A bi-regional Input-Output model for Portugal: Centro and Rest of the Country

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Abstract

Regional Input-Output models aim to quantify the impacts on industry's outputs, and other economic indicators, of different final demand vectors for goods and services produced in the same or in different regions. These models are well suited for regional economic analysis as they combine intra-industrial and interregional economic interdependencies. MULTI2C is a general flexible procedure, developed by a group of researchers from the University of Coimbra, Portugal, that allows for the construction of that kind of models for different geographic configurations.

This work describes the construction of a bi-regional input-output model for Portugal, based on the MULTI2C approach, considering two regions: the NUT II Centro of Portugal and the Rest of the Country. This model considers rectangular matrixes with 431 products and 125 industries. Furthermore, we distinguish between 5 types of households according to their main source of income, i.e., labour earnings, capital income, real estate income, retirement benefits and other social transfers. This modelling framework may be closed with respect to the consumption of different households types, but this paper only considers as endogenous the labour earnings type. Besides the presentation of the model structure and a brief account about the methodological choices made in its construction, this work focuses on estimating interregional trade.

Finally, this model is used to assess the impacts in the Centro of Portugal region, and in the Rest of Country, derived from a shift in the distribution of income in the Centro region, consisting in a reduction of the labour share, compensated by an increase in business investment, which however do not confine to the NUT II Centro of Portugal but may into some extent spillover to the Rest of the Country.

1. Introduction

Regional Input-Output models are useful to quantify the impacts on industry's outputs, and other economic indicators, of different final demand vectors for goods and services produced in the same or in different regions. These models are well suited for regional economic analysis as they combine intra-industrial and interregional economic interdependencies.

The initial purpose of this work is to build an input-output model for the *Centro* region (*C*), Portugal. This model uses 2010 data and analyses the interactions between the *Centro* region and the rest of Portugal, hereafter designated as "Rest of the Country" (*RC*). The *Centro* region is a NUT II located in mainland Portugal, occupying the central part of its territory (between Lisbon and Oporto) and corresponding to 31% (28 405 Km^2) of the country's total area. This region has 2,3 millions of residents (22% of the country's total) and its GDP represents about 18,5% of the Portuguese GDP. Next, the bi-regional *Centro-Rest of the Country* input-output model is explored to assess the impacts in both regions, derived from a shift in the income's distribution in the *Centro* region, consisting in a reduction of the labour share in this region, compensated by an increase in business investment.

According to the scope and objectives considered, the analysis is organized as follows. Section 2 presents, in sub-section 2.1, the structure of the bi-regional *Centro - Rest of the Country* input-output model; in sub-section 2.2 are explained the main procedures regarding the consideration of different household types, according to their main source of income; sub-section 2.3 proposes a discussion on the estimation of the inter-regional trade between the two regions. Section 3 presents an application of the model to assess the impacts in the *Centro* region, and in the *Rest of the Country*, derived from a shift in the income's distribution in the *Centro* region. Section 5 concludes.

2. The Modelling framework

The bi-regional input-output model proposed in this work is an application of the MULTI2C (multi-sectoral multi-regional Coimbra model) framework. MULTI2C is a general flexible approach, developed by a group of researchers, mainly from the University of Coimbra (Portugal) that allows for the construction of input-output tables

for different geographic configurations[1]. The MULTI2C approach has a great level of detail concerning both the products (or groups of products) included (431) and the industries (125) that produce them. The bi-regional *Centro-Rest of the Country* input-output model uses 2010 data and is focused on the Portuguese NUT II *Centro* region. Accordingly, this model considers that the 431 products included in the MULTI2C approach are produced by the 125 industries in the two different regions or are being internationally imported (M), i.e., part of these products are produced outside the Portuguese territory.

2.1 The structure of the bi-regional *Centro-Rest of the Country* input-output model

The structure of the multi-sector bi-regional *Centro-Rest of the Country* input-output model is schematically presented in Table 1.

[1] As a rule, MULTI2C models are of the bi-regional kind, as the one used here, although multi-regional structures are also being considered. Sargento *et al.* (2013) have already adopted a similar framework, dividing Portugal in the "interior" and the "coast" parts of the country. The interior-coast dichotomy is again considered in Ramos *et. al* (2014) (in this Conference). For an example of a tri-regional application please see Ferreira *et al.* (2014) (also in this Conference).

Table 1 - Structure of the multi-sector bi-regional *Centro - Rest of the Country* input-output model

		Products				Industries				Other Final Demand		Total
		Centro (C)		Rest of the Country (RC)		Centro (C)		Rest of the Country (RC)		Centro (C)	Rest of the Country (RC)	
Products	Centro (C)	0				IC^{CC}	HC^{CC} (Lab)	IC^{CRC}	HC^{CRC} (Lab)	OFD^{CC}	OFD^{CRC}	TPO^{C}
						HI^{C} (Lab)	0	0	0	0	0	HI^{C} (Lab)
	Rest of the Country (RC)					IC^{RCC}	HC^{RCC} (Lab)	IC^{RCRC}	HC^{RCRC} (Lab)	OFD^{RCC}	OFD^{RCRC}	TPO^{RC}
						0	0	HI^{RC} (Lab)	0	0	0	HI^{RC} (Lab)
Industries	Centro (C)	P^{CC}	0	0		0				0		TIO^{C}
		0	HI^{C} (Lab)									HI^{C} (Lab)
	Rest of the Country (RC)	0		P^{RCRC}	0							TIO^{RC}
				0	HI^{RC} (Lab)							HI^{RC} (Lab)
Taxes less subsidies on products, falling upon intermediate consumption or final demand		0				$T(IC)^{C}$	$T(HC)^{C}$ (Lab)	$T(IC)^{RC}$	$T(HC)^{RC}$ (Lab)	$T(OFD)^{C}$	$T(OFD)^{RC}$	TT
International Imports destined to intermediate consumption or final demand						$M(IC)^{C}$	$M(HC)^{C}$ (Lab)	$T(IC)^{RC}$	M (HC) (Lab)	$M(OFD)^{C}$	$M(OFD)^{RC}$	TM
Total Intermediate Consumption / Final Demand, at purchasers' prices						TIC^{C}	THC^{C} (Lab)	TIC^{RC}	THC^{RC} (Lab)	OFD^{C}	OFD^{RC}	TIC + TFD
Gross Value Added which is not directly distributed to households						$NHVA^{C}$	0	$NHVA^{RC}$	0	0	0	TNHVA
Savings and net transfers to other institutional sectors of households living mainly from their labour income							S^{C} (Lab)		S^{RC} (Lab)			TS
Total		TPO^{C}	HI^{C} (Lab)	TPO^{RC}	HI^{RC} (Lab)	TIO^{C}	HI^{C} (Lab)	TIO^{RC}	HI^{RC} (Lab)	OFD^{C}	OFD^{RC}	

Legend:

C - Centro

RC - Rest of the Country

IC^{ij} *i,j = C, RC* - Intermediate consumption of i's regional products, used by j's industries

HC^{ij} (Lab) *i,j = C, RC* - Final consumption of i's regional products, consumed by households mainly dependent from labour income living in region j

$OFD^{i,j}$ *i,j = C, RC* - Other final demand for i's regional products, used in region j

HI^{i} (Lab) *i = C, RC* - Region i's households income distributed to the households that live mainly from their labour compensations

TPO^{i} *i = C, RC* - Total output of products produced in region i, at basic prices

P^{ii} *i = C, RC* - i's regional products, according to their production industry (generic element of the i's supply table)

TIO^{i} *i = C, RC* - Region i's total industry output, at basic prices

$T(g)^{i}$ *i = C, RC; g = IC, HC, OFD* - Taxes less subsidies on products, falling upon g, in region i

TT - Total taxes less subsidies on products

$M(g)^{i}$ *i = C, RC; g = IC, HC, OFD* - International imports destined to use g, in region i

TM - Total International Imports

TIC^{i} *i = C, RC* - Total intermediate consumption by industries, in region i, at purchaser's prices

THC^{i} (Lab) *i = C, RC* - Total region i's consumption by households mainly dependent on labour income, at purchaser's prices

OFD^{i} *i = C, RC* - Other final demand in region i, at purchaser's process

TIC + TFD - Total intermediate and final demand, at purchaser's prices

$NHVA^{i}$ *i = C, RC* - Gross Value Added which is not directly distributed to households, in region i

TNHVA - Total Gross Value Added which is not directly distributed to households

S^{i} *i = C, RC* - Savings and net transfers to other institutional sectors of the households that live mainly from their labour income, in region i

TS - Total savings and net transfers to other institutional sectors of the households that live mainly from their labour income

The structure of the model in Table 1 considers the following main characteristics and hypothesis:

- The model considers primarily "domestic flows" (unlike the National Accounts Supply and the Use Tables, from where it is derived, which favour an accounting approach at "total flows"). This means that this model considers the industries operating within the Portuguese economy, i.e., the rows and the columns for each

of the 431 products include the products actually produced in Portugal (in *C* and/or *RC*).

- The model is at basic prices. Total products output (TPO) and total industries output (TIO) are evaluated at basic prices (nevertheless the industries output (TIO) includes, as usually, intermediate consumption at purchasers' prices - IC); total final demand is also considered at purchasers' prices, although the final demand of each product is consistently considered at basic prices; finally, trade and transport margins are considered as inputs provided by trade services (wholesale, retail or specifically motor vehicles or fuels) or transport services (by different types of freight).
- The model considers 431 products and 125 industries, therefore allowing each industry to produce more than one product, whether they are primary or secondary products (i.e., that are main products of other industries). The rows of matrices $\mathbf{P}^{CC}$ and $\mathbf{P}^{RCRC}$ describe the products produced by each industry in *C* and *RC*, respectively. Regarding primary products, based on the product-industry dichotomy that is typical of rectangular input-output tables, whenever each industry produces more than one product, it is used more specific information about the actual structure and major dominant products of each industry in *C* and *RC*. Concerning secondary products, the same weight in total industries production in each of the regions is considered (note that those products represent a non-significant share of the total output).
- Rows corresponding to products (431 products × 2 regions) describe their different destinations, which include: the intermediate consumption (IC) in each region (naturally, a product produced in *C* can be inter-regionally exported and used as intermediate consumption in *RC*); the final consumption of the different types of households in both regions; and other destinations in the "Other Final Demand".
- Columns corresponding to industries describe their technologies in absolute values, i.e., each product's intermediate consumption in each industry, according to the origin's region (*C* or *RC*); the intermediate inputs internationally imported (although in this case, the total inputs are not disaggregated by products); the (non deductible) taxes less subsidies falling upon the purchased inputs (in order to assure that each industry IC is expressed at purchaser's prices); the income generated in each industry and in each region, i.e., the GVA, whether it is directly distributed to

households living mainly from their labour income, or distributed to some other institutional units through an automatic endogenous process (NHVA).

- The model considers, both in *C* and *RC*, different household's types, according to their main source of income, namely: labour earnings, capital income, real estate income, pensions and other social transfers.
- The model is *"*closed*"* regarding the consumption of households that live mainly from labour income (employees or self-employed workers), i.e., labour income endogenously determines consumption. The income generated in each region contributes only for the consumption of households living in the same region; commuting and other periodical or seasonal migrations between *C* and *RC* (that are negligible between these regions) were not considered. Consumption of other household's types (the non-labour income dependent ones) is considered exogenous, i.e., their consumption expenditures are independent of the generation of productive income (which we do not know how, where and when is distributed to these families), and therefore considered as part of the Other Final Demand.
- The Other Final Demand includes: the consumption of other household's types (the non-labour income dependent ones); the consumption expenditures of general government and non-profit institutions; the investment (i.e., demand for products used as investment goods, produced in the country, allocated to *C* or *RC* according to the place of production); the consumption of non-residents in Portugal that visit both regions; and other international exports of goods and services.
- Residential and business rents paid to households were not considered as benefiting those living mainly from labour income, but were instead included in the NHVA vector. Thus, an increase in these does not automatically induce an increase in consumption (as the consumption of the other household's types is deemed to be exogenous).

Moreover, this rectangular bi-regional input-output model admits that each industry has its own technology, identically to the production of all its primary or secondary products[2].

It is also important to sign that the part of Table 1 inside the bold border - a square matrix of dimension 1116 (431 products plus 125 industries plus 2 rows relating to

[2] See Sargento *et al.* (2011) for a discussion on the (dis)advantages of rectangular input-output models. Deeper descriptions of this kind of structure can be seen in the pioneering contribution of Oosterhaven (1984) and in Miller and Blair (2009: Chapter 5).

household income, per each of the two regions) - is the core of the input-output framework implemented. Indeed, one departs from this core to compute the inverse matrix, which comprises a set of multipliers that measure impacts of exogenous final demand shifts on products and industries production. Also, this inverse matrix includes the impacts caused by shocks on products in the income of the households that live mainly from their labour earnings. On the other hand, it is possible to assume exogenous shocks in such income and compute their effects on products/industries outputs. Further, exogenous final demand shocks (where, as a rule, shocks hit) can be formulated either in terms of products, or be redirected to industries.

2.2 The consumption structure of the different household types

The multi-sector bi-regional *Centro-Rest of the Country* input-output model distinguishes five private consumption structures, by different household types, according to their main source of income, namely: *(i)* labour earnings, *(ii)* capital income, *(iii)* real estate income, *(iv)* retirement benefits and other *(v)* social transfers. The technical details on the procedures used to derive the consumption structure for these different household types are briefly mentioned.

The vector of national household's final consumption, for the 431 products, provided by the Portuguese National Accounts Supply and Use Tables, was the initial data analysed. Then, to disaggregate this vector by the household's main source of income and also by region, firstly, we proceeded to the estimation of total households' consumption by each household type, in *C* and *RC*. The data sources used (all by the Portuguese National Statistical Institute – INE) to estimate such values were: the "Household's Expenditure Survey 2010-2011" (HES) (that provides information on the consumption expenditure per household type); the "2011 Census" for data concerning the number of individuals per region and per household type (in order to reweight the sample of the HES); and the regional *per capita* Purchasing Power Index, also referring to 2011 (to decide upon the total relative consumption between the two regions). Secondly, we have estimated the consumption of the 431 products by each household type, in C and RC. As the HES only considers data disaggregated for 200 products, such information was used as a primary data source, i.e., to estimate the corresponding disaggregation for the 431 products level (as considered by the National Accounts), it was assumed that the

relative significance of the sub-products was the same in the 2 regions and for all the household types, namely identical to the corresponding shares in the National Accounts.

Finally, Table 2 shows the estimated consumption structures by household types (including the different values of residential rents paid by these families and the consumption of residents outside the Portuguese territory), in *C* and *RC*. This table refers to resident household's consumption at purchasers' prices, including also the consumption of internationally imported goods and services.

Table 2 - Consumption structure by household type (%)

Region:	**Centro (*C*)**				**Rest of the Country (*RC*)**			
Household's main source of income: / *Products*	Labour earnings	Capital and real estate incomes	Pensions	Other social transfers	Labour earnings	Capital and real estate incomes	Pensions	Other social transfers
Agriculture, forestry and fishing products	3,35	3,32	5,24	4,01	3,03	3,32	5,00	3,76
Food industry products	13,60	11,62	17,06	16,80	14,64	11,62	17,39	19,63
Other products of industry and construction	42,07	34,80	40,84	41,27	41,01	34,79	38,61	40,03
Energy, water supply and sewerage	3,50	3,47	5,40	4,74	3,17	3,46	4,68	4,74
Accommodation and food services; Wholesale and retail trade, repair of motor vehicles and motorcycles	10,02	10,56	6,55	6,93	10,52	10,56	7,12	7,80
Transportation and storage; information and communication products	6,59	6,83	6,01	6,64	6,54	6,83	6,38	7,13
Financial, insurance and real estate services	6,57	7,22	4,84	6,77	5,34	7,22	5,18	2,96
Other services	11,44	16,67	11,44	9,70	11,69	17,41	12,49	10,11
Housing rents	1,25	0,87	1,02	3,07	2,26	1,09	1,63	3,74
Resident's expenditures abroad	1,61	4,65	1,60	0,07	1,79	3,70	1,52	0,09

Table 2 data confirm the importance of considering different households' sources of income as well as the structures of consumption in the *C* and *RC* regions. First, it is possible to conclude that the highest proportion of consumption expenditures, for all household types in both regions, concerns to "Other products of industry and construction". Again in both regions, households mainly depending on income from "Capital and real estate" are leaders in the relative importance of the products "Accommodation and food services" and "Financial, insurance and real estate services" while households depending predominantly from pensions stand out for "Food industry products", "Agriculture, forestry and fishing products" and "Energy, water supply and sewerage". Finally, "Housing rents" are relatively more important for those mainly depending on income from "Other social transfers". Secondly, regardless the household

type, the products included in the categories "Agriculture, forestry and fishing products", "Other products of industry and construction", and "Energy, water supply and sewerage" have higher relative values in the *C* than in the *RC* region. Conversely, products included in the categories "Food industry products", "Accommodation and food services; Wholesale and retail trade, repair of motor vehicles and motorcycles", "Other services" and "Housing rents" stand relatively higher in the families of the Rest of the Country.

Finally, as described in subsection 2.1, there is the need to convert the information contained in Table 2 from purchasers' prices to basic prices and from "total flows" to "domestic flows". Accordingly, from the matrix at purchasers' prices and for each product, were removed: the percentage of VAT (Value Added Tax); other taxes less subsidies; wholesale and retail margins; and the value of international imports. Basically, the margins were reclassified to the trade and transport industries, being considered as household's consumption of those industries products. Taxes less subsidies were removed from each product and inserted at the bottom part of Table 1 ($T(g)^i$). A similar procedure was used regarding international imports ($M(g)^i$). Further, it was assumed equal propensity to (internationally) imports in both regions and for each of the 431 products.

2.3 The *Centro - Rest of the Country* inter-regional trade

The inter-regional trade problem is perhaps the most critical issue in building up regional input-output models. In this research, this task was accomplished, in a first approach, by the "residual method"[3]. This method is based on the following assumption: if there is more supply (including international imports) than demand (including international exports) of one product in a given region, this product is inter-regionally exported (in net terms) by this region. Thus, all the components of each product's supply and demand are estimated for the region and the difference gives us the interregional net trade. For bi-regional models, net flows are symmetrical between the two regions (and, of course, we know the export's destination region and the import's origin region for each case).

[3] This is the general methodology adopted in the MULTI2C models. The method and corresponding procedures are described in Barata *et al.* (2011), when the aim was to estimate inter-regional gross imports, for single region models (for small Portuguese NUTS III regions, in the interior part of the country), and developed in Ramos et al. (2013) already in a bi-regional model.

Further, it is essential to have information not only on net inter-regional trade, but also about export and import gross values (at least regarding the endogenous part of the model)[4].

The approach implemented in this research first estimates gross imports. The method for estimating gross imports is based on a detailed product classification that relies on several hypotheses and the expertise of the MULTI2C team members, namely their effective knowledge of the Portuguese reality. Three different product types (A, B and C) and corresponding assumptions are considered regarding the determination of gross inter-regional imports, as follows:

- *Type A* products, regionally non-tradable. These products have necessarily to be produced in the same region where they are consumed; the inter-regional imports of these products are zero in both regions, as there is no inter-regional trade; the residue between these products supply and demand is not significant in the majority of the products but it may not be exactly 0 (it has a positive value in one region and the symmetric value in the other). These residues are included in the R^i column of Table 1.
- *Type B* products, fully international and inter-regionally tradable. These products move around the two regions at negligible costs; there is no reason for a local delivering preference; thus, demand is assumed to be satisfied by local supply or by imports from the other region according to the proportion of the regional products output.
- *Type C* products, regionally tradable between specific locations; this "intermediate" category includes mainly products with high transportation costs or with a strong regional preference; they also include some products for which the demand is usually locally manifested, but satisfied by national companies - a significant part of these product's production process takes place in the company's (national or regional) headquarters, often located in *RC* - we call this the *"*headquarters effect*"*, and this *"*headquarters*"* participation on the production process is considered equivalent to an inter-regional export of the headquarter region to their establishment region.

These procedures generate a first estimate of the gross inter-regional trade in both regions. Gross imports depend on the type of product classification and inter-regional

[4] This is the well-known Crosshauling problem, firstly approached by Robinson and Miller (1988).

exports are obtained residually. However, contrarily to what is observed in net inter-regional trade, after this, most of the product's gross imports do not match with the gross exports of the same products in the other region. It is therefore essential to consider a final adjustment, consisting on a simultaneous increase of one product inter-regional exports and imports (XIR and MIR) in one region, combined with a simultaneous reduction, for the same product, in exports and imports, in the other region, until the interregional trade gross flows are equal (i.e., XIR (i) = MIR (j), *i,j = C, RC*). The distribution of these two adjustment weights is associated with the product's relative output in both regions.

Then, gross exports are determined residually as the difference between the net balance of inter-regional trade of the product, previously known, and the gross imports estimated.

Table 3 shows the main products regarding gross exports and net exports (i.e. exports less imports) from *C* region, which can be considered as forming its economic basis. It is important to note that when export's destination is investment or consumption expenditure of the general government or non-profit institutions (which were not estimated in the model) the gross exports do not include inter-regional exports to *RC*. International re-exportation of imported goods are equally excluded as they were not "distributed" through the two regions.

Table 3 - Main products (international and inter-regional) exported from *Centro* region

Unit: 10^6 € (2010)	***Gross exports***	***(% total gross exports)***	***Net exports***
Production, distribution and trade of electricity	2189,34	9,02	199,99
Fabricated metal products, except machinery and equipment	1385,59	5,71	599,21
Pulp, paper and paperboard (excluding corrugated)	1245,79	5,13	997,29
Agriculture, farming of animals, hunting and related services	1141,70	4,70	136,86
Food and beverage services	1095,68	4,51	487,84
Freight transport by road and removal services	1027,74	4,23	796,66
Plastics products	804,99	3,31	413,88
Accessories for motor vehicles	783,74	3,23	208,81
Basic chemicals, fertilizers and nitrogen compounds, plastics and synthetic rubber in primary forms	777,06	3,20	-418,81
Refractory ceramic products; Ceramic building materials; Other porcelain and ceramic products, non-refractory	684,69	2,82	644,56
…	...	...	...
Total Exports from *Centro region*	24283,47	100	-1191,22

According to Table 3 data, the three major gross exporting industries in the *C* region are "Production, distribution and trade of electricity", "Fabricated metal products, except machinery and equipment" and "Pulp, paper and paperboard (excluding corrugated)". However, regarding net exports, only "Pulp, paper and paperboard" remains on the top three and it becomes relevant to note the position in the *C* region economic basis of "Freight transport by road and removal services" and "Refractory ceramic products; Ceramic building materials; Other porcelain and ceramic products, non-refractory".

3. The impacts of an income redistribution in the *Centro* region of Portugal

The bi-regional *Centro - Rest of the Country* input-output model is now considered to assess the impacts, in both regions, resulting from a shift in the income's distribution *in the C* region. More exactly, it is assumed a 5% reduction in the labour earnings in *C*, with such amount being in its turn relocated in gross fixed capital formation (GFCF). Naturally, the GFCF increase is not confined to the *C* region, but is expected to spread all over the country. This happens because, contrarily to labour income, capital remuneration is not tied to the place/region where the production factor is employed and the corresponding remuneration is paid. Actually, employees generally live in the place/region where they work, but the same may not happen with capital holders as they usually spend their income in investments through different parts of the country, regardless their place of living. Further, in this modelling framework what is actually relevant is where the production of the investment goods takes place, which may happen anywhere in the Portuguese territory, or even abroad, and not necessarily at the actual location of the investment (note that this also matters concerning workers' consumption, since consumption products can also be produced outside the region, but with less expected relevance).

The results of this modelling exercise indicate that the shift in income's distribution would generate a net expansionist effect on the Portuguese economy. However, concerning *Centro* region's total production, the model foresees a reduction of approximately 90 million €uros, which is expected to be balanced by an increase of approximately 1020 million €uros in the *Rest of the Country*'s total production. Table 4 shows how these effects in the *Centro* region are distributed, emphasising the products whose production has changed the most, as a result of this shock.

Table 4 - *Centro* region's products with higher changes in production

(year: 2010)	**Absolute** (**10^6 €**)	**Relative** (**%**)
Higher increases		
Development of building projects; Construction of buildings	43,85	24,68
Civil engineering	38,37	21,60
Specialized construction	23,13	13,02
Fabricated metal products, except machinery and equipment	16,34	9,20
Cement, lime and plaster; Articles of concrete, cement and plaster	11,51	6,48
Total change in products whose production increased	177,66	
Higher reductions		
Education	-12,38	4,61
Wholesale and retail trade and repair of motor vehicles and motorcycles	-13,43	5,00
Food and beverage services	-22,55	8,39
Renting of own or leased real estate	-53,90	20,07
Wholesale trade (include commission trade), except of motor vehicles and motorcycles	-55,56	20,68
Total change in products whose production decreased	-268,59	
Total net change in Centro region's production	**-90,94**	

To analyse Table 4 results it is important to remember that the rates of household's savings and transfers to other institutional sectors are very high, such that only a portion of household's income is applied in consumption expenditures. Contrarily, when household's income is considered to be redistributed in benefit of firm's profits, it is assumed that this amount is invested, therefore generating a net expansionist effect for the country as a whole. Accordingly, the estimated simultaneous expansionist effect on the Portuguese economy and an output decrease in *Centro* region happens because the initial income reduction occurs in *Centro* region's households that depend mainly from their labour income, and these households spend most of their money in the region where they live. Additionally, a portion of this income is spent on non-tradable (type A) products, which have to be produced in the *Centro* region itself. Naturally, the products with higher increases in production are those that are directly or indirectly linked to investment, while the higher reductions are mainly connected to household's consumption expenditure (that is deemed to depend on labour income). The overall (negative) impact in the *Centro* region of this shock in income distribution shows that the (negative) effect on the consumption products' output outweighs the (positive) impact resulting from investment and related goods' output.

This scenario can be criticised and considered as extreme or disproportionate. Indeed, we assume that the labour compensations reduction is fully converted into more

investment (except for the part corresponding to taxes on products falling upon the investment goods), but actually only a fraction of household's income is available for consumption – e.g., a part of the revenue retained by companies (NHVA) is used in income taxes or in more transfers to other institutional sectors. Accordingly, we have tested the sensitiveness of these modelling results to this assumption, by considering an additional scenario, where only 80% of the total labour income reduction in *Centro* region is compensated by an increase in GFCF. However, even under this new milder assumption, the national expansionist impact remained, namely because household's income that is not consumed (saved or transferred to other sectors) is about 50%, while we admit not to invest 20% of firm's profits. Additionally, this new scenario estimates an output decrease in *Centro* region of about 152 million €uros (0,26% reduction against the 0,15% in the initial scenario) strengthening the negative effect on production in *Centro* region, while the estimated production growth in the *Rest of the Country* of approximately 733 million €uros (an increase of 0,28% comparing with 0,39% in the initial scenario) becomes lower.

Noteworthy, in general, these scenarios confirm that regions benefit from income distributions that favour workers (because they generally spent their income in the same region), while are negatively affected by income distributions that benefit capital holders (as is not certain where the increased profits that benefit capital, after the income redistribution, are really invested, and where the corresponding investment goods are produced). These research results are in accordance with those proposed in Ramos *et al.* (2011), when estimating the impact on employment for different scenarios concerning the distribution of productivity gains among employees and capital owners, in Portuguese depressed peripheral regions.

4. Conclusions

The leading ambition of this paper is to establish the structure of a bi-regional input-output model for the *Centro* region of Portugal and the *Rest of the Country*. The characteristics of this modelling framework allow assessing the impacts of a shock occurring in the *Centro* region, not only on the region itself, but also the spillover effects that leak to the *Rest of the Country*. These spillovers return then to *Centro* region in the form of a feedback effect. In this modelling approach, these total effects are influenced

not only by the private consumption structures in each region but also by the relative weight of different household types, according to their main source of income.

Accordingly, this research estimates the impact in the *Centro* region and nationwide of an income distribution shock. More specifically we analyse a 5% redistribution of the income generated in the *Centro* region, considering a reduction in the income distributed to the households that live mainly from their labour income, and transferring it to the firms, which are supposed to spend it in investment. The results indicate that this shift in income distribution has an expansionist effect in the Portuguese economy, namely because the share of this additional firm's profit invested is expected to be higher than the share of household's income that is consumed. However, remarkably, the *Centro* region should not benefit with this income redistribution towards firms. The arguments to explain this result include the fact that household's consumption is largely concentrated on the region where those households live (and work), whereas investments are usually spread all over the country. Thus, overall, this analysis claims that regions themselves may benefit from income distributions that favour workers but are negatively affected by income distributions that benefit capital holders.

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