A Computable General Equilibrium Approach to Hypothetical Extractions and Missing Links[1]

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Abstract

Identifying key sectors or key locations in an interconnected economy is of paramount importance for improving policy planning and directing economic strategy. Hence the relevance of categorizing them and hence the corresponding need of evaluating their potential synergies in terms of their global economic thrust. We explain in this paper that standard measures based on gross outputs do not and cannot capture the relevant impact due to self-imposed modeling limitations. In fact, common gross output measures will be systematically downward biased. We argue that an economy wide Computable General Equilibrium (CGE) approach provides a modelling platform that overcomes these limitations since it provides (i) a more comprehensive measure of linkages and (ii) an alternate way of accounting for links' relevance that is in consonance with standard macromagnitudes in the National Income and Product Accounts.

Keywords:
Economy-wide modeling, Computable general equilibrium, Linkages, Key-sectors

JEL: C63, C68, D58

Introduction

In defining economic policies and planning strategies a key piece of information should be the foreseeable extent of impact of a given policy. To elicit such an impact an accounting of costs and benefits is needed. From the viewpoint of costs we can simplify and identify total monetary cost as an investment baseline. With a given cost the balance of the alternate policies will rest with their accrued potential benefits. In a networked economy such benefits will depend on where –meaning, which economic sector– the policy is implemented. Not all sectors are created equal and the way they translate an spending impulse into economic benefits will depend on their interdependencies and mutual links. Thus less integrated sectors will produce fewer benefits since they will tend to multiply less of their impulses into more activity. This leads to the crucial point of measuring a sector's role in the economy. Two approaches have been used in the literature. The classical one involves measuring multiplier effects (Rasmussesn, 1956, Chenery and Watanabe, 1958) with extensions identifying backward and forward linkages (Shultz, 1977, Cella, 1986, Clements, 1992, Heimler, 1991, Sonis et al, 1995, 1997, Dietzenbacher, 2002). Sophisticated as they may be, multiplier effects can be seen to be average ripple effects of a given economic structure. The second approach goes beyond multiplier effects and aims at gauging the role of a sector by way of simulating its absence. This is the hypothetical extraction method (HEM) and its goal is to measure what would be the economic cost, in terms of lost output, should a sector cease to relate with the remaining sectors of the economy. Miller and Lahr (2001) provide the most comprehensive review of the hypothetical extraction method and variations while recent applications can be found in Sanchez-Chóliz and Duarte (2003) and Cai and Leung (2004). Both of these approaches are limited in the sense that they closely follow the tenets of the linear interindustry model. There are however substantial income and expenditure links that the interindustry approach misses. To account for them one could extend the model to the SAM facility and compute extended multipliers. Even more interestingly, one could adapt the extraction methodology to the SAM model. This is what Cardenete and Sancho (2006) do and there it is shown this straightforward extension changes not only output levels (as it should be expected) but also that the rank ordering of the output effects may be quite different from those of the interindustry setup. This is limited but nonetheless suggestive empirical evidence that the missing income-expenditure links do matter. In contrast, Miller and Lahr (2001) provide empirical evidence that the type of extraction does not seem to matter that much in terms of sectoral ordering as long as we restrict linkage computations to the interindustry concept. Thus if external to production linkages matter then it is only natural that they be examined using the CGE (Computable General Equilibrium) approach since it encompasses a more detailed accounting structure which is well rooted in sound microeconomic theory but also yields results that easily and nicely fit within the National Income and Products Accounts categories. This is in fact more than a convenience. To the best of our knowledge all evaluations of linkages turn out to be expressed in units of gross output while in practical policy terms the relevant measure of output change should be final output (or GDP) rather than gross output. By the nature of the interindustry and SAM models, however, measures of final output associated to multipliers or extractions cannot be calculated since they require a combined, interconnected and simultaneous output and price computation that these modeling options do not and cannot provide.

The rest of the paper is organized as follows. Section I further develops the rationale for implementing extractions in a CGE setup. In Section II we briefly annotate the nature of the CGE model we used. Section III shows numerical illustrations of sector extractions for a simple reference economy. Section IV concludes.

I. The Hypothetical Extraction Method in a CGE framework.

Let us start by considering a simple, constant returns to scale, interindustry economy described by a matrix of technical coefficients *A* and an exogenous vector of final demand *D*. Let *X* stand for the vector of gross output and let us partition all matrix and vectors using the convention that the index 1 represents the sector[1] that

[1] If regional or spatial data is available, the reinterpretation to key locations is immediate. We focus here on sectors because of data availability.

hypothetically ceases to relate with the rest of the economy and the indices 2, 3,…, *n* represent the rest of the economy's sectors. Then the quantity interindustry equation can be expressed as:

$$X = A \cdot X + D = \begin{bmatrix} A_{11} & A_{12} & \cdots & A_{1n} \\ A_{21} & A_{22} & \cdots & A_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ A_{n1} & A_{n2} & \cdots & A_{nn} \end{bmatrix} \cdot \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix} + \begin{bmatrix} D_1 \\ D_2 \\ \vdots \\ D_n \end{bmatrix} \tag{1}$$

Suppose now that sector 1 is "extracted" in the sense that it neither sells goods to nor purchase inputs from the "remaining" sectors 2, 3,…, *n*. Sector 1 still operates but it is "isolated" from the rest of the economy. Under this assumption, to satisfy the final demand levels in vector *D* will require a gross output level $\overline{X}$ such as:

$$\overline{X} = \overline{A}_{(-1)} \cdot \overline{X} + D = \begin{bmatrix} A_{11} & 0 & \cdots & 0 \\ 0 & A_{22} & \cdots & A_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 0 & A_{n2} & \cdots & A_{nn} \end{bmatrix} \cdot \begin{bmatrix} \overline{X}_1 \\ \overline{X}_2 \\ \vdots \\ \overline{X}_n \end{bmatrix} + \begin{bmatrix} D_1 \\ D_2 \\ \vdots \\ D_n \end{bmatrix} \tag{2}$$

where $\overline{A}_{(-1)}$ is the matrix of technical coefficients once the hypothetical extraction of sector 1 is undertaken. Solving for the reduced forms of (1) and (2) we find the differential output $\Delta X_{(-1)}$ explained by the omitted links between sector 1 and the rest of sectors:

$$\Delta X_{(-1)} = X - \overline{X} = \left((I - A)^{-1} - (I - \overline{A}_{(-1)})^{-1} \right) \cdot D \tag{3}$$

The vector difference $\Delta X_{(-1)}$ in (3) indicates the sectoral output loss if sector 1 stops relating to the rest of economic sectors. Under a fix price assumption and a unit normalization the scalar $i' \cdot X_{(-1)}$, where i' is a summation vector of ones, represent total gross output loss should sector 1 be extracted from the economy. Since we can exchange the role of sectors (sector 2 being "extracted", then 3, 4, etc.) a sequential extraction $\overline{A}_{(-1)}, \overline{A}_{(-2)}, \overline{A}_{(-3)}, \ldots, \overline{A}_{(-n)}$ of all economic sectors from the initial matrix A can be visualized. It is clear then that the larger the aggregate output loss associated to a given sector j being "extracted", that is $i' \cdot \Delta X_{(-j)}$, the more relevant that sector is to the networked economy. It is in this sense that a sector can be termed as being a "key" sector and that the omitted or "missing" links are indeed significant.

A novel and different interpretation can be provided in terms of efficiency gains. Notice that since in (3) the vector D remains constant, the vector difference $X - \overline{X}$ shows to what extent the extraction of the sector decreases he overall input levels needed to continue satisfying final demand D. This diminished demand for intermediate inputs is therefore an indication of the implicit productive efficiency of sector 1. Clearly then, the larger the output loss in the standard interpretation the larger the efficiency gain, in our interpretation. The advantage of this alternate explanation is that the notion of efficiency gain can be extended straightforwardly to modeling options quite different from the explicit linear one present in equations (1) and (2), in particular to capture gains not only from an output perspective but also from the point of view of price adjustments.

Indeed, the effect of the extraction is measured, in the standard approach, only against the initial baseline gross output X. From a policy or planning perspective, however, the appropriate measure to evaluate the impact of the extraction should be final output, or GDP. Notice that a cursory look at (1) and (2) tells us that since final demand is, as we have already pointed out, constant there is no real effect on final output, or real GDP, after performing an extraction. This is not very satisfactory since then all we are measuring using $X - \overline{X}$ are adjustments in intermediate production. This is a magnitude that that is not of interest in the National Income and Product Accounts and that seldom gets reported. Another shortcoming of this standard formulation is that it is not clear how sectors 2, 3, etc. obtain their needed inputs if the extracted sector, say sector 1, is not supplying them. Or where the extracted sector 1 obtains its necessary inputs if it is not buying them from 2, 3, etc. This question is sometimes dispatched by appealing to the external sector as a substitute provider or purchaser but no explicit links with the external sector appear in the subsequent modeling.

From a circular flow of income perspective, the results of an extraction should be calculated taking account of all the standing economic connections, both in terms of quantity adjustments but also in terms of the cost and price changes that must necessarily follow. A combined price and quantity appraisal is the natural setup for a computable general equilibrium (CGE) model of the Walrasian type to be of use. This is what we propose in this paper. When the technology matrix A is replaced, even if hypothetically, by a matrix $A_{(-j)}$ a chain reaction of allocation adjustments will take place in order to achieve a new equilibrium and these changes will take place through quantities but also through prices. This is in fact the essence of the general equilibrium paradigm. If this chain reaction is studied under an empirically calibrated version of a general equilibrium model, then its computable nature would allow us to work out and measure the numerical effects and possibly identify what sectors, if extracted, would promote the most change –once all general equilibrium interactions are internalized. All in all, we need to compute all the counterfactual equilibria resulting from all possible sector extractions. For an economy with n production sectors this means n equilibrium computations, once for each extracted sector, where the baseline productive technology is sequentially replaced by the hypothetical ones with their omitted links.

II. The CGE model

We use a model of the Spanish economy as the background for the computations. The model is implemented using a 1995 SAM database assembled by Cardenete and Sancho, (2004). The structure of this SAM has been adapted to minimize possible distortions by the government and its fiscal and expenditure policies. Using Pyatt's apportioning methodology (Pyatt, 1985) we have reduced all government and fiscal tax categories to just one account. Using this procedure a unique government account collects all expenditure and tax receipts in such a way that only a single equivalent indirect production tax and an income tax remain. This course of action apparently, but only apparently, alters the aggregate structure of the SAM but in fact it preserves the underlying network of interactions while minimizing the distorting role of the government in the counterfactual computations.

Apart from the role of the government the model is quite standard. There are 35 economic sectors operating under CRS nested technologies governed by CES functions. In the first level of the nest, total output is obtained combining domestic and imported outputs using an Armington (1969) specification for those sectors with trade. In the rest of sectors total output obviously coincides with domestic output. In the second level of the nested technology, domestic output is produced combining value–added and intermediate inputs in fixed proportions. Following traditional conventions, therefore, no substitution between materials and primary factors is allowed. In the third level, finally, value–added is generated using a CES substitution technology that combines labor and capital. In formal but simplified terms:

$$X_j = CES_1\left(CES_2\left(X_{ij}, CES_3\left(L_j, K_j\right)\right), XM_j\right) \quad (4)$$

Here CES_3 generates value-added VA_j using labor L_j and capital K_j with a positive elasticity of substitution $\sigma_{j,LK}$, CES_2 generates domestic output XD_j combining value-added VA_j and materials X_{ij} with zero substitution elasticity and, finally, CES_1 yields total output X_j combining domestic output and imports XM_j with a positive substitution elasticity σ_{jG} .

Imports are consolidated into a unique account and we do not distinguish them by origin (European Union and rest of the world) since this distinction does not bear on the question at hand. Depending on the closure rule for the external sector, exports can be considered fixed or endogenous, depending on whether the external balance is considered to be, respectively, endogenous or exogenous.

All goods, services and primary factors belong to competitive markets. There are aggregate resource constraints for labor and capital but these homogeneous factors are mobile among sectors and fully utilized in equilibrium.

There is a representative consumer that formulates final consumption demands facing prices p for goods, w for factors under a budget constraint that includes factor income from resource properties, government transfers T and some lump-sum external transfers but detracts income from a linear income tax schedule. Consumption includes consumption today and consumption tomorrow, as a proxy for savings within the static model configuration. The representative consumer adjusts consumption following a simple Cobb-Douglas preference relation that we symbolize by $C(p,w,T)$.

The government collects an output tax $T_X(p, w, X)$ and a tax on income and on capital earnings $T_I(p, w, X)$. These receipts are used to finance the purchase of public consumption for goods and services. The level of public consumption $G(p, w, X)$ depends on prices and the overall activity level. Tax receipts also allow the government to finance its social policies which are measured here by the provision of social transfers T to the private representative agent. The public deficit δ can be considered endogenous or exogenous depending on the selected closure rule.

We close the model in concordance with the circular flow of income embedded in the SAM database, and thus a rule stipulating investment demand is needed. We use an activity analysis approach here. Savings generated from the private representative agent plus the external and public balances add-up to total savings and this figure drives the corresponding investment demand to guarantee the correct circular flow of income closure. We posit an investment activity with fixed coefficients in such a way that the level of aggregate savings determines the level of aggregate investment which in turn is distributed using the fixed coefficients activity vector. Since the different origins of savings are determined by the same price variables as private consumption and by total activity levels, we will write the investment function as $I(p, w, X)$.

Total final demand adds up private consumption, public consumption, investment and exports yielding an aggregate final demand function that we represent by $D(p, w, T)$:

$$D(p,w,T) = C(p,w,T) + G(p,w,X) + I(p,w,X) + \bar{E}$$

The equilibrium concept is Walrasian and very standard. Simply stated, for an economy characterized by a technology $(A, \sigma_G, \sigma_{LK})$ and a fixed level of exports, a fixed public deficit equilibrium is a gross output allocation X^*, vector prices for goods, services and factors (p^*, w^*), and a level of government transfers T^*, such that all markets clear, the government expenditure function "clears" all taxes paid by private agents, the aggregate savings function "clear" with the level of investment demand and given the CRS assumption prices for goods and services follow the average cost rule ensuring zero after tax profits for all firms. Let us omit now, for the sake of simplicity, some of the technical details that characterize the equilibrium configuration and let us make just some of the main equations explicit. For instance, on the production side gross output should cover intermediate and final demands and hence the following should be satisfied in equilibrium:

$$X^* = A \cdot X^* + D(p^*, w^*, T^*) \tag{5}$$

Because of the CRT technology assumption, factors' demands are given by the conditional demand functions for labor and capital. In equilibrium:

$$\begin{aligned} L^d(p^*, w^*, X^*) &= L^s \\ K^d(p^*, w^*, X^*) &= K^s \end{aligned} \tag{6}$$

Government activities will necessarily satisfy:

$$T^* + G(p^*, w^*) + \delta = T_X(p^*, w^*, X^*) + T_I(p^*, w^*, X^*) \tag{7}$$

Finally, the zero profit condition under CRT requires:

$$p^* = p^* \cdot A + pu_{va}(w^*) \cdot VA(w^*) \tag{8}$$

where $pu_{va}(w)$ is the efficient price index for value-added and $VA(w)$ is unitary value-added demand. The simplified model represented by equations (5) to (8) comprises 2*n*+3 equations and 2*n*+3 variables but because of Walras' Law one equation is redundant. Choosing a price as *numeraire* solves the problem and a solution with relative prices can be computed. Now for each sector extraction, there is a hypothetical economy $\left(A_{(-j)},\sigma_G,\sigma_{LK}\right)$ and a hypothetical equilibrium configuration in prices and quantities. For each of these economies, the equilibrium allows us to compute the effects on GDP that can be ascribed to the extraction of each productive sector.

III. Some empirical results

We performed the following hypothetical experiment: Each sector is extracted and the counterfactual equilibrium recomputed. This involves a general reallocation of resources with adjustments in quantities and prices. We then measure changes in GDP and compare them to baseline GDP, all in terms of the same *numeraire*–the wage rate. The change in GDP can be seen as the efficiency gain (or loss) of extracting a sector. This "central" experiment is undertaken for a configuration of substitution elasticities that correspond to the Cobb-Douglas variety. Then we complement the experiment by repeating the computations for a range of substitution elasticities that depart from the unitary ones. We allow first for technologies with a higher degree of substitution and then for technologies with a higher degree of complementarity between inputs. In the Appendix, Tables 1-3 show a summary of the results.

The first striking result in comparison to standard extractions in linear models is that there are sectors that win and sectors that loose–unlike the systematic output losses of linear models. When there is a full reallocation of resources, or at least, full in terms of the more complex structure of a CGE model, and both output and price effects are allowed to adjust, then the combined effect may yield an increase in GDP as a result of the efficiency gains, or not. If we look at Table 1, for instance, the extraction of sector 1 ends up having a positive effect on GDP (1.75 percent) whereas extracting sector 2 yields a fall, even if small, in GDP. In contrast, gross output falls (1.91 percent) when we extract sector 1. Again, from the perspective of linear models the conclusion would be a fall in gross output and would have a negative connotation. However, final output as measured by GDP increases–a positive implication that would be masked should we have looked only at gross output measures. In terms of the key sectors' literature we observe that sector 10 induces the largest percentage drop in gross output whereas it turns out to have the largest, and positive, impact on GDP. With full price and quantity reallocation all possibilities seem to arise. See for instance sector 14, where both final and gross output measures increase; and sector 25 where we observe a decrease in GDP and an increase in gross output; or sector 2 that presents a negative increase in both. From the viewpoint of categorizing economic sectors as "key" sectors, the measure of final production that is GDP provides a more relevant appraisal that is in consonance with the standard accounting procedures of official statistical bureaus as far as output quantification is concerned.

Table 2 illustrates a recomputation of all equilibria under a higher degree of technological substitution. We choose a common Armington elasticity of $\sigma_A = 3$ for all sectors with trade in the database and a labor-capital elasticity of substitution of $\sigma_{LK} = 2$, values that are empirically reasonable, yet they posit somehow flatter isoquants in the first and second level of the nested production functions. Table 3 repeats calculations but now for isoquants with higher complementarities. For this case we select elasticities of substitution of $\sigma_A = \sigma_{LK} = 0.5$, again within the range of reasonable, though low, empirical values.

A comparison of the GDP data points out that more (or less substitution) possibilities does not necessarily translate into a smaller (respectively, larger) effect. It is true that in most cases (about 2/3 of them), higher elasticities of substitution give rise to smaller impacts in term of percentage change, but not in all cases (about 1/3). Similarly, but on the opposite end, lower substitution elasticities correspond to larger percentage effects in many but not all cases. As for gross output effects, the higher (the lower) the elasticity of substitution, the larger (the smaller) the percentage drop in output in all but a few cases.

All this empirical evidence points out that technology matters, and matters substantially, when evaluating the economic weight of linkages induced by networked sectors. Linear models, be interindustry or SAM models, assume a very specific set of technology relationships among sectors and in doing so force or condition the results to be obtained in a very specific direction. As long as we believe that substitution possibilities do arise and do regularly take place in current-day economies, it becomes of paramount importance to have as good an empirical estimate as possible, since whether a sector turns out to be a "key" sector (or not) seems to depend on how that sector *inter-relates* to other sectors in the network of sectors but also on the way the output of a sector *intra-relates* to its inputs and their substitution possibilities.

IV. Concluding remarks

We have explored in this note the role played by technology relationships and output-income-demand links in defining the extent a given economic sector ends up being a "key" sector. We have argued that a CGE model may yield more in-depth insights on this issue since this type of models allows for a more comprehensive representation of the economic reality in terms of actual linkages. To this effect the hypothetical extraction methodology has been extended to a CGE model under a scenario of sector isolation. A critical advantage of CGE models over standard linear models is that they provide indicators of impact on final production, as well as gross output. We also explain how natural it is to reinterpret the effects of an extraction in terms of efficiency variations that can be attributed to reallocation effects on quantities and prices. Unlike linear models where any sector extraction systematically can be seen to produce a gross output loss, in a CGE model resource reallocation can yield a positive or negative impact, depending on the combined price and quantity general equilibrium effects. It is because of the structure of linear models that extractions will unequivocally produce a negative impact on gross output. This is a limitation that a non-linear CGE model does not have. Finally, we observe that substitution possibilities in production are a significant parameter in order to elicit extraction effects. If so, a careful estimation (or at the very least an educated choice based on a wide literature search) of appropriate Armington and labor-capital substitution elasticities is called for. There seems to be, anyhow, more empirical consensus on sensible values of the labor-capital substitution than on Armington elasticities but a flow of recent estimates are providing good empirical foundations that fortunately can be borrowed and fruitfully used by CGE practitioners[2].

[2] Roland-Holst and Reinert (1992) and Balistreri and McDaniel (2003) estimate Armington elasticities. Chirinko (2002) and Klump et al. (2007) present substitution elasticities for primary inputs.

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Appendix

Table 1. Extraction effects: Cobb-Douglas case.

Sector	% change in GDP	% change in gross output
1. Agriculture, stockbreeding, hunting, fishing and silviculture	1,75	-1,91
2. Coal	-0,07	-0,08
3. Petroleum	0,73	0,03
4. Metallic products manufacture	0,07	0,03
5. Non-metallic mineral products industry	0,19	-0,06
6. Petroleum refine and nuclear fuel processing	1,43	-0,01
7. Electricity	1,42	-0,46
8. Gas Distribution	0,13	0,03
9. Water Distribution	0,06	-0,04
10. Food, beverage and tobacco industry	2,28	-3,00
11. Textil and leathers	1,06	-0,51
12. Wood	0,21	-0,00
13. Paper industry; publishing, graphic arts and reproduction	0,62	0,13
14.Chemical Products	1,23	0,42
15. Rubber processing and plastic materials industry	0,47	-0,00
16. Cement and glass	0,72	-0,29
17. Metallurgy	1,35	0,15
18. Machinery	1,09	0,59
19. Electric, electronic and optical materials and equipment industry	0,30	0,22
20. Vehicles	1,44	-0,72
21. Furniture	0,73	-0,11
22. Recycling Services	0,05	0,01
23. Construction	1,82	-0,20
24. Commerce	2,07	-0,77
25. Hotels and Restaurants	-0,05	2,00
26. Transport	2,31	-1,88
27. Financial Services	1,01	-0,08
28. Other Services	0,53	-1,63
29. Education	0,28	0,05
30. Non Commercial Services	0,25	0,12
31. Personal Services	0,46	0,14
32. Public Services	0,50	-0,18
33. Non Commercial Education	0,13	-0,01
34. Health Services	0,53	0,04
35. Cultural Services	0,11	-0,00

Source: Own Elaboration.

Table 2. Extraction effects: High substitution case.

Sector	% change in GDP	% change in gross output
1. Agriculture, stockbreeding, hunting, fishing and silviculture	0,78	-2,23
2. Coal	-0,02	-0,08
3. Petroleum	0,90	-0,37
4. Metallic products manufacture	0,07	0,03
5. Non-metallic mineral products industry	0,15	-0,11
6. Petroleum refine and nuclear fuel processing	1,57	-0,81
7. Electricity	1,08	-0,52
8. Gas Distribution	0,11	0,03
9. Water Distribution	0,06	-0,03
10. Food, beverage and tobacco industry	1,78	-4,07
11. Textil and leathers	1,01	-0,86
12. Wood	0,21	-0,06
13. Paper industry; publishing, graphic arts and reproduction	0,65	0,03
14.Chemical Products	1,31	-0,26
15. Rubber processing and plastic materials industry	0,52	-0,50
16 Cement and glass	0,63	-0,62
17. Metallurgy	1,49	-0,80
18. Machinery	1,37	0,16
19. Electric, electronic and optical materials and equipment industry	0,43	0,29
20. Vehicles	1,66	-3,16
21. Furniture	0,62	-0,25
22. Recycing Services	0,04	0,01
23. Construction	1,67	-0,22
24. Commerce	1,96	-1,08
25. Hotels and Restaurants	0,51	2,02
26. Transport	2,03	-2,17
27. Financial Services	1,12	-0,09
28. Other Services	1,18	-1,77
29. Education	0,20	0,05
30. Non Commercial Services	0,23	0,13
31. Personal Services	0,40	0,20
32. Public Services	0,43	-0,19
33. Non Commercial Education	0,10	-0,01
34. Health Services	0,40	0,04
35. Cultural Services	0,08	0,00

Source: Own Elaboration.

Armington elasticity = 3
VA elasticity = 2

Table 3. Extraction effects: Low substitution case.

Sector	% change in GDP	% change in gross output
1. Agriculture, stockbreeding, hunting, fishing and silviculture	4,04	-1,85
2. Coal	-0,20	-0,08
3. Petroleum	0,35	0,11
4. Metallic products manufacture	0,07	0,04
5. Non-metallic mineral products industry	0,28	-0,05
6. Petroleum refine and nuclear fuel processing	1,09	0,22
7. Electricity	2,23	-0,43
8. Gas Distribution	0,18	0,04
9. Water Distribution	0,04	-0,04
10. Food, beverage and tobacco industry	3,55	-2,79
11. Textil and leathers	1,40	-0,46
12. Wood	0,24	0,01
13. Paper industry; publishing, graphic arts and reproduction	0,61	0,14
14.Chemical Products	1,16	0,50
15. Rubber processing and plastic materials industry	0,32	0,12
16. Cement and glass	0,90	-0,20
17. Metallurgy	1,22	0,34
18. Machinery	0,74	0,55
19. Electric, electronic and optical materials and equipment industry	0,25	0,16
20. Vehicles	1,20	-0,26
21. Furniture	1,00	-0,15
22. Recycling Services	1,00	-0,11
23. Construction	2,16	-0,19
24. Commerce	2,29	-0,68
25. Hotels and Restaurants	-1,41	1,96
26. Transport	2,95	-1,80
27. Financial Services	0,78	-0,08
28. Other Services	-0,94	-1,62
29. Education	0,46	0,06
30. Non Commercial Services	0,29	0,12
31. Personal Services	0,65	0,11
32. Public Services	0,68	-0,18
33. Non Commercial Education	0,19	-0,01
34. Health Services	0,84	0,05
35. Cultural Services	0,18	0,00

Source: Own Elaboration.

Armington elasticity = 0.5

VA elasticity = 0.5