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Updating and adjustment of the trade flows of an Input-Output Table

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1.- Introduction

The specific treatment of trade flows in the updating and adjustment process of an Input-Output Table is not normally considered in the updating literature. It could actually be considered to be just a secondary step in the sense that once the total flows has been updated one could proceed to the separation of the different flows by origin.

However, we believe that information on trade flows can be considered to be a main part of the prior information available for the updating of an IOT and should therefore be used simultaneously in the updating of the total flows.

Trade flows are usually subdivided attending to the nature of the goods in three main groups: intermediate, consumption and investment goods. However, even if this classification could be helpful in the updating procedure, by introducing restrictions related to the intermediate matrix and the consumption and the investment vectors of final demand, it is not directly applicable without being previously treated. The main reason for this treatment is the fact that many of the goods could be classified in more than one of these groups. The typical example being beverages, which can be considered to be either consumption goods for households or intermediate goods for restaurants. The optimization program presented in this paper includes special restrictions to allow the treatment of a reclassification of the trade flows that is described in the next section. We have applied this method to the updating of the 1985 Input Output Table of the Canary Islands and the results seem to confirm the usefulness of our approach.

The paper includes three more sections. Section 2 describes the treatment of the data used and the new import categories created. Section 3 shows the main characteristics of the adjustment and updating model presented and, section 3 summarizes the main results obtained in the application included. The annex included describes in detail the optimization model proposed in this paper.

2.- Preparation of the data

For the preparation of the data on foreign trade, we had to use two main correspondences, the TARIC/NACE and the TARIC/Group of final use (GFU) one. The first correspondence assigns each foreign flow to one of the sectors of the IO Table (IOT). The first digit of the GFU classification allows us to group the different goods in three main categories. Group 1 corresponds to the goods for final consumption, group 2 to capital goods and group 3 to intermediate goods. However, this classification cannot be strictly applied in all cases. This is the case of many goods belonging to the food and beverages category, which could be considered both goods for final consumption and intermediates for the hotels and restaurants sectors.

For this reason, and with the aim of identifying this "hybrid" cases we proceeded to the revision of the 1,338 categories corresponding to the first four Taric digits in order to obtain five extra categories:

- Group 4: contains those categories (126) of group 1 that could be also considered to be classified as belonging to group 3.
- Group 5: contains those categories (4) of group 3 that could be also considered to be classified as belonging to group 1.
- Group 6: contains those categories (4) of group 1 that could be also considered to be classified as belonging to group 2.
- Group 7: contains one category of group 3 that could be also considered to be classified as belonging to group 2.
- Group 8: contains those categories (4) of group 1 that could be also considered to be classified as belonging to groups 1, 2 and 3.

Both flows of goods and import duties (ILM) where classified according to these grouping. The results of this reclassifications process can be analyzed in **Tables 1** and **2**. They show the import and export vectors as they will be used in the adjustment and updating process (AUP). This information allows imposing the necessary restrictions to the final vectors of intermediate outputs or final demand. However, it is of no help in the adjustment of the elements of the matrix of intermediate requirements.

With the aim of giving more accuracy to the updating of the matrix of intermediate requirements, we studied with more precision the glass sub sector, integrated in sector 3 of the IOT (Construction materials and mines). A detailed scrutiny (at Taric level) of all the different imports of this sub sector allowed us to prepare **Table 3**. This table shows, at the 4-digit Taric level (TARIC4), how the imports of the different types of glasses can be assigned to the different potential demanding sectors of the IOT. We can now separate these imports from GFU 3 and 4 of sector 3 in table 1 and proceed to adjust them separately. These imports are presented in **Table 4**. Although the adjustment process followed with this glass sub sector will not be explained in detail, we can observe in **Table 3** how certain groups can be directly assigned to the only sector potentially demanding them (i.e. 7001, 7002, 7003, 7011, 7015, 7016 and 7018). The rest can follow their own assignment rules independently from those that would correspond to the complete glass sector, therefore reducing the potential assignment errors.

TABLE 1
Vectors of imports (PSA & CIF)
(in Ptas.)

SECTOR	MG1PSA	MG2PSA	MG3PSA	MG4PSA	MG5PSA
1	281.522.248	32.829.069	10.776.336.066	14.092.481.060	1.720.518.575
2	26.309.958	0	82.911.165.389	0	0
3	180.399.160	1.165.463.950	36.476.913.505	2.723.091.297	59.560
4	38.539.082.393	1.920.455.794	49.851.708.228	1.634.648	128.391.779
5	84.571.932.726	85.490.667.365	58.306.458.200	0	252.476.139
6	1.177.580.618	0	8.177.173.327	72.160.292.639	39.031.208
7	25.096.781	0	1.519.216.656	13.038.797.805	0
8	1.414.882.813	0	12.635.942.038	0	0
9	65.649.574.786	1.430.536.443	8.467.778.552	0	0
10	317.453.580	0	17.765.204.735	12.544.376.664	0
11	15.407.522.568	3.609.336.210	12.895.901.826	2.348.823.921	0
TOTAL	207.591.357.631	93.649.288.831	299.783.798.522	116.909.498.034	2.140.477.261

SECTOR	MG6PSA	MG7PSA	MG8PSA	MCIF	ILM
1	0	0	0	26.681.971.044	221.715.974
2	0	0	0	82.864.513.637	72.961.710
3	0	0	0	40.140.287.201	405.640.27
4	0	0	649.759.097	89.414.185.781	1.676.846.158
5	2.037.022.481	46.423.889	2.001.070.633	217.926.689.986	14.779.361.447
6	0	0	0	80.401.075.275	1.153.002.517
7	0	0	0	13.416.071.668	1.167.039.574
8	0	0	0	13.161.788.110	889.036.741
9	0	0	0	74.112.004.941	1.435.884.840
10	0	0	0	30.302.692.064	324.342.915
11	0	0	13.442.502.755	46.715.991.067	988.096.213
TOTAL	2.037.022.481	46.423.889	16.093.332.485	715.137.270.774	23.113.928.360

Source: Departamento de Aduanas de la AEAT and Dirección General de Tributos de la C.A. de Canarias. Own elaboration.

Notes:

ILM: Import duties
M: Imports
X: Exports
G: Group of final use (G1: final consumption; G2: Capital goods; G3: intermediates etc)
Ptas.: Peseta (1€=166.386 Ptas.)
PSA: Price duties paid
CIF: Cost Insurance Freight
FOB: Free on Board

TABLE 2
Vectors of Exports (FOB)
(in Ptas.)

SECTOR	XG1	XG2	XG3
1	57.491.752.784	659.501	2.560.801.301
2	2.198.147.506	0	41.898.983.789
3	59.287.733	1.530.389	1.811.132.900
4	824.385.349	12.948.371	2.187.771.575
5	4.680.193.703	7.125.883.870	3.668.558.445
6	24.606.166.280	0	2.779.974.749
7	652.141.726	0	972.037.433
8	30.597.781.275	0	18.591.048
9	986.847.340	890.233.761	2.163.733.634
10	683.907.283	0	2.741.863.576
11	710.913.552	154.209.132	133.739.421
TOTAL	123.491.524.531	8.185.465.024	60.937.187.871

Source: Departamento de Aduanas de la AEAT and Dirección General de Tributos de la C.A. de Canarias. Own elaboration.

Table 3

Assignment of the different types of glass imports

TARIC4	DESCRIPCIÓN	SECTORS IOT-92	SECTORS IOT-90
7001	CULLET AND OTHER WASTE AND SCRAP OF GLASS; GLASS IN THE MASS	16	3
7002	GLASS IN BALLS, RODS OR TUBES, UNWORKED	16	3
7003	CAST GLASS AND ROLLED GLASS, IN SHEETS OR PROFILES, WHETHER OR NOT HAVING AN ABSORBENT, REFLECTING OR NON-REFLECTING LAYER, BUT NOT OTHERWISE WORKED	16	3
7004	SHEETS OF GLASS, DRAWN OR BLOWN, WHETHER OR NOT HAVING AN ABSORBENT, REFLECTING OR NON-REFLECTING LAYER, BUT NOT OTHERWISE WORKED	16, 41, 46, 49	3, 4, 18
7005	FLOAT GLASS AND SURFACE GROUND OR POLISHED GLASS, IN SHEETS, WHETHER OR NOT HAVING AN ABSORBENT, REFLECTING OR NON-REFLECTING LAYER, BUT NOT OTHERWISE WORKED	16, 42, 49	3, 11
7006	SHEETS OR PROFILES OF GLASS, WHETHER OR NOT HAVING AN ABSORBENT, REFLECTING OR NON-REFLECTING LAYER, BENT, EDGE-WORKED, ENGRAVED, ENAMELLED OR OTHERWISE WORKED, BUT NOT FRAMED OR FITTED WITH OTHER MATERIALS	42, 46, 49	4, 11, 18
7007	SAFETY GLASS, TOUGHENED "TEMPERED", LAMINATED SAFETY GLASS	22, 26, 46, 49	4, 5, 18
7008	MULTIPLE-WALLED INSULATING UNITS OF GLASS	22, 41, 46	4, 5, 11
7009	GLASS MIRRORS, WHETHER OR NOT FRAMED, INCL. REAR-VIEW MIRRORS	26, 48, 49	5, 11, 14
7010	CARBOYS, BOTTLES, FLASKS, JARS, POTS, PHIALS, AMPOULES AND OTHER CONTAINERS, OF GLASS, OF A KIND USED FOR THE CONVEYANCE OR PACKING OF GOODS, PRESERVING JARS, STOPPERS, LIDS AND OTHER CLOSURES, OF GLASS	16, 19, 20, 30, 34, 35, 36, 69, 70	3, 4, 6, 7, 17
7011	GLASS ENVELOPES, INCL. BULBS AND TUBES, OPEN, AND GLASS PARTS THEREOF, WITHOUT FITTINGS, FOR ELECTRIC LAMPS, CATHODE-RAY TUBES OR THE LIKE	25, 26	5
7012	GLASS INNERS FOR VACUUM FLASKS OR FOR OTHER VACUUM VESSELS	53, 54	11, 13
7013	GLASSWARE OF A KIND USED FOR TABLE, KITCHEN, TOILET, OFFICE, INDOOR DECORATION OR SIMILAR PURPOSES	53, 54, 56	13, 15
7014	SIGNALLING GLASSWARE AND OPTICAL ELEMENTS OF GLASS, NOT OPTICALLY WORKED	48, 49	11, 14
7015	CLOCK OR WATCH GLASSES AND SIMILAR GLASSES, GLASSES FOR NON-CORRECTIVE OR CORRECTIVE SPECTACLES, CURVED, BENT, HOLLOWED OR THE LIKE, BUT NOT OPTICALLY WORKED, HOLLOW GLASS SPHERES AND THEIR SEGMENTS, FOR THE MANUFACTURE OF SUCH GLASSES (EXCL. FLAT GLASS FOR SUCH PURPOSES)	16	3
7016	PAVING BLOCKS, SLABS, BRICKS, SQUARES, TILES AND OTHER ARTICLES OF PRESSED OR MOULDED GLASS, WHETHER OR NOT WIRED, FOR BUILDING OR CONSTRUCTION PURPOSES	48	14
7017	LABORATORY, HYGIENIC OR PHARMACEUTICAL GLASSWARE, WHETHER OR NOT GRADUATED OR CALIBRATED	19, 20, 69, 70	4, 17
7018	GLASS BEADS, IMITATION PEARLS, IMITATION PRECIOUS OR SEMI-PRECIOUS STONES AND SIMILAR GLASS SMALLWARES, AND ARTICLES THEREOF; GLASS EYES; STATUETTES AND OTHER ORNAMENTS OF LAMP-WORKED GLASS; GLASS MICROSPHERES WITH A DIAMETER OF <= 1 MM	47	11
7019	GLASS FIBRES, INCL. GLASS WOOL, AND ARTICLES THEREOF (EXCL. MINERAL WOOLS AND ARTICLES THEREOF, OPTICAL FIBRES, FIBRE BUNDLES OR CABLE, ELECTRICAL INSULATORS OR PARTS THEREOF, BRUSHES OF GLASS FIBRES, DOLLS' WIGS)	16, 26, 48	3, 5, 14
7020	ARTICLES OF GLASS, N.E.S.	9, 25, 48	2, 5, 14
8546	ELECTRIC ISOLATORS OF ANY MATERIAL	9, 25, 48	2, 5, 14
8547	OTHER ISOLATING PIECES	9, 25, 48	2, 5, 14
9001	OPTICAL FIBRES AND OPTICAL FIBRE BUNDLES; OPTICAL FIBRE CABLES	25, 48	5, 14
9405	PARTS OF LAMPS AND LIGHTING FITTINGS, ILLUMINATED SIGNS AND NAME-PLATES AND THE LIKE, OF GLASS, N.E.S.	25, 48	5, 14

Table 4
Dissagregation of the imports of the glass sub sector
(in Ptas.)

TARIC4	MG3	MG4	TRIBG3	TRIBG4
7001	130.280	0	3.830	0
7002	712.221	0	56.058	0
7003	142.043.149	0	3.478.045	0
7004	10.681.843	0	113.299	0
7005	521.508.196	0	8.780.029	0
7006	31.825.433	0	860.153	0
7007	253.877.770	0	2.657.183	0
7008	7.708.571	0	54.648	0
7009	0	392.243.971	0	7.114.484
7010	263.565.906	0	12.922.340	0
7011	6.993.789	0	101.860	0
7012	277.950	0	2.319	0
7013	0	1.374.780.482	0	31.660.120
7014	2.147.367	0	63.947	0
7015	3.037.553	0	73.368	0
7016	55.604.044	0	279.377	0
7017	58.858.442	0	696.643	0
7018	40.156.188	0	799.326	0
7019	179.959.082	0	34.234	0
7020	33.824.145	0	722.638	0
8546	46.294.790	0	1.420.768	0
8547	44.436.816	0	212.977	0
9001	59.111	0	1.738	0
9405	170.693.619	0	7.712.896	0
TOTAL	1.874.396.265	1.767.024.454	41.047.676	38.774.604

Source: Departamento de Aduanas de la AEAT and Dirección General de Tributos de la C.A. de Canarias. Own elaboration.

3.- Adjustment and updating of final demand, intermediate outputs and total resources

Figures 1 to **3** describe the adjustment and updating process (AUP) for the vectors of final demand, intermediate outputs and total resources that we propose in this paper. **Figure 1** shows all the different elements participating in this AUP. Each variable has two upper indices and one lower index. The upper left index t can take values 0 (1985) and T (1990). The upper right index can refer to the origin of the flows (D: domestic; R: foreign) or to the total flows (T=R+D). The lower right index includes references to the sectors ("i" in rows and "j" in columns) and to the different elements of each of the variables (cpri, ccol etc). The variables considered in this AUP are intermediate outputs (OI), final demand (DF), use and origin of total resources (UREC and OREC) and primary inputs (IP). This last variable includes not only primary inputs but also some adjustment elements such as transfer of goods and imports. The circled elements show the exogenous values of the variables that can be considered to be fixed in the AUP.

Private consumption is divided into two elements. First, we consider the value of consumption we estimated using household surveys (CPRI). On the other hand we included an adjustment coefficient (COEFCP) that allows the model to adjust the estimated value. Assigning a value of unity to this coefficient would force the model to keep the estimated value of private consumption unchanged. We also know beforehand the value of public consumption, total exports and imports and import duties. We therefore know the foreign component of total resources.

Since we know the values of the secondary production and residual public sales coefficients**,** the vector of transfer of goods can be assumed to me known and passing from effective production to distributed production can be considered to be automatic in both senses.

The adjustment process is based on the objective of achieving that certain structural coefficients of the new IOT (1990) differ as little as possible from the same coefficients related to the original IOT (1985). The optimization model used in this paper in order to minimize this divergence follows the procedures defined by (Manrique and Santos, 2003). The structural coefficients considered in this AUP are those contained in **Figure 2**. As can be easily observed, there are two types of coefficients. First, we can refer to those coefficients that measure the proportion of the value of the imported goods over the total value of flows for the same good of one of the variables (AROI and ARDF). On the other hand, we use another type of coefficients that measure the relative importance of the different elements of total resources over its total for each sector (AOI and ADF). Knowing the commercial margins applicable to the elements of final demand (MCDF), allowed us to define the elements of sector 12 (Trade) for the vectors of private consumption and gross fixed capital.

Figure 3 shows the different restrictions applied to foreign trade that have to be considered for each of the tradable goods. Naturally, these restrictions apply only to the foreign component (R) of each of the variables that build the vector of total resources. For each of the import flows we have to consider not only the assignment of the 8 GFUs defined previously, but also the fact that they could end up forming part of the Changes in Stocks vector or even being re-exported in the case of the first three GFUs.

Figure 1
Adjustment model for final demand, intermediate outputs and total resources
Global description of the problem

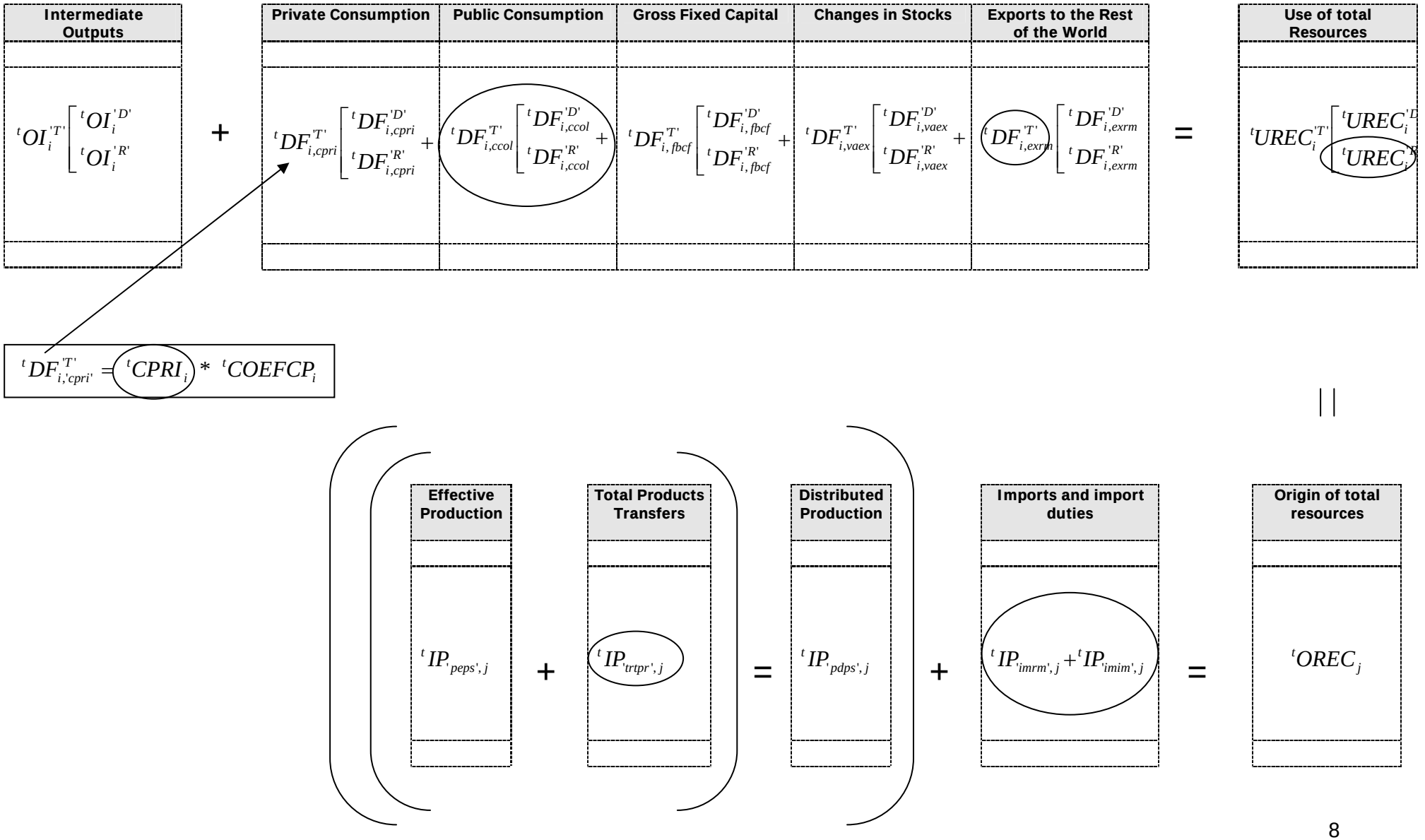

Figure 2
Adjustment model for final demand, intermediate outputs and total resources
Principal adjustment elements

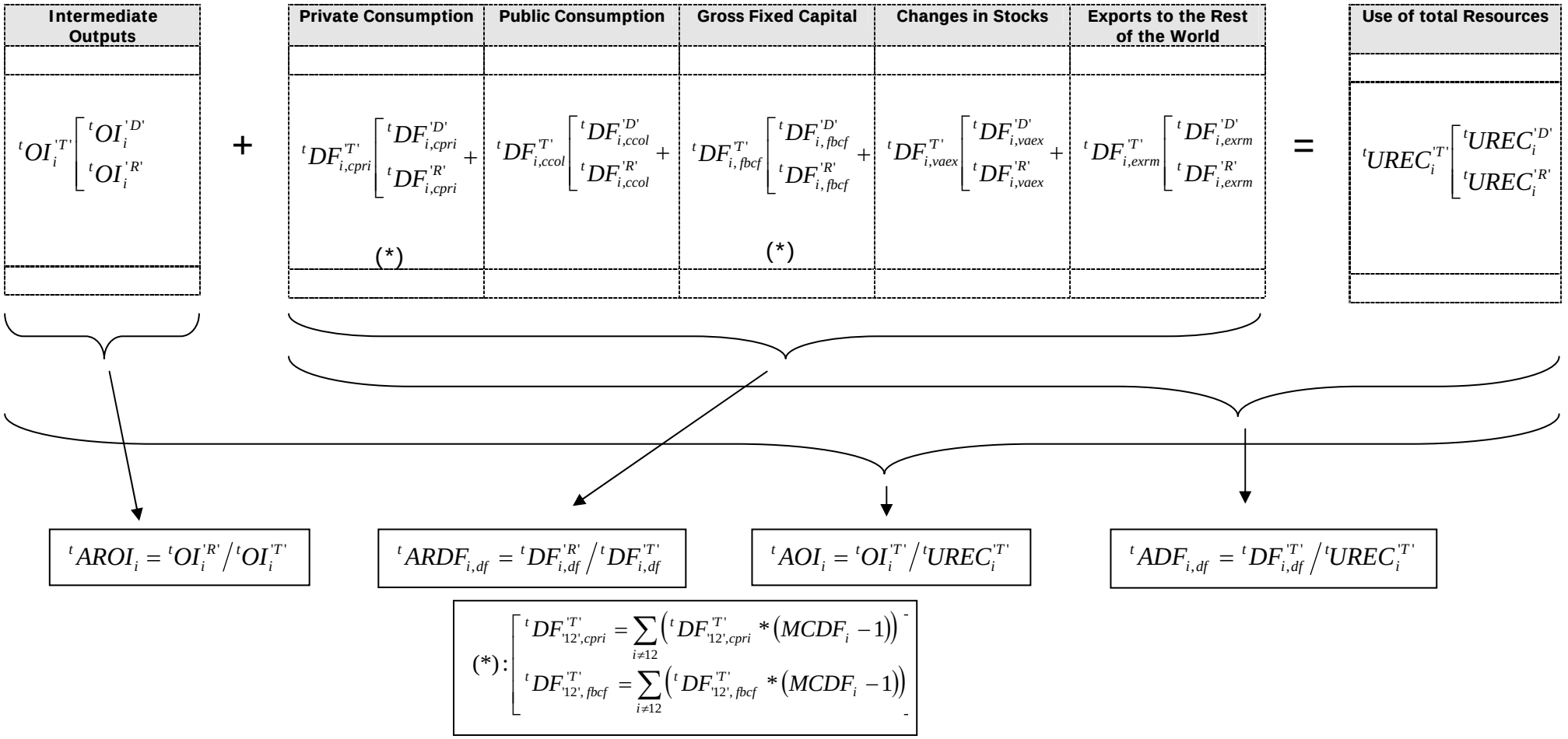

Figure 3
Adjustment model for final demand, intermediate outputs and total resources
Restriccions related to foreign trade

Type of imports	Private Consumption (1)	Gross Fixed Capital (2)	Intermediate Outputs (3)	Changes in Stocks (1)	(2)	(3)	Exports To the Rest of the World (1)	(2)	(3)	Parameters
MG1	X			X			X			$CM_{i,'1'}$
MG2		X			X			X		$CM_{i,'2'}$
MG3			X			X			X	$CM_{i,'3'}$
MG4	X		X	X		X				$CM_{i,'4'}$
MG5	X		X	X		X				$CM_{i,'5'}$
MG6	X	X		X	X					$CM_{i,'6'}$
MG7		X	X		X	X				$CM_{i,'7'}$
MG8	X	X	X	X	X	X				$CM_{i,'8'}$
				$\sum = {}^{t}DF^{'R'}_{i,'vaex'}$			$\sum = {}^{t}DF^{'R'}_{i,'exrm'}$			
TOTAL	${}^{t}DF^{'R'}_{i,cpri}$	${}^{t}DF^{'R'}_{i,fbcf}$	${}^{t}OI^{'R'}_{i}$	${}^{t}VAEXRCX1_i$	${}^{t}VAEXRCX2_i$	${}^{t}VAEXRCX3_i$	${}^{t}EXRCX1_i$	${}^{t}EXRCX2_i$	${}^{t}EXRCX3_i$	Imp. Tot.

$$CM1_i \begin{cases} \geq CM_{i,'1'} \\ \leq CM_{i,'1'} + CM_{i,'4'} + \\ \quad CM_{i,'5'} + CM_{i,'6'} + CM_{i,'8'} \end{cases}$$

$$CM2_i \begin{cases} \geq CM_{i,'2'} \\ \leq CM_{i,'2'} + CM_{i,'6'} + \\ \quad CM_{i,'7'} + CM_{i,'8'} \end{cases}$$

$$CM3_i \begin{cases} \geq CM_{i,'3'} \\ \leq CM_{i,'3'} + CM_{i,'4'} + CM_{i,'5'} + \\ \quad CM_{i,'7'} + CM_{i,'8'} \end{cases}$$

	${}^{t}EXRCX1_i$	${}^{t}EXRCX2_i$	${}^{t}EXRCX3_i$
	${}^{t}EXDCX1_i$	${}^{t}EXDCX2_i$	${}^{t}EXDCX3_i$
TOTAL	${}^{t}EXTCX1_i$	${}^{t}EXTCX2_i$	${}^{t}EXTCX3_i$
RESTRICCIÓN	$CX_{i,'1'}$	$CX_{i,'2'}$	$CX_{i,'3'}$

Therefore, the total of imports of group 1 (MG1) that is used as exogenous ($CM_{i,'1'}$), has to be shared between the vectors of private consumption, changes in stocks and exports (cells marked with an X in the first row of figure 3). A similar distribution can be described for the two subsequent import groups (MG2 and MG3). The distribution process for the rest of the groups is somehow more complex because the assignment alternatives are greater. Imports belonging to group MG8, for example, have six of those alternatives.

This is the case because both the vector of changes in stocks and exports had to be subdivides into three items, such that we could consider separately the goods for final consumption (VAEXRCX1, EXRCX1), capital goods (VAEXRCX2, EXRCX2) and intermediates (VAEXRCX3, EXRCX3).

In order to be able to establish the basic foreign trade restrictions, we created three variables, CM1, CM2 and CM3. They allow us to group all different flows of consumption capital and intermediate goods that have been previously described. Cm1, for example, retains the private consumption, change in stocks and exports of the same type of goods (final consumption goods). The same occurs with CM2 and CM3. The elements of these variables are connected through similar arrows in **Figure 3.**

Parameters CM can be used to establish the foreign trade restrictions as reflected in the lower part of **Figure 3**. Those boxes show the lower and upper limits to be imposed in terms of the parameters that have been described below.

We should also describe parameters CX, that reflect the known values of total exports. These values reflect the available information on total exports for each sector of the three main groups of goods: final consumption goods ($CX_{i,'1'}$), capital goods ($CX_{i,'2'}$) and intermediates($CX_{i,'3'}$). However, the origin of these goods (domestic or foreign) cannot be distinguished beforehand.

The value of total exports (EXTCX) of goods of each type has to respect the CX parameters. On the other hand, those total exports can de divided between domestic goods (EXDCX) and foreign goods (EXRCX), which have been described as re-exports. These exports of foreign goods (EXRCX) has to respect the restrictions based on the CM parameters as described below.

4.- Results obtained from the proposed adjustment and updating process

The AUP described in the previous section was applied to the 1985 IOT of the Canary Islands (TIOCAN85) in order to obtain the IOT referred to the 1990 data (TIOCAN90). Since there exists an IOT of the Canary Islands for 1992, elaborated with direct methods, it was also used for comparisons with the 1990 estimated one.

Tables 5 to **6** show the results obtained. The first three tables try to identify the structural parallelisms by sectors of the different vectors obtained. Without any doubt, the worst results are those related to Gross Fixed Capital and Changes of Stocks, due to their residual character. Beside these two cases, the structure of both IOT (85 and 90) show more then reasonable similarities.

Most of the differences between TIOCAN90 and TIOCAN92 have their explanation in the different structure of the starting point (TIOCAN85). However, there are many cases in which the structure obtained by the TIOCAN90 is nearer to the 92 IOT than to the initial one (TIOCAN85). These results have their origin in the additional information used (e.g.: private consumption and exports) that is, logically, in many cases nearer to the TIOCAN92 than to the TIOCAN85.

The differences observed in public consumption in Tables 5 and 6 are exclusively due to an aggregation problem. The classification by sectors of TIOCAN90 and TIOCAN92 did not allow an aggregation compatible with a perfect separation between the provision of private and public goods. On the other hand, the TIOCAN92 does not show any foreign entries neither for exports nor for changes in stocks. Therefore, the observed differences in this area are due to the differences in conception of both tables more than to a misbehavior of the proposed AUP.

The basic elements of the updating process are of two types. First, the objective of the model is to maintain the shares of the different vectors of total resources. Expressed differently, it tries to minimize the differences between the AOI and ADF coefficients of both tables. On the other hand, the model tries to minimize the differences between the share of foreign flows for each of the cells of the different vectors, therefore minimizing the difference between the AROI and ARDF coefficients of both tables.

The results obtained in terms of the first objective are summarized in Table 9, which shows very satisfactory results. The main differences appear in sectors 2,4,7 and 9 where we can observe important divergences. These differences can be explained describing the impact of the additional information included in the AUP. In this sense the most important piece of information is the one related to private consumption contained in Table 8. It shows how those sectors for which the relative importance of private consumption grows more significantly (2, 14 and 17) are those for which the relative importance seems to have achieved also the greatest levels in the updated IOT. The contrary occurs in sectors 4, 7 and 9. We can therefore conclude that the main differences observed are due to the initial data used more then to the model itself.

Table 5

Comparison of the relative importance by sectors

(Total flows: domestic plus foreign origin)

	Intermediate Outputs			Private Consumption			Public Consumption			Gross Fixed Capital			Changes in Stocks			Exports			Total Resources		
	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92
1	5,5	2,1	3,8	4,7	3,6	2,0	0	0	0	0,32	1,0	-0,01	0,5	3,1	0	23,1	27,4	30,5	6,6	4,6	3,6
2	40,5	14,0	11,4	4,9	4,5	4,3	0	0	0	0	0	0	42,9	4,8	22,2	44,0	20,1	10,7	20,7	8,2	5,8
3	5,7	9,6	6,8	0,1	0,01	0,1	0	0	0	0	0,8	0,1	1,2	0,6	-13,2	0,79	0,9	0,6	2,0	3,1	2,1
4	3,4	9,0	2,5	4,3	2,3	3,1	0	0	0	0	1,2	0	23,3	0	4,1	2,5	1,4	0,5	3,2	4,1	2,2
5	6,6	13,7	2,1	5,2	3,9	0,4	0	0	0	14,62	64,1	2,0	8,2	0	0,3	3,2	7,1	0,6	6,1	10,4	1,1
6	4,3	1,3	4,5	8,8	9,7	8,7	0	0	0	0	0	0	13,0	0	-25,6	4,8	12,5	4,0	5,5	5,9	5,5
7	1,4	4,5	1,9	2,4	0,6	2,3	0	0	0	0	0	0	1,2	0,2	21,5	0,2	0,7	0,6	1,4	1,7	1,6
8	0,1	2,5	0,5	1,5	1,4	1,1	0	0	0	0	0	0	3,2	24,3	63,8	6,8	14,0	24,5	1,5	3,1	1,9
9	1,5	0,8	0,6	4,2	1,7	4,1	0	0	0	0,17	0,3	0,12	1,1	61,8	0,1	1,4	1,8	0,3	2,4	2,7	2,0
10	3,3	5,5	2,9	1,3	1,5	1,4	0	0	0	0	0	0	3,2	3,0	19,1	1,2	1,6	1,1	1,7	2,6	1,5
11	2,3	3,8	7,3	2,1	2,3	6,1	0	0	0	3,20	2,4	22,6	2,1	2,4	7,7	0,03	0,5	4,1	1,9	2,5	7,9
12	6,8	7,9	9,9	13,5	11,2	17,0	0	0	0	4,83	0,0	7,81	0	0	0	11,9	11,9	1,7	9,5	8,6	11,7
13	0,4	0,6	2,2	21,2	24,0	23,0	0	0	0	0	0	0	0	0	0	0	0	0	8,5	11,5	11,0
14	2,0	0,7	1,9	1,1	1,9	1,9	0	0	0	73,62	28,4	58,15	0	0	0	0	0	0	8,6	2,8	8,5
15	4,4	3,6	10,1	4,7	3,1	4,0	0	0	0	1,35	1,8	0	0	0	0	0,13	0,1	20,8	3,4	2,7	5,9
16	3,7	8,1	11,5	1,0	1,8	0,6	0	0	0	0	0	0	0	0	0	0	0	0	1,6	3,3	3,7
17	0	0	0,8	1,1	3,3	2,3	100	100	96,6	0	0	0	0	0	0	0	0	0	5,5	7,3	9,1
18	8,0	12,5	19,3	17,9	23,3	17,6	0	0	3,4	1,86	0	9,25	0	0	0	0	0	0	9,8	14,8	15,1
	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 6

Comparison of the relative importance by sectors

(domestic origin)

	Intermediate Outputs			Private Consumption			Public Consumption			Gross Fixed Capital			Changes in Stocks			Exports			Total Resources		
	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92
1	5,0	2,0	3,5	4,1	2,8	1,7	0	0	0	0,4	2,1	-0,3	0,7	9,1	0	24,3	31,3	30,5	6,8	5,0	3,6
2	25,0	7,7	10,0	6,2	5,3	4,5	0	0	0	0	0	0	69,7	17,4	22,2	48,7	24,0	10,7	16,3	7,1	5,4
3	6,0	9,1	4,9	0,1	0,01	0,01	0	0	0	0,04	0,2	0,1	1,6	1,7	-13,2	0,5	0,6	0,6	1,5	2,3	1,4
4	1,4	3,2	0,5	1,0	0,5	0,2	0	0	0	0	0	0	5,4	0	4,1	1,2	0,7	0,5	0,9	1,1	0,2
5	1,9	3,6	0,5	1,3	1,1	0,03	0	0	0	4,3	33,8	0,9	7,2	0	0,3	0,1	0,3	0,6	1,6	2,8	0,3
6	4,3	1,1	2,3	4,4	5,1	5,1	0	0	0	0	0	0	6,8	0	-25,6	4,1	11,7	4,0	3,5	4,1	3,1
7	2,0	5,8	1,4	1,6	0,4	1,8	0	0	0	0	0	0	0,9	0,3	21,5	0,2	0,7	0,6	1,2	1,7	1,2
8	0,1	3,0	0	1,5	1,3	0,9	0	0	0	0	0	0	3,8	63,2	63,8	7,1	15,5	24,5	1,8	3,5	1,9
9	0,1	0,1	0,1	0,1	0,1	0,1	0	0	0	0	0	0	0	0	0,1	0	0	0,3	0,1	0	0,1
10	3,6	5,3	1,4	1,1	1,2	0,5	0	0	0	0	0	0	3,5	7,1	19,1	0,6	0,8	1,1	1,4	2,1	0,7
11	0,8	1,1	1,3	1,3	1,3	1,0	0	0	0	1,7	2,23	2,2	0,5	1,2	7,7	0	0,1	4,1	0,9	1,1	1,3
12	13,5	13,8	13,2	17,2	13,2	21,7	0	0	0	5,5	0	10,1	0	0	0	13,1	14,2	1,7	13,0	11,7	14,5
0	0,8	1,0	2,9	27,2	28,4	29,2	0	0	0	0	0	0	0	0	0	0	0	0	11,7	15,6	13,7
14	3,9	1,1	2,6	1,4	2,2	2,4	0	0	0	84,4	57,9	75,1	0	0	0	0	0	0	11,8	3,8	10,5
15	8,7	6,3	13,3	6,0	3,7	4,9	0	0	0	1,5	3,8	0	0	0	0	0,1	0,2	20,8	4,7	3,7	7,2
16	7,3	14,1	15,3	1,3	2,1	0,8	0	0	0	0	0	0	0	0	0	0	0	0	2,1	4,5	4,6
17	0,0	0,0	1,0	1,4	3,9	2,9	100	100	96,6	0	0	0	0	0	0	0	0	0	7,5	9,9	11,3
18	15,73	21,8	25,7	22,9	27,5	22,4	0	0	3,4	2,1	0	11,9	0	0	0	0	0	0	13,4	20,1	18,8
	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 7

Comparison of the relative importance by sectors

(foreign origin)

	Intermediate Outputs			Private Consumption			Public Consumption			Gross Fixed Capital			Changes in Stocks			Exports			Total Resources		
	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92
1	6,1	2,2	4,7	7,0	7,9	2,9	0	0	0	0	0	0,9	0	0	0	12,4	7,3	0	6,4	3,6	3,3
2	56,6	22,5	15,6	0,3	0,4	3,4	0	0	0	0	0	0	-48,3	-1,9	0	0	0	0	32,9	11,2	7,5
3	5,3	10,4	12,3	0,1	0	0,5	0	0	0	0	1,4	0	0	0	0	3,3	2,1	0	3,3	5,5	4,8
4	5,6	16,9	8,6	16,4	12,3	14,0	0	0	0	0	2,3	0	84,3	0	0	14,0	4,7	0	9,4	12,3	10,1
5	11,4	27,2	6,7	19,0	19,0	1,8	0	0	0	85,0	93,1	5,9	11,7	0	0	32,1	42,7	0	18,3	31,5	4,2
6	4,3	1,5	11,2	24,5	34,4	22,1	0	0	0	0	0	0	34,1	0	0	10,7	16,8	0	10,9	11,0	15,0
7	0,8	2,8	3,2	5,3	1,9	4,1	0	0	0	0	0	0	2,1	0,1	0	0,4	1,0	0	2,2	2,0	3,2
8	0,1	1,7	1,9	1,5	1,9	2,1	0	0	0	0	0	0	1,5	3,8	0	4,9	5,9	0	0,7	1,9	1,7
9	3,0	1,7	2,3	18,8	10,8	18,8	0	0	0	1,4	0,7	0,5	4,7	94,2	0	14,9	11,5	0	8,5	10,2	10,1
10	3,0	5,7	7,6	2,2	3,6	4,7	0	0	0	0	0	0	2,4	0,8	0	7,1	5,6	0	2,8	4,1	5,1
11	3,9	7,4	25,5	4,9	7,8	25,0	0	0	0	13,5	2,5	92,7	7,5	2,97	0	0,3	2,5	0	4,6	6,5	34,5
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0,4	0	0	0,7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	100	100	100	100	100	100	0	0	0	100	100	100	100	100	0	100	100	0	100	100	100

Table 8
Private consumption data
(thousands of Ptas.)

	TIOCAN90	TIOCAN85	% (90/85)
1	46.888.150	40.642.813	115,4
2	59.637.610	42.151.353	141,5
3	179.615	731.878	24,5
4	30.676.440	37.384.270	82,1
5	51.086.990	44.328.450	115,2
6	126.922.257	75.538.197	168,0
7	8.062.060	20.639.273	39,1
8	17.821.170	12.963.236	137,5
9	22.611.757	36.355.996	62,2
10	20.250.967	11.309.143	179,1
11	30.838.929	17.985.119	171,5
12	146.641.560	115.831.051	126,6
13	314.840.755	182.832.688	172,2
14	24.912.076	9.615.140	259,1
15	40.665.916	40.367.254	100,7
16	22.997.095	8.487.489	271,0
17	42.801.480	9.378.283	456,4
18	153885767	153.885.767	100,0

Table 10 shows the results sustained by the second objective of the AUP. In this case the adjustment seems to be almost perfect. This perfection is precisely its main defect. The adjustment model presented in this paper is anchored in the import data and the initial AOI and ADF proportions. The rest of the structure has adapted to this restriction.

Even considering this rigidity, the global results of this effort that can be browsed in tables 9 and 10 are not deficient. However, it definitely reduces the flexibility of the adjustment and therefore is one of the elements that should be ameliorated in future developments of the model. Changing the weights of the different variables in the objective function did not achieve any significant results.

Reference

Manrique C. and Santos D. (2003). New Nonlinear Approaches for the Adjustment and Updating of a SAM. Economics of Planning 36: 259-272.

Table 9

Shares of total Resources

(AOI and ADF coefficients by sector)

	Intermediate Outputs			Private Consumption			Public Consumption			Gross Fixed Capital			Changes in Stocks			Exports			Total Resources		
	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92
1	26,6	14,1	32,1	28,0	36,3	25,2	0	0	0	0,5	1,32	-0,05	0,03	1,7	0,0	44,9	46,5	42,8	100	100	100
2	62,5	53,0	57,8	9,3	26,2	32,9	0	0	0	0	0	0,0	0,9	1,5	0,1	27,4	19,4	9,1	100	100	100
3	92,6	95,7	96,0	1,7	0,2	2,2	0	0	0	0,2	1,49	0,6	0,3	0,5	-0,2	5,2	2,2	1,5	100	100	100
4	34,0	68,6	34,4	53,2	27,0	64,3	0	0	0	0	1,7	0,0	3,0	0,0	0,1	9,8	2,7	1,2	100	100	100
5	34,8	40,7	57,2	33,4	17,6	17,3	0	0	0	24,6	36,4	22,6	0,6	0,0	0,0	6,7	5,3	2,8	100	100	100
6	24,9	6,6	24,6	63,0	76,8	71,9	0	0	0	0	0	0,0	1,0	0,0	-0,2	11,2	16,6	3,6	100	100	100
7	31,7	79,9	34,3	66,3	16,6	63,3	0	0	0	0	0	0,0	0,3	0,3	0,5	1,6	3,3	1,9	100	100	100
8	2,0	24,7	7,3	39,1	20,6	27,0	0	0	0	0	0	0,0	0,9	19,4	1,3	58,0	35,4	64,4	100	100	100
9	20,8	8,6	8,8	70,5	29,6	89,9	0	0	0	0,8	0,72	0,7	0,2	55,8	0,0	7,8	5,3	0,6	100	100	100
10	60,7	64,8	56,4	29,8	27,8	39,5	0	0	0	0	0	0,0	0,8	2,8	0,5	8,8	4,7	3,6	100	100	100
11	39,1	47,0	27,6	43,2	43,8	35,0	0	0	0	17,1	5,55	34,7	0,5	2,3	0,0	0,2	1,4	2,6	100	100	100
12	23,0	28,3	25,3	55,7	60,9	65,9	0	0	0	5,2	0	8,1	0,0	0,0	0,0	16,1	10,8	0,7	100	100	100
13	1,6	1,6	5,9	98,4	98,4	94,1	0	0	0	0	0	0,0	0,0	0,0	0,0	0	0	0,0	100	100	100
14	7,3	7,3	6,8	5,1	32,2	10,1	0	0	0	87,6	60,5	83,1	0,0	0,0	0,0	0	0	0,0	100	100	100
15	41,2	41,3	51,4	54,2	54,2	31,0	0	0	0	4,1	4,05	0,0	0,0	0,0	0,0	0,5	0,4	17,7	100	100	100
16	75,2	75,2	92,5	24,8	24,8	7,5	0	0	0	0	0	0,0	0,0	0,0	0,0	0	0	0,0	100	100	100
17	0,0	0,0	2,5	7,8	21,0	11,3	92,2	79,0	86,2	0	0	0,0	0,0	0,0	0,0	0	0	0,0	100	100	100
18	26,1	26,1	38,1	72,0	73,9	52,6	0	0	1,9	1,9	0	7,4	0,0	0,0	0,0	0	0	0,0	100	100	100

Table 10

Relative importance of imports

(AROI and ARDF coefficients by sector)

	Intermediate Outputs			Private Consumption			Public Consumption			Gross Fixed Capital			Changes in Stocks			Exports			Total Resources		
	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92	85	90	92
1	54,3	45,1	30,6	32,3	34,3	30,8	0	0	0	1,9	1,9	-1504,4	0	0	0	5,1	4,3	0	25,8	20,8	18,3
2	68,7	68,7	33,9	1,5	1,5	16,7	0	0	0	0	00	0	-25,6	-25,6	0	0	0	0	42,8	36,4	25,1
3	46,3	46,3	45,0	35,0	35,0	95,2	0	0	0	90	90	0	0,0	0	0	40,4	40,4	0	45,6	46,6	45,3
4	79,9	79,9	84,5	82,2	82,2	96,0	0	0	0	100	100	0	82,1	82,1	0	55,0	55,0	0	78,8	80,2	90,8
5	85,1	85,1	80,8	80,4	76,1	94,3	0	0	0	74,1	74,1	66,2	32,2	32,2	0	97,0	97,0	0	81,3	80,1	77,5
6	49,4	49,4	61,4	61,0	55,4	54,1	0	0	0	0	0	0	59,5	59,5	0	21,6	21,6	0	53,7	49,4	54,0
7	26,5	26,5	42,3	48,0	48,0	38,3	0	0	0	0	0	0	42,1	42,1	0	21,2	21,2	0	40,7	29,9	38,7
8	29,6	29,6	100,0	22,1	22,1	39,6	0	0	0	0	0	0	10,2	10,2	0	6,8	6,8	0	13,3	16,2	18,0
9	96,1	96,1	93,2	97,4	97,4	98,5	0	0	0	100	100	100	100	100	0	99,7	99,7	0	97,3	98,9	97,4
10	44,5	44,5	64,3	36,0	36,0	73,4	0	0	0	0	0	0	17,2	17,2	0	57,1	57,1	0	42,9	42,0	65,3
11	83,1	83,1	86,5	51,5	51,5	87,1	0	0	0	54,0	54,0	92,4	82,7	82,7	0	93,3	86,6	0	64,5	67,7	86,5
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	1,1	0	0	3,6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,7
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

ANNEX

Algebraic description of the model

INDICES AND VARIABLES

Indices

or: Origin of the transaction. It can take the following values: D (domestic), R (Rest of the World) or T (All origins: D+R).

t: Period to which the variable corresponds. It can take the following values: 0 (initial period) and t (final period).

i,j: Sectors.

df: Final demand components. It can take the following values:

cpri	private consumption
ccol	public consumption
fbcf	gross fixed capital
vaex	changes in stocks
exrm	exports

ip: Primary inputs components and balance elements.
It can take the following values:

trnpr	negative transfers of goods
trppr	positive transfers of goods
trtpr	total transfers of goods
imrm	imports
imim	import duties
peps	effective production
pdps	distributed production

tb: Types of goods considered.

1	final consumption goods
2	capital goods
3	intermediate goods
4	goods of type 1 equally assignable as type 3
5	goods of type 3 equally assignable as type 1
6	goods of type 1 equally assignable as type 2
7	goods of type 3 equally assignable as type 2
8	goods that can be classified as type 1, 2 or 3

$$M_5 = \{(cpri, ccol), (ccol, fbcf), (fbcf, vaex), (vaex, exrm)\}$$

Parameters

All variables related to period 0 are known and therefore considered as parameters

$PS_{i,j}$: Coefficients of secondary production and residual sales of the public sector, in % over total effective production.

${}^{t}CM_{i,tb}$: Imports of type tb fixed beforehand.

${}^{t}CX_{i,tb}$: Exports of type tb fixed beforehand.

${}^{t}CPRI_{i}$: Private consumption by sector i fixed beforehand.

${}^{t}CCOL_{i}$: Public consumption by sector i fixed beforehand.

Variables:

${}^{t}X_{i,j}^{or}$: Goods of origin ***or*** of sector ***i*** required as intermediates by sector ***j,*** in moment ***t.***

${}^{t}II_{j}^{or}$: Total intermediate inputs of origin ***or*** of sector ***j***, in moment ***t***. That is:

$$ {}^{t}II_{j}^{or} = \sum_{i} {}^{t}X_{i,j}^{or} $$

${}^{t}OI_{i}^{or}$: Total intermediate outputs of origin ***or*** andn of sector ***j***, in moment ***t***. That is:

$$ {}^{t}OI_{i}^{or} = \sum_{j} {}^{t}X_{i,j}^{or} $$

${}^{t}IP_{ip,j}$: Primary inputs and balance elements of type ***ip***, for sector ***j***, in moment t ***t***. This variable can take the following values:

$$ {}^{t}IP_{'peps',j} = {}^{t}IP_{'vabp',j} + {}^{t}II_{j}^{'T'} $$

$$ {}^{t}IP_{'trppr',j} = \sum_{j/(i,j)\in M_4} \left(PS_{i,j} * {}^{t}IP_{'peps',j} \right)/100 $$

$$ {}^{t}IP_{'trnpr',j} = \sum_{i/(i,j)\in M_4} \left(PS_{i,j} * {}^{t}IP_{'peps',j} \right)/100 $$

where M_4 is defiend later

$$^{t}\mathrm{IP}_{'trtpr',j} = {}^{t}\mathrm{IP}_{'trnpr',j} - {}^{t}\mathrm{IP}_{'trptr',j}$$

$$^{t}\mathrm{IP}_{'pdps',j} = {}^{t}\mathrm{IP}_{'peps',j} + {}^{t}\mathrm{IP}_{'trpr',j}$$

$^{t}\mathrm{DF}_{i,df}^{or}$: Final demand of sector ***i***, of type ***df***, of origin ***or***, in moment ***t***

$^{t}OREC_{j}$: Total resources (Origin) of sector ***j***, defined as

$$^{t}OREC_{j} = {}^{t}\mathrm{IP}_{'pdps',j} + {}^{t}\mathrm{IP}_{'imim',j} + {}^{t}\mathrm{IP}_{'imrm',j}$$

$^{t}UREC_{i}^{or}$: Total use of resources of sector ***j*** of origin ***or***, defined as:

$$^{t}UREC_{i}^{or} = {}^{t}OI_{i}^{or} + \sum_{df} {}^{t}DF_{i,df}^{or}$$

$^{t}ARDF_{i.df}$: Share of imports over the total value of element df of final demand, for sector i. That is:

$$^{t}ARDF_{i,df} = \frac{^{t}DF_{i,df}^{'R'}}{^{t}DF_{i,df}^{'T'}}$$

$^{t}AROI_{i}$: Share of imports over the value of intermediate outputs for sector i. That is:

$$^{t}AROI_{i} = \frac{^{t}OI_{i}^{'R'}}{^{t}OI_{i}^{'T'}}$$

$^{t}ADF_{i,df}$: Share of element df of final demand over total resources of sector i. That is,

$$^{t}ADF_{i,df} = \frac{^{t}DF_{i,df}^{'T'}}{^{t}UREC_{i}^{'T'}}$$

$^{t}AOI_{i}$: Share of element df of intermediate outputs over total resources of sector i. That is,

$$^{t}AOI_{i} = \frac{^{t}OI_{i}^{'T'}}{^{t}UREC_{i}^{'T'}}$$

$CX1_i$: Variable that allows to incorporate ${}^{t}DF^{'R'}_{i,'vaex'}$ and ${}^{t}DF^{'R'}_{i,'emrm'}$ in the group of imports of type 1

$CX2_i$: Variable that allows to incorporate ${}^{t}DF^{'R'}_{i,'vaex'}$ and ${}^{t}DF^{'R'}_{i,'emrm'}$ in the group of imports of type 2

$CX3_i$: Variable that allows to incorporate ${}^{t}DF^{'R'}_{i,'vaex'}$ and ${}^{t}DF^{'R'}_{i,'emrm'}$ in the group of imports of type 3

$EXRCX1_i$: Variable that represents imports of type 1 of ${}^{t}DF^{'T'}_{i,'emrm'}$

$EXRCX2_i$: Variable that represents imports of type 2 of ${}^{t}DF^{'T'}_{i,'emrm'}$

$EXRCX3_i$: Variable that represents imports of type 3 of ${}^{t}DF^{'T'}_{i,'emrm'}$

$EXDCX1_i$: Variable that represents the share of goods of domestic origin of type 1 in ${}^{t}DF^{'T'}_{i,'emrm'}$

$EXDCX2_i$: Variable that represents the share of goods of domestic origin of type 2 in ${}^{t}DF^{'T'}_{i,'emrm'}$

$EXDCX3_i$: Variable that represents the share of goods of domestic origin of type 3 in ${}^{t}DF^{'T'}_{i,'emrm'}$

$VAEXRCX1_i$: Variable that represents imports of type 1 in ${}^{t}DF^{'T'}_{i,'vaex'}$

$VAEXRCX2_i$: Variable that represents imports of type 2 in ${}^{t}DF^{'T'}_{i,'vaex'}$

$VAEXRCX3_i$: Variable that represents imports of type 3 in ${}^{t}DF^{'T'}_{i,'vaex'}$

Deviation variables of level 1

$YCP_i, YCC_i, YFB_i, YVE_i, YEX_i, YOI_i$
$ZCP_i, ZCC_i, ZFB_i, ZVE_i, ZEX_i, ZOI_i$
$YRECCP_i, YRECCC_i, YRECFB_i, YRECVE_i, YRECEX_i, YRECOI_i$
$ZRECCP_i, ZRECCC_i, ZRECFB_i, ZRECVE_i, ZRECEX_i, ZRECOI_i$

Deviation variables of level 2

$WRCPCC_i, WRCCFB_i, WRFBVE_i, WRVEEX_i, WREXOI_i$
$XRCPCC_i, XRCCFB_i, XRFBVE_i, XRVEEX_i, XREXOI_i$
$WCPCC_i, WCCFB_i, WFBVE_i, WVEEX_i, WEXOI_i$
$XCPCC_i, XCCFB_i, XFBVE_i, XVEEX_i, XEXOI_i$

Adjustment variables

${}^tCOEFCP_i$: Adjustment coefficient of parameter $CPRI_i$

ADJUSTMENT MODEL

Objetive Function

This function is the sum of the absolute values of the deviations defined by deviation variables of levels 1 and 2

$$\text{Minimize } \sum_{\text{i}} \left(YCP_i + YCC_i + YFB_i + YVE_i + YEX_i + YOI_i \right) * \text{w}_{\text{rec1}} +$$
$$\sum_{i} \left(ZCP_i + ZCC_i + ZFB_i + ZVE_i + ZEX_i + ZOI_i \right) * w_{rec1} +$$
$$\sum_{\text{i}} \left(YRECCP_i + YRECCC_i + YRECFB_i + YRECVE_i + YRECEX_i + YRECOI_i \right) * \text{w}_{\text{rec2}} +$$
$$\sum_{\text{i}} \left(ZRECCP_i + ZRECCC_i + ZRECFB_i + ZRECVE_i + ZRECEX_i + ZRECOI_i \right) * \text{w}_{\text{rec2}} +$$
$$\sum_{I} \left(WRCPCC_i + WRCCFB_i + WRFBVE_i + WRVEEX_i + WREXOI_i \right) * w_{rec3} +$$
$$\sum_{I} \left(XRCPCC_i + XRCCFB_i + XRFBVE_i + XRVEEX_i + XREXOI_i \right) * w_{rec3} +$$
$$\sum_{I} \left(WCPCC_i + WCCFB_i + WFBVE_i + WVEEX_i + WEXOI_i \right) * w_{rec4} +$$
$$\sum_{I} \left(XCPCC_i + XCCFB_i + XFBVE_i + XVEEX_i + XEXOI_i \right) * w_{rec4}$$

Where $w_{rec1}, w_{rec2}, w_{rec3}$ y w_{rec4} are the weights of the corresponding deviation variables.

Restrictions

Adjustment restriction to include the data on private consumption known beforehand:

$$^{t}DF_{i,'cpri'}^{'T'} = {}^{t}CPRI_{i} * {}^{t}COEFCP_{i}$$

Adjustment restriction to include the data on public consumption known beforehand:

$$^{t}DF_{i,'ccol'}^{'T'} = {}^{t}CCOL_{i}$$

Restrictions based on foreign trade data:

$$^{t}OI_{i}^{'R'} + \sum_{df} {}^{t}DF_{i,df}^{'R'} = {}^{t}IP_{'imrm',i} + {}^{t}IP_{'imim',i}$$

$$^{t}CM1_{i} = {}^{t}DF_{i,'cpri'}^{'R'} + {}^{t}VAEXRCX1_{i} + {}^{t}EXRMRCX1_{i}$$

$$^{t}CM2_{i} = {}^{t}DF_{i,'fbcf'}^{'R'} + {}^{t}VAEXRCX2_{i} + {}^{t}EXRMRCX2_{i}$$

$$^{t}CM3_{i} = {}^{t}OI_{i}^{'R'} + {}^{t}VAEXRCX3_{i} + {}^{t}EXRMRCX3_{i}$$

$$^{t}EXTCX1_{i} = {}^{t}EXRCX1_{i} + {}^{t}EXDCX1_{i}$$

$$^{t}EXTCX2_{i} = {}^{t}EXRCX2_{i} + {}^{t}EXDCX2_{i}$$

$$^{t}EXTCX3_{i} = {}^{t}EXRCX3_{i} + {}^{t}EXDCX3_{i}$$

$$^{t}EXTCX1_{i} = {}^{t}CX_{i,'1'}$$

$$^{t}EXTCX2_{i} = {}^{t}CX_{i,'2'}$$

$$^{t}EXTCX3_{i} = {}^{t}CX_{i,'3'}$$

$$^{t}EXRMTC_{i} = {}^{t}EXTCX1_{i} + {}^{t}EXTCX2_{i} + {}^{t}EXTCX3_{i}$$

$$^{t}EXRMTC_{i} = {}^{t}DF_{i,'exrm'}^{'T'}$$

$$^{t}DF_{i,'vaex'}^{'R'} = {}^{t}VAEXRCX1_{i} + {}^{t}VAEXRCX2_{i} + {}^{t}VAEXRCX3_{i}$$

$$^{t}DF_{i,'exrm'}^{'R'} = {}^{t}EXRCX1_{i} + {}^{t}EXRCX2_{i} + {}^{t}EXRCX3_{i}$$

$$^{t}DF_{i,'exrm'}^{'D'} = {}^{t}EXDCX1_{i} + {}^{t}EXDCX2_{i} + {}^{t}EXDCX3_{i}$$

$$CM1_{i} \geq CM_{i,'1'}$$

$$CM2_{i} \geq CM_{i,'2'}$$

$$CM3_{i} \geq CM_{i,'3'}$$

$$CM1_{i} \leq CM_{i,'1'} + CM_{i,'4'} + CM_{i,'5'} + CM_{i,'6'} + CM_{i,'8'}$$

$$CM2_{i} \leq CM_{i,'2'} + CM_{i,'6'} + CM_{i,'7'} + CM_{i,'8'}$$

$$CM3_{i} \leq CM_{i,'3'} + CM_{i,'4'} + CM_{i,'5'} + CM_{i,'7'} + CM_{i,'8'}$$

Restrictions included to define effective and distributed production:

Since ${}^{t}OREC_{j} = {}^{t}UREC_{j}^{'T'}$ and ${}^{t}IP_{imim',j}, {}^{t}IP_{imrm',j}, {}^{t}PS_{(i,j)}$ are known values, we directly obtain ${}^{t}IP_{pdps',j}, {}^{t}IP_{peps',j}$.

Restrictions included to set bounds to certain variables of the model:

Upper and lower limits where imposed on variables ${}^{t}ADF_{i.df}$, ${}^{t}AOI_{i}$, ${}^{t}ARDF_{i,df}$ and ${}^{t}AROI_{i}$.

Non negativity restrictions:

All variables, with the exception of "transfers of goods" and "change in stocks" are considered to be positive.

Restrictions for the adjustment of level 1:

$$ {}^{T}ADF_{i,df} - {}^{0}ADF_{i,df} + {}^{0}ADF_{i,df} * \left(YDF_{i,df} - ZDF_{i,df}\right) = 0 $$

$$ {}^{T}AOI_{i} - {}^{0}AOI_{i} + {}^{0}AOI_{i} * \left(YOI_{i} - ZOI_{i}\right) = 0 $$

$$ {}^{T}ARDF_{i,df} - {}^{0}ARDF_{i,df} + {}^{0}ARDF_{i,df} * \left(YRDF_{i,df} - ZRDF_{i,df}\right) = 0 $$

$$ {}^{T}AROI_{i} - {}^{0}AROI_{i} + {}^{0}AROI_{i} * \left(YROI_{i} - ZROI_{i}\right) = 0 $$

Restrictions for the adjustment of level 2:

$$ \left(YDF_{i,u} + ZDF_{i,u}\right) - \left(YDF_{i,u'} + ZDF_{i,u'}\right) + \left(WDF_{i,u,u'} - XDF_{i,u,u'}\right) = 0, \ \forall \ (u,u') \in M_{5} $$

$$ \left(YDF_{i,exrm} + ZDF_{i,exrm}\right) - \left(YOI_{i} + ZOI_{i}\right) + \left(WEXOI_{i} - XEXOI_{i}\right) = 0 $$