# DECOMPOSITION OF FINAL DEMAND BY PRODUCTS INTO PRIMARY INPUT CONTENTS – METHODOLOGY AND APPLICATIONS

**Ana Maria Dias** (anadias@dpp.pt)

Department of Foresight and Planning and International Affairs (DPP)
Ministry of Environment and Spatial Planning
Av. D. Carlos I, 126, 1249-073 Lisboa – PORTUGAL. Web: www.dpp.pt

**19th International Input-Output Conference, Virginia, Alexandria, USA, 13-17 June 2011**

## Abstract

This paper presents a methodology for decomposing final demand (by demanded product and type of demand) into its primary input contents (value added, imports and taxes), direct, indirect, and total, using coefficients calculated from a system of symmetric input-output tables (product by product) built under ESA95 rules. An application is made to Portugal and the relationship between the level of unit import contents of final demand and its macroeconomic impact is analyzed, considering a number of public policies evaluated through an input-output based model for Portugal.

**Keywords:** input-output methods; primary input contents; policy evaluation; macroeconomic impact.

## 1. INTRODUCTION

This paper presents a methodology for decomposing final demand at purchasers'prices (by demanded product and type of demand) into its direct and indirect primary input contents (value added, imports and taxes), using coefficients calculated from a system of symmetric input-output tables (product by product) built under ESA95 rules.

Section 2 describes the methodology used, while section 3 presents a summary of the results of its application to Portugal (2005). In section 4 a brief analysis is made concerning the evolution of primary input contents of final demand along the period 1995-2006 and section 5 analyses the relationship between the level of unit import contents of final demand and the macroeconomic impact of a number of public policies with incidence on final demand, evaluated through an input-output based model for Portugal (MODEM 6C). Finally, section 6 presents some concluding remarks, evidencing some peculiarities of the proposed methodology.

## 2. METHODOLOGY USED

### 2.1 General features

Final demand for each product can be satisfied either by domestic output or by imports, generating also taxes (net of subsidies) on the demanded products (direct effects).

This domestic output can itself be decomposed into domestically produced intermediate inputs and the so-called primary inputs (because they are not domestically produced) (imported inputs, value added and taxes (net of subsidies) on inputs).

Domestically produced inputs can, again, be decomposed into intermediate and primary inputs, so that, at the end, the value of final demand can be totally decomposed into primary inputs: imports (direct and indirect), gross value added and taxes (net of subsidies) on products (direct and indirect contents).

The calculation of primary input contents of final demand was made using the following symmetric input-output matrices (for 2005[1], in the case of the results presented in this paper):

- FT: Total Flows at purchasers' prices;
- PN: Domestic Output;
- M : Imports CIF;
- TS: Taxes, net of Subsidies, on products;
- MCi: Trade Margins of type i, for i= trade sectors (in the P60 nomenclature, basis 2000 of National Accounts, these sectors are: 50: car and fuel trade; 51: other wholesale trade; and 52 (other retail trade) (three matrices));
- MTNi: Transport Margins of type i, satisfied by domestic output (in the P60 nomenclature, basis 2000 of National Accounts, these sectors are: 60: land transport; 61 water transport (two matrices));
- MTMi: Transport Margins of type i, satisfied by imports.

The matrix of Total Flows at purchasers' prices is equal to the sum of all the other matrices:

(1) $FT = PN+M+TS+MC+MTN+MTM$

where:

$MC = \sum MCi$ for i = trade sectors;

$MTN = \sum MTNi$ for i = transport sectors (land and water);

$MTM = \sum MTMi$ for i = transport sectors (land and water).

Elements of order (i,j) and (i,F) of each of the abovementioned matrices ($MAT_{ij}$ e $MAT_{iF}$ , using MAT as a generic designation of those matrices), represent, respectively, intermediate consumption of product i by the homogeneous branch j and final demand of type F for product i, with F = C (Household' Final Consumption Expenditure), CS15

[1] These matrices (product by product, considering 59 products, according to the ESA95 P60 nomenclature) are available in Dias (2008), except trade and transport margins matrices by types of margin, which were calculated in DPP (from data supplied by the Portuguese statistic office, INE) but were not published (only the total trade margins and total transport margins were published). Matrix TIS is obtained through the sum of the matrices for Import Duties (ID), Value Added Tax (VAT), Other Taxes on Products (OTP) and Subsidies (Z). The PN and M matrices are also available at the EUROSTAT website (input-output tables for Portugal). The methodology for building this system of matrices is also presented, in English, in Dias (2009).

(NPISH[2]' Final Consumption Expenditure), G (Government Final Consumption Expenditure), I (GFCF), VE (Change in inventories), V (Net Acquisition of valuables), EX (Exports).

Let $X_j$ represent domestic output of product j and Ftot represent total final demand of type F.

Technical coefficients were calculated using the following formulas:

$a_{ij}=FT_{ij}/X_j$ Total technical coefficient of order (i, j), representing the quantity of product *i* (at purchasers' prices) necessary to produce one unit of product *j* (at basic prices);

$a_{iF}=FT_{iF}/Ftot$ Share of product *i* (at purchasers' prices) in total final demand of type F (at purchasers' prices);

$an_{ij}=PN_{ij}/X_j$ Quantity of domestically produced good *i* (at basic prices) used to produce one unit of product *j* (at basic prices);

$an_{iF}=PN_{iF}/Ftot$ Share of domestically produced good *i* (at basic prices) in total final demand of type F (at purchasers' prices);

$am_{ij}=M_{ij}/X_j$ Quantity of imported product *i* (CIF) used to produce one unit of product *j* (at basic prices);

$am_{iF}=M_{iF}/Ftot$ Share of imported product good *i* (CIF) in total final demand of type F (at purchasers' prices);

$ats_{ij} = TS_{ij}/X_j$ Taxes on products (net of subsidies) included in the input of product *i* necessary to produce one unit of product j;

$ats_{iF}=TS_{iF}/Ftot$ Share of taxes on products (net of subsidies) paid for product *i* in total final demand of type F (at purchasers' prices);

$av_i = VAB_i/X_i$ Product transformation coefficient for product *i* (share of GVA in the value of domestic output of product *i*, at basic prices);

[2] Non Profit Institutions Serving Households.

From these calculations we created the following square matrices of coefficient (n×n), for n = number of products/sectors considerered (59 for 2005), identified with the corresponding generic element of order (i,j):

- $A = [a_{ij}]$ - Matrix of total technical vertical coefficients;
- $AN = [an_{ij}]$ - Matrix of vertical coefficients for domestically produced inputs;
- $AM = [am_{ij}]$ - Matrix of vertical coefficients for imported inputs;
- $ATS = [ats_{ij}]$ - Matrix of vertical coefficients for taxes (net of subsidies) on inputs;
- $\hat{AV}$ - Diagonal matrix for value added ($av_i$) coefficients.

The following column vectors (n×1) were also defined:

- $X = [X_i]$ – Domestic Output by products, at basic prices;
- $F = [FT_{iF}]$ - Final Demand of type F (total flows) by products, at purchasers prices;
- $FN = [PN_{iF}]$ - Final Demand, of type F, for domestically produced goods, by products, at basic prices;
- $FM = [M_{iF}]$ - Final Demand, of type F, for imported goods (CIF), by products;
- $FTS = [TS_{iF}]$ – Taxes, net of subsidies, on Final Demand of type F, by products;
- $VAB = [VAB_i]$ - Gross Value Added by sectors (products);
- $MT = [M_i]$ - Total Imports (CIF) by products;
- $TST = [TS_i]$ - Total taxes, net of subsidies, applying to each product;
- $AF = [a_{iF}]$ - Structure of distribution, by products, of final demand of type F.

## 2.2 Direct contents

We defined the following square matrices (n×n) representing direct unit contents of final demand in domestic output (QNF), imports (QMF) and taxes (net of subsidies) on products (QTSF), for the various types of final demand. These matrices were calculated in order to meet the following identities:

(2) $FN = QNF*F$

(3) $FM = QMF*F$

(4) $FTS = QTSF*F$

Each element of these matrices, $qnf_{ij}$, $qmf_{ij}$, $qtsf_{ij}$, represents, respectively, domestic output, imports and taxes (net of subidies) regarding product i, for each unit of final demand, of type F, for product j (direct contents).

Note that QNF and QMF are not diagonal matrices because, for each demanded product (with demand evaluated at purchasers' prices), there is (for most of the products) a direct content of trade and transport margins, the supply of which is made by the trade and transport sectors (off-diagonal).

Therefore, the elements of QNF were calculated as follows:

$qnf_{ii} = PN_{iF}/FT_{iF}$ for $i \neq$ trade and transport (land and water) sectors

$qnf_{ij} = 0$ for $i \neq j$ and $i \neq$ trade and transport (land and water) sectors

$qnf_{ii} = (PN_{iF} + MCi_{iF})/FT_{iF}$ for i = trade sectors (contents of domestic output of final demand addressed to trade sectors which do not correspond to trade margins[3])

$qnf_{ij} = MCi_{jF}/FT_{jF}$ (trade margin rate, of type I, on final demand of type F, for product j), for $i \neq j$ and i = trade sectors

$qnf_{ii} = (PN_{iF} + MTNi_{iF})/FT_{iF}$ for i = transport sectors (land and water) (contents of domestic output of final demand addressed to land and water transport sectors which do not correspond to transport margins[4])

$qnf_{ij} = MTNi_{jF}/FT_{jF}$ (transport margin rate, of type i, satisfied by domestic output, on final demand of type F, for product j), for $i \neq j$ and i = transport sectors (land and water).

In the same way, considering that part of the imports of land and water transport servives result from transport margins (satisfied by imports) applied to products of the remaining, the elements of QMF were calculated as follows:

$qmf_{ii} = M_{iF}/FT_{iF}$ for $i \neq$ transport (land and water) sectors

$qmf_{ij} = 0$ for $i \neq j$ and $i \neq$ transport (land and water) sectors

$qmf_{ii} = (M_{iF} + MTMi_{iF})/FT_{iF}$ for i = transport (land and water) sectors (contents of imports of final demand addressed to land and water transport sectors which do not correspond to imported transport margins[5])

[3] Note that $MCi_{iF}$ and $MTNi_{iF}$ have negative values when i = trade/transport sectors, which are equal to the symmetric of the total value of the respective margins applied to the various products (*vide* Dias, 2009, page 4, 3rd paragraph). Therefore the sums ($PN_{iF} + MCi_{iF}$) and ($PN_{iF} + MTNi_{iF}$) represent the part of sector i's domestic output that does not correspond to margins of type i.

[4] *Vide* previous note.

$qmf_{ij} = MTMi_{jF}/FT_{jF}$ (transport margin rate, of type i, satisfied by imports, on final demand of type F, for product j), for $i \neq j$ and i = transport sectors (land and water).

QTSF (the matrix of direct unit contents in taxes, net of subsidies, on products, for final demand of type F) is a diagonal matrix which elements of the principal diagonal were calculated as follows:

$qtsf_{ii} = TS_{iF}/FT_{iF}$

Total direct unit contents in domestic output, imports and taxes (net of subsidies) on products, regarding final demand of type F, for product j, called, respectively, $qnf_j$, $qmf_j$ and $qtsf_j$ , are given by:

(5) $qnf_j = \sum_i qnf_{ij} = (PN_{jF} + MC_{jF} + MTN_{jF})/FT_{jF}$

(6) $qmf_j = \sum_i qmf_{ij} = (M_{jF} + MTM_{jF})/FT_{jF}$

(7) $qtsf_j = \sum_i qtsf_{ij} = TS_{jF}/FT_{jF}$

Given identity (1), we verify that the sum of these three direct contents is equal to one, for each demanded product and type of demand:

(8) $qnf_j+qmf_j+qtsf_j = (PN_{jF}+MC_{jF}+MTN_{jF}+M_{jF}+MTM_{jF}+TS_{jF})/FT_{jF} = FT_{jF}/FT_{jF} = 1$

## 2.3 Indirect and total contents

Product i's domestic output may be used as an intermediate input by the various domestic productive sectors and also to satisfy the various types of final demand for domestically produced good i ($FN_i$,), which may be expressed by the following equation:

(9) $X_i = \sum_j an_{ij} * X_j + \sum_F FN_i$

Expressing this equation in matrix notation yields:

(10) $X = AN * X + \sum_F FN$

---

[5] Note that $MTMi_{iF}$ has a negative value when i = land and water transport sectors, which is equal to the symmetric of the total value of the respective transport margins (satisfied by imports) applied to the various products (*vide* Dias, 2009, page 4, 3rd paragraph). Therefore the sum ($M_{iF}$ +$MTM_{iF}$) represents the part of sector i's imports that does not correspond to imported transport margins of type i.

from which we can deduct that:

$$(11)\ X = (I-AN)^{-1} *(\sum_{F} FN) = \sum_{F} [(I-AN)^{-1} *FN]$$

Matrix $(I-AN)^{-1}$ is the so-called Leontief inverse. The element of order (i,j) of this matrix ($b_{ij}$) represents the quantity of domestic output of product i necessary to satisfy one unit of final demand for domestically produced product j. Therefore, this matrix is also known as the matrix of output multipliers.

Combining equations (2) and (11) we can write the equation for X as a function of total final demand:

$$(12)\ X = \sum_{F} [(I-AN)^{-1} *QNF]*F$$

Given that :

$$(13)\ VAB = \hat{AV}*X$$

We have, combining (12) with (13):

$$(14)\ VAB = \sum_{F} [\hat{AV}*(I-AN)^{-1} *QNF]*F$$

Matrix (n×n) resulting from the operations inside straight brackets in (14) represents total unit contents of Gross Value Added for final demand of type F. Element of order (i,j) of this matrix represents Gross Value Added generated in sector i per unit of final demand, of type F, for product j.

Imports of each product are made in order to satisfy intermediate and final demand, which may be expressed in the following equation:

$$(15)\ M_i = \sum_{j} am_{ij}*X_j + \sum_{F} FM_i$$

In matrix notation we have:

$$(16)\ MT = AM*X + \sum_{F} FM$$

Combining (16) with (3) and (12) we have:

$$(17)\ MT = \sum_{F}[AM*(I-AN)^{-1} *QNF + QMF]*F$$

Matrix (n×n) resulting from the operations inside straight brackets in (17) represents unit contents of Imports (direct+indirect) for final demand of type F. Element of order (i,j) of this matrix represents imports of product i, per unit of final demand, of type F, for product j. This matrix has two components, representing, respectively direct (QMF) and indirect $[AM*(I-AN)^{-1}*QNF]$ unit contents of imports.

Concerning taxes, net of subsidies, on products, we have the following matrix equation:

(18) $TST = ATS*X + \sum_{F} FTS$

Combining (18) with (4) and (12) we have:

(19) $TST = \sum_{F} [ATS*(I-AN)^{-1} *QNF + QTS]*F$

Matrix (n×n) resulting from the operations inside straight brackets in (19) represents unit contents of taxes (net of subsidies) on products (direct+indirect) for final demand of type F. Element of order (i,j) of this matrix represents net taxes on product i, per unit of final demand, of type F, for product j. This matrix has two components, representing, respectively direct (QTS) and indirect [$ATS*(I-AN)^{-1}*QNF$] unit contents of taxes (net of subsidies) on products.

## 2.4 Summary

### 2.4.1. Matrices of unit contents of final demand (n×n):

Table 1 presents a summary of matrices (n×n) of direct, indirect and total contents of final demand of type F, by types of contents. The element of order (i,j) of each one of these matrices (generically denoted by CONT), $cont_{ij}$, represents a certain type of content (imports, taxes, domestic output, GVA), direct, indirect or total, of product i, per unit of final demand of type F, addressed to product j.

**Table 1 – Matrices of unit contents of final demand of type F (n×n)**

| Type of contents : | Direct | Indirect | Total |
|---|---|---|---|
| Imports | QMF | $AM*(I-AN)^{-1}*QNF$ | $QMF+AM*(I-AN)^{-1}*QNF$ |
| Taxes, net of subsidies, on products | QTSF | $ATS*(I-AN)^{-1}*QNF$ | $QTSF+ ATS*(I-AN)^{-1}*QNF$ |
| Domestic Output | QNF | | |
| Gross Value Added (GVA) | | | $\hat{A}V*(I-AN)^{-1}*QNF$ |

### 2.4.2 Vectors of unit contents for all products, by demanded product

When we calculate these matrices' column sums, we obtain row-vectors, generically denoted by CONTT (1×n), whose elements of order j represent contents in all

(produced/imported) goods, per unit of final demand (of type F), for product j. Denoting a unit column vector (n×1) by **i** (with all elements equal to 1) and by **i'** its transposed (row vector) we have, in matrix notation:

(20) CONTT = **i**'*CONT

Given that the generic elements of order j of **i**'*QNF, **i**'*QMF e **i**'*QTSF are, respectively, $qnf_j$, $qmf_j$ e $qts_j$, previously defined in section 2.1 by equations (5), (6) and (7), and given the identity presented in (8), we verify that the sum of these three vectors is equal to a row unit vector:

(21) QNFT+QMFT+QTSFT = **i**'*QNF + **i**'*QMF + **i**'*QTSF = **i**'

On the other hand, given that, for each sector j, the sum of all inputs per unit produced (intermediate and GVA) is equal to 1:

(22) $\sum_i an_{ij} + \sum_i am_{ij} + \sum_i ats_{ij} + av_j = 1$

or, equivalently:

(23) $\sum_i am_{ij} + \sum_i ats_{ij} + av_j = 1 - \sum_i an_{ij}$

we verify that the sum of the row-vectors of indirect contents of imports and of taxes (net of subsidies) on products with the row-vector for total GVA contents is equal to the row-vector for direct contents of domestic output. In fact, it follows from (23) that:

(24) **i**'*(AM + ATS +$\hat{A}$V) = **i**'*(I-AN)

Therefore we can deduct that:

(25) **i**'*[AM*(I-AN)$^{-1}$*QNF]+**i**'*[ATS*(I-AN)$^{-1}$*QNF]+**i**'*[$\hat{A}$V*(I-AN)$^{-1}$*QNF] =

= **i**'*(AM+ATS+$\hat{A}$V)*(I-AN)$^{-1}$*QNF = **i**'*(I-AN)*(I-AN)$^{-1}$*QNF = **i**'*QNF

### 2.4.3. Contents by products (and for all products), per composite unit of final demand

We can also calculate vectors of contents, by (produced/imported) products, of a composite unit of final demand, *i.e.*, for each unit of final demand containing a combination of various demanded products, considering, for example, the observed structure of final demand from National Accounts. The column-vector (n×1), for each type of contents, obtained from CONT, which will be denoted by CONTC, is obtained by the formula:

(26) CONTC = CONT*AF

where AF is a column-vector (n×1) representing the structure of breakdown, by demanded products, of type F final demand.

Finally, we can calculate scalars (1×1) representing the contents, in all produced/imported goods, per composite unit of type F final demand (CONTTC), through the formula:

(27) CONTTC = **i**'*CONT*AF

### 2.4.4. Contents in value

Multiplying unit contents by the respective value of final demand (expressed, for example, in million euros), we obtain the value of these contents in the same monetary units.

## 3. ANALYSIS OF RESULTS

Table 2 presents a summary of results (scalars) obtained for direct, indirect and total primary input contents of final demand (at purchasers'prices) for Portugal, in 2005[6]. The upper part of the table presents unit contents (per unit of final demand) while the lower part shows contents in million euros, regarding total final demand observed for Portugal in 2005, at current prices.

Contents of GDP at market prices (GDPmp) are equal to the sum of contents of Gross Value Added at basic prices (GVAbp) with contents of taxes (net of subsidies) on products.

Final demand components presenting a higher unit import content in 2005 are, by decreasing order, Change in Inventories (49%), Net Acquisition of Valuables (ACOV) and Exports (both with 41%), followed by GFCF (34%), Households' Consumption (25%) and NPISH's Consumption (16%). The component of final demand with the lowest import content is Public Consumption (9%) and the average import content of total final demand is 27%.

Taxes, (net of subsidies) on products represented, in 2005, 10% of total value of final demand, having a greater incidence in Net Acquisition of Valuables (17%), Households' Consumption (15%) and in GFCF (11%).

As final demand is totally decomposed into primary input contents of Imports, of taxes (net of subsidies) on products and of GVA, contents of GVA are as higher as the respective import and tax contents are lower.

Unit contents of GDP are equal to 1 minus total unit import contents.

In terms of total final demand, GVA content represented, in 2005, 63% and GDP content 73%, while Public Consumption was the final demand component with the highest GVA (86%) and GDP (91%) contents, due to its low import content.

[6] More detailed results for 2005 (including primary input contents, by demanded product, for each type of final demand, *i.e.*, column vectors of CONTT' type, see equation (20) above) are presented in Dias (2010).

**Table 2 – Primary input contents of Final Demand – Portugal, 2005**

| | Imports CIF | | | Taxes, net of subsidies, on products | | | GVAbp | GDPmp | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Direct | Indirect | Total | Direct | Indirect | Total | | | |
| **1. Unit contents for each type of Final Demand:** | | | | | | | | | |
| **Households' Consumption Expenditure** | 0.125 | 0.124 | 0.249 | 0.128 | 0.023 | 0.150 | 0.601 | 0.751 | 1.000 |
| **Government Consumption Expenditure** | 0.016 | 0.076 | 0.091 | 0.002 | 0.042 | 0.045 | 0.864 | 0.909 | 1.000 |
| **NPISH' Consumption Expenditure** | 0.010 | 0.149 | 0.159 | 0.000 | 0.078 | 0.078 | 0.763 | 0.841 | 1.000 |
| **Gross Fixed Capital Expenditure** | 0.178 | 0.159 | 0.337 | 0.066 | 0.041 | 0.107 | 0.556 | 0.663 | 1.000 |
| **Net Acquisition of valuables** | 0.310 | 0.098 | 0.408 | 0.153 | 0.019 | 0.172 | 0.421 | 0.592 | 1.000 |
| **Change in Inventories** | 0.400 | 0.088 | 0.488 | 0.001 | 0.026 | 0.027 | 0.484 | 0.512 | 1.000 |
| **Exports** | 0.010 | 0.397 | 0.407 | 0.001 | 0.023 | 0.024 | 0.570 | 0.593 | 1.000 |
| **Total Final Demand** | 0.094 | 0.172 | 0.267 | 0.073 | 0.029 | 0.102 | 0.631 | 0.733 | 1.000 |
| **2. Contents of Final Demand in value (million euros at current prices):** | | | | | | | | | |
| **Households' Consumption Expenditure** | 12205 | 12085 | 24290 | 12441 | 2196 | 14637 | 58518 | 73155 | 97444 |
| **Government Consumption Expenditure** | 503 | 2416 | 2919 | 73 | 1350 | 1423 | 27632 | 29055 | 31974 |
| **NPISH' Consumption Expenditure** | 29 | 449 | 478 | 0 | 235 | 235 | 2298 | 2534 | 3012 |
| **Gross Fixed Capital Expenditure** | 5904 | 5252 | 11156 | 2191 | 1348 | 3540 | 18402 | 21942 | 33098 |
| **Net Acquisition of valuables** | 53 | 17 | 69 | 26 | 3 | 29 | 71 | 101 | 170 |
| **Change in Inventories** | 153 | 34 | 186 | 0 | 10 | 10 | 185 | 195 | 382 |
| **Exports** | 359 | 14820 | 15179 | 28 | 857 | 886 | 21256 | 22142 | 37321 |
| **Total Final Demand** | 19205 | 35073 | 54278 | 14761 | 6000 | 20760 | 128363 | 149123 | 203401 |

Primary input contents presented on table 2 are average values, per composite unit of final demand. In the Appendixes of Dias (2010) are presented the primary input contents by demanded product, for each type of demand.

## 4. EVOLUTION OF FINAL DEMAND PRIMARY INPUT CONTENTS IN PORTUGAL, FROM 1995 TO 2006

Table 3 presents a summary of primary input contents of final demand for Portugal. calculated for 2005 at current prices (Dias, 2010) as well as 1995 (at current and at 1999 prices) and for 1999, at current prices (Martins, 2004)). However, these studies are not strictly comparable because they rely on different National Accounts basis (basis 1995 in Martins (2004) and basis 2000 in Dias (2010).

**Table 3 – Primary input contents of Final Demand (direct+indirect) in Portugal, per unit of each type of final demand - 1995, 1999 and 2005 (a)**

| | Imports CIF | | | | Taxes, net of subsidies, on products | | | | Gross Value Added at Basic prices | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Basis 1995 | | | Basis 2000 | Basis 1995 | | | Basis 2000 | Basis 1995 | | | Basis 2000 |
| | 1995 at current prices | 1995 at 1999 prices | 1999 at current prices | 2005 at current prices | 1995 at current prices | 1995 at 1999 prices | 1999 at current prices | 2005 at current prices | 1995 at current prices | 1995 at 1999 prices | 1999 at current prices | 2005 at current prices |
| **Households' Consumption Expenditure** | 0.240 | 0.224 | 0.260 | **0.249** | 0.146 | 0.143 | 0.153 | **0.150** | 0.614 | 0.633 | 0.587 | **0.601** |
| **Government Consumption Expenditure** | 0.080 | 0.071 | 0.087 | **0.091** | 0.045 | 0.040 | 0.043 | **0.045** | 0.875 | 0.889 | 0.869 | **0.864** |
| **NPISH' Consumption Expenditure** | 0.120 | 0.102 | 0.119 | **0.159** | 0.083 | 0.080 | 0.087 | **0.078** | 0.797 | 0.818 | 0.794 | **0.763** |
| **Gross Fixed Capital Expenditure** | 0.335 | 0.306 | 0.365 | **0.337** | 0.094 | 0.097 | 0.102 | **0.107** | 0.571 | 0.597 | 0.534 | **0.556** |
| **Net Acquisition of valuables** | 0.253 | 0.240 | 0.265 | **0.408** | 0.165 | 0.161 | 0.174 | **0.172** | 0.582 | 0.599 | 0.561 | **0.421** |
| **Change in Inventories** | 0.579 | 0.712 | 0.590 | **0.488** | 0.022 | 0.018 | 0.024 | **0.027** | 0.399 | 0.270 | 0.386 | **0.484** |
| **Exports** | 0.365 | 0.344 | 0.383 | **0.407** | 0.016 | 0.018 | 0.021 | **0.024** | 0.619 | 0.638 | 0.596 | **0.570** |
| **Total Final Demand** | 0.260 | 0.240 | 0.280 | **0.267** | 0.096 | 0.096 | 0.101 | **0.102** | 0.644 | 0.665 | 0.619 | **0.631** |
| **Total Final Demand (basis 2000)** | 0.252 | | 0.270 | **0.267** | 0.092 | | 0.097 | **0.102** | 0.655 | | 0.633 | **0.631** |

(a) Values for 1995 and 1999 on basis 1995 – source: Martins (2004).

In order to allow an analysis of the evolution of these contents along the period 1995-2006. we calculated them with data compatibilized with basis 2000 of National Accounts , which are presented in the last row of table 3 (calculations at current prices) e on table 4 (values at current and at 2000 prices, for total contents of total final demand).

Comparing the last two rows of table 3 we verify that import contents of total final demand were downsized with the change in the basis of National Accounts from 1995 to 2000 due to the upwards revaluation of GDP.

Tables 3 and 4 evidence an increase in the volume (at 2000 prices) of final demand import content along the period 1995-2006 (except for 2001-2003). However, at current prices this trend is less pronounced, due to a lower increase in import prices compared to final demand implicit prices.

**Table 4 – Primary input unit contents (direct+indirect) of total Final Demand Portugal (basis 2000)**

| Year | At 2000 prices | | | At current prices | | |
|---|---|---|---|---|---|---|
| | Imports CIF | Taxes, net of subsidies, on products | GVAbp | Imports CIF | Taxes, net of subsidies, on products | GVAbp |
| **1995** | 0.241 | 0.087 | 0.672 | 0.252 | 0.092 | 0.655 |
| **1996** | 0.243 | 0.088 | 0.669 | 0.253 | 0.094 | 0.653 |
| **1997** | 0.254 | 0.087 | 0.659 | 0.261 | 0.092 | 0.646 |
| **1998** | 0.270 | 0.090 | 0.640 | 0.268 | 0.095 | 0.637 |
| **1999** | 0.280 | 0.092 | 0.627 | 0.270 | 0.097 | 0.633 |
| **2000** | 0.283 | 0.092 | 0.625 | 0.283 | 0.092 | 0.625 |
| **2001** | 0.281 | 0.090 | 0.629 | 0.274 | 0.093 | 0.633 |
| **2002** | 0.279 | 0.090 | 0.631 | 0.261 | 0.097 | 0.643 |
| **2003** | 0.279 | 0.088 | 0.633 | 0.252 | 0.098 | 0.651 |
| **2004** | 0.289 | 0.086 | 0.625 | 0.261 | 0.096 | 0.643 |
| **2005** | 0.294 | 0.086 | 0.620 | 0.267 | 0.102 | 0.631 |
| **2006** | 0.302 | 0.084 | 0.614 | 0.276 | 0.104 | 0.619 |

Source: DPP, based on National Accounts (basis 2000).

## 5. PRIMARY INPUT CONTENTS OF FINAL DEMAND AND THE MACROECONOMIC IMPACT OF PUBLIC POLICIES

The macroeconomic impact of public policies with incidence on final demand (public consumption, investment, transfers to households, subsidies to firms) tends to be negatively correlated (from a demand-side perspective) with total import content of final demand generated by those policies. In effect, besides directs and indirect effects of public expenditure on GDP (evaluated by the its GDP unit content[7]) there are the induced effects resulting from the additional private consumption due to the increase in households' disposable income derived from the increase in domestic output and employment to satisfy additional demand generated by public expenditure.

The whole of this effects is considered in the simulations with the input-output based model, MODEM 6 C (described in Dias and Lopes, 2010[8]), of which some results (simulated using technical coefficients estimated for 2005) are presented in table 5,

[7] Note that: GDP unit content of final demand = 1- total unit import content of this demand.

[8] The 2009 version of this model (MODEM 6A) is presented, in English, in Dias and Lopes (2009).

comparing import (and GDP) contents of various types of public expenditure with the respective multiplier effect on GDP evaluated with the model[9].

**Table 5**

**Multiplier effect of some types of public expenditure on GDP (evaluated with model MODEM 6C, with no fiscal policy rule) compared to the expenditure import content (Portugal, 2005)**

| Type of public expenditure (P60 product nomenclature in brackets) | Import content | | | GDP content | Multiplier effect on GDP(a) |
|---|---|---|---|---|---|
| | Direct | Indirect | Total | | |
| Investment in Equipment (28 to 36) (b) | 0.55 | 0.13 | 0.68 | 0.32 | 0.42 |
| Investment in Construction (45) | 0.00 | 0.20 | 0.20 | 0.80 | 1.03 |
| Investment in computer services (72) | 0.09 | 0.08 | 0.17 | 0.83 | 1.08 |
| Research & Development (73) | 0.00 | 0.06 | 0.06 | 0.94 | 1.26 |
| Public Consumption – Administration (75) | 0.00 | 0.06 | 0.06 | 0.94 | 1.28 |
| Public Consumption - Education (80) | 0.00 | 0.03 | 0.03 | 0.97 | 1.34 |
| Current transfers to Households | | | | | 0.59 |

(a) simulated with MODEM 6C, considering a marginal propensity to consume (mpc) of 0.7.
(b) GFCF in the products 28 to 36 (using the structure for those products observed for Portuguese total GFCF in 2005).

**Source:** Dias and Lopes (2010)

The dimension of the multiplier effect of public expenditure on GDP also depends on the level of marginal propensity to consume (assumed to be 0.7, in the presented results).

From the presented examples, expenditure with Education is the one evidencing the highest multiplier effect, due to its low import content (3%), while investment in equipment has the lowest impact for the opposite reason (an average import content of 68%).

Transfers to households do not have a direct impact on final demand but only an induced effect through consumption generated by this additional income. Therefore, its impact on GDP results from the combination of households' consumption GDP content (75% on average, *vide* table 2), combined with their marginal propensity to consume.

[9] It should be stressed that this model considers only demand-side (short-term) effects of public expenditure, ignoring, for example, supply-side effects of investment (*e.g.*, resulting from its impact on productive capacity and on factor productivity), that may occur in a longer term.

## 6. CONCLUDING REMARKS

In this paper a methodology was presented for decomposing final demand (by demanded product and category of demand) into its primary input contents (direct, indirect and total), in terms of (n×n) matrices of unit contents by produced/imported goods×demanded products, considering total (category F) final demand for each product.

The proposed methodology allows the calculation of the direct+indirect impact of each unit of additional final demand for a particular product j, considering that this demand is not only addressed to domestically produced goods but to what is available in the market, including both domestically produced and imported goods.

The methodology starts with the use of "share" matrices (n×n) for direct contents of final demand (of category F, at purchasers' prices) regarding domestic output (QNF), imports (QMF) and taxes (net of subsidies) on products (QTSF), which may be either calculated (as it is explained in section 2.2) from observed macroeconomic data (systems of input-output tables), or exogenously defined, or even endogenously calculated as functions of, *e.g.*, relative (domestic/import) prices (provided that they meet some rules, such as identity (21)). These matrices represent direct unit contents of final demand.

Direct unit contents of final demand in domestic output are subsequently decomposed into indirect primary input contents of imports, taxes and value added, through the multiplication of import, tax and value added coefficient matrices by the "Leontief inverse" and by QNF (as it is explained in sections 2.3 and 2.4).

Finally, total primary input contents of final demand are obtained from the sum of the corresponding direct and indirect primary input contents.

Some applications to Portugal were presented, including a comparison of direct+indirect effects of some types of public expenditure on GDP with the corresponding direct+indirect+induced effects, measured with an input-output based model for Portugal (MODEM 6C).

## 7. REFERENCES

**DIAS**, Ana Maria (2008), *Sistema Integrado de Matrizes Input-Output para Portugal*, 2005, Lisboa, DPP, Documento de Trabalho nº 8/2008, downloadable in www.dpp.pt

**DIAS**, Ana Maria (2009), *Building a System of Symmetric Input-Output Tables – Application to Portugal, 2005*, paper presented to the 17th international Input-Output Conference, São Paulo, Brazil, 13-17 July 2009, downloadable in www.dpp.pt .

**DIAS**, Ana Maria (2010), *Conteúdos de inputs primários da Procura Final – Portugal, 2005*, Lisboa, DPP, downloadable in www.dpp.pt

**DIAS,** Ana Maria; **LOPES**. Emídio (2009), *A Multisectoral Model for Portugal with a Multiregional extension*, paper presented to the 17th International Input-Output Conference, São Paulo, Brazil, 13-17 July 2009, downloadable in www.dpp.pt

**DIAS,** Ana Maria; **LOPES,** Emídio (2010), *O Modelo MODEM 6C e o Impacto Macroeconómico de Políticas Públicas – Avaliação por Tipos de Despesa*, Lisboa. DPP, Documento de Trabalho nº 2/2010, downloadable in www.dpp.pt

**MARTINS,** Natalino (2004), *Produção de Valor Acrescentado e Competitividade da Economia Portuguesa. no período de 1995 a 1999,* Lisboa, DPP, downloadable in www.dpp.pt .