 1 305 | 3 549 | 7 196 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 4 212 | 13 630 | 38 563 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Labour (employers and/or own- / Own Assets) | Lower | 4 | 66 | 431 | 2 961 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Medium | 5 | 100 | 445 | 1 771 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Higher | 6 | 94 | 200 | 587 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 259 | 1 076 | 5 319 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Capital | 7 | 5 323 | 2 341 | 26 842 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 5 583 | 3 417 | 32 161 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 9 794 | 17 047 | 70 725 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ACTIVITIES | Agriculture, hunting and foresty.. | 8 | 0 | 0 | 0 | 6 060 | 379 | 2 | 0 | 19 | 0 | 6 460 | 0 | 0 | 0 | 0 | 0 |
| | Industry, including energy | 9 | 0 | 0 | 0 | 0 | 55 321 | 69 | 2 | 413 | 48 | 55 852 | 0 | 0 | 0 | 0 | 0 |
| | Construction | 10 | 0 | 0 | 0 | 0 | 12 | 14 191 | 0 | 0 | 0 | 14 204 | 0 | 0 | 0 | 0 | 0 |
| | Wholesale and retail trade, repair .. | 11 | 0 | 0 | 0 | 0 | 25 | 13 | 31 749 | 683 | 0 | 32 469 | 0 | 0 | 0 | 0 | 0 |
| | Financial, real-estate, renting and.. | 12 | 0 | 0 | 0 | 0 | 5 | 14 | 0 | 20 967 | 0 | 20 987 | 0 | 0 | 0 | 0 | 0 |
| | Other service activities | 13 | 0 | 0 | 0 | 3 | 81 | 28 | 78 | 852 | 23 379 | 24 421 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 0 | 0 | 0 | 6 064 | 55 823 | 14 317 | 31 829 | 22 934 | 23 427 | 154 394 | 0 | 0 | 0 | 0 | 0 |
| PRODUCTS | Products of agriculture, hunting .. | 14 | 0 | 78 | 5 693 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 459 | 488 | 527 | 73 | 2 546 |
| | Products from mining and quarry.. | 15 | 1 559 | 3 346 | 47 524 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 17 408 | 5 553 | 4 088 | 918 | 27 967 |
| | Construction work | 16 | 525 | 128 | 4 606 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 | 10 | 21 | 3 | 74 |
| | Wholesale & retail trade services.. | 17 | 897 | 896 | 7 552 | 1 236 | 13 886 | 0 | - 15 122 | 0 | 0 | 0 | 3 659 | 1 062 | 574 | 172 | 5 467 |
| | Financ.intermediation serv, real .. | 18 | 7 514 | 2 365 | 16 666 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 752 | 1 588 | 864 | 185 | 6 388 |
| | Other services | 19 | 713 | 623 | 2 062 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 020 | 1 087 | 874 | 155 | 6 136 |
| | Total | | 11 209 | 7 437 | 84 102 | 1 236 | 13 886 | 0 | - 15 122 | 0 | 0 | 0 | 30 337 | 9 787 | 6 949 | 1 505 | 48 578 |
| INSTITUTIONS CURRENT ACCOUNT — Households | employees | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 124 | 49 | 17 | 15 | 206 |
| | employers and/or o.a. work. | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52 | 20 | 7 | 6 | 86 |
| | recipients of pensions | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 15 | 5 | 5 | 62 |
| | others | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 70 | 28 | 10 | 9 | 116 |
| | Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 285 | 112 | 39 | 35 | 470 |
| | Enterprises (non financial corporations) | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 307 | 122 | 880 | 30 | 1 339 |
| | Financial corporations | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 715 | 223 | 144 | 43 | 2 125 |
| | Government | 26 | - 13 | - 50 | - 346 | - 1 | 7 108 | 405 | 1 046 | 1 347 | 378 | 10 283 | 11 825 | 1 061 | 828 | 169 | 13 883 |
| | Non Profit Inst.Serv.Househ. (NPISH) | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 215 | 65 | 17 | 27 | 323 |
| | Total | | - 13 | - 50 | - 346 | - 1 | 7 108 | 405 | 1 046 | 1 347 | 378 | 10 283 | 14 346 | 1 582 | 1 908 | 304 | 18 141 |
| CAPITAL A. | Households | 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 615 | 6 385 | 1 071 | - 119 | 7 952 |
| | Enterprises (non financial corporations) | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Financial corporations | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Government | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Non Profit Inst.Serv.Househ. (NPISH) | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | 7 952 |
| FINANCIAL ACCOUNT | | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 |
| REST OF THE WORLD | | 34 | - 3 | - 13 | - 87 | 1 481 | 24 689 | 32 | 840 | 1 181 | 156 | 28 379 | 1 126 | 363 | 205 | 49 | 1 743 |
| TOTAL | | | 20 987 | 24 421 | 154 394 | 8 781 | 101 506 | 14 754 | 18 592 | 25 462 | 23 961 | 193 056 | 46 424 | 18 117 | 10 133 | 1 740 | 76 413 |

Source: *Instituto Nacional de Estatística* (Portuguese National Accounts and Portuguese Pilot - National Accounting Matrix, for 1995)

**Table 3** (continued). Portuguese SAM (Social Accounting Matrix) for 1995 (in millions of euros)

| Outlays (expenditures) → Incomes (receipts) ↓ | | | | Enterprises (nonfinancial corporations) 24 | Financial corporations 25 | Government 25 | Non Profit Institutions Serving Households (NPISH) 27 | Total | Households 28 | Enterprises (nonfinancial corporations) 29 | Financial corporations 30 | Government 31 | Non Profit Institutions Serving Households (NPISH) 32 | Total | FINANCIAL ACCOUNT 33 | REST OF THE WORLD 34 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FACTORS | Labour (employees) | Lower | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 79 | 18 708 |
| | | Medium | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 12 742 |
| | | Higher | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 | 7 234 |
| | | Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 | 38 683 |
| | Own Assets / Labour (employers and/or own-) | Lower | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 961 |
| | | Medium | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 771 |
| | | Higher | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 587 |
| | | Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 319 |
| | Capital | | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 123 | 29 965 |
| | Total | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 123 | 35 285 |
| | Total | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 243 | 73 968 |
| ACTIVITIES | | Agriculture, hunting and foresty.. | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 460 |
| | | Industry, including energy | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 852 |
| | | Construction | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 204 |
| | | Wholesale and retail trade, repair .. | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 32 469 |
| | | Financial, real-estate, renting and.. | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 987 |
| | | Other service activities | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 24 421 |
| | | Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 154 394 |
| PRODUCTS | | Products of agriculture, hunting .. | 14 | 0 | 0 | 18 | 0 | 2 564 | 185 | 130 | 0 | 3 | 0 | 318 | 0 | 205 | 8 781 |
| | | Products from mining and quarry.. | 15 | 0 | 0 | 628 | 0 | 28 595 | 768 | 5 282 | 347 | 452 | 246 | 7 095 | 0 | 18 292 | 101 506 |
| | | Construction work | 16 | 0 | 0 | 0 | 0 | 74 | 4 148 | 2 816 | 437 | 2 552 | 120 | 10 072 | 0 | 1 | 14 754 |
| | | Wholesale & retail trade services.. | 17 | 0 | 0 | 37 | 0 | 5 504 | 91 | 194 | 19 | 1 | 0 | 305 | 0 | 5 231 | 18 592 |
| | | Financ.intermediation serv, real .. | 18 | 0 | 0 | 77 | 43 | 6 508 | 505 | 1 049 | 110 | 8 | 0 | 1 671 | 0 | 617 | 25 462 |
| | | Other services | 19 | 0 | 0 | 14 272 | 1 245 | 21 653 | 58 | 91 | 10 | 1 | 1 | 160 | 0 | 87 | 23 961 |
| | | Total | | 0 | 0 | 15 032 | 1 288 | 64 898 | 5 755 | 9 562 | 922 | 3 018 | 366 | 19 623 | 0 | 24 433 | 193 056 |
| INSTITUTIONS – CURRENT ACCOUNT | Households (by main source of income) | employees | 20 | 312 | 667 | 2 238 | 3 | 3 426 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 353 | 49 613 |
| | | employers and/or o.a. work. | 21 | 124 | 145 | 885 | 1 | 1 242 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 754 | 15 096 |
| | | recipients of pensions | 22 | 881 | 778 | 6 245 | 9 | 7 975 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 | 9 915 |
| | | others | 23 | 33 | 460 | 254 | 0 | 864 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 66 | 1 789 |
| | | Total | | 1 349 | 2 051 | 9 623 | 13 | 13 506 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 293 | 76 413 |
| | Enterprises (non financial corporations) | | 24 | 58 | 363 | 0 | 0 | 1 759 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 | 13 344 |
| | Financial corporations | | 25 | 329 | 29 | 4 | 14 | 2 501 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 4 323 |
| | Government | | 26 | 2 108 | 229 | 6 866 | 7 | 23 092 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 609 | 31 081 |
| | Non Profit Inst.Serv.Househ. (NPISH) | | 27 | 50 | 34 | 878 | 0 | 1 286 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 423 |
| | Total | | | 3 894 | 2 705 | 17 371 | 35 | 42 145 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 960 | 126 583 |
| INSTITUTIONS – CAPITAL A. | | Households | 28 | 0 | 0 | 0 | 0 | 7 952 | 0 | 0 | 812 | 206 | 0 | 1 018 | - 4 023 | 147 | 5 095 |
| | | Enterprises (non financial corporations) | 29 | 9 342 | 0 | 0 | 0 | 9 342 | 0 | 0 | 0 | 707 | 0 | 707 | - 49 | 896 | 10 896 |
| | | Financial corporations | 30 | 0 | 1 558 | 0 | 0 | 1 558 | 0 | 484 | 328 | 2 | 0 | 814 | - 287 | 0 | 2 085 |
| | | Government | 31 | 0 | 0 | - 1 661 | 0 | - 1 661 | 63 | 161 | 3 | 1 870 | 4 | 2 100 | 4 423 | 1 275 | 6 136 |
| | | Non Profit Inst.Serv.Househ. (NPISH) | 32 | 0 | 0 | 0 | 100 | 100 | 0 | 0 | 0 | 291 | 0 | 291 | - 23 | 1 | 370 |
| | | Total | | 9 342 | 1 558 | - 1 661 | 100 | 17 291 | 63 | 645 | 1 143 | 3 075 | 4 | 4 930 | 40 | 2 320 | 24 582 |
| FINANCIAL ACCOUNT | | | 33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 030 | 9 257 | 44 287 |
| REST OF THE WORLD | | | 34 | 108 | 60 | 339 | 0 | 2 249 | - 723 | 689 | 20 | 43 | 0 | 29 | 9 217 | 0 | 43 213 |
| TOTAL | | | | 13 344 | 4 323 | 31 081 | 1 423 | 126 583 | 5 095 | 10 896 | 2 085 | 6 136 | 370 | 24 581 | 44 287 | 43 213 | |

Source: *Instituto Nacional de Estatística* (Portuguese National Accounts and Portuguese Pilot - National Accounting Matrix, for 1995)

## 3. The Algebraic Version of the SAM
### 3.1. Framework and Assumptions

The starting idea will be the one outlined in the article "Macroeconomic Modelling Based on Social-Accounting Principles" and expressed in the following words:

"A dictum usually attributed to Lord Keynes posits that every economic model has a corresponding accounting framework. For macroeconomic models, this accounting framework must be complete in the sense that every receipt must be offset by a corresponding expenditure. One consequence is that all the transactions in a model can be expressed within a SAM framework. The values assumed by all the different types of transactions can therefore be set out as the elements of a SAM" (Drud et al., 1986: 112).

Therefore, a static model will be defined and conceived as a starting point for both a comparative static and dynamic approach. At the same time, since it will not be possible to calculate and work with price and volume indexes, a fixed-price model will be designed. Linear equations will be worked with, thereby avoiding elasticities, marginal propensities and other parameters that should be estimated from an empirical base, which is not available.

Thus, the main concern will be to capture (very simply at first) all the national accounting transactions considered in the numerical version of the SAM (the database for this model), and, after its calibration, to conduct an experiment and define a scenario that highlights the aspects that the author intends to study.

The process of calibration will involve determining the parameters and exogenous variables that are to be specified, so that, after processing the model, the basic SAM (presented in Section 2) is exactly replicated. The software used to process the model was the General Algebraic Modelling System (GAMS), and the quantification of the whole process took into consideration all the available information, involving the values calculated using the information contained in that same basic SAM, further supplemented by additional data. These values will be assumed as valid for the scenario showing "the distributional impact caused by a reduction in the direct tax rate paid by households", which are to be outlined in Section 4, except for those which will be subject to shock.

Since the purpose of this model is to study income distribution, some common specifications for the model will not be considered. These specifications include the ones that are also constructed within a general equilibrium framework, usually to study trade issues, such as the distinction between domestically produced and imported products, while external trade will be considered exogenous in this version of the model.

For the purposes of simplification, it will also be assumed that all domestically produced output is market output, and therefore any output produced for own final use and other non-market output will be considered as non-existent.

On the other hand, it will be assumed that there is sufficient production capability available in the economy to enable domestic output to respond to aggregate demand. Such a response will be considered exclusive, since (for the time being) imports are exogenous.

Many fixed parameters will be adopted and some variables will be calculated from exogenous parameters and other variables, in order to enable future experiments to be carried out with their respective changes.

This model is considered to be a step forward in comparison with the ones that the author has previously worked with, and, at the same time, a (necessary) stage along a path that she would like to pursue in SAM modelling. From her own experience, the author feels that SAM modelling does have a convenient path. Thus, on the one hand, when working on SAM modelling or with SAM-based models, some knowledge of SAM construction is considered to be a necessary, although not a sufficient, condition. On the other hand, underlying SAM modelling is a process of gradual maturation, which should begin with the construction and decomposition of accounting and fixed-price multipliers and the conducting of experiments with them. That is what the author has done, based essentially on the works of Pyatt, 1988; Pyatt and Roe, 1977; and Pyatt and Round, 1985. For an illustration of this work, see Santos, 1999; 2001; 2003; 2003a; 2004; 2004a; 2005a; and 2007.

This paper represents the materialisation of the first step after multipliers.

As this model is supported by a SAM database, constructed in perfect consonance with the national accounts, its specifications will either obey or be derived from the SNA.

By convention, the parameters will be stated in lower case and the variables in upper case (at least the first letter of these). Endogenous variables will be written in normal letters, whereas exogenous variables, as well as the parameters, will be written in italics. The indices of each variable and parameter (the sets in the Appendix) – identified in lower-case subscripts – describe the SAM accounts, the first index representing the row and the second one the column, being separated by commas. The symbols used in the description of the model will be listed alphabetically and without any indices, according to their type (endogenous or exogenous variables and parameters) in the Appendix.

The entire model will be worked upon in gross terms, so that the consumption of fixed capital will therefore not be considered.

## 3.2. THE BLOCKS OF THE SAM

The SAM blocks, identified in Table 4, are sub-matrices or sets of sub-matrices (as seen in the Basic SAM – Table 1) with common characteristics. The specification of these blocks will be carried out below and involves, on the one hand, identifying the transactions of the National Accounts that are considered in the calculation of the same in the numerical SAM and, on the other hand, defining the equation, or system of equations, to be considered in the algebraic SAM or SAM-based model.

**Table 4**. Basic SAM by blocks

| Incomes (receipts) \ Outlays (expenditures) | | Production and Trade | | | Institutions | | | Rest of the World (rw) |
|---|---|---|---|---|---|---|---|---|
| | | Factors (f) | Activities (a) | Products (p) | Current A. (dic) | Capital A. (dik) | Financial A. (dif) | |
| Production and Trade | Factors (f) | 0 | *(Compensation of the factors of production)* | 0 | 0 | 0 | 0 | *(Compensation of the factors of production)* |
| | Activities (a) | 0 | 0 | Production | 0 | 0 | 0 | 0 |
| | Products (p) | 0 | *(Domestic Trade)* | Trade and Transport Margins | *(Domestic Trade)* | *(Domestic Trade)* | 0 | *(External Trade)* |
| Institutions | Current A. (dic) | *(Compensation of the factors of production)* | *(Net Indirect Taxes)* | *(Net Indirect Taxes)* | *(Current Transfers)* | 0 | 0 | *(Current Transfers)* |
| | Capital A. (dik) | 0 | 0 | 0 | Gross Saving | *(Capital Transfers)* | ( -) Net lending/ borrowing | *(Capital Transfers)* |
| | Financial A. (dif) | 0 | 0 | 0 | 0 | 0 | *(Financial Transactions)* | *(Financial Transactions)* |
| Rest of the World (rw) | | *(Compensation of the factors of production)* | *(Net Indirect Taxes)* | *(External Trade)* | *(Current Transfers)* | *(Capital Transfers)* | *(Financial Transactions)* | X |

Blocks with more than one sub-matrix:

- Compensation of the factors of production
- Domestic Trade
- External Trade
- Net Indirect Taxes
- Current Transfers
- Capital Transfers
- Financial Transactions

a) **Compensation of factors of production** consists of the income of the institutional sectors originating from the compensation of the services provided through their real and financial assets to the activities of production and to the rest of the world, namely compensation of employees (transaction D1 of the National Accounts) and compensation of own-account assets, including the compensation of employers and/or own-account workers, and of capital, namely property income (transaction D4, balances B2g and B3g of the National Accounts).

$$\text{GAV}_a = \beta_a * \text{VP}_a \tag{3.1}$$

$$\text{GAV}_{\text{fle},a} = d1s_{\text{fle},a} * \text{GAV}_a \tag{3.2}$$

$$\text{D1}_a = \Sigma_{\text{fle}}\text{GAV}_{\text{fle},a} \tag{3.3}$$

$$\text{GAV}_{\text{fle}} = \Sigma_a\text{GAV}_{\text{fle},a} \tag{3.4}$$

$$\text{GAV}_{\text{foal},a} = b3s_{\text{foal},a} * \text{GAV}_a \tag{3.5}$$

$$\text{B3g}_a = \Sigma_{\text{foal}}\text{GAV}_{\text{foal},a} \tag{3.6}$$

$$\text{GAV}_{\text{foal}} = \Sigma_a\text{GAV}_{\text{foal},a} \tag{3.7}$$

$$\text{GAV}_{\text{foak},a} = b2gp_{\text{foak},a} * (\text{D1}_a + \text{B3g}_a) \tag{3.8}$$

$$\text{B2g}_a = \Sigma_{\text{foak}}\text{GAV}_{\text{foak},a} \tag{3.9}$$

$$\text{GAV}_{\text{foak}} = \Sigma_a\text{GAV}_{\text{foak},a} \tag{3.10}$$

$$CFR_{\text{fle,rw}} = D1RW_{\text{fle}}$$

$$CFR_{\text{foak,rw}} = D4RW$$

$$\text{GNI}_{\text{fle}} = \text{GAV}_{\text{fle}} + CFR_{\text{fle,rw}} - \text{CFS}_{\text{rw,fle}} \tag{3.11}$$

$$\text{GNI}_{\text{dic,fle}} = ce_{\text{dic,fle}} * \text{GNI}_{\text{fle}} \tag{3.12}$$

$$\text{GNI}_{\text{foal}} = \text{GAV}_{\text{foal}} \tag{3.13}$$

$$\text{GNI}_{\text{dic,foal}} = coa_{\text{dic,foal}} * \text{GNI}_{\text{foal}} \tag{3.14}$$

$$\text{GNI}_{\text{foak}} = \text{GAV}_{\text{foak}} + CFR_{\text{foak,rw}} - CFS_{\text{rw,foak}} \tag{3.15}$$

$$\text{GNI}_{\text{dic,foak}} = sk_{\text{dic,foak}} * \text{GNI}_{\text{foak}} \tag{3.16}$$

$$\text{GNI}_{\text{dic}} = \Sigma_{\text{fle}}\text{GNI}_{\text{dic,fle}} + \Sigma_{\text{foal}}\text{GNI}_{\text{dic,foal}} + \text{GNI}_{\text{dic,foak}} \tag{3.17}$$

$$\text{GNI} = \Sigma_{\text{dic}}\text{GNI}_{\text{dic}} \tag{3.18}$$

$$\text{CFS}_{\text{rw,fle}} = clr_{\text{rw,fle}} * \text{GAV}_{\text{fle}} \tag{3.19}$$

$$CFS_{\text{rw,foak}} = D4PRW$$

b) **Production** represents the output of goods and services (transaction P1 of the National Accounts).

$$\text{VP}_p = \text{AD}_p - \text{TMT}_p - \text{NTP}_p - IM_p \tag{3.20}$$

$$\text{VP}_{a,p} = \text{VP}_p * \alpha_{a,p} \tag{3.21}$$

$$VP_a = \Sigma_p VP_{a,p} \tag{3.22}$$

c) **External Trade** considers the transactions in goods and services from non-residents to residents, or imports (transaction P7 of the National Accounts – $IM_{rw,p}$), and from residents to non-residents, or exports (transaction P6 of the National Accounts – $EX_{p,rw}$)

d) **Net indirect taxes or net taxes on production and imports**

d.1) **Net Taxes on Production** represents the (other) taxes on production (transaction D29 of the National Accounts) minus the (other) subsidies to production (transaction D39 of the National Accounts).

$$NTA_{dic,a} = ntag_{dic,a} * NTAA_a \tag{3.23}$$

$$NTA_{rw,a} = ntarw_{rw,a} * NTAA_a \tag{3.24}$$

$$NTA_{dic} = \Sigma_a NTA_{dic,a} \tag{3.25}$$

$$NTA_a = \Sigma_{dic} NTA_{dic,a} \tag{3.26}$$

$$NTA_{rw} = \Sigma_a NTA_{rw,a} \tag{3.27}$$

$$NTA = \Sigma_{dic} NTA_{dic} + NTA_{rw} \tag{3.28}$$

d.2) **Net Taxes on Products** represents the taxes on products (transaction D21 of the National Accounts) minus the subsidies on products (transaction D31 of the National Accounts).

$$NTP_p = tp_p * DT_p \tag{3.29}$$

$$NTP_{dic,p} = ntpg_{dic,p} * NTP_p \tag{3.30}$$

$$NTP_{rw,p} = ntprw_{rw,p} * NTP_p \tag{3.31}$$

$$NTP_{dic} = \Sigma_p NTP_{dic,p} \tag{3.32}$$

$$NTP_{rw} = \Sigma_p NTP_{rw,p} \tag{3.33}$$

$$NTP = \Sigma_{dic} NTP_{dic} + NTP_{rw} \tag{3.34}$$

e) **Trade and Transport Margins** are realised on goods purchased for resale and are a part of the production of wholesale trade services, retail trade services and the repair services of motor vehicles, motorcycles and personal and household goods. They amount to zero, since they are negative in relation to the three above-mentioned activities (because the corresponding value has already been recorded in the production sub-matrix), but are positive and have the same amount in relation to all the other ones.

$$TM_{p,p} = tm_{p,p} * DT_p \tag{3.35}$$

$$TMc_{p,p} = tmc_{p,p} * DT_p \tag{3.36}$$

$$TMT_p = \Sigma_p (TM_{p,p} + TMc_{p,p}) \text{ (column sum)} \tag{3.37}$$

f) **Domestic Trade** is represented by the value of domestically transacted products, either domestically produced or imported.

$$DTmp_p = VIC_p + FC_p + GCF_p \tag{3.38}$$

$$DT_p = DTmp_p - TMT_p - NTP_p \tag{3.39}$$

f.1) **Intermediate Consumption** consists of the value of the goods and services consumed as inputs by a process of production, excluding those fixed assets whose consumption is recorded as consumption of fixed capital (transaction P2 of the National Accounts).

$$VIC_a = \gamma_a * VP_a \tag{3.40}$$

$$VIC_{p,a} = icp_{p,a} * VIC_a \tag{3.41}$$

$$VIC_p = \Sigma_a VIC_{p,a} \tag{3.42}$$

$$VIC = \Sigma_p \Sigma_a VIC_{p,a} \tag{3.43}$$

f.2) **Final Consumption** consists of the expenditure incurred by resident institutional units on those goods or services that are used for the direct satisfaction of individual needs or wants or of the collective needs of members of the community (transaction P3 of the National Accounts).

$$FC_{dic} = apc_{dic} * DI_{dic} \tag{3.44}$$

$$FC_{p,dic} = fcs_{p,dic} * FC_{dic} \tag{3.45}$$

$$FC_{rw,dic} = fcsrw_{rw,dic} * FC_{dic} \tag{3.46}$$

f.3) **Gross Capital Formation** includes: gross fixed capital formation (transaction P51 of the National Accounts), changes in inventories (transaction P52), and acquisitions minus disposals of valuables (transaction P53).

$$GCF_{p,dik} = gfcf_{p,dik} * P51_{dik} + P52_p * chinv_{p,dik} + adv_{p,dik} * P53_{dik} \tag{3.47}$$

$$GCF_{dik} = \Sigma_p GCF_{p,dik} \tag{3.48}$$

$$P52_p = chinvc_p * AS_p \tag{3.49}$$

$$P53_{dik} = advc_{dik} * S_{dik} \tag{3.50}$$

g) **Current Transfers** includes: current taxes on income, wealth, etc. (transaction D5 of the National Accounts); social contributions (transaction D61); social benefits in cash (transaction D62); other current transfers (transaction D7); adjustment made for the change in the net equity of households in pension fund reserves (transaction D8).

$$CT_{dic,dic} = d5s_{dic,dic} * D5_{dic} + d61s_{dic,dic} * D61_{dic} + d62s_{dic,dic} * D62P_{dic} +$$
$$+ d7_{dic,dic} * D7P_{dic} + D8_{dic,dic} \tag{3.51}$$

$$CT_{rw,dic} = d62rws_{rw,dic} * D62P_{dic} + d7rws_{rw,dic} * D7P_{dic} \tag{3.52}$$

$$CT_{dic,rw} = D62RW_{dic,rw} + D7RW_{dic,rw} \tag{3.53}$$

$$CTR_{dic} = \Sigma_{dic} CT_{dic,dic} \text{ (row sum)} \tag{3.54}$$

$$CTP_{dic} = \Sigma_{dic} CT_{dic,dic} \text{ (column sum)} \tag{3.55}$$

$$D5_{dic} = ti_{dic}*AI_{dic} \tag{3.56}$$

$$D61_{dic} = sc_{dic}*GNI_{dic} \tag{3.57}$$

h) **Capital Transfers** includes: capital taxes (transaction D91 of the National Accounts), investment grants (transaction D92); other capital transfers (transaction D99) and acquisitions less disposals of non-financial non-produced assets (transaction K2).

$$KT_{dik,dik} = d91_{dik,dik} *D91P_{dik} +D92R_{dik}*d92_{dik,dik} + D99R_{dik}*d99_{dik,dik} \tag{3.58}$$

$$KT_{rw,dik} = D92P_{rw,dik} + D99P_{rw,dik} + K2_{rw,dik} \tag{3.59}$$

$$KT_{dik,rw} = D92R_{dik} *d92rw_{dik,rw} + D99R_{dik}*d99rw_{dik,rw} \tag{3.60}$$

$$D91P_{dik} = tk_{dik} * D99R_{dik} \tag{3.61}$$

$$D92R_{dik} = cgfcf_{dik}*P51_{dik} \tag{3.62}$$

$$KTR_{dik} = \Sigma_{dik}KT_{dik,dik} \text{ (row sum)} \tag{3.63}$$

$$KTP_{dik} = \Sigma_{dik}KT_{dik,dik} \text{ (column sum)} \tag{3.64}$$

i) **Gross Saving** measures the portion of aggregate income that is not used for final consumption expenditure and current transfers to Portuguese institutions or to the rest of the world.

$$S_{dic} = (1-apc_{dic})*DI_{dic} \tag{3.65}$$

$$S_{dik,dic} = si_{dik,dic}*S_{dic} \tag{3.66}$$

$$S_{dik} = \Sigma_{dik}S_{dik,dic} \tag{3.67}$$

j) **Financial Transactions** represent the transactions in financial assets and liabilities between institutional units, and between these and the rest of the world. They are classified as monetary gold and special drawing rights; currency and deposits; securities other than shares; loans; shares and other equity; insurance technical reserves; and other accounts receivable/payable (F1-7 of the National Accounts).

$$FTRW_{dif,rw} = FT_{rw,dif} + NLB_{dif} \tag{3.68}$$

k) **Closure - Net borrowing/lending**

The net lending (+) or borrowing (-) of the total economy is the sum of the net lending or borrowing of the institutional sectors. It represents the net resources that the total economy makes available to the rest of the world (if it is positive) or receives from the rest of the world (if it is negative). The net lending (+) or borrowing (-) of the total economy is equal (but with an opposite mathematical sign) to the net borrowing (-) or lending (+) of the rest of the world.

Here, those amounts that fall short of (+) or exceed (-) the investment funds used to cover aggregate investment are registered in the capital and financial accounts, since they are

financial transactions either from (in the case of net borrowing) or to (in the case of net lending) the rest of the world. This is why the mathematical signs defined in the first paragraph of this item have been exchanged.

$$NLB_{dik,dif} = AINV_{dik} - (S_{dik} + KTR_{dik} + KT_{dik,rw}) \tag{3.69}$$

$$NLB_{dif} = \Sigma_{dik} NLB_{dik,dif} \tag{3.70}$$

### 3.3. Macroeconomic Aggregates and Balances

Gross domestic product at market prices:

$$GDP = \Sigma_a GAV_a + NTP + NTA \tag{3.71}$$

Gross national income (at market prices):

$$GNIMP = GNI + \Sigma_{dic} NTP_{dic} + \Sigma_{dic} NTA_{dic} \tag{3.72}$$

Gross disposable income:

$$DI = \Sigma_{dic} DI_{dic} \tag{3.73}$$

$$DI_{dic} = GNI_{dic} + NTA_{dic} + NTP_{dic} + CTR_{dic} + CT_{dicrw} - CTP_{dic} - CT_{rwdic} \tag{3.74}$$

Gross saving:

$$S = \Sigma_{dic} S_{dic} \tag{3.75}$$

Net lending/borrowing (of the economy): $NLB_{dif}$

The main items in the budget of all institutions, namely of the government, can be calculated from the respective accounts. Thus, the total budget balance is the respective net lending/borrowing – $NLB_{dik,dif.}$; the current budget balance is the respective gross saving – $S_{dik}$; and the capital budget balance is the difference between the first and the second.

The main items of the balance of payments can also be calculated from the rest of the world account. However, this will not be done here, because the relations with the rest of the world were not considered relevant within the framework of this paper (see Santos, 2006).

### 3.4. Structural Indicators of the Distribution and Use of Income

Since that the distributional relationships across production sectors or activities and social groups are determined by macro behaviour, which, in turn, is determined by the behaviour of individuals within and on behalf of institutions, this means that if we are to study the distributional impact of exogenous shocks resulting from any policy, as proposed in the Introduction (Section 1) and exemplified in Section 4, it is important to have some indicators that, in addition to the macroeconomic aggregates and balances, synthesise that impact as much as possible. Therefore, two aspects will be considered: the distribution of generated income and the distribution and use of disposable income.

Due to a lack of information about the total number of persons by groups of households, only the structures of the distribution and use of income will be considered here – leaving the identification of inequality to be dealt with at a subsequent stage.

## A. Distribution of generated income

### A.1. Among factors of production and activities

The functional distribution of income can be studied here through an analysis of the division of gross added value at factor cost (excluding indirect taxes) between labour and capital, disaggregated by activity. It is also important to distinguish between types of labour (Dervis et al., 1982) – in this case by the level of education of workers.

$$\text{Digav}_{\text{fle},a} = (D1_a / GAV_a)*100 \tag{3.76}$$

$$\text{Digav}_{\text{foal},a} = (B3g_a / GAV_a)*100 \tag{3.77}$$

$$\text{Digav}_{\text{foak},a} = (B2g_a / GAV_a)*100 \tag{3.78}$$

$$\text{Digav}_{\text{fle}} = (\Sigma_a D1_a / \Sigma_a GAV_a)*100 \tag{3.79}$$

$$\text{Digav}_{\text{foal}} = (\Sigma_a B3g_a / \Sigma_a GAV_a)*100 \tag{3.80}$$

$$\text{Digav}_{\text{foak}} = (\Sigma_a B2g_a / \Sigma_a GAV_a)*100 \tag{3.81}$$

$$\text{Digavfle}_{\text{fle},a} = (GAV_{\text{fle},a}/ D1_a)*100 \tag{3.82}$$

$$\text{Digavfoal}_{\text{foal},a} = (GAV_{\text{foal},a} / B3g_a)*100 \tag{3.83}$$

$$\text{Digavfle}_{\text{fle}} = (GAV_{\text{fle}} / \Sigma_a D1_a)*100 \tag{3.84}$$

$$\text{Digavfoal}_{\text{foal}} = (GAV_{\text{foal}} / \Sigma_a B3g_a)*100 \tag{3.85}$$

### A.2. Among institutions and socioeconomic groups, within households

By excluding from the gross added value at factor cost generated in the domestic economy the compensation of the factors of production sent to the rest of the world, and by including the compensation of the factors of production received from the rest of the world (in accordance with equation (3.17)), the gross national income is obtained and its institutional distribution can be studied.

$$\text{Digni}_{\text{dic}} = (GNI_{\text{dic}} / GNI) *100 \tag{3.86}$$

### B. Distribution and use of disposable income among institutions and socioeconomic groups, within households.

By excluding from gross national income the current transfers paid to other institutions and to the rest of the world, and by including the current transfers received from the other institutions and from the rest of the world and, in the case of the government, the net indirect taxes (in accordance with equation (4.4)), the institutional distribution of gross disposable income can also be studied. In turn, the use made of gross disposable income is divided into

final consumption and saving, although non-financial and financial corporations do not have any final consumption.

$$\text{Didi}_{dic} = (\text{DI}_{dic} / \text{DI}) * 100 \tag{3.87}$$

$$\text{UdiFC}_{dic} = (\text{FC}_{dic} / \text{DI}_{dic}) * 100 \tag{3.88}$$

$$\text{UdiS}_{dic} = (\text{S}_{dic} / \text{DI}_{dic}) * 100 = 100 - \text{UdiFC}_{dic} \tag{3.89}$$

More specific and exact conclusions would require specification of the households' composition – number of workers by household, size, age composition, dependency ratios, etc. (Dervis et al., 1982).

## 4. A Scenario showing the Distributional Impact caused by a Reduction in the Direct Tax Rate paid by Households

Considering the framework, assumptions and purposes of this version of the algebraic SAM, an experiment was carried out involving current transfers from households.

Because the intention was to study the distributional impacts of government policies, a scenario was defined, considering a 1percent reduction in the direct tax rate (ti) paid by households to the government, involving a leakage from the government's main source of receipts (current transfers from households) and an injection of receipts (resulting from the reduction in expenditure) into one item of the expenditure of households (current transfers to the government), although not the most important one.

The immediate purpose of this experiment is to improve the financial situation of households.

In the framework within which the above-mentioned scenario will be defined and the experiment performed, the direct taxes, or the current taxes on income, wealth, etc. paid by households, represent 6.5 percent of their aggregate income (households pay 68.9 percent of the direct taxes paid by all institutions). On the other hand, employees pay 8.5 percent of their aggregate income, which is the highest direct rate within the groups of households (they also pay 58.7 percent of the direct taxes paid by all institutions and 85.2 percent of those paid by households). Employers and own-account workers pay the lowest rate: 2.5 percent.

At the level of macroeconomic aggregates and balances, the performed experiment resulted in a decrease of 1.5 percent in gross domestic product at market prices (GDP), as well as in gross national income at market prices (GNIMP). The disposable income (DI) of households only increased by 0.04 percent and, curiously, employees, who pay the major share of direct taxes, are the only household group that shows a decrease, due to the importance of generated income (gross national income, which decreased by 1.5 percent) in

their disposable income. The other institutions showed a generalized decrease in their DI, particularly the government, with a decrease of 7.9 percent, which had a consequent negative impact on both demand and production. This situation led to decreases in GDP and GNIMP, as mentioned above, as well as in the gross saving and net borrowing of the economy, the latter showing a significant increase of 6.3 percent.

The dependence of final consumption on the gross disposable income of all domestic institutions, including the government, as well as the relationship between aggregate demand and production, are certainly the main causes of these results.

At the level of the budgets of institutions, the impacts on current balances, expressed by gross saving, and on total balances, expressed by the net lending/borrowing, a generalized decrease was observed, except in the case of the current balance of those households that do not belong to the group of employees. The current balance of the general government was the one that suffered the greatest impact, with a reduction in the current deficit resulting mainly from the impact of the reduction in disposable income on final consumption. The impacts at the level of the capital balance were not significant – which was expected, because the experiment was conducted with the flows of the current account. As far as the total balance is concerned, the net lending of households recorded a slight improvement (0.4 percent), whereas that of financial corporations and non-profit institutions serving households worsened – the former significantly (- 14.7 percent) and the latter slightly (- 0.2 percent). In turn, the net lending of non-financial corporations was converted into net borrowing, although the net borrowing of the general government recorded a decrease of 3.0 percent – reflecting the decrease observed in the current deficit. All these fluctuations in the total budget balances resulted in an increase in the net borrowing of the economy of 6.3 percent, as seen above.

Because the experiment was performed using a version of the algebraic SAM with too many fixed parameters and exogenous variables, the structural changes were certainly not significant. Let us, however, look at the results.

At the level of the distribution of generated income among factors of production, before the experiment, the compensation of labour received by employees represented 54.5 percent, whereas the compensation of labour received by employers and/or own-account workers represented 7.5 percent, and the compensation of capital represented 38.0 percent of generated income. After the experiment, a slight improvement can be seen in the positions of the latter two factors of production in detriment to the first. Workers with high and medium education levels were worse affected than workers with a low education level.

On the other hand, in the case of the distribution of generated income among institutions and socioeconomic groups within households, while, before the experiment, households received 84.5 percent of gross national income, with 62.1 percent corresponding to the group whose main source of income was wages and salaries (employees), non-financial corporations received 16.4 percent, and the remainder was distributed within the other institutions – with the general government recording a negative share. After the experiment, the position of the institutions either did not change or registered a slight improvement – except in the case of the households in general and of the group whose main source of income is wages and salaries (employees) in particular, and, in both scenarios, in the case of the general government, which recorded an increase in its negative position.

The distribution of disposable income among institutions before the experiment revealed that households had 69.3 percent of disposable income, with the group whose main source of income is wages and salaries (employees) having 41.9 percent; the general government had a share of 16.0 percent (similar to the group of households whose main source of income is the compensation of labour received by employers, including own-account workers); and the non-financial corporations had a share of 11.2 percent, with the others being less significant. The scenario that resulted from the experiment showed an improvement in the relative positions of households, non-financial corporations and non-profit institutions serving households in detriment to the other two, with special emphasis being given to the case of the general government. Mention should also be made of the positive impact that was noted in the relative position of the group of households whose main source of income is connected with old age (recipients of pensions).

In parallel with this, an experiment was carried out (Santos, 2008) involving current transfers to households, more concretely social benefits other than social transfers in kind paid by the government to households, and, generally speaking, the defined scenario revealed smaller generated impacts with similar mathematical signs.

## 5. CONCLUDING REMARKS

Within a SNA framework, the application performed for Portugal showed that numerical and algebraic versions of a SAM can each be constructed. In the former version, each cell assumed a specific numerical value, with the sums of the rows being equal to the sums of the columns. In the latter version, each cell was represented by algebraic expressions that, together with those of all the other cells, represent a SAM-based model, the calibration of which involved a replication of the numerical version. In both versions, each cell includes

all the known national accounting transactions, making it possible to deduce macroeconomic aggregates and balances, as well as structural indicators of the distribution and use of income.

With the initial aim of improving the financial situation of households, the scenario resulting from a reduction of 1.0 percent in the direct tax rate paid by households to the government showed that not only did the situation of both households and the general government worsen, but so did the situation of the whole economy.

Research should, however, continue, revising the assumptions, the parameters, the structure and all the details of these two versions of the indispensable working instrument that is the Social Accounting Matrix.

## Conventions and declarations

*Sets (set indices: lower-case subscripts)*

**f ε Factors of production**

- Labour – employees (**fle**) [with low education level (**flel**), with medium education level (**flem**), with high education level (**fleh**)]

- Own assets (**foa**)

  - Labour – employers and/or own-account workers (foal) [with low education level (**foall**), with medium education level (**foalm**), with high education level (**foalh**)]

  - Capital - interests, profits, rents (**foak**)

*a* **ε Activities** [agriculture, hunting and forestry; fishing and operation of fish hatcheries and fish farms (group1, *a***1**); industry, including energy (group 2, *a***2**); construction (group 3, *a***3**); wholesale and retail trade, repair of motor vehicles and household goods, hotels and restaurants; transport and communications (group 4, *a***4**); financial, real-estate, renting and business activities (group 5, *a***5**); other service activities (group 6, *a***6**)]

**p ε Products** [products of agriculture, hunting, forestry, fisheries and aquaculture (group 1, **p1**); products from mining and quarrying, manufactured products and energy products (group 2, **p2**); construction work (group 3, **p3**); wholesale and retail trade services, repair services, hotel and restaurant services, transport and communication services (group 4, **p4**); financial intermediation services, real-estate, renting and business services (group 5, **p5**); other services (group 6, **p6**)]

di ε **Domestic Institutions**

- **dic** (current account of di) [households (**dich**): employees (group 1, **dich1**), employers and own-account workers (group 2, **dich2**), recipients of pensions (group 3, **dich3**), others (group 4; **dich4**); non-financial corporations (**dicnfc**); financial corporations (**dicfc**); general government (**dicg**); non-profit institutions serving households (**dicnp**-NPISHs)]

- **dik** (capital account of di) [households (**dikh**), non-financial corporations (**diknfc**), financial corporations (**dikfc**), general government (**dikg**), and non-profit institutions serving households (**diknp**-NPISHs)]

- **dif** (financial account of di)

**rw ε rest of the world**

In variables and parameters with **two indices**, the **first** represents the **row** and the **second** the **column accounts** (both indices may be equal).

*Parameters (lower-case, italics)*

*α* ..     share of the production of each group of activities in the value of production of each group of products

*β* ..    proportion of gross added value in the value of production of each group of activities

*γ* ..    proportion of intermediate consumption in the value of production of each group of activities

*adv*..   share of the value of acquisitions less disposals of valuables of each group of products by each group of domestic institutions in the total value of acquisitions less disposals of valuables by these institutions

*advc* .. coefficient of acquisitions less disposals of valuables: amount expended by each group of domestic institutions on acquisitions less disposals of valuables per unit of gross saving

*apc* ..  average propensity to consume of each group of domestic institutions: amount of final consumption per unit of (gross) disposable income

*b2gp*..  proportion of capital compensation (gross operating surplus) in labour compensation

*b3s*..   share of compensation of employers and/or own-account workers (gross mixed income) in the gross added value

*ce* ..   coefficient of main source of income of domestic institutions (households) recipients of compensation of employees

*cgfcf* .. rate of coverage of gross fixed capital formation of each group of domestic institutions by investment grants received by these institutions

*chinv* .. share of the value of changes in inventories of each group of products by each group of domestic institutions in the total value of changes in inventories of that group of products

*chinvc* .. coefficient of changes in inventories: amount of change in inventories of each group of products per unit of supply

*clr* ..   share of compensation of employees paid by activities and sent to the rest of the world

*coa* ..  coefficient of main source of income of domestic institutions (households) recipients of compensation of employers and/or own-account workers

*d1s* ..  share of compensation of employees in the gross added value

*d5s* ..  share of current tax on income, wealth, etc. paid by each group of domestic institutions to each group of domestic institutions (Portuguese general government), in the total of current tax on income, wealth, etc. paid by the former

*d61s* .. share of social contributions paid by each group of domestic institutions to each group of domestic institutions in the total of social contributions paid by the former

*d62s* .. share of social benefits other than  social transfers in kind paid by each group of domestic institutions to each group of domestic institutions in the total of  social benefits other than social transfers in kind paid by the former

*d62rws*.. share of social benefits other than  social transfers in kind paid by each group of domestic institutions to the rest of the world in the total of social benefits other than social transfers in kind paid by the former

*d7* .. share of other current transfers paid by each group of domestic institutions to each group of domestic institutions in the total of other current transfers paid by the former

*d7rws* .. share of other current transfers paid by each group of domestic institutions to the rest of the world in the total of social benefits other than social transfers in kind paid by the former

*d91* .. share of capital taxes paid by each group of domestic institutions (households) to each group of domestic institutions (Portuguese general government) in the total of  capital taxes paid by the former

*d92*.. share of investment grants paid by each group of domestic institutions (Portuguese general government) to each group of domestic institutions in the total of  investment grants received by the latter

*d92rw*.. share of investment grants paid by the rest of the world to each group of domestic institutions in the total of  investment grants received by the latter

*d99*.. share of other capital transfers paid by each group of domestic institutions to each group of domestic institutions in the total of  other capital transfers received by the latter

*d99rw*.. share of other capital transfers paid by the rest of the world to each group of domestic institutions in the total of  other capital transfers received by the latter

*fcs* .. proportion of expenditure on final consumption in each group of products in the total value of the final consumption of each group of domestic institutions

*fcsrw* .. proportion of expenditure on final consumption in the rest of the world in the total value of the final consumption of each group of domestic institutions

*gfcf* .. share of the value of gross fixed capital formation in each group of products by each group of domestic institutions in the total value of gross fixed capital formation by these institutions

*icp* .. coefficient of the intermediate consumption of products: proportion of intermediate consumption of each group of products per unit of intermediate consumption of each group of activities

*ntag* .. share of net taxes on production paid by each group of activities and received by domestic institutions (Portuguese general government)

*ntarw* .. share of net taxes on production paid by each group of activities and received by the rest of the world (European Union institutions)

*ntpg* .. share of net taxes on each group of products received by domestic institutions (Portuguese general government)

*ntprw* ..share of net taxes on each group of products received by the rest of the world (European Union institutions)

*sc* .. social contribution rate: social contributions paid by domestic institutions, per unit of received gross national income

*si* .. saving identity special

*sk*.. share of compensation of capital received by domestic institutions

*ti* .. direct tax rate: current taxes on income, wealth, etc. paid by domestic institutions, per unit of received aggregate income

*tk* .. rate of capital tax levied on other capital transfers received by domestic institutions

*tm* .. rate of trade and transport margins on each group of domestically transacted products: amount of trade and transport margins per unit of value of domestically transacted products

*tmc* .. trade and transport margins coefficient of correction

*tp* .. (net) tax rate on each group of products: amount of (net) taxes on products per unit of the value of domestically transacted products

### *Exogenous variables (upper-case, at least the first letter, italics)*

*CFR*.. compensation of the factors of production received from the rest of the world

*CFS*.. compensation of the factors of production sent to the rest of the world

*D1RW*.. compensation of employees (transaction D1 of the SNA) received from the rest of the world

*D4PRW* .. property income (transaction D4 of the SNA) sent to the rest of the world

*D4RW* .. property income (transaction D4 of the SNA) received from the rest of the world

*D62P* .. social benefits other than social transfers in kind (transaction D62 of the SNA) paid by domestic institutions

*D62RW* .. social benefits other than social transfers in kind (transaction D62 of the SNA) received by domestic institutions from the rest of the world

*D7P* .. other current transfers (transaction D7 of the SNA) paid by domestic institutions

*D7RW* .. other current transfers (transaction D7 of the SNA) received by domestic institutions from the rest of the world

*D8* .. adjustment made for the change in the net equity of households in pension fund reserves (transaction D8 of the SNA)

*D92P* .. investment grants (transaction D92 of the SNA) paid by domestic institutions (Portuguese general government) to the rest of the world

*D99P* .. other capital transfers (transaction D99 of the SNA) paid by domestic institutions to the rest of the world

*D99R* .. other capital transfers (transaction D99 of the SNA) received by domestic institutions

*EX* .. value of exports (transaction P6 of the SNA, at f.o.b. prices)

*FT* .. financial transactions (transactions F1 to F7 of the SNA), except those received from the rest of the world

*IM* .. value of imports (transaction P7 of the SNA, at c.i.f. prices)

*K2* .. acquisitions less disposals of non-financial non-produced assets (transaction K2 of the SNA)

*NTAA* .. net taxes on production paid by each group of activities

*P51* .. value of gross fixed capital formation (transaction P51 of the SNA)

***Endogenous variables (upper-case, at least the first letter, normal)***

AD .. value of aggregate demand (at market prices)

AFIP .. aggregate factors income (paid)

AFIR .. aggregate factors income (received)

AI .. aggregate income (received)

AINV .. aggregate investment

AIP .. aggregate income (paid)

AS .. aggregate supply (value at market prices)

B2g .. gross operating surplus (balance B2g of the SNA)

B3g .. gross mixed income (balance B3g of the SNA)

CFS.. compensation of the factors of production sent to the rest of the world (except, property income sent to the rest of the world)

CT .. current transfers

CTP .. (total) current transfers paid by each group of domestic institutions to (all) domestic institutions

CTR .. (total) current transfers received by each group of domestic institutions from (all) domestic institutions

DI .. (gross) disposable income

Didi .. percentage of gross disposable income received by domestic institutions

Digav .. percentage of income generated by the factors production

Digavfle .. percentage of income generated by employees, by level of education

Digavfoal .. percentage of income generated by employers and/or own-account workers, by level of education

Digavfoak ..indicator of the distribution of income (gross added value) generated by capital among activities (in percentage terms)

Digni.. percentage of generated income (gross national income) received by domestic institutions

DT.. value of domestically transacted products, at basic-c.i.f. prices

DTmp ..value of domestically transacted products, at market prices

D1 .. compensation of employees (transaction D1 of the SNA)

D5 .. current taxes on income, wealth, etc. (transaction D5 of the SNA)

D61 .. social contributions (transaction D61 of the SNA)

D91P .. capital taxes (transaction D91 of the SNA) paid by domestic institutions

D92R ..investment grants (transaction D92 of the SNA) received by domestic institutions

FC .. value of final consumption (transaction P3 of the SNA), at market prices

FTRW .. financial transactions (transactions F1 to F7 of the SNA) received by domestic institutions from the rest of the world

GAV .. gross added value, at factor cost

GCF .. value of gross capital formation (transaction P5 of the SNA), at market prices

GDP.. gross domestic product, at market prices

GNI .. gross national income, at factor cost

GNIMP.. gross national income, at market prices

INVF .. investment funds

KT .. capital transfers

KTP .. (total) capital transfers paid by each group of domestic institutions to (all) domestic institutions

KTR .. (total) capital transfers received by each group of domestic institutions from (all) domestic institutions

NLB .. net lending / borrowing

NTA .. net taxes on production (transaction D29-D39 of the SNA)

NTP .. net taxes on products (transaction D21-D31 of the SNA)

P52 .. value of changes in inventories (transaction P52 of the SNA)

P53 .. value of acquisitions less disposals of valuables (transaction P53 of the SNA)

S .. gross saving

TFTP .. total financial transactions (paid)

TFTR .. total financial transactions (received)

TM .. trade and transport margins (without correction)

TMc .. trade and transport margins – correction

TMT .. trade and transport margins with correction

TVRWP .. value of transactions to the rest of the world

TVRWR .. transactions value from the rest of the world

UdiFC ..percentage of gross disposable income used in final consumption by domestic institutions

UdiS .. percentage of gross disposable income used in (gross) saving by domestic institutions

VCT .. value of total costs (at basic prices)

VIC .. value of intermediate consumption (transaction P2 of the SNA) at market prices

VP .. value of production (transaction P1 of the SNA), at basic prices

VPT.. total production value (at basic prices)

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