XVIII

Volume XVIII, Number 1, May 2015

Journal of Applied Economics

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UCEMA

Edited by the Universidad del CEMA
Print ISSN 1514-0326
Online ISSN 1667-6726

Journal of Applied Economics. Vol XVIII, No. 1 (May 2015), 45-70

ALTERNATIVE STRATEGIES TO REDUCE PUBLIC DEFICITS:TAXES VS. SPENDING*

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Submitted May 2013; accepted May 2014

We examine the effects of several alternative measures intended to reduce government deficits for the case of Spain, distinguishing between those acting through taxes and through spending. The Spanish case is relevant as an example of front-loaded fiscal adjustment that has led to a large GDP fall, where (unlike the cases of Greece, Ireland and Portugal) the authorities were able to choose the composition of the adjustment measures. The empirical methodology is based on a computable general equilibrium model. All the simulated policies lead to a decrease in the levels of output and employment, and to a higher unemployment rate. The greatest contractionary effects appear in the case of an increase in the income tax, followed by spending cuts, especially in public education; in contrast, the contractionary effect is weaker for indirect tax increases. While income distribution for labour worsens with spending cuts, it slightly improves with tax increases.

JEL classification codes: C68, H62, H20, H50
Key words: computable general equilibrium, government deficit, taxes, spending

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I. Introduction

Since the beginning of the current economic crisis, major fiscal imbalances are a matter of concern in many developed countries (Auerbach 2011). This is particularly true for most European countries, especially those belonging to the euro area. Accordingly, fiscal consolidation strategies are being pursued in those countries in order to reduce such "excessive" government deficits, thus recovering the confidence of financial markets and avoiding the risk of sovereign default.

The effectiveness of fiscal policy on the levels of economic activity is a recurrent topic in the academic literature; a broad survey is provided in Hemming et al. (2002). However, the traditional "Keynesian" effects of fiscal policy (i.e., a fiscal expansion leading to an increase in output and a fiscal contraction leading to a decrease in output) have been challenged in recent years following the pioneering work of Giavazzi and Pagano (1990). According to the so called "non-Keynesian" effects of fiscal policy, a contractionary fiscal policy can provoke an expansionary effect on output, due to the increased confidence of the private agents on government's solvency, which would lead to lower expected taxes in the next future.

However, the generality of these "non-Keynesian" effects of fiscal policy has been put into question. On the one hand, successful expansionary fiscal contractions have been coupled with other simultaneous events (such as a decrease in interest rates, a depreciation of the exchange rate, episodes of wage moderation, or a decrease in taxes on labour), which should preclude explaining the favourable economic evolution exclusively in terms of the restrictive fiscal policy; see, e.g., Creel et al. (2005) or Perotti (2013). On the other hand, recent studies using a novel methodology (namely, identifying changes in fiscal policy motivated by the desire to reduce the budget deficit from historical documents) find that fiscal consolidations have a contractionary effect on economic activity, as expected from standard Keynesian models; see Romer and Romer (2010) and Guajardo et al. (2011). Even more, as shown by Auerbach and Gorodnichenko (2013), fiscal policy multipliers seem to be larger in recessions. This would follow in turn from several features that characterize depressed economies, such as the absence of supply constraints in the short run, and a binding zero lower bound on interest rates (DeLong and Summers 2012).

Another issue that has received considerable attention in the literature relates to the composition of the fiscal adjustment measures. Following earlier

work by Alesina and collaborators (e.g., Alesina and Perotti 1995, 1997; or Alesina and Ardagna 1998), Alesina and Ardagna (2010) find that, in the case of a fiscal consolidation, spending cuts are more effective than tax increases in order to stabilize the debt and avoid a recession; whereas, for the case of a fiscal stimulus, the opposite result would hold, i.e., tax cuts are more expansionary than spending increases. The less contractionary effect of spending cuts, compared to tax increases, in the case of fiscal consolidations, was also found in Guajardo et al. (2011). Following this line of research, Alesina et al. (2012) have recently found that, for 15 OECD countries, spending-based fiscal consolidations had been associated with minor and short-lived recessions; unlike tax-based consolidations, which led to deeper and longer recessions. According to the authors, the ultimate reason would lie in the confidence of investors, which recovers much sooner following a spending-based adjustment than a tax-based one.

In this paper, we will examine the effects of several alternative measures intended to reduce public deficits, distinguishing between those acting through taxes and through spending, for the case of Spain. In Table 1 we present data on general government expenditure, revenue, surplus (i.e., net lending/borrowing of consolidated general government sector) and consolidated gross debt, as a percentage of GDP, for Spain and the euro area, from 1999 (i.e., the year in which the European monetary union started) to 2012. As can be seen, the Spanish government deficit was lower than the average of the euro area until 2007; an even a surplus was registered between 2005 and 2007. The start of the crisis meant a dramatic change, with government deficits reappearing in 2008, soaring in 2009 to 11% of GDP, and (very) slowly decreasing after that date; as a result, the Spanish government deficit as a percentage of GDP in 2012 stands for almost three times the deficit of the euro area. On the other hand, government expenditure as a percentage of GDP has increased in Spain after the start of the crisis more than in the euro area (8.6 versus 3.8 percentage points between 2007 and 2012), whereas the ratio of government revenue to GDP has experienced a significant fall (4 percentage points between 2007 and 2012) that is strongly at odds with its stability for the euro area along the same period. Finally, these developments have led to a large increase in the ratio of government debt to GDP, which is however still lower than the average of the euro area.

Table 1. Government expenditure, revenue, surplus and debt in Spain and the euro area, 1999-2012 (% of GDP)

	Government expenditure		Government revenue		Government surplus		Government debt	
	Spain	euro area	Spain	euro area	Spain	euro area	Spain	euro area
1999	39.9	48.2	38.6	46.7	−1.3	−1.5	62.4	71.6
2000	39.2	46.2	38.2	46.2	−0.9	−0.1	59.4	69.2
2001	38.7	47.3	38.1	45.3	−0.5	−1.9	55.6	68.1
2002	38.9	47.6	38.6	44.9	−0.3	−2.7	52.6	68.0
2003	38.4	48.1	38.1	44.9	−0.3	−3.1	48.8	69.1
2004	38.9	47.5	38.8	44.6	−0.1	−2.9	46.3	69.6
2005	38.4	47.4	39.7	44.9	1.3	−2.5	43.2	70.2
2006	38.4	46.8	40.7	45.4	2.4	−1.3	39.7	68.5
2007	39.2	46.1	41.1	45.4	2.0	−0.7	36.3	66.2
2008	41.4	47.2	36.9	45.1	−4.5	−2.1	40.2	70.1
2009	46.2	51.3	35.1	44.9	−11.1	−6.4	54.0	79.9
2010	46.3	51.1	36.7	44.8	−9.6	−6.2	61.7	85.4
2011	45.7	49.5	36.2	45.3	−9.6	−4.2	70.5	87.2
2012	47.8	49.9	37.1	46.3	−10.6	−3.7	86.0	90.5

Source: Eurostat.

Notice, however, that the above figures on government expenditure are biased upwards since a significant part corresponds to the bailout of the financial system, which amounted to 3.6% of GDP in 2012. Accordingly, the figures from Table 1 suggest that the huge increase registered in the Spanish government deficit, compared to the euro area, should be attributed more to the fall in revenues rather than to the rise in spending. In fact, as Reinhart and Rogoff (2009) have emphasized, the decrease in public revenues due to the subsequent recession is the main reason behind the higher government deficits associated with financial crises. In relation to this, a recent paper by Baldacci et al. (2012) stresses the need of relying on an increase in public revenues, and not only on spending cuts, in a process of fiscal consolidation when deficits are large, and even more if they follow a financial crisis.

Several features make the Spanish experience particularly relevant in this context. As the figures in Table 1 show, the Spanish public budget moved in two

years (2007 to 2009) from a surplus of 2%, in terms of GDP, to a deficit above 10%, with the ratio of government debt to GDP more than doubling in the last five years. Following these developments, and given the commitments within the European Union (EU) under the Pact for Stability and Growth, the Spanish authorities have implemented a series of consolidation measures. These measures have involved cuts in government expenditure, mostly on education, health and public investment, as well as on the compensation of government employees; together with increases in the rates of the value added tax and some changes in the regulation of the income tax. These policies of austerity have resulted in a deeper recession, a feature common to all Southern European countries (De Grauwe and Ji 2013). And all this has occurred in the middle of a serious turmoil affecting the Spanish financial system, which has required a bailout by the EU institutions starting in June 2012 that complicated the policy stance even further. The Spanish case looks mostly relevant in its uniqueness because it is a good example of front-loaded fiscal adjustment that has led to a large GDP fall, which could be compared to other back-loaded cases of adjustment (like the US, Italy or France) that did it gradually and waited until 2011-12 to start the consolidation. In addition, and unlike other peripheral European countries (i.e., Greece, Ireland and Portugal) with no access to normal market financing, where the adjustment measures were mostly expenditure-based as imposed by the IMF and the EU, Spain was able to choose the composition of the adjustment measures. Summarizing, a sudden and huge increase in the government deficit, a consolidation strategy that has intensified the recession in the context of a severe financial crisis, and the ability of the authorities to choose the composition of the fiscal adjustment (unlike the cases of Greece, Ireland and Portugal) make Spain a unique and relevant case study in order to quantify the economic effects of several alternative policies of fiscal consolidation.

In the rest of the paper, we will provide an empirical assessment of several alternative policy measures intended to reduce the Spanish government deficits, from both the expenditure and revenue sides. The empirical methodology will make use of a computable general equilibrium (CGE) model, which allows obtaining the consequences of changes in a particular variable on the whole economy under analysis, as well as the specific effects across the different productive sectors. Thus, the potential of CGE models lies in their ability to integrate micro and macro elements (Devarajan and Robinson 2005).

There are some papers using a general equilibrium approach, which analyse changes in the government deficit to GDP ratio. For instance, from the revenue

point of view Roeger and in 't Veld (2010) and European Commission (2011, 2013) highlight the relevance of the tax instrument applied, as direct taxation proves to be more distortionary than indirect taxes. On the public expenditure side, we can quote the CGE model by Mabugu et al. (2013), which simulates the effects from expansionary fiscal policies focused on public spending in infrastructure for the case of South Africa; also, Jensen and Rutherford (2002) analyse the distributional effects of fiscal consolidation. However, as far as we know, there are no general equilibrium analyses comparing the impact of both expenditure and revenue-based policies on the government deficit to GDP ratio.

The rest of the paper is organized as follows. A brief description of the model is provided in Section II. The data and calibration process are discussed in Section III. The results from the simulations, both at the macroeconomic and sectoral levels, are presented in Section IV. Section V concludes.

II. The model

The model in this paper follows earlier contributions on this methodology (Bajo-Rubio and Gómez-Plana 2004, 2005; Fæhn et al. 2009; Gómez-Plana and Pascual-Arzoz 2011), and represents a static CGE model describing an open economy, disaggregated into 18 productive sectors, one representative consumer, the public sector and a foreign sector representing the rest of the world. The main extensions with respect to standard CGE models (see, e.g., Shoven and Whalley 1992, or Burfisher 2011) refer to: (i) the modelling of capital as a factor of production, and the specificity assumption; (ii) the modelling of the public sector, whose main characteristic features change according to the simulations performed; and (iii) unlike the common assumption of full employment in the labour market, the model includes unemployment in a way derived from trade unions models, due to the high unemployment rates registered in the Spanish economy. In addition, the choice of the productive sectors represented in the model has been the result of a careful selection; see below.

In the rest of this section we provide a short description of the model. The full set of equations, together with the complete list of the endogenous and exogenous variables and parameters of the model, are shown in Online Appendix A.

A. Equilibrium conditions

The equilibrium of the model is a set of prices and an allocation of goods and factors. It involves the simultaneous solution of three sets of equations:

- Zero-profit conditions.
- Market clearing in goods and factor (capital) markets.
- Constraints on disposable income (total revenue must equal total expenditure), labour market (that includes unemployment), public sector, and macroeconomic closure of the model.

B. Firms and production

Production is based on a technology characterized by a nested structure of intermediate inputs, capital and labour. The firms' decision problem is to maximise profits subject to the technology constraints, obtaining the unit cost functions, which are further used in the zero-profit conditions. In turn, the demands for factors and intermediate inputs are obtained from Shephard's lemma on cost functions, and then used in the market-clearing equations.

Firms show constant returns to scale in their technologies and fix a competitive pricing rule, with free entry and exit of firms. Figure A1 in Online Appendix B shows the nested structure of firms' technology in sector i. This is a two-level technology. The first nest is a Leontief function over intermediate inputs and a composite of labour and capital, where a value added tax (vat_i^{II}) and other indirect taxes (oit_i^{II}) can be levied on intermediate inputs. The second nest is a CES function over labour and capital, where social contributions (soc_i) are levied on labour.

C. Representative household and consumption

There is a representative consumer household that behaves as a rational consumer. The level of consumer's welfare is determined by the endowments of capital and labour net of income tax, jointly with exogenous net transfers paid by the public sector.

The fixed endowment of labour should be interpreted as a maximum supply of labour since leisure and unemployment are assumed to be endogenous. Hence, labour supply would be elastic up to the endowment constraint. The fixed endowment of capital is supplied to all sectors except to sectors 1, 2, 3, 8 and 10 (see Table 2 below), which only utilize public capital.

The household's decision problem consists of choosing an optimal consumption bundle, by maximizing a nested utility function subject to the budget constraint. As shown in Figure A2 in Online Appendix B, preferences are represented by a nested utility function on (consumption of) goods, leisure and savings. Notice that, given our static approach, we consider a unit elasticity of substitution between savings and (consumption of) goods (Howe 1975), so that savings can be interpreted as the purchase of bonds for future consumption. The representative consumer buys all the final consumption goods, except the good from sector 1. Goods can be subject to a value added tax (vat_i^{CF}) and other indirect taxes (oit_i^{CF}).

The budget constraint includes total factor rents net of income tax, jointly with exogenous net transfers paid by the public sector. Demand functions for goods, leisure and savings are derived from the first-order conditions, and are included in the goods and factor markets equations, as well as in the macroeconomic closure for savings.

D. Public sector

The role of the public sector in the model is twofold, i.e., it is an owner of resources (e.g., from its capital endowment and tax revenues), and a purchaser of certain goods. We deal with these two functions in turn.

As an owner of resources, public sector's wealth includes income from capital rents, tax revenues, and net transfers from the representative household. Capital rents of the public sector include, by definition (see Eurostat 1996), the fixed capital consumption because the net operating surplus is zero for the public sector. The fixed capital consumption has been assigned to sectors 1, 2, 3, 8, 10, and 18, where all capital in the first five is owned by the public sector, whereas in the latter some capital is publicly owned and the rest is private, according to empirical data (see below). Taxes consist of social contributions paid by both employers and employees, value added tax, other net indirect taxes, and income tax. All of them have been modelled using actual ad valorem rates calibrated from benchmark data, with an endogenous revenue level.

On the other hand, the public sector also enters the model as a purchaser of goods. Public sector expenditure includes both market (i.e., output that is disposed of in the market at economically significant prices) and non-market goods (i.e., output that is provided at prices that are not economically significant).

The representation of the public sector changes according to the scenario modelled (see Section IV for a full description of the scenarios). So, when simulating a cut in public expenditure in one sector, spending for that particular sector is represented as exogenous, while the remaining public expenditure is assumed endogenous. In turn, when simulating tax increases, tax rates are represented as endogenous.

E. Foreign sector

The model incorporates the small open economy assumption, meaning that the country faces a perfectly elastic export supply function. There is also a constant elasticity of transformation function between domestic and foreign sales. Regarding imports, we assume that goods are differentiated according to their origin (i.e., domestic or foreign), following Armington's assumption (Armington 1969), which allows for the possibility of intra-industry trade despite the assumption of exogenous world prices.

The foreign sector is closed by assuming that the difference between receipts and payments from the rest of the world is exogenous. This constraint would avoid, e.g., a permanent increase in exports with no change in imports, an unlikely scenario since it would involve an unlimited capital inflow to the country. However, this requires a matching movement in trade flows.

F. Factor markets

Two factors enter into the model: capital and labour. Regarding capital, both the representative household and the public sector own fixed endowments. Capital rents adjust to clear the domestic capital market, under the assumptions of international immobility of capital, and no mobility across domestic sectors. Capital is specific in two levels, i.e., each sector employs only specific capital, and capital is differentiated in relation to the owner (public or private).

The only owner of labour is the representative household. The demand for leisure is derived from the household's optimization problem. Hence, labour supply (i.e., the labour endowment less the demand for leisure) would be elastic up to the fixed amount of labour. Labour is assumed to be internationally immobile, but mobile across domestic sectors.

In addition, we assume that the labour owners (i.e., workers) have some market power so that their bargained real wage is related to the unemployment rate (Kehoe et al. 1995). Accordingly, the model includes the following constraint:

$$w = \left(\frac{1-u}{1-\overline{u0}}\right)^{\frac{1}{\beta}}$$

where w denotes the real wage, u is the unemployment rate, $\overline{u0}$ is the unemployment rate in the benchmark, and β is a nonnegative parameter that measures the sensitivity of real wages to the rate of unemployment. Thus, as β approaches infinity, the real wage approaches its benchmark value (which is 1 according to the calibration process explained below): this is the case of rigid real wages when wages do not change when unemployment does. At the other extreme, as β approaches zero, the unemployment rate approaches its benchmark value, with real wages being flexible. Other intermediate values for β would mean different flexibility levels of real wages to the unemployment rate.

G. Macroeconomic closure

Total investment is split into sectoral gross capital formation using a fixed-coefficients Leontief structure (Dervis et al. 1981). Notice that, in our static framework, total gross capital formation affects the economy as a component of final demand. The model embodies a macroeconomic closure equation stating that investment and savings (private, public, and foreign) are equal.[1]

Finally, the model is solved as explained in Rutherford (1999), with the general equilibrium model defined as a mixed complementarity problem (see Mathiesen 1985). The software used in the empirical application is GAMS/MPSGE.

[1] A caveat should be placed here on to the lack of capacity of the CGE models to incorporate financial constraints, which would be relevant in the current crisis where credit markets and, in general, the financial sector have not worked properly. However, such financial constraints cannot be satisfactorily represented in a Walrasian Arrow-Debreu framework.

III. Calibration and data

The model has been calibrated using Spanish data. The calibration method is based on a benchmark equilibrium corresponding to the National Accounts and a set of exogenous parameters. A detailed explanation of the calibration method can be found in Mansur and Whalley (1984) and Dawkins et al. (2001).

To build the Social Accounting Matrix (SAM), we start from the last Input-Output symmetric table available for the Spanish economy, for the year 2005. In order to do so we further use the institutional sectors accounts from the Spanish National Statistics Institute (Instituto Nacional de Estadística 2012). Public revenue data have been disaggregated into Value Added Tax (VAT), Other indirect taxes, Income tax and Social security contributions. The 18-sector disaggregation in the SAM, from the 72 sectors of the Input-Output table, includes (see Table 2):

- Group 1: sectors 1 to 3, directly representing the most part of public expenditure;
- Group 2: sectors 4 to 10, where final public expenditure is over 1600 million €;
- Group 3: sectors 11 to 16, whose outputs are intermediate inputs for the Group 1 sectors (so that each sector sells by more of 1000 million € to the Group 1 sectors);
- Group 4: sector 17, where public final expenditure represents a limited amount;
- Group 5: sector 18, with no public final expenditure at all.

On the other hand, the choice of elasticities plays a key role in the model. The benchmark values for those elasticities are:

- Elasticities of substitution in the welfare function:
  - between consumption and savings: 1;
  - between final consumption and leisure: 1;
  - across final consumption goods: 1.
- Elasticities related to production:
  - between intermediate inputs and value added composite: 0;
  - between labour and capital: values fluctuate between 1.26 and 1.68;
  - between domestic and foreign goods (Armington elasticities): values fluctuate between 0.70 and 2.90;
  - between goods sold in the domestic market and abroad (elasticities of transformation): values fluctuate between 1.90 and 4.30.

The literature sources for the elasticities are Narayanan and Walmsley (2008) for the elasticity of substitution between labour and capital and Armington elasticities; de Melo and Tarr (1992) for the elasticities of transformation; and the elasticity of substitution between consumption and leisure is consistent with the survey by Ballard and Kang (2003). The rest of values are common in the literature.

Table 2. Definition of sectors

Group	Sector	Input-output framework	Description	Acronym
1	1	67	Public administration	Public administration
1	2	68	Non-market education	Public education
1	3	69	Non-market health and social work	Public health
2	4	23	Manufacture of chemicals and chemical products	Chemicals
2	5	43	Retail trade; repair of personal and household goods	Retail trade
2	6	59	Research and development	Research and development
2	7	61	Market education	Private education
2	8	62	Market health and social work	Private health
2	9	70	Non-market sewage and refuse disposal, sanitation and similar activities	Sewage
2	10	72	Non-market recreational, cultural and sporting activities	Culture
3	11	9	Production and distribution of electricity	Electricity
3	12	35	Manufacture of medical, precision and optical instruments	Medical and precision instruments
3	13	37	Manufacture of other transport equipment	Other transport equipment
3	14	42	Wholesale trade and commission trade	Wholesale trade
3	15	52	Post and telecommunications	Post and telecommunications
3	16	60	Other business activities	Other business activities
4	17	21, 46, 47, 48, 49, 50, 51, 56, 65, 66	Paper; Transport; Travel agencies; Real estate; Market recreational, cultural and sporting activities; Other services	Other sectors with public final expenditure
5	18	Rest	Other activities	Sectors without public final expenditure

Source: Own elaboration, from the Spanish National Statistics Institute.

IV. Empirical results

The aim of the different fiscal policy reforms simulated in this paper is to get a reduction in the government deficit as a ratio to GDP, which stands as the reference variable for fiscal policymakers. This decrease in public deficit can be achieved through either a cut in public expenditures or an increase in tax revenues; and both strategies, in turn, can be accomplished by acting on alternative expenditure items or taxes.

A. Definition of scenarios

Simulations have been performed under six scenarios, where the first three involve a spending cut with no change in taxes, and the last three mean a tax increase with no change in spending. Specifically, these scenarios are:

(i) A spending cut in Public administration (i.e., sector 1 in Table 2).
(ii) A spending cut in Public education (i.e., sector 2 in Table 2).
(iii) A spending cut in Public health (i.e., sector 3 in Table 2).

Recall that sectors 1, 2 and 3 represent the most part of public expenditure (79% of total in the benchmark, namely, 38% Public administration, 18% Public education, and 23% Public health), and concentrate the highest share of the spending cuts implemented by the Spanish government; notice that the first scenario would proxy a cut in wages for the public sector workers. The remaining scenarios are:

(iv) A rise in tax collections via an increase in VAT rates.
(v) A rise in tax collections via an increase in the rates of Other indirect taxes.
(vi) A rise in tax collections via an increase in the Income tax rate.

For each scenario, we have simulated a decrease in the ratio government deficit/GDP of one percentage point. Alternatively, we have also simulated the case in which the ratio government deficit/GDP was reduced by three percentage points, instead of one, but the results were fairly analogous; the only difference was merely quantitative, with the figures in Table 3 (see below) resulting around three times greater (results available from the authors upon request). The government surplus (if positive) or deficit (if negative) is measured by the net lending/net borrowing of the general government, computed by subtracting public investment from the value of public savings given from equations (A20) and (A24) in Online Appendix A. The six scenarios have been implemented in the model as follows. For the first

three scenarios, final public consumption in the sector concerned (i.e., sector 1, 2 or 3 in Table 2) was reduced in equations (A19) and (A25) of Online Appendix A, in order to get the desired target (i.e., a 1% decrease in the ratio of government deficit to GDP). In turn, for the last three scenarios, the rates of VAT, Other indirect taxes or Income tax, in each case, were increased to get the desired target in the equations (see Online Appendix A) where they appear, namely, equations (A1), (A16), (A23), (A25) and (A27) for VAT; equations (A1), (A16), (A22), (A25) and (A27) for Other indirect taxes; and equations (A15) and (A24) for Income tax.[2]

B. Simulation results

The results from the above simulations on the main macroeconomic variables appear in Table 3 as percentage changes from benchmark, except for the unemployment rate, in which case changes are expressed as percentage points.

Table 3. Simulation results: Effects on macroeconomic variables (% change from benchmark)

	∇ Public administration	∇ Public education	∇ Public health	Δ VAT	Δ Other indirect taxes	Δ Income tax
GDP	−0.50	−0.58	−0.39	−0.34	−0.31	−0.73
Employment	−0.77	−1.07	−0.80	−0.12	−0.42	−1.51
Unemployment rate (p.p.)	0.38	0.54	0.40	0.05	0.33	1.24
Real wage rate	−0.30	−0.41	−0.31	−1.50	−1.14	−0.94
GDP at factor cost	−0.61	−0.72	−0.50	−1.65	−1.62	−0.72
Compensation of employees	−1.13	−1.52	−1.09	−1.61	−1.55	−0.70
Gross operating surplus	0.03	0.28	0.24	−1.69	−1.71	−0.74
Public revenue	−1.30	−1.39	−0.85	3.74	3.85	4.90
Public expenditure	−7.43	−7.53	−6.87	−0.91	−0.96	0.50

[2] The referee of this paper requested some additional scenarios of mixed fiscal adjustment; in particular: (i) half the adjustment based on an increase in the income tax and half on education/health cuts, and (ii) half the adjustment based on a VAT increase and half on public administration cuts. To save space, the results from these simulations, together with the sensitivity analysis, are shown in Online Appendix C. The results lie somewhat in the middle of the polar cases represented in our six basic simulations, for each specific mixed scenario.

As shown in Table 3, GDP falls in all scenarios. The negative effects on GDP are larger for spending cuts than for indirect tax increases, and the highest fall follows the increase in the income tax. The decrease in GDP lies between 0.73% for an increase in the rate of the Income tax, and 0.34% for an increase in the rates of Other indirect taxes. Employment also falls, and the rate of unemployment rises, in all scenarios. Again, the worse results correspond to the Income tax rise, followed by spending cuts, especially in the case of Public education; on the contrary, the decrease in employment and the increase in the rate of unemployment seem to be smaller for indirect tax increases, especially when VAT rates are increased. On the other hand, real wages fall in all scenarios, and more strongly in the cases of tax increases.

The next line in Table 3 shows the change in GDP at factor cost, i.e., the sum of the payments to the productive factors (namely, compensation of employees for labour, and gross operating surplus for capital). As can be seen, the contractionary effect when GDP is measured at factor cost is higher in the scenarios of indirect tax increases, unlike the case in which GDP is measured at market prices. This result follows from the fact that GDP at market prices includes indirect taxes, which are raised in our simulations, so the smaller decrease in GDP shown in the first line of the table would be somewhat misleading. Regarding distributive issues, the compensation of employees clearly falls in all scenarios following the decrease in both real wages and employment, especially for indirect tax increases, and, to a lower extent, spending cuts in Public education. In turn, the gross operating surplus slightly increases in the scenarios of spending cuts, and falls strongly in the scenarios of tax increases. As a result, income distribution clearly worsens for labour in the scenarios of spending cuts (especially in the case of spending cuts in Public education and Public health), and improves, but very slightly, in the scenarios of tax increases.

Finally, total government expenditure should fall by around 7% in order to reduce the ratio government deficit/GDP in one percentage point in the spending cuts scenarios, which is accompanied by a decrease in government revenue. On the other hand, total government revenue should rise by around 4% in order to reduce the ratio government deficit/GDP in one percentage point in the tax increases scenarios, coupled with a small additional change in government expenditure (a decrease in the case of indirect taxes, and increase for the income tax).

Next, we present in Tables 4 and 5 the results across sectors for the two most relevant variables, namely, output and employment. In order to interpret these

sectoral results one should take into account the constraints that the model imposes on productive factors, i.e., labour is modelled under an unemployment rule and leisure can take place, but capital is assumed fully employed and specific at the sectoral level. Notice also that in a general equilibrium framework the results can be driven by several forces which, in some cases, move in opposite directions.

Table 4. Simulation results: Effects on sectoral output (% change from benchmark)

	∇ Public administration	∇ Public education	∇Public health	Δ VAT	Δ Other indirect taxes	Δ Income tax
Public administration	–15.69	–1.12	–0.63	0.00	0.00	0.00
Public education	–1.12	–32.33	–0.60	–0.01	–0.02	–0.15
Public health	–1.07	–1.02	–23.59	–0.06	–0.04	–0.26
Chemicals	0.36	0.42	–0.69	–0.38	–0.44	–0.83
Retail trade	–0.01	–0.02	–0.26	0.02	–0.29	–1.77
Research and development	–0.34	0.20	0.08	–0.08	–0.23	–0.64
Private education	–0.26	–0.24	–0.14	–0.22	–0.22	–1.41
Private health	–1.13	–1.08	–0.61	–0.07	0.00	–0.11
Sewage	–0.29	–0.26	–0.75	–0.33	–0.21	–1.50
Culture	–0.89	–0.87	–0.50	–0.02	–0.44	–0.60
Electricity	–0.27	0.02	0.00	–0.47	–0.42	–0.90
Medical and precision instruments	1.47	1.55	–2.51	0.67	0.68	–0.52
Other transport equipment	0.11	1.91	1.86	0.99	1.42	–0.19
Wholesale trade	0.26	0.45	0.12	0.13	–0.20	–1.05
Post and telecommunications	–0.38	0.10	–0.04	–0.62	–0.29	–1.02
Other business activities	0.17	0.69	0.31	0.14	–0.09	–0.72
Other sectors with public final expenditure	0.18	0.27	0.21	–0.10	–0.60	–1.01
Sectors without public final expenditure	0.85	0.93	0.84	–0.07	–0.17	–0.81

Table 5. Simulation results: Effects on sectoral employment (% change from benchmark)

	∇ Public administration	∇ Public education	∇ Public health	Δ VAT	Δ Other indirect taxes	Δ Income tax
Public administration	–18.21	–1.31	–0.74	0.00	0.00	0.00
Public education	–1.18	–33.84	–0.63	–0.01	–0.02	–0.16
Public health	–1.11	–1.07	–24.53	–0.06	–0.04	–0.27
Chemicals	0.64	0.73	–1.22	–0.66	–0.78	–1.45
Retail trade	–0.02	–0.03	–0.43	0.03	–0.47	–2.90
Research and development	–0.36	0.22	0.08	–0.08	–0.25	–0.67
Private education	–0.39	–0.36	–0.21	–0.32	–0.33	–2.11
Private health	–1.50	–1.44	–0.82	–0.09	0.00	–0.15
Sewage	–0.45	–0.41	–1.17	–0.52	–0.33	–2.33
Culture	–1.08	–1.06	–0.61	–0.02	–0.53	–0.74
Electricity	–1.32	0.12	0.01	–2.33	–2.09	–4.39
Medical and precision instruments	1.85	1.95	–3.14	0.84	0.86	–0.66
Other transport equipment	0.15	2.52	2.46	1.30	1.87	–0.25
Wholesale trade	0.56	0.98	0.27	0.28	–0.44	–2.27
Post and telecommunications	–1.23	0.33	–0.13	–1.98	–0.94	–3.25
Other business activities	0.27	1.09	0.49	0.22	–0.14	–1.13
Other sectors with public final expenditure	0.65	0.97	0.75	–0.35	–2.14	–3.57
Sectors without public final expenditure	1.49	1.64	1.49	–0.13	–0.31	–1.42

According to the results in the tables, in the scenarios based on cuts in government spending both output and employment fall sharply in the concerned sector, the strongest effect being again in the case of spending cuts in Public education (32% in output and 34% in employment), followed by Public health (24% in output and 25% in employment), and Public administration (16% in output and 18% in employment). For the remaining sectors, the fall in output and employment is especially intense for sectors included in groups 1 and 2 (see Table 2), i.e., those sectors where final public expenditure plays a greater role; with some exceptions, such as Medical and precision instruments, where the reductions in output and employment are noticeable in the case of spending cuts in Public health. On the other hand, recall that in the scenarios based on indirect tax increases the

reductions in output and employment were smaller, especially when VAT rates were increased. Specifically, in the latter case output and employment rise in those sectors that provide intermediate inputs to other sectors, so VAT revenues are low (Medical and precision instruments, Other transport equipment, Wholesale trade, Other business activities); conversely, the sectors supporting a higher burden of VAT in absolute terms are those experiencing the highest reductions in output and employment (Post and telecommunications, Electricity, Chemicals). In turn, in the case of an increase in the rates of Other indirect taxes, the fall in aggregate demand leads to a generalized reduction of output and employment in almost all sectors. Finally, an increase in the rate of the income tax causes a general fall in both output and employment across sectors, where the latter is positively correlated with the degree of sectoral labour intensity, given the specific capital assumption.

C. Sensitivity analysis

To conclude, we present a sensitivity analysis of the above results.The results are shown in Table 6, for four macroeconomic variables (namely, GDP, total public revenue and expenditure, and employment); the full sensitivity analysis for all variables is available from the authors upon request. We perform a change in the different elasticities appearing in the model, which are alternatively doubled and halved. In addition, the assumption of sectoral capital specificity has been also checked, by adopting instead a uniform rental rate of capital across sectors.

The results for all variables are robust in sign, and changes in general tend to be very small, when the values of the elasticities are modified. The case of the elasticity of substitution between labour and capital is that showing a higher variance in results (especially when the income tax increases), and the figures for public revenue and expenditure are robust to changes in those elasticities in all cases. The analysis regarding the flexibility of the real wage to the unemployment rate β, allows checking the robustness of the effects on the labour market. Recall that a higher β involves a more rigid real wage and a higher adjustment in employment, whereas a lower β means a more elastic real wage and smaller changes in employment. This is the case for all scenarios, especially in the income tax scenario; in particular, the changes in the effects on public revenue and expenditure are very small. Finally, perfect intersectoral capital mobility softens the effects on macroeconomic variables in the spending cut scenarios, and has only a small influence in the tax increase scenarios; importantly, the results are stable in both sign and size.

Table 6. Sensitivity analysis: Effects on macroeconomic variables (% change from benchmark)

	∇ Public administration				∇ Public education				∇ Public health			
	GDP	Public revenue	Public expenditure	Employment	GDP	Public revenue	Public expenditure	Employment	GDP	Public revenue	Public expenditure	Employment
Benchmark	−0.50	−1.30	−7.43	−0.77	−0.58	−1.39	−7.53	−1.07	−0.39	−0.85	−6.87	−0.80
τ_{sav} = 1												
$\tau'_{sav}=2*\tau_{sav}$	−0.50	−1.32	−7.44	−0.77	−0.59	−1.41	−7.55	−1.08	−0.41	−0.87	−6.89	−0.82
$\tau'_{sav}=0.5*\tau_{sav}$	−0.49	−1.29	−7.42	−0.76	−0.57	−1.38	−7.52	−1.06	−0.39	−0.84	−6.86	−0.79
σ^{CL} = 1												
$\sigma'^{CL}=2*\sigma^{CL}$	−0.53	−1.32	−7.51	−0.84	−0.63	−1.43	−7.65	−1.17	−0.43	−0.88	−6.96	−0.88
$\sigma'^{CL}=0.5*\sigma^{CL}$	−0.48	−1.29	−7.38	−0.72	−0.55	−1.37	−7.46	−1.01	−0.37	−0.83	−6.81	−0.76
τ_i = 1												
$\tau'_i=2*\tau_i$	−0.51	−1.31	−7.46	−0.78	−0.58	−1.38	−7.54	−1.06	−0.39	−0.85	−6.89	−0.80
$\tau'_i=0.5*\tau_i$	−0.50	−1.29	−7.40	−0.76	−0.58	−1.39	−7.52	−1.07	−0.39	−0.85	−6.86	−0.80
σ_i^{LK} = [1.26-1.68]												
$\sigma_i'^{LK}=2*\sigma_i^{LK}$	−0.30	−0.80	−6.74	−0.51	−0.35	−0.93	−6.84	−0.71	−0.22	−0.52	−6.35	−0.53
$\sigma_i'^{LK}=0.5*\sigma_i^{LK}$	−0.74	−2.00	−8.35	−1.04	−0.83	−1.96	−8.34	−1.43	−0.58	−1.27	−7.49	−1.08
σ_i^A = [0.70-2.90]												
$\sigma_i'^A=2*\sigma_i^A$	−0.50	−1.30	−7.43	−0.77	−0.58	−1.39	−7.53	−1.07	−0.39	−0.85	−6.87	−0.80
$\sigma_i'^A=0.5*\sigma_i^A$	−0.50	−1.30	−7.43	−0.77	−0.58	−1.39	−7.53	−1.07	−0.39	−0.85	−6.87	−0.80
ε_i = [1.90-4.30]												
$\varepsilon'_i=2*\varepsilon_i$	−0.50	−1.30	−7.43	−0.77	−0.58	−1.39	−7.53	−1.07	−0.39	−0.85	−6.87	−0.80
$\varepsilon'_i=0.5*\varepsilon_i$	−0.50	−1.30	−7.42	−0.77	−0.58	−1.39	−7.53	−1.07	−0.39	−0.85	−6.87	−0.80
β = 1.5												
β'=2*β	−0.61	−1.43	−7.66	−0.98	−0.73	−1.58	−7.88	−1.36	−0.51	−1.01	−7.14	−1.03
β'=0.5*β	−0.41	−1.19	−7.22	−0.59	−0.45	−1.22	−7.23	−0.82	−0.29	−0.72	−6.64	−0.61
Capital mobility												
$R_i = R$	−0.25	−0.53	−6.46	−0.53	−0.46	−0.98	−7.01	−0.94	−0.33	−0.63	−6.57	−0.73

Table 6. Sensitivity analysis: Effects on macroeconomic variables (% change from benchmark) (continued)

	Δ VAT				Δ Other indirect taxes				Δ Income tax			
	GDP	Public revenue	Public expenditure	Employment	GDP	Public revenue	Public expenditure	Employment	GDP	Public revenue	Public expenditure	Employment
Benchmark	−0.34	3.74	−0.91	−0.12	−0.31	3.85	−0.96	−0.42	−0.73	4.90	0.50	−1.51
τ_{sav} = 1												
$\tau'_{sav}=2*\tau_{sav}$	−0.35	3.74	−0.91	−0.12	−0.36	3.83	−0.96	−0.50	−0.76	4.91	0.52	−1.56
$\tau'_{sav}=0.5*\tau_{sav}$	−0.34	3.74	−0.91	−0.11	−0.28	3.86	−0.96	−0.38	−0.71	4.90	0.49	−1.48
σ^{CL} = 1												
$\sigma'^{CL}=2*\sigma^{CL}$	−0.52	4.01	−0.88	−0.47	−0.44	4.06	−0.94	−0.71	−0.87	5.16	0.60	−1.82
$\sigma'^{CL}=0.5*\sigma^{CL}$	−0.25	3.60	−0.92	0.07	−0.24	3.74	−0.96	−0.27	−0.65	4.76	0.45	−1.34
τ_i = 1												
$\tau'_i=2*\tau_i$	−0.39	3.84	−0.94	−0.16	−0.33	3.93	−0.97	−0.45	−0.76	4.91	0.52	−1.56
$\tau'_i=0.5*\tau_i$	−0.31	3.68	−0.89	−0.09	−0.29	3.80	−0.95	−0.40	−0.71	4.90	0.49	−1.48
σ_i^{LK} = [1.26-1.68]												
$\sigma_i'^{LK}=2*\sigma_i^{LK}$	−0.40	3.74	−0.94	−0.20	−0.48	3.86	−1.08	−0.69	−1.36	5.29	0.45	−2.61
$\sigma_i'^{LK}=0.5*\sigma_i^{LK}$	−0.30	3.74	−0.88	−0.06	−0.18	3.84	−0.87	−0.22	−0.34	4.66	0.52	−0.83
σ_i^{A} = [0.70-2.90]												
$\sigma_i'^{A}=2*\sigma_i^{A}$	−0.35	3.74	−0.91	−0.12	−0.30	3.85	−0.95	−0.41	−0.74	4.90	0.50	−1.52
$\sigma_i'^{A}=0.5*\sigma_i^{A}$	−0.34	3.74	−0.91	−0.11	−0.31	3.85	−0.96	−0.43	−0.72	4.90	0.50	−1.50
ε_i = [1.90-4.30]												
$\varepsilon'_i=2*\varepsilon_i$	−0.35	3.74	−0.91	−0.12	−0.30	3.85	−0.95	−0.41	−0.73	4.90	0.50	−1.52
$\varepsilon'_i=0.5*\varepsilon_i$	−0.34	3.74	−0.91	−0.12	−0.31	3.85	−0.96	−0.43	−0.72	4.90	0.50	−1.50
β = 1.5												
β'=2*β	−0.36	3.75	−0.91	−0.14	−0.40	3.92	−0.95	−0.60	−1.23	5.52	0.83	−2.51
β'=0.5*β	−0.30	3.73	−0.91	−0.09	−0.23	3.79	−0.96	−0.27	−0.40	4.50	0.29	−0.85
Capital mobility												
$R_i = R$	−0.38	3.72	−0.93	−0.16	−0.38	3.78	−1.02	−0.51	−0.84	4.80	0.41	−1.66

Note: τ_{sav} = elasticity of substitution between consumption and savings, σ^{CL} = elasticity of substitution between final consumption and leisure, τ_i = elasticity of substitution across final consumption goods, σ_i^{LK} = elasticity of substitution between labour and capital, σ_i^{A} = Armington elasticity of substitution, ε_i = elasticity of transformation, β = flexibility of the real wage to the unemployment rate, R_i = capital rental rate.

V. Concluding remarks

Since the beginning of the current crisis, most advanced economies are deeply concerned with the size of government deficits, which has led them to pursue severe fiscal consolidations in order to curb those deficits. However, such consolidation strategies have been associated with lower growth than expected, which makes the reduction of deficits even more difficult (Blanchard and Leigh 2013). On the other hand, some authors have argued that spending cuts are more effective than tax increases to get a successful fiscal consolidation, and at the same time avoid a recession, the opposite result holding in the case of a fiscal stimulus; see, e.g., Alesina and Ardagna (2010).

In this paper, we have examined the effects of several alternative measures intended to reduce government deficits, distinguishing between those acting through taxes and through spending, for the case of Spain. The Spanish case looks mostly relevant in its uniqueness because it is a good example of front-loaded fiscal adjustment that has led to a large GDP fall; and (unlike the cases of Greece, Ireland and Portugal) the Spanish authorities were able to choose the composition of the adjustment measures. The empirical methodology is based on a CGE model, which allows obtaining the consequences of changes in a particular variable on the whole economy under analysis, as well as the specific effects across the different productive sectors. Six scenarios have been simulated, aimed to reduce the ratio government deficit/GDP by one percentage point. These six scenarios consist of either (i) a spending cut with no change in taxes, in three sectors of the economy (namely, Public administration, education and health, where the first scenario proxies a cut in wages for the public sector workers), or (ii) a tax increase with no change in spending (namely, through an increase in the rates of VAT, Other indirect taxes and Income tax).

We found that GDP and employment fell, and the unemployment rate rose, in all the simulated scenarios. When comparing the relative performance of spending cuts and tax increases, the strongest negative effects on GDP and employment appeared in the case of an increase in the income tax, followed by spending cuts, especially in Public education; in contrast, for indirect tax increases the negative effects on GDP and employment were milder, especially for employment in the case of an increase in VAT rates. On the other hand, spending cuts were accompanied with a worsening of income distribution for labour, unlike tax increases, where income distribution for labour showed a very slight improvement.

As can be seen, all the simulated policies reduce the government deficit as a percentage of GDP, at the expense of a fall in the levels of activity and employment in the short run (i.e., the time period contemplated in our model). This result, as well as meaning an aggravation of the current recession, should yield afterwards a higher government deficit, since public spending should rise and tax collections fall through the operation of the automatic stabilizers. In addition, a lower GDP would raise the ratio government deficit/GDP, for a given level of the deficit.

On the other hand, if the consolidation strategy was based on spending cuts the contractionary effects would be greater than if based on indirect tax increases (unlike the case of an income tax increase, where the opposite result holds), according to our results. Even though the empirical methodologies are not directly comparable, notice that this result contrasts with that of Alesina and Ardagna (2010), unless GDP is measured at factor cost, where the opposite result holds (see Table 3). This might be related to the fact that a more accommodating monetary policy seems to follow spending-based adjustments, as pointed by Guajardo et al. (2011); such an effect is absent in our approach. Our results, on the other hand, would be in line with those of Martínez and Zubiri (2014), who estimate fiscal multipliers for Spain that are substantially higher for spending than for taxes, and even more in times of recession. Finally, from a longer term viewpoint, public expenditure items such as education or health care (as well as R&D or public investments) are deemed to be potentially growth-enhancing, so that consolidation strategies based on these items might harm future growth prospects (European Commission 2012). Overall, our results show the challenges that the fiscal consolidation strategies currently pursued pose in a context of recession and very high unemployment rates.

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