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**Self-Defeating Austerity? Assessing the Impact of  
Fiscal Consolidations on Unemployment**

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# Self-Defeating Austerity? Assessing the Impact of Fiscal Consolidations on Unemployment

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**Abstract.** The great recession of 2008/2009 has had a huge impact on unemployment and public finances in most advanced countries, and these impacts were magnified in the southern Euro area countries by the sovereign debt crisis of 2010/2011. The fiscal consolidation imposed by the European Union on highly indebted countries was based on the assumptions of the so-called expansionary austerity. However, the reality so far shows proof to the contrary, and the results of this paper support the opposing view of a self-defeating austerity. Based on the input-output relations of the productive system, an unemployment rate/budget balance trade-off equation is derived, as well as the impact of a strong fiscal consolidation based on social transfers and the notion of neutral budget balance. An application to the Portuguese case confirms the huge costs of a strong fiscal consolidation, both in terms of unemployment and social policy regress, and it allows one to conclude that too much consolidation in one year makes consolidation more difficult in the following year.

**JEL codes:** E23; E62; C67; D57

**Keywords:** Self-defeating austerity; Fiscal consolidation; Unemployment; Input-output analysis; Portugal

# **Self-Defeating Austerity? Assessing the impact of fiscal consolidations on unemployment**

## **1. Introduction**

The policies of fiscal consolidation imposed by the European Union on highly indebted countries are based on the assumption that a sharp reduction in public expenditure, together with an increase in taxes, reduces the budget deficit, whilst at the same time increasing the confidence of private investors, leading to a significant flow of private capital that will expand the economy compensating the short term negative impacts of the fiscal consolidation. This assumption is supported by the pre-great recession (near) consensus view of mainstream economics that the value of fiscal multipliers tends to be low (Perotti, 2005) or even negative, in the extreme version of expansionary austerity (Alesina and Ardagna, 2009; Dow, 2015).

However the experience of some European countries, such as Portugal and Greece, does not substantiate the virtuous effects of the austerity mechanism, where this approach was tested. The recessive effects were much deeper and lasting than expected and the fiscal consolidation was not only disappointing but it showed no correspondence with the enormous social costs of the policies (Zezza, 2012; Carneiro et al, 2014; Orphanides, 2015).

One possible explanation for these meagre results may reside with the underestimation of the negative impacts of austerity upon employment and upon fiscal consolidation itself, due to the negative impact on public revenue (a reduction of payroll contributions and general tax revenue) and also the increase in public expenditure (namely, unemployment benefits). These impacts are particularly strong in downturns and recessions, leading to high fiscal multiplier values (Blanchard and Leigh, 2013; Gechert et al, 2015) and the creation of self-defeating fiscal consolidation policies (DeLong and Summers, 2012; Chowdhury and Islam, 2012 ; Skidelsky, 2015).

The objective of this paper is to test this assumption for the Portuguese case, in the context of the Economic and Financial Assistance Programme 2011-2014, following the Portuguese sovereign debt crisis of 2010-2011 (European Commission, 2011). This test has two components. First the assessment of the impact of fiscal consolidation on employment is obtained by determining the value of the unemployment rate that would correspond to a balanced budget in 2012. The empirical results show this to be a huge negative effect.

Secondly, we assess the effects of fiscal consolidation of one year on the fiscal consolidation of the following year. For this purpose, the concept of neutral deficit is used. The empirical results show that too much consolidation in one year (such as the one that was imposed by the Programme) makes consolidation more difficult in the following year.

The methodology used for this purpose is based on input-output relations. Input-output analysis is not an adequate tool for making short-term forecasts, however it provides a useful method for assessing macroeconomic projections using a comparative statics framework in a context of economic and financial crisis given its relative robustness *vis a vis* the other methods that rely on (econometric) relations that are erroneously supposed to be stable in the unstable context of a crisis (Amaral and Lopes, 2015).

The techniques and empirical results of this paper add to the recent and relevant literature regarding the impact of the global economic crisis and the ensuing fiscal adjustments on unemployment (Pappa, 2012; Andrés and Doménech, 2013; Turrini, 2013; Bahce and Memiş, 2014; Blanchard et al, 2014; Jalles, 2014; Bova et al, 2015; Junankar, 2015).

The remainder of the paper is organized as follows. Section 2 describes the methodology used for determining the unemployment rate corresponding to a zero deficit and for calculating the neutral deficit. Section 3 presents the results for Portugal for 2012. Section 4 presents the main conclusions of the paper, providing an explanation for the poor results of the austerity policy in achieving fiscal consolidation in Portugal.

## 2. Methodology

### 2.1 Basic assumptions and Input-Output (IO) relationships

Considering an economy modelled with IO relationships, Gross Domestic Product at market prices ( $GDP_{mp}$ ),  $Y$ , is given by:

$$Y = va_C C + va_G G + va_I I + va_{Ex} Ex \quad (1)$$

Where:  $C$  is Private Consumption;  $G$  is Public Consumption;  $I$  is (Total) Investment, resulting from the sum of Private and Public Investment ( $I^{Priv} + I^{Pub}$ );  $Ex$  is Exports, and  $va_C$ ,  $va_G$ ,  $va_I$  and  $va_{Ex}$  are the coefficients of value added content of the respective final demand components (for the calculation of these coefficients, see Appendix 1).

The General Government Budget Balance,  $S$ , is given as:

$$S = tY + O - G - I^{Pub} - TR \quad (2)$$

Where:  $t$  is the average tax rate ( $T/Y$ ), with  $T$  meaning the value of total fiscal receipts (taxes plus payroll contributions);  $O$  are Other net Government Receipts (including public debt interest); and  $TR$  are Government Transfers to the Families.

The Available Income of the Families,  $Y_d$ , is equal to  $Y - tY + TR$ , and Private Consumption is a function of  $Y_d$ :  $C = nY_d$ , with  $n$  representing the average propensity to consume.

### 2.2 Unemployment/Budget Balance trade-off

With the previous assumptions,  $C$  is given by:

$$C = n(Y + O^* - S) \quad (3)$$

Where:  $O^* = O - G - I^{Pub}$

Therefore, after some simple algebraic manipulations:

$$Y = \frac{va_C n O^* + va_G G + va_I I + va_{Ex} Ex - va_C n S}{1 - va_C n} \quad (4)$$

From which the value of C is obtained, depending on S, as:

$$C(S) = n \left( \frac{va_C n O^* + va_G G + va_I I + va_{Ex} Ex - va_C n S}{1 - va_C n} + O^* - S \right) \quad (5)$$

With this value of C depending on S, and given the values of G, I and Ex, exogenous, we may arrive at the Employment/Budget Balance trade-off equation:

$$L = l_C C(S) + l_G G + l_I I + l_{Ex} Ex \quad (6)$$

Where:  $L$  is the Employment of the economy, given by the number of employees, and  $l_C$ ,  $l_G$ ,  $l_I$  and  $l_{Ex}$  are the labour content coefficients of the respective final demand component ( $C$ ,  $G$ ,  $I$  and  $Ex$ ) (for the calculation of these coefficients, see Appendix 2).

Substituting  $C(S)$  given by (5) in equation (6), the Employment/Budget Balance trade-off equation is:

$$L = l_C \left[ n \left( \frac{va_C n O^* + va_G G + va_I I + va_{Ex} Ex - va_C n S}{1 - va_C n} + O^* - S \right) \right] + l_G G + l_I I + l_{Ex} Ex \quad (7)$$

Fixing  $S = 0$  in equation (7), we can obtain the Employment value corresponding to General Government Budget equilibrium. Moreover, knowing the value of the Labor Force,  $N$ , the trade-off equations Unemployment and Unemployment Rate/Budget Balance can be build. The cross-country comparison of these trade-offs is a very interesting exercise.

### 2.3 Fiscal consolidation through Transfers (TR), with $O^*$ exogenous

As previously stated, the Budget Balance is:  $S = tY + O^* - TR$ , with  $O^* = O - G - I^{Pub}$ .

Imposing  $S = 0$  implies that  $TR = tY + O^*$ .

So, using the expression of  $Y$  given by equation (4) and making  $S = 0$ , gives:

$$TR = t \frac{va_c n O^* + va_G G + va_I I + va_{Ex} Ex - va_c n S}{1 - va_c n} + O^* \quad (8)$$

Or, alternatively:

$$\begin{aligned} TR &= \\ &= \frac{[1 + (t - 1)va_c n]O + (tva_G - 1 + va_c n)G + tva_I I + (tva_{I^{Pub}} - 1 + va_c n)I^{Pub} + tva_{Ex} Ex}{1 - va_c n} \end{aligned} \quad (9)$$

With this result, interesting trade-offs can be calculated, namely  $dTR/dG$ ,  $dTR/dI^{Pub}$ , etc.

## 2.4 The neutral Budget Balance

Another interesting indicator can result from the calculation of Government Budget balance,  $S$ , which would have no repercussion on the following year.

The repercussion exists in two ways:

- Change in expenditure resulting from unemployment variation
- Change in the interest burden of public debt

Based on equation (7) and with more compact notation, we obtain the Unemployment value,  $U$ , as:

$$U = N - L = AS + B \quad (10)$$

with  $A > 0$ , and where:

$$A = l_c \frac{1 + (n^2 va_c)}{1 - va_c}$$

$$B = N - l_c \left[ n \left( \frac{va_c n O^* + va_G G + va_I I + va_{Ex} Ex}{1 - va_c n} + O^* \right) \right] + l_G G + l_I I + l_{Ex} Ex$$

Therefore, the change in unemployment relatively to the previous year will be:

$$\Delta U = AS + B - U_{-1} \quad (11)$$

If  $\theta$  is the burden on public finances by unemployed worker (reduction of the corresponding social security contributions plus unemployment benefits), the policy for next year will face a potential change in expense from unemployment due to the setting of the previous year's balance given by:

$$-\theta \Delta U = -\theta(AS + B - U_{-1}) \quad (12)$$

On the other hand, the change in public debt interests in the next year is given by  $iS$ , in which  $i$  is the expected nominal interest rate.

The sum of the two parcels gives the total impact value over next year budget balance from the policy chosen in the reference year. This impact value is, therefore:

$$-\theta(AS + B - U_{-1}) + iS \quad (13)$$

Equating (13) to 0 we obtain the value of  $S$  which would be, from this point of view, neutral.

The value is:

$$S = \frac{\theta(B - U_{-1})}{i - \theta A} \quad (14)$$

If  $i > \theta A$  the neutral budget balance is positive. If  $i < \theta A$ , it is negative. If  $i = \theta A$ , there will be no solution.



The EU policies of economic adjustment programs can also be assessed from this neutrality point of view.

### 3. Empirical results: the Portuguese case

The methodology described in section 2 is illustrated with an empirical application to the Portuguese economy in the year 2011. This year was chosen because this methodology is strongly based on the IO Leontief model, and 2011 is the most recent year for which an IO Table is available. It is also an interesting year for this research, as it corresponds to the first fiscal consolidation measures under the Economic Adjustment Program of the Troika. For an interesting exercise of measuring the unemployment forecasting errors of this program see Amaral and Lopes (2015).

#### 3.1 Basic macroeconomic values and IO coefficients, Portugal - 2011

The first step to obtain the consequences on employment/unemployment of fiscal consolidation, i.e. of obtaining a State Budget Balance null ( $S=0$ ), is to calculate the value added coefficients of the component of Final Demand ( $C$ ;  $G$ ;  $I$ ;  $Ex$ ). These values, and also the import content coefficients of these variables, are given in Table 1. They were calculated from the IO Table of Portugal for the year 2011, available in the WIOD database (for a description of this database, see Timmer et al, 2012).

Table 1: Value added contents of Final Demand components

	$C$	$G$	$I$	$Ex$
$va_{FD}$	0.728469	0.890525	0.648486	0.650422

Source: National IO Table – Portugal, 2011 (WIOD), and authors' calculations

As expected, Private, and above all, Public Consumption have a greater value added content, because the import content of Exports and Investment is larger.

The second step is the calculation of employment content coefficients of the components of Final Demand, which are given in Table 2. This calculation is based on the Portuguese IO Table as well as the values of employment by sector given in the Socioeconomic

Accounts of WIOD database, adjusted with the values of sectoral and total employment in Portugal for 2011, given by the Portuguese Statistical Institute (INE).

Table 2: Employment content of Final Demand components

	<i>C</i>	<i>G</i>	<i>I</i>	<i>Ex</i>
<i>l<sub>FD</sub></i>	0.017545	0.025089	0.019234	0.019825

Source: National IO Table – Portugal, 2011 (WIOD), and authors' calculations

The main employment content regards Public Consumption, but it is interesting to note that the second value is that of Exports, and Private Consumption has the smaller employment content.

The third step is to obtain the values of the macroeconomic variables used in the analysis, regarding the demand optic of production activity (GDP and its main components), labour force, employment and unemployment values, as well as public finances (the main Government receipts and expenditures, and the corresponding Budget Balance). These values (presented in Table 3) were obtained in the National Accounts – 2011 of INE and the General Government Budget for 2011.

Table 3: Values of Macroeconomic variables, Portugal 2011

<i>Y</i>	176166.7	<i>T</i>	61 272.3	<i>N</i>	5428.3
<i>C</i>	115961.1	<i>TR</i>	29 773.4	<i>L</i>	4740.1
<i>G</i>	34983.4	<i>O</i>	2 361.5	<i>U</i>	688.2
<i>I</i>	32764.2	<i>S</i>	-7 262.5		
<i>Ex</i>	60409.9	<i>I<sup>pub</sup></i>	6 139.5		
<i>I<sup>priv</sup></i>	26 624.7				

Sources: Portuguese National Accounts – 2011 (INE) and Government Budget - 2011

Notes: Nominal variables: million euros; Labour variables: thousands

From these macroeconomic values, it was possible to calculate the remaining necessary values:  $Y_d$ : 144 667.8;  $n$ : 0.801568;  $u$ : 0.1268;  $t$ : 0.3478 and  $O^*$ : -45 385.3.

### 3.2 Unemployment/Budget Balance trade-off in Portugal

The next step is to consider the consumption function:  $C = 0.801568 Y_d$ , and afterwards quantifying equation (5):

$$C(S) = 101\,970.2 - 1.926464 S$$

This equation gives the value of Private Consumption as a function of the Government Budget Balance,  $S$ . With this value, and given the (exogenous) values  $G$ ,  $I$  and  $Ex$  of Table 4, we are finally able to quantify the Employment/Budget Balance trade-off equation (6):

$$L(S) = 4\,494.62566 - 0.0338003 S$$

From this equation we can see that to a General Government Budget Balance in equilibrium,  $S = 0$ , corresponds a value of Employment equal to 4 496.6.

It is also possible to derive from equation (6) the Unemployment/Budget Balance trade-off equation, as:

$$U(S) = 933.6743402 + 0.0338003 S,$$

which allows us to conclude that to an equilibrium Budget Balance situation, the unemployment in Portugal would be 933,6 thousand workers.

And finally, the same procedure can be done in terms of the unemployment rate,  $u$ :

$$u(s) = 0.172001241 + 0.00000623 S,$$

from which a very important result emerges: a (strong) fiscal consolidation in 2011 that assures in only one year a complete equilibrium in public finances, would imply an unemployment rate of 17,2%, that is to say, the unemployment rate would augment 4,5 percentage points, from the 2011 reference value of 12,7%. This gives a valuable indication of the enormous short-term negative impact of fiscal consolidation on employment.

### 3.3 Fiscal consolidation through Transfers when $O^*$ is exogenous, in Portugal

Using the result obtained in sub-section 2.3, equation (7), when  $S = 0$  is assured with a fiscal consolidation based only on Government Transfers to the families ( $TR$ ), keeping  $G$  and  $P^{pub}$  unchanged, would imply a value of  $TR$  equal to 19 009.4, i.e., the transfers with diminished 36.15%. This strong, and politically and socially unjustified measure, would provoke a serious recession, with GDP decaying 5.71%. The main message of these calculations is that, of course, it is completely wrong to promote a complete fiscal consolidation in just one year.

### 3.4 The neutral Budget Balance in Portugal

The neutral Budget Balance in Portugal for 2012 can be calculated applying the methodology presented in sub-section 2.4:  $S = \theta (B - U_{-1}) / (i - \theta A)$ , using the values known in 2011.

Considering that the value of effective Social Security contributions was 16 100.3 for a level of employment of 4 740.1, the average per worker was 3.3966. The expenditure with unemployment subsidies was 2 103.8 for a level of unemployment of 688.2, which means an average of 3.0570. Summing these two average values gives a value for  $\theta = 6.4536$ .

The stock of public debt in 2011 was 196 231.4 and the expenditure in interest 7 604.4, which means an implicit interest rate,  $i = 0.0388$ .

The number of unemployed persons, given in Table 3, was 688.2, and with the values and coefficients used to quantify  $C/S$  and  $U/S$  trade-off equations, the values of  $A$  and  $B$  can be obtained:  $A = 0.03380$ ;  $B = 933.674340$ .

Taking all these values into account, the neutral Government Budget Balance for 2012 would be  $S = -8 831.4$ , a value significantly larger (in module) than that of 2011,  $-7 262.5$ , corresponding to an increase of 21.6 per cent. An objective of a lower deficit for 2011 would mean a more difficult consolidation in 2012. This is an important result, meaning

that too much consolidation in one year makes more difficult the consolidation in the following year. In the next sub-section we can get a better, quantified notion of these effects.

### 3.5 Quantifying next year budgetary effects of current year fiscal targets

The previous analysis gave us valuable indications about the effects we can expect on unemployment from an intensive fiscal consolidation policy and also on the effects of this consolidation in the following year.

It is possible now to quantify the relation between unemployment and fiscal consolidation in the following year. Suppose that  $S_0$  is the budget target for year 0. Then with our model we can expect a level of unemployment for that year given by:

$$U_0 = AS_0 + B$$

On the other hand, according with equation (13) we can expect an effect on the deficit of the following year given by:

$$\Delta S_1 = -\theta(AS_0 + B - U_{-1}) + iS_0$$

And this gives us the relation between the two effects for alternative policies each one corresponding to one value of  $S_0$ . Considering 2012 to be the year 0 we show some numerical examples in Table 4:

Table 4. Next year budgetary effects of current year fiscal targets in Portugal, 2012

$S_0$	$U_0$	$-\theta(AS_0 + B - U_{-1})$	$iS_0$	$\Delta S_1$
0	933.7	-1 584.2	0.0	-1 584.2
-4 000	798.5	-711.7	-155.0	-866.7
-8 831.4	635.2	342.2	-342.2	0.0
-12 000	528.1	1 033.4	-465.0	568.4

Source: Own calculations

By definition, if the target budget value is -8 431.4 (the neutral budget value, calculated in sub-section 3.4), the effect on next year budget is null, and the corresponding unemployment value is 635.2, a value lower than the unemployment of 2011, 688.2, given the expansionary nature of fiscal policy (remember that  $S = -7\,262.5$  in 2011).

If instead of a fiscal expansion we have a fiscal consolidation ( $S = -4\,000$ ), we would have a higher unemployment value (798.5) and its corresponding expenses, as well as a slight budget deterioration effect. These effects would be stronger in radical fiscal consolidations. For example, to a complete fiscal consolidation in one year ( $S = 0$ ) would correspond a situation of almost one million unemployed persons, plus a budgetary weight for next year of 1 584 million euros, which points to the self-defeating nature of austerity policies. The opposite occurs in the case of (virtuous) fiscal expansions (for instance,  $S = -12\,000$ ), when there are margin for them, i.e. in a depressed economy, with high unemployment and physical capital slack, such as the present situation in Portugal and other Eurozone periphery countries.

#### **4. Concluding remarks**

The great recession of 2008/2009 has had a huge impact on unemployment and public finances in most advanced countries. This impact has been magnified in several euro area peripheral countries (Greece, Ireland, Portugal and Cyprus) by the sovereign debt crisis of 2010/2011, where the fiscal consolidation efforts imposed in the Economic Adjustment Programs created a vicious circle of recession, unemployment growth, lower tax receipts, higher social expenditures and fiscal (deficit and debt) deterioration.

These macroeconomic imbalances of a magnitude never seen (at least since the 1930's) brought to the fore a huge literature about the (presumed) values of fiscal multipliers, the effectiveness of fiscal expansions in downturns and the self-defeating nature of austerity policies.

The main contribution of our paper to this large and expanding literature is to base the empirical assessment of the link between fiscal consolidation and unemployment on

respecting some crucial technological and final demand relations, given by the input-output system of a country in a certain year. These relations are relatively stable in the short run and, although not very useful for making macroeconomic projections for the future, they are nevertheless appropriate instruments in (comparative static) impact shock exercises.

Considering an economy modelled by an input-output system, as well as some basic fiscal and budgetary relationships, a trade-off unemployment rate/budget balance equation was derived, useful to assess the unemployment impact of fiscal consolidation. An empirical application to the Portuguese case in 2011 (the first year of the Economic Adjustment Programme for this country) allows to conclude that a complete fiscal consolidation in one year would imply an unemployment rate increase of 4.5 per cent.

Moreover, an exercise was also made considering that the fiscal consolidation effort is based on state transfers to the families. In this case, the budget balance equilibrium would imply a huge social cost of -36 per cent in transfers, with a strong recessive effect of -5.7 per cent in real GDP.

A third interesting exercise was proposed, using what we call the neutral budget balance, i.e., assessing the effects of fiscal consolidation for one year on the fiscal consolidation in the following year. In this case, the empirical results show that too much consolidation in one year (such that the one that was imposed by the Programme in 2011) makes more difficult consolidation in the following year, 2012, as the budget deficit would have to increase 21.6 per cent.

Overall, the main results of our research point to at the least partially self-defeating nature of austerity policies in Portugal, three-fold: by a significant increase in unemployment; by a disproportionate and unacceptable regression in social policies and by a huge neutral budget balance. The methods to achieve these results are relatively simple and straightforward and the data supporting them easily available. They can prove to be useful in assessing the impact of fiscal consolidation measures in other countries, subject or not to the adjustment programs of the Troika (European Commission, ECB and IMF).

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## Appendix 1. The value added content of Final Demand components

If an economy is modeled according to the well-known Leontief model (for a detailed exposition of this model see Miller and Blair (2009), the basic equation is:

$$\mathbf{x} = \mathbf{A} \mathbf{x} + \mathbf{y}, \quad (\text{A1})$$

Where  $\mathbf{x}$  is the column vector of gross output values of the  $n$  sectors of the economy;  $\mathbf{y}$  is the final demand vector and  $\mathbf{A}$  is the technical coefficients matrix.

The solution of this system is:

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1} \mathbf{y}, \quad (\text{A2})$$

Where  $(\mathbf{I} - \mathbf{A})^{-1}$  is the so called Leontief inverse matrix of output multipliers (hereinafter represented by  $\mathbf{B}$ ), whose generic element,  $b_{ij}$ , gives the increase of sectors'  $j$  production caused by an additional unitary final demand directed to sector  $i$ .

The vector of (total) final demand can be decomposed in four vectors, each one corresponding to one of the components of this variable: Private Consumption, C; Public Consumption, G, Investment, I and Exports, Ex:

$$\mathbf{y} = \mathbf{y}^C + \mathbf{y}^G + \mathbf{y}^I + \mathbf{y}^{\text{Ex}} \quad (\text{A3})$$

In this case, the solution of the Leontief system is given by:

$$\mathbf{x} = \mathbf{B} (\mathbf{y}^C + \mathbf{y}^G + \mathbf{y}^I + \mathbf{y}^{\text{Ex}}). \quad (\text{A4})$$

The next step is to calculate the primary factors' incomes (salaries and profits, including also, for simplicity, the net indirect taxes) necessary for sectoral production,  $\mathbf{x}$ , and for final demand,  $FD$ .

$$VA = \mathbf{a}^v \mathbf{B} \mathbf{a}^C C + \mathbf{a}^v \mathbf{B} \mathbf{a}^G G + \mathbf{a}^v \mathbf{B} \mathbf{a}^I I + \mathbf{a}^v \mathbf{B} \mathbf{a}^{\text{Ex}} \text{Ex} + a^t_C C + a^t_I I \quad (\text{A5})$$

where:  $VA$  is the total amount of salaries and profits (plus net indirect taxes) of the economy, i.e. Gross Value Added ( $VA$ ), corresponding to GDP at market prices;  $\mathbf{a}^v$  is the vector of value added coefficients of the  $n$  sectors ( $a^v_j = VA_j/X_j$ );  $\mathbf{a}^C$ ,  $\mathbf{a}^G$ ,  $\mathbf{a}^I$  and  $\mathbf{a}^{\text{Ex}}$  are the vertical coefficients of final demand components directed to the productive sectors;  $a^t_C$ ,

and  $a^I_I$  are the vertical coefficient of net indirect taxes on final demand components (consumption and investment only, as this coefficient is null in the case of public consumption, as well as exports); C, G, I and Ex are the values of the final demand components.

From (A5) the value added content of final demand components can be deducted as:

$$va_{FD} = \mathbf{a}^v \mathbf{B} \mathbf{a}^{FD} + a^I_{FD}, \text{ with } FD = C, G, I, Ex.$$

## **Appendix 2. The employment content of Final Demand components**

The deduction of the employment content of Final Demand components starts by considering the employment coefficients of the productive sectors, given by the (row) vector,  $\mathbf{a}^l$ . The generic element of this vector is obtained dividing the employment (number of employees) of sector  $j$  by its gross output value:  $a^l_j = L_j / X_j$ .

Next, assuming that the vertical structure of sectoral final demand components, given by the (column) vectors  $\mathbf{a}^{FD}$ , remains constant, the employment content of one unit of final demand value is given by:

$$l_{FD} = \mathbf{a}^l \mathbf{B} \mathbf{a}^{FD},$$

with  $FD = C, G, I, Ex$