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# Self-defeating austerity? Assessing the impact of a fiscal consolidation on unemployment

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## Abstract

The great recession of 2008/2009 had a huge impact on unemployment and public finances in most advanced countries, and these impacts were magnified in the southern Euro area 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 so-called expansionary austerity. However, the reality so far provides proof to the contrary, and the results outlined in this article support the opposing view of a self-defeating austerity. Based on a model of 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 a 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. The conclusion is that too much consolidation in anyone year makes consolidation more difficult in the following year.

**JEL Codes:** C67, E23, E62

## Keywords

Austerity, fiscal consolidation, input–output analysis, Portugal, self-defeating austerity, unemployment

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## Introduction

The policies of fiscal consolidation imposed by the European Union (EU) on highly indebted countries are based on a chain of assumptions. A sharp reduction in public expenditure, together with an increase in taxes, reduces the budget deficit, while increasing the confidence of private investors. This will lead to a significant flow of private capital that will expand the economy, compensating for the short-term negative impacts of the fiscal consolidation. These assumptions are based on the conviction 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 has been tested. The contractionary effects were much deeper and lasting than expected, and not only was the fiscal consolidation disappointing, it showed no correspondence with the enormous social costs of the policies (Carneiro et al., 2014; Orphanides, 2015; Zezza, 2012).

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 (Chowdhury and Islam, 2012; DeLong and Summers, 2012; Skidelsky, 2015).

The objective of this article is to test these arguments 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.

Second, we assess the effects of fiscal consolidation of 1 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 1 year (such as the one that was imposed by the Portuguese programme) makes consolidation more difficult in the following year.

The methodology used for this purpose is based on input–output (IO) relations. IO analysis is not an adequate tool for making short-term forecasts, but it provides a useful method for assessing macroeconomic projections using a comparative statics framework in a context of economic and financial crisis. It is a methodology that is relatively robust vis-a-vis 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 article add to the recent and relevant literature regarding the impact of the global economic crisis (Bahce and Memiş, 2014; Blanchard et al., 2014; Bova et al., 2015) and the ensuing fiscal adjustments (Andrés and Doménech, 2013; Jalles, 2014; Junankar, 2015; Pappa, 2012; Turrini, 2013) on

unemployment. They use a different approach, based on considering the productive structure of the economy.

The remainder of this article is organised as follows: the section ‘Methodology’ describes the methodology used for determining the unemployment rate corresponding to a zero deficit and for calculating a neutral deficit; the section ‘Empirical results: The Portuguese case’ presents the results for Portugal for 2012; and section ‘Concluding remarks’ presents the main conclusions of this article, providing an explanation for the poor results of the austerity policy in achieving fiscal consolidation in Portugal.

## Methodology

### Basic assumptions and 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,  $B$ , is given as

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

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 families.

The available income of 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.

### Unemployment/budget balance trade-off

With the previous assumptions,  $C$  is given by

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

where  $O^* = O - G - I^{Pub}$ .

Therefore, after some simple algebraic manipulations

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

From which, the value of  $C$  is obtained, depending on  $B$ , as

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

With this value of  $C$  depending on  $B$ , and given the values of  $G$ ,  $I$  and  $Ex$ , exogenous, we may arrive at the employment/state budget balance trade-off equation

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

where  $L$  is the employment level 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).

Note that we consider that exports and investment are exogenous, that is, the respective values in the short term are not dependent on the budgetary options. We consider this to be a reasonable assumption. In any case, in relation to investment, the impact of austerity although not very significant in the short term is certainly negative and if considered would reinforce our conclusions. In what concerns exports we do not see any justification for considering in the short term a significant effect of austerity.

Substituting  $C(B)$  given by equation (5) in equation (6), the employment/budget balance trade-off equation is

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

Fixing  $B=0$  in equation (7), we can obtain the employment value corresponding to general government budget equilibrium. Moreover, knowing the value of the labour force,  $N$ , the trade-off equations for unemployment and unemployment rate/budget balance can be built. The cross-country comparison of these trade-offs is a very interesting exercise.

**Fiscal consolidation through transfers (TR), with  $O^*$  exogenous**

As previously stated, the budget balance is  $B = tY + O^* - TR$ , with  $O^* = O - G - I^{pub}$ . Imposing  $B=0$  implies that  $TR = tY + O^*$ . So, using the expression of  $Y$  given by equation (4) and making  $B=0$  give

$$TR = t \frac{va_C n O^* + va_G G + va_I I + va_{Ex} Ex - va_C n B}{1 - va_C n} + O^* \tag{8}$$

Or, alternatively

$$TR = \frac{[1 + (t-1)va_C n] O + (tva_G - 1 + va_C n) G + tva_I I + (tva_{I^{pub}} - 1 + va_C n) I^{pub} + tva_{Ex} Ex}{1 - va_C n} \tag{9}$$

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

### The neutral budget balance

Another interesting indicator can result from the calculation of the government budget balance,  $B$ , which would have no repercussion on the following year.

The repercussion occurs 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

$$U = N - L = AB + D \tag{10}$$

with  $A > 0$  and where

$$A = l_C \frac{1 + (n^2 va_C)}{1 - va_C}$$

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

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

$$\Delta U = AB + D - U_{-1} \tag{11}$$

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

$$-\theta \Delta U = -\theta (AB + D - U_{-1}) \tag{12}$$

However, the change in public debt interests in the next year is given by  $iB$ , where  $i$  is the expected nominal interest rate.

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

$$-\theta (AB + D - U_{-1}) + iB \tag{13}$$

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

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

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 relating to economic adjustment programmes can also be assessed from this neutrality point of view.

## Empirical results: The Portuguese case

The methodology described in the section ‘Methodology’ 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 Programme of the Troika (the European Commission, the European Central Bank and the International Monetary Fund). For an interesting exercise of measuring the unemployment forecasting errors of this programme, see Amaral and Lopes (2016).

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

The first step in obtaining the consequences for employment/unemployment of fiscal consolidation, that is, of obtaining a government budget balance null ( $B = 0$ ), is to calculate the value added coefficients of the components of final demand ( $C$ ,  $G$ ,  $I$  and  $Ex$ ). These values, together with the import content coefficients of these variables, are provided in Table 1. The values were calculated from the IO table of Portugal for the year 2011, which is available in the World Input-Output Database (WIOD; for a description of this database, see Timmer et al., 2012).

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 the employment content coefficients of the components of final demand, which are given in Table 2. This calculation is based on the Portuguese IO table and also on the values of employment by sector given in the socio-economic accounts of the WIOD (2015) database, adjusted by the values of sectoral and total employment in Portugal for 2011, given by the Portuguese Statistical Institute (INE, 2015).

The main employment content is based on public consumption, but it is interesting to note that the second value derives from exports, with private consumption generating the smallest 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 from the National Accounts – 2011 of INE and the General Government Budget Report for 2011 (Ministério das Finanças, 2011).

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  $O^* = -45,385.3$ . It is

**Table 1.** Value added contents of final demand components.

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

Sources: WIOD (2015) and authors' calculations.

**Table 2.** Employment content of final demand components.

	C	G	I	Ex
$l_{FD}$	0.017545	0.025089	0.019234	0.019825

Sources: WIOD (2015) and authors' calculations.

**Table 3.** Values of macroeconomic variables, Portugal 2011.

$Y$	176,166.7	$T$	61,272.3	$N$	5428.3
$C$	115,961.1	$TR$	29,773.4	$L$	4740.1
$G$	34,983.4	$O$	2361.5	$U$	688.2
$I$	32,764.2	$B$	-7262.5		
$Ex$	60,409.9	$J^{Pub}$	6139.5		
$J^{Priv}$	26,624.7				

Sources: INE (2015) and Ministério das Finanças (2011).

Nominal variables: million euro; labour variables: thousand workers.

worth mentioning that our purpose here is not to quantify the actual impacts of the fiscal policy implemented in this year on unemployment or GDP growth but to assess the unemployment/budget consolidation trade-off.

### *Unemployment/budget balance trade-off in Portugal*

The next step is to consider the consumption function:  $C=0.801568 Y_d$  and following that to quantify equation (5)

$$C(B) = 101,970.2 - 1.926464B$$

This equation gives the value of private consumption as a function of the government budget balance,  $B$ . With this value, and given the (exogenous) values  $G$ ,  $I$  and  $Ex$  of Table 3, we are finally able to quantify the employment/budget balance trade-off equation (6)

$$L(B) = 4494.62566 - 0.0338003B$$

From this equation, we can see that for a general government budget balance in equilibrium,  $B=0$ , corresponds a value of employment equal to 4496.6.

It is also possible to derive from equation (6) the unemployment/budget balance trade-off equation as

$$U(B) = 933.6743402 + 0.0338003B$$

which allows us to conclude that for an equilibrium budget balance situation, unemployment in Portugal would be 933,674 workers.

Finally, the same procedure can be carried out in terms of the unemployment rate,  $u$

$$u(B) = 0.172001241 + 0.00000623B$$

from which a very important result emerges. A (strong) fiscal consolidation in 2011 which assures in only 1 year a complete equilibrium in public finances would imply an unemployment rate of 17.2%, that is to say, the unemployment rate would increase 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.

Note that the impact on unemployment is probably underestimated due to the fact that we considered private investment as exogenous. As investment, if anything, will react negatively to a reduction of growth, the impact on unemployment of having a complete equilibrium in public finances would be even worse if investment is considered endogenous.

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

Using the result obtained in section 'Fiscal consolidation through transfers ( $TR$ ), with  $O^*$  exogenous', equation (7), when  $B=0$  is assured with a fiscal consolidation based only on government transfers to the families ( $TR$ ), keeping  $G$  and  $I^{Pub}$  unchanged, would imply a value of  $TR$  equal to 19,009.4 million euro, that is, transfers would be diminished to 36.15%. This strong and politically and socially unjustifiable measure would provoke a serious recession, with GDP reducing by 5.71%. The main message of these calculations is that, of course, it is completely wrong to promote a complete fiscal consolidation in just 1 year.

### *The neutral budget balance in Portugal*

The neutral budget balance in Portugal for 2012 can be calculated by applying the methodology presented in section 'The neutral budget balance':  $B = \theta(D - U_{-1}) / (i - \theta A)$ , using the values known in 2011.

Considering that the value of effective social security contributions was 16,100.3 million euro for a level of employment of 4740.1 thousand workers, the average contribution per worker was 3396.6 euro. The expenditure with unemployment benefits was 2103.8 million euro for an unemployment level of 688.2 thousand workers, which means an average of 30570 euro. Summing these two average values gives a value for  $\theta = 64,536$ .

The stock of public debt in 2011 was 196,231.4 million euro and expenditure in interest was 7604.4 million euro, which means an implicit interest rate,  $i = 0.0388$ .



The number of unemployed, which is provided in Table 3, was 688.2 thousand workers, and with the values and coefficients used to quantify  $C/B$  and  $U/B$  trade-off equations, the values of  $A$  and  $D$  can be obtained:  $A=0.03380$  and  $D=933.674340$ .

Taking all these values into account, the neutral government budget balance for 2012 would be  $B=-8831.4$  million euro, which is a value significantly larger (in absolute value) than that of 2011,  $-7262.5$ , corresponding to an increase of 21.6%. 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 1 year makes more difficult the consolidation in the following year. In the next section, we can get a better, quantified notion of these effects.

### *Quantifying following 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  $B_0$  is the budget target for year 0. Then, with our model, we can expect a level of unemployment for that year given by

$$U_0 = AB_0 + D$$

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

$$\Delta B_1 = -\theta(AB_0 + D - U_{-1}) + iB_0$$

This gives us the relation between the two effects for alternative policies, each one corresponding to one value of  $B_0$ . Considering 2012 to be the year 0, we show some numerical examples in Table 4.

By definition, if the target budget balance value is  $-8431.4$  (the neutral budget balance value, calculated in the section ‘The neutral budget balance in Portugal’), the effect on the 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  $B=-7262.5$  in 2011).

If instead of a fiscal expansion we have a fiscal consolidation ( $B=-4000$ ), 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, for a complete fiscal consolidation in 1 year ( $B=0$ ) would correspond a situation of almost 1 million unemployed, plus a budgetary weight for the next year of 1584 million euro, which points to the self-defeating nature of austerity policies. The opposite occurs in the case of (virtuous) fiscal expansions (for instance,  $B=-12,000$ ), when there is a margin for them, that is, in a depressed economy, with high unemployment and physical capital slack, such as the present situation in Portugal and other Eurozone periphery countries.

**Table 4.** Following-year budgetary effects of current-year fiscal targets in Portugal, 2012.

$B_0$	$U_0$	$-\theta(AB_0 + D - U_{-1})$	$iB_0$	$\Delta B_1$
0	933.7	-1584.2	0.0	-1584.2
-4000	798.5	-711.7	-155.0	-866.7
-8831.4	635.2	342.2	-342.2	0.0
-12,000	528.1	1033.4	-465.0	568.4

Source: authors' calculations.

Nominal variables: million euro; unemployment: thousand workers.

## Concluding remarks

The great recession of 2008/2009 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 Programmes 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 not seen since the 1930s 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 this article to this large and expanding literature is that it bases an empirical assessment of the link between fiscal consolidation and unemployment on respecting some crucial technological and final demand relations, which are provided by the IO system of a country in a certain year. These relations are relatively stable in the short run and, although they are not very useful for making macroeconomic forecasts, they are, nevertheless, appropriate instruments for (comparative static) impact shock exercises.

Considering an economy modelled by an IO system, as well as some basic fiscal and macroeconomic relationships, a trade-off unemployment rate/budget balance equation was derived, which is 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 one to conclude that a complete fiscal consolidation in 1 year would imply an unemployment rate increase of 4.5%.

Moreover, an exercise was also undertaken based on an assumption that the fiscal consolidation effort is based on government transfers to families. In this case, the budget balance equilibrium would imply a huge social cost of -36% in transfers, with a strong contractionary effect of -5.7% in real GDP.

A third interesting exercise was proposed, using what we call the neutral budget balance, that is, assessing the effects of fiscal consolidation for 1 year on the fiscal consolidation of the following year. In this case, the empirical results show that too much consolidation in 1 year (such that the one that was imposed by the programme in 2011) makes more difficult the consolidation in the following year, 2012, as the budget deficit would have to increase 21.6%.

Overall, the main results of our research point to the at least partially self-defeating nature of austerity policies in Portugal. The negative impacts are threefold: a significant increase in unemployment, a disproportionate and unacceptable reduction in social policies and a huge neutral budget balance. The methods used to derive these results are relatively simple and straightforward, and the data supporting them is easily available. These methods can prove useful in assessing the impact of fiscal consolidation measures in other countries, subject or not to the adjustment programmes of the Troika.

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## Appendix I

### The value added content of final demand components

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

$$\mathbf{x} = \mathbf{A} \mathbf{x} + \mathbf{y} \tag{15}$$

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

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1} \mathbf{y} \tag{16}$$

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 into four vectors, each one corresponding to one of the components of this variable: private consumption,  $\mathbf{C}$ ; public consumption,  $\mathbf{G}$ ; investment,  $\mathbf{I}$ ; and exports,  $\mathbf{Ex}$

$$\mathbf{y} = \mathbf{y}^{\mathbf{C}} + \mathbf{y}^{\mathbf{G}} + \mathbf{y}^{\mathbf{I}} + \mathbf{y}^{\mathbf{Ex}} \tag{17}$$

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

$$\mathbf{x} = \mathbf{B}(\mathbf{y}^{\mathbf{C}} + \mathbf{y}^{\mathbf{G}} + \mathbf{y}^{\mathbf{I}} + \mathbf{y}^{\mathbf{Ex}}) \tag{18}$$

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,  $FD$

$$VA = \mathbf{a}^v \mathbf{B} \mathbf{a}^{\mathbf{C}} \mathbf{C} + \mathbf{a}^v \mathbf{B} \mathbf{a}^{\mathbf{G}} \mathbf{G} + \mathbf{a}^v \mathbf{B} \mathbf{a}^{\mathbf{I}} \mathbf{I} + \mathbf{a}^v \mathbf{B} \mathbf{a}^{\mathbf{Ex}} \mathbf{Ex} + a'_C \mathbf{C} + a'_I \mathbf{I} \tag{19}$$

where  $VA$  is the total amount of salaries and profits (plus net indirect taxes) of the economy, that is, gross value added ( $VA$ ), corresponding to gross domestic product (GDP) at market prices;  $\mathbf{a}^v$  is the vector of value added coefficients of the  $n$  sectors ( $a_j^v = VA_j / X_j$ );  $\mathbf{a}^{\mathbf{C}}$ ,  $\mathbf{a}^{\mathbf{G}}$ ,  $\mathbf{a}^{\mathbf{I}}$  and  $\mathbf{a}^{\mathbf{Ex}}$  are the vertical coefficients of final demand components directed to the productive sectors;  $a'_C$  and  $a'_I$  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); and  $C$ ,  $G$ ,  $I$  and  $Ex$  are the values of the final demand components.

From equation (19), the value added content of final demand components can be deducted as

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

## 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:  $a_j^l = L_j/X_j$ .

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

$$l_{FD} = \mathbf{a}^l \mathbf{B} \mathbf{a}^{FD}, \quad \text{with } FD = C, G, I, Ex$$