A general equilibrium evaluation of tax policies in Spain during the Great Recession

María Teresa Álvarez-Martínez

Clemente Polo[1]

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Abstract

The main goal of the paper is to assess the effects of several permanent tax rate hikes implemented by the Spanish Government in 2009 and 2010 to counteract the rapid increase of the public deficit and debt registered in 2009 and 2010. It uses a numerical general equilibrium model calibrated to a social accounting matrix elaborated by the authors for the year 2000. The effects of increases in excise, value added and personal income taxes are simulated separately and jointly. The results indicate that the extra revenues obtained from each tax figure are lower than ex-ante calculations estimated by the Government. Moreover, the reductions in the public deficit accomplished are considerably smaller due to general equilibrium effects generally ignored, such as the fall in production levels, increased unemployment, higher prices of public consumption and investment and larger Government transfers. The joint results also indicate that additional measures should be implemented to continue closing the deficit gap in the next future.

Keywords: Computable General Equilibrium models, tax reforms.

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[1] María Teresa Álvarez-Martínez (mta60@rci.rutgers.edu), Rutgers University, and Clemente Polo (clemente.polo@uab.es), Universidad Autónoma de Barcelona. They are indebted to the Spanish Ministry of Education and Science, grant SEJ2007-61046.

1. Introduction

As other developed economies, Spain entered into recession in the fourth quarter of 2008. Since 1995, it had enjoyed a sustained expansion fueled by three powerful shocks: first, the four devaluations of the peseta implemented by the Government between September 1992 and May 1995; second, the sustained reduction of the intervention rate of the Bank of Spain until it reached 3 % at the end of 1998, the target accorded by EMU members; and, third, the availability of international credit at low interest rates since the launching of the euro on January 1st, 1999. At the height of the boom in 2007, gross fix capital formation absorbed 30.7 percent of GDP, although a good share of it (33.5 %) was real estate investment in residential and other type of constructions.[2] In the meanwhile, the private sector (financial institutions and non-financial businesses) accumulated a huge external debt (close to 1.6 times GDP in 2007) while the current account surplus (0.76 % of GDP in 1996) soon evaporated and turned into a deficit that reached 10% of GDP in 2007.

The closure of international financial markets and the start of a global recession in the second semester of 2008 reduced exports and put an abrupt end to the capital accumulation process. The average volume index of exports (excluding tourism) and tourists' services from the third quarter of 2008 until the second quarter of 2009 fell 9.4 and 8.75 percent, respectively, relative to their average values in the previous four quarters. In the same time span, the average volume index of gross fix capital formation fell 13.07 %, GDP dropped 2.16 % and the unemployment rate increased 5.96 percentage points (pp).

[2] Total investment in all agriculture and industry branches of the economy amounted to just 13.0 % of gross fix capital formation.

The sudden turnabout of the economic scenario put highly indebted credit institutions, non-financial businesses and families under serious stress.[3] Although the expansionary budget of 2008 (an election year) and the fall of tax revenues had already turned the 2007 budget surplus (20,057 EUR millions) into a large deficit in 2008 (45,162 EUR millions), the Government approached the situation convinced that it would be enough to back financial institutions' debt emissions and temporarily increase government expenditures and transfers to weather the storm. Numerous initiatives were approved to that end during the last quarter of 2008, including the 2009 budget that contemplated a public deficit of 70,654.4 EUR million. By June, the Government had to approve an extraordinary credit (19,821 EUR millions) to pay rapidly growing unemployment benefits. It also decided to increased excise taxes on oil products and tobacco. As fiscal revenues continued falling, the Government changed tracks and included in the 2010 budget two measures to boost revenues: it raised value added tax (VAT) rates effective on July 1st, and eliminated the 400 EUR tax rebate introduced a year earlier. 2009 closed with a public deficit of 117,268 EUR millions or 11.1 percent of GDP.

The effect of changes in VAT rates has received some attention in recent years. Crossley, Low and Wakefield (2009), Barrell and Weale (2009) and Blundell (2009) discuss the effects of a temporary cut rate[4] in the central VAT rate (from 17.5 to 15 per cent) implemented by the U.K Government in December 2008. In the case of Spain, Fernández de Córdoba and Torres (2010) and Conesa *et al*. (2010) have estimated the effects of a permanent increase in VAT rates in Spain employing intertemporal aggregated models of a close economy. Since the measure was known three quarters in

[3] Out of a total external debt of 1,563,730 EUR millions, the general Government was only responsible for 197,835 EUR millions at the end of 2007.

[4] The temporary reduction lasted until December 2009. At the beginning of 2011, the U.K Government increased the central VAT rate from 17.5 to 20 per cent. Portugal also raised VAT rates from 20 to 21 percent in May 2010 and then to 23 per cent in September 2010.

advance of the date it was actually implemented, Fernández de Córdoba and Torres estimate that in the interim period –since the policy was announced until it was implemented–, the expectation of price increases raises consumption (0.6 %) and VAT revenues (0.5 %), but reduces output (0.6 %), employment (0.7 %), investment (5.4 %) and government revenues (0.4%). In the long run, output, consumption, investment and employment fall 0.74 %, VAT revenues increase 9.2 % and total revenues 1.9 %. The figures reported by Conesa *et al*., although slightly different, confirm the fall in production (0.85 %), consumption (1.1 %), investment (-1.0 %) and employment (1.0 %), as well as the increase in VAT revenues (10.5 %) and total revenues (1.7 %) in the long-run.

Both models share two controversial features. First, the labor market clears in all periods. On this respect, it seems appropriate to recall that the unemployment rate climbed from 8.03 % in the third quarter of 2007 to 21.3 % in the first quarter of 2011. Even accepting that official figures probably overstate the unemployment problem, few economists would accept that market clearing is an accurate description of the Spanish labor market. Second, they take for granted that in response to an increase in VAT rates "households substitute working hours in the labor market by hours dedicated to non paid activities" (Conesa *et al*., p. 7).[5] What they mean by "non paid activities" is unclear, but assuming the category includes reading, jogging, playing music, going to movies and concerts, dining in restaurants, drinking in bars, shopping, preparing meals at home, etc., doing more of them requires paying more taxes for books, running shoes, CD's, cinema and concert tickets, drinks, food, electricity, etc. Therefore, one would expect less (not more) consumption of them when VAT rates go up. All that can be said

[5] Gonzalo de Córdoba-Torres (2010) assume that the representative household optimally allocates its time endowment of 96 (6x18) hours between working hours and leisure. Conesa *et al.* (2010) talk of paid and unpaid hours.

in favor of this assumption is that having ruled out unemployment in the model economy, reducing the labor supply is the only way they can obtain a fall in production.

This paper simulates the effects of increases in oil products and tobacco, VAT rates and personal effective income taxes implemented by the Spanish Government to reduce the public deficit in 2009 and 2010. It employs a static disaggregated general equilibrium model that provides a much more detailed picture of the Spanish economy than aggregate models. It distinguishes thirty different products and services and six types of different capital goods. Production and consumption commodities are different and so are production and consumption prices. Demand of products and services is satisfied with a mix of domestic products and equivalent imports. There are six types of taxes: social security contributions, personal income tax, corporate tax, VAT, other taxes on production, and import taxes. Private investment (except residential construction) and exports are VAT exempted, but public consumption and investment do pay VAT rates. Most parameters of the model have been calibrated with a 2000 social accounting matrix (SAMES-00) elaborated by the authors. Another important difference with previous models is that the labor market does not clear and the real wage depends on the unemployment rate. Finally, the model provides information on sectoral prices and production levels, government revenues and expenditures and major aggregate variables.

The rest of the paper is divided in three sections. First, the main features of the model are presented. In section 3, the policies simulated are explained and the simulation results obtained discussed. The main findings are summarized in the concluding section.

2. The model

This section presents the main features of the disaggregated general equilibrium model employed to simulate tax policies.

Agents and commodities

There are 30 producers, one representative consumer, the government, the corporate sector and two external sectors and foreign consumers, the European Union (EU) and the rest of the world (ROW). There are 30 produced commodities, 30 consumption goods and services, labor and capital and six types of private and public capital goods.

Producers

Products are obtained with domestic production and equivalent imports. Domestic products are aggregates of products and value added; and value added is, in turn, produced with labor and capital services. The production technology is represented by a nested production function with constant returns to scale. At the top level, total output, Y_i, is a CES aggregate of domestic products, Y_{di}, and imports from the EU, Y_{eui}, and the ROW, Y_{rowi}.

$$Y_i = \phi_i\left(\delta_{di}Y_{di}^{\rho_i} + \delta_{eui}Y_{eui}^{\rho_i} + \delta_{rowi}Y_{rowi}^{\rho_i}\right)^{1/\rho_i}, \quad -\infty < \rho_i < 1 \tag{1}$$

where δ_{di}, δ_{eui} and δ_{rowi} are, respectively, the domestic and foreign distributive parameters and ρ_i the parameter that determines the constant elasticity of substitution between domestic production and equivalent imports. At the second level, domestic production is obtained combining intermediate inputs and value added in fixed proportions

$$Y_{di} = \min\left(\frac{X_{1i}}{a_{1i}}, \frac{X_{2i}}{a_{2i}}, ..., \frac{X_{30i}}{a_{30i}}, \frac{V_i}{v_i}\right) \tag{2}$$

being X_{ji} and V_i are the amounts of product *j* and value added used to produce domestic output, Y_{di}, and a_{ji} and v_i the corresponding technical coefficients. Finally, valued added is a Cobb-Douglas aggregate of labor, L_i, and capital services, K_i

$$V_i = \gamma_i L_i^{\beta_{li}} K_i^{(1-\beta_{li})} \tag{3}$$

where γ_i, is a scale parameter and β_{li} and $(1-\beta_{li})$ the distribution parameters.

Firms maximize profits. At the lowest level of the nest, they minimize labor and capital cost subject to the value added function

$$\min w(1+\tau_i^{ssc})L_i + rK_i \qquad s.t. \quad V_i = \gamma_i L_i^{\beta_{li}} K_i^{(1-\beta_{li})} \tag{4}$$

where w and r are the prices of labor and capital and τ_i^{ssc} are the social security contribution rate paid by employers and employees. The solution provides the labor, L_i^*, and capital, K_i^*, demands. The price of value added is set equal to the minimum average production cost

$$pv_i^* = w(1+\tau_i^{ssc})\frac{L_i^*}{V_i} + r\frac{K_i^*}{V_i} \tag{5}$$

to insure profits are zero. Similar problems are set at the intermediate and upper levels of the nest. Taxes (net of subsidies) on products enter in the equations of domestic prices and import taxes in the equations of prices of products.

The consumption commodities are produced by a Leontief technology

$$C_c = \min\left(\frac{Z_{1c}}{z_{1c}}, \frac{Z_{2c}}{z_{2c}}, ..., \frac{Z_{30c}}{z_{30c}}\right) \tag{6}$$

where Z_{ic} is the amount of product i employed to produce commodity c, and z_{ic} is the unitary requirement. VAT rates enter in the price equations of products.

Household

The representative household derives utility from consumption commodities, C_c and savings. Preferences are represented by a Cobb-Douglas utility function

$$U(C_1, C_2, ..., C_{30}, S) = \prod_{c=1}^{30} C_c^{\alpha_c} S^{1-\sum_{c=1}^{30}\alpha_c} \quad 0 < \alpha_c < 1, \sum_{c=1}^{30}\alpha_c < 1. \tag{7}$$

The household sells its labor, $\overline{L}$, and capital, $\overline{K}$, services to firms. It also receives unemployment and welfare benefits, property income and other current transfers

$$GI_h = w(1-u)\overline{L} + r\overline{K} + \mu \cdot w \cdot u \cdot \overline{L} + EISSC + p_c(ADJ + TRR + PIR + WFR) \tag{8}$$

where w and r are the prices of labor and capital services, respectively; $\overline{L}$, and $\overline{K}$ the endowments of labor and capital; u the unemployment rate; μ the proportion of the wage rate paid to unemployed; $EISSC$ employers' imputed social security contributions; ADJ transfers to households due to changes in net equity in pension funds' reserves; TRR current transfers; PIR property income receipts; and, WFR welfare benefits other than social transfers in kind. Disposable income, DI_h, is obtained by subtracting personal income tax, self-employees social security contributions, current transfers, property income payments and residents' consumption in the EU and the ROW.

Consumption and savings demands are the solution to

$$\max \prod_{c=1}^{30} C_c^{\alpha_c} S^{1-\sum_{c=1}^{30}\alpha_c} \qquad \text{s. t.} \qquad DI_h = \sum_{c=1}^{30} p_c C_c + p_I S \tag{9}$$

where p_I is a weighted price index of investment goods. It is assumed that a fixed proportion of savings ι_r is devoted to purchase residential investment RI

$$p_r RI = \iota_r p_s S \tag{10}$$

where p_r is the production price of construction (sector 17). Since residential investment is subject to the VAT, its price is

$$p_r = p_{17}\left(1+\tau_{17}^{vat}\right). \tag{11}$$

Government

The Government collects taxes from labor, income, production and consumption, which together with capital income and transfers are used to finance public consumption and investment, unemployment benefits and transfers. Public consumption and investment are exogenous but since prices, revenues and some expenditures are endogenous, the budget surplus, GS, is also endogenous. It is important to keep in mind that public purchases are subject to the VAT.

Foreign sectors

There are two foreign sectors, the EU and the ROW. Revenues stem from labor and capital endowments, imports of commodities, residents' consumption out of the territory and taxes and transfers received from domestic agents. These revenues are used to pay exports, income payments to residents and transfers. Exports and transfers are exogenously fixed, but since imports and prices are endogenous, the current account balance CAB is also endogenous.

Factors' markets

For the capital services market, the demand of services by all producers equals the endowment. In the case of labor, however, the model includes a real wage-unemployment rate equation

$$\frac{w\left(1-\tau_h^{cs}-\tau^i\right)}{p_c}=k\left(1-u\right)^{\frac{1}{\eta}}\ ,\ \ \eta>0 \tag{12}$$

where w is the wage rate; p_c the consumption price index, τ_h^{cs} the social contributions tax rate on households, τ^i the personal income tax rate; k a calibration constant; η the parameter that determines the response of the real wage to the unemployment rate and u the endogenous unemployment rate. In this case, the demand of labor services by producers equals the labor endowment multiplied by one minus the unemployment rate. Notice that the smaller the value of η, the larger the elasticity of the real wage to the unemployment rate:[6]

$$\varepsilon_u^{\frac{w}{p_c}}=-\frac{1}{\eta}\frac{u}{1-u}\,. \tag{13}$$

Private non-residential investment

The level of non-residential private investment determined by households and corporate savings, the public deficit and the current account surplus of the foreign sectors:

$$p_I I_{nr}=p_I S_h(1-\iota_r)+S_{cs}+GS+CAS_{EU}+CAS_{ROW}\ . \tag{14}$$

Equilibrium

The equilibrium can be defined as a set of prices, production plans for producers, a consumption-savings plan for the representative household, an unemployment rate, a public deficit and a current account deficit such that producers maximize profits, the household maximize utility, all commodity markets and the capital market clear, effective labor supply equals labor demand and the difference between revenues and

[6] The unemployment rate is 13.87 % in 2000, the base year.

expenditures for the government and the two foreign sectors equal government surplus and the current account surpluses.

Calibration of the model

The 2000 SAM for the Spanish economy (SAMES-00) elaborated by the authors is the database used to specify the parameters and the exogenous variables of the model. It is a 128x128 square matrix with accounts for 30 products, 30 consumption commodities, 6 capital goods, labor and capital, a representative household, a corporate sector, the Government, two foreign consumers and two foreign sectors. The elasticities of substitution between domestic products and equivalent imports have been taken from Blake (2000). Finally, the central value chosen for η in the real wage-unemployment equation (1.2) was derived from Andrés *et al*. (1988). More recent estimates of wage curves by Montuenga *et al*. (2003) and García-Mainar and Montuenga (2005) confirm 1.2 as a central estimate.[7]

3. Simulations and results

This section presents the results of simulating three tax policies implemented by the Spanish Government in 2009 and 2010 to cut down the public deficit.[8] Simulation S1 estimates the effects of tobacco and oil products tax rates increases enacted in June 2009. Using the input-output supply table, it was estimated that the new effective production tax rates of 'Food, beverages and tobacco' and 'Extraction of energetic products, coke and refined petroleum', the two production sectors affected, would increase by 13.08 and 10.5 percent, respectively. Simulation S2 quantifies the

[7] The wage curves estimated by Montuenga *et al*. (2003) and García-Mainar and Montuenga(2005) imply values for η in the range (0.8-1.5). Sanz-de-Galdeano and Turunen (2006) results for a panel of 11 EU countries point to a value of 0.9.

[8] Given the commitment of the Government to bring down the deficit to 3% of GDP in 2013, those changes can be assumed to be permanent.

consequences of VAT rate increases implemented in July 2010. Although the increase in VAT rates is not uniform, the simulation assumes all effective VAT rates increased 12.5 %.[9] Finally, the scenario S3 simulates the elimination of the 400 EUR tax rebate in personal income tax filed in 2010. Using information provided by the government, the effective income tax rate in the model has been raised by 7.2%. The results of the three simulations appear in the first three columns of Tables 1-5. Column S4 presents the results of jointly simulating the three stated policies.

Effects of increases in oil and tobacco tax rates

The increase of tax rates on tobacco and oil has a noticeable impact on the domestic prices of a few production commodities. Domestic prices of the two sectors directly affected by the tax rates hikes go up: the price of 'Extraction of energetic products, coke and refined petroleum' increases by 4.75 % and that of 'Food, beverages and tobacco' 0.94 %. Prices of other energy intensive sectors (Electricity, Gas and water, Chemical industry, Extraction of other mining and quarrying, Transportation and Accommodation and catering, etc.) also go up. There are, however, other sectors whose prices are smaller due to the fall of the price of capital services. Changes in domestic prices are passed through and the consumer price index (CPI) increases by 0.26 %. Domestic production levels fall in those sectors most affected by the tax hike but go up in investment oriented sectors because the tax increase reduces the public deficit.

[9] The Government increased the reduced VAT rate from 6 to 7 percent (14.3%) and the normal VAT rate from 16 to 18 percent (12.5%). Since the difference is small, the increase in the normal rate has been applied to all effective rates in the base year.

Table 1. Variation in domestic production prices

(In percentage)

	Sector	S1	S2	S3	S4
I1	Agriculture, fishing and aquaculture	-0.05	-0.59	-0.41	-1.05
I2	Extraction of other mining and quarrying	0.15	-0.45	-0.31	-0.62
I3	Extraction of energetic products, coke and refined petroleum	4.75	-0.47	-0.32	3.92
I4	Electricity, gas and water	0.78	-0.54	-0.37	-0.13
I5	Food, beverages and tobacco	0.94	-0.47	-0.32	0.15
I6	Textile and dressing	-0.04	-0.41	-0.28	-0.73
I7	Leather products	0.01	-0.41	-0.28	-0.68
I8	Wood	0.03	-0.41	-0.29	-0.67
I9	Paper, publishing and printing	-0.05	-0.42	-0.29	-0.76
I10	Chemical industry	0.20	-0.42	-0.29	-0.52
I11	Non-metallic mineral products	0.03	-0.43	-0.30	-0.70
I12	Metallurgy and metal products	0.03	-0.41	-0.28	-0.66
I13	Mechanical machinery and equipment	-0.02	-0.39	-0.27	-0.68
I14	Manufacture of electrical machinery and precision instruments	0.00	-0.40	-0.28	-0.68
I15	Manufacture of vehicles and other transport material	0.03	-0.40	-0.28	-0.65
I16	Other manufacturing industries	-0.03	-0.39	-0.27	-0.69
I17	Construction	-0.03	-0.36	-0.25	-0.64
I18	Wholesale trade and retail trade	-0.11	-0.44	-0.30	-0.85
I19	Accommodation and catering	0.07	-0.43	-0.30	-0.66
I20	Transport and communications	0.12	-0.48	-0.33	-0.69
I21	Financial intermediation	-0.14	-0.39	-0.27	-0.80
I22	Real estate activities	-0.18	-0.51	-0.35	-1.04
I23	Market Education	-0.07	-0.31	-0.22	-0.59
I24	Market Healthcare and Social services	-0.08	-0.39	-0.27	-0.73
I25	Other activities and associative market services	-0.13	-0.45	-0.31	-0.89
I26	Households which employ household personnel	0.00	0.00	0.00	0.00
I27	Public Administration	-0.03	-0.24	-0.16	-0.43
I28	Non market Education	0.02	-0.09	-0.06	-0.13
I29	Non market healthcare and Social services	0.05	-0.17	-0.12	-0.23
I30	Other activities and associative non market services	0.01	-0.34	-0.23	-0.55

S1: Taxes on products: Extraction of energetic products, etc.: 10.5 %; Food, beverages and tobacco: 13.08 %.

S2: VAT: 12.50 %.

S3: Income tax on households: 7.2 %.

S4: S1+S2+S3.

Table 2. Variation in consumer prices

(In percentage)

	Sector	S1	S2	S3	S4
I1	Agriculture, fishing and aquaculture	-0.02	-0.04	-0.40	-0.46
I2	Extraction of other mining and quarrying	0.17	0.75	-0.31	0.61
I3	Extraction of energetic products, coke and refined petroleum	3.00	1.32	-0.32	4.03
I4	Electricity, gas and water	0.78	1.43	-0.37	1.84
I5	Food, beverages and tobacco	0.86	0.47	-0.32	1.02
I6	Textile and dressing	0.02	1.18	-0.29	0.91
I7	Leather products	0.05	1.07	-0.29	0.83
I8	Wood	0.06	1.10	-0.29	0.87
I9	Paper, publishing and printing	-0.01	0.64	-0.29	0.33
I10	Chemical industry, rubber and plastic products	0.20	0.67	-0.30	0.57
I11	Non-metallic mineral products	0.04	1.42	-0.30	1.16
I12	Metallurgy and metal products	0.07	1.77	-0.29	1.55
I13	Mechanical machinery and equipment	0.07	1.53	-0.28	1.32
I14	Manufacture of electrical machinery and precision instruments	0.10	1.72	-0.29	1.52
I15	Manufacture of vehicles and other transport material	0.09	1.25	-0.29	1.06
I16	Other manufacturing industries	0.01	1.29	-0.28	1.01
I17	Construction	-0.03	1.31	-0.25	1.03
I18	Wholesale trade and retail trade	-0.11	1.30	-0.30	0.89
I19	Accommodation and catering	0.07	0.36	-0.30	0.13
I20	Transport and communications	0.13	1.03	-0.33	0.83
I21	Financial intermediation	-0.12	-0.35	-0.27	-0.74
I22	Real estate activities	-0.15	0.19	-0.35	-0.31
I23	Market Education	-0.07	-0.31	-0.22	-0.59
I24	Market Healthcare and Social services	-0.08	-0.38	-0.27	-0.72
I25	Other activities and associative market services	-0.10	0.32	-0.31	-0.10
I26	Households which employ household personnel	0.00	0.00	0.00	0.00
I27	Public Administration	-0.03	-0.24	-0.16	-0.43
I28	Non market Education	0.02	-0.09	-0.06	-0.13
I29	Non market healthcare and Social services	0.05	-0.17	-0.12	-0.23
I30	Other activities and associative non market services	0.01	-0.32	-0.23	-0.54
	Consumption Prices Index (CPI)	0.26	0.56	-0.30	0.52

S1: Taxes on products: Extraction of energetic products, etc.: 10.5 %; Food, beverages and tobacco: 13.08 %.

S2: VAT: 12.50 %.

S3: Income tax on households: 7.2 %.

S4: S1+S2+S3.

Table 3. Variation in domestic production

(In percentage)

	Sector	S1	S2	S3	S4
I1	Agriculture, fishing and aquaculture	-0.38	-0.36	-0.50	-1.24
I2	Extraction of other mining and quarrying	0.07	-0.33	-0.02	-0.28
I3	Extraction of energetic products, coke and refined petroleum	-6.97	-0.72	-0.37	-7.96
I4	Electricity, gas and water	-0.49	-0.78	-0.38	-1.64
I5	Food, beverages and tobacco	-0.95	-0.61	-0.65	-2.19
I6	Textile and dressing	0.11	-1.04	-0.60	-1.52
I7	Leather products	0.07	-0.86	-0.53	-1.32
I8	Wood	-0.04	-0.52	-0.19	-0.75
I9	Paper, publishing and printing	-0.02	-0.47	-0.35	-0.83
I10	Chemical industry, rubber and plastic products	-0.08	-0.37	-0.22	-0.67
I11	Non-metallic mineral products	-0.04	-0.34	-0.04	-0.43
I12	Metallurgy and metal products	0.16	-0.37	0.04	-0.17
I13	Mechanical machinery and equipment	0.23	-0.34	0.22	0.11
I14	Manufacture of electrical machinery and precision instruments	0.29	-0.37	0.22	0.13
I15	Manufacture of vehicles and other transport material	0.36	-0.48	-0.02	-0.14
I16	Other manufacturing industries	0.03	-0.79	-0.22	-0.99
I17	Construction	-0.07	-0.35	0.04	-0.39
I18	Wholesale trade and retail trade	-0.37	-0.60	-0.33	-1.29
I19	Accommodation and catering	-0.21	-0.59	-0.70	-1.49
I20	Transport and communications	-0.21	-0.33	-0.18	-0.72
I21	Financial intermediation	-0.09	-0.20	-0.48	-0.77
I22	Real estate activities	-0.04	-0.32	-0.13	-0.49
I23	Market Education	-0.11	-0.08	-0.55	-0.74
I24	Market Healthcare and Social services	-0.10	-0.03	-0.58	-0.70
I25	Other activities and associative market services	-0.03	-0.47	-0.52	-1.01
I26	Households which employ household personnel	-0.18	-0.34	-1.14	-1.64
I27	Public Administration	0.00	0.00	0.00	0.00
I28	Non market Education	-0.01	-0.01	-0.06	-0.08
I29	Non market healthcare and Social services	0.00	0.00	-0.01	-0.01
I30	Other activities and associative non market services	-0.01	0.00	-0.03	-0.04

S1: Taxes on products: Extraction of energetic products, etc.: 10.5 %; Food, beveages and tobacco: 13.08 %.

S2: VAT: 12.50 %.

S3: Income tax on households: 7.2 %.

S4: S1+S2+S3.

Table 4. Public revenues and expenditures

(In percentage of GDP)

	Base year	S1	S2	S3	S4
Total revenues	**52.92**	**53.16**	**53.49**	**53.47**	**54.28**
Property income	1.17	1.17	1.18	1.17	1.18
Total income tax	10.15	10.16	10.14	10.67	10.65
Income tax (households)	6.95	6.96	6.94	7.47	7.45
Income tax (corporate)	3.20	3.20	3.20	3.20	3.20
SSCE	9.51	9.50	9.46	9.52	9.45
SSCH	1.92	1.92	1.91	1.93	1.91
SSCS	1.11	1.11	1.10	1.11	1.10
Current transfers	16.08	16.15	16.18	16.12	16.29
Taxes on production	1.25	1.25	1.24	1.25	1.24
Taxes on imports	0.02	0.02	0.02	0.02	0.02
VAT	5.68	5.68	6.30	5.65	6.28
Taxes on products	4.41	4.60	4.37	4.41	4.55
Capital	1.62	1.61	1.60	1.62	1.60
Total current expenditure	**49.84**	**50.03**	**50.08**	**50.05**	**50.48**
Public consumption	18.05	18.09	18.04	18.13	18.14
Property income	3.27	3.28	3.29	3.27	3.31
Unemployment benefits	1.97	2.01	2.05	2.04	2.16
Other social benefits	9.68	9.72	9.73	9.70	9.80
Current transfers	15.75	15.81	15.84	15.79	15.95
Subsidies on production	0.63	0.63	0.63	0.63	0.62
Subsidies on products	0.50	0.50	0.50	0.50	0.49
Public investment	**3.22**	**3.23**	**3.26**	**3.23**	**3.28**
Non residential public investment	3.10	3.10	3.14	3.10	3.15
Agriculture products	0.00	0.00	0.00	0.00	0.00
Machinery and mechanical products	0.48	0.48	0.49	0.48	0.49
Transport equipment	0.07	0.07	0.07	0.07	0.07
Other constructions	2.32	2.32	2.35	2.33	2.36
Other products	0.23	0.23	0.23	0.23	0.23
Residential public investment	0.13	0.13	0.13	0.13	0.13
Public surplus	**-0.14**	**-0.09**	**0.15**	**0.18**	**0.52**

S1: Taxes on products: Extraction of energetic products, etc.: 10.5 %; Food, beverages and tobacco: 13.08 %.

S2: VAT: 12.50 %.

S3: Income tax on households: 7.2 %.

S4: S1+S2+S3.

Table 5. Aggregate variables

Main aggregates and welfare index

	Base year	S1	S2	S3	S4
Unemployment rate (%)	13.87	14.14	14.45	14.28	15.12
Employment growth rate	-	-0.31	-0.67	-0.48	-1.45
Variation of households' net disposable income	411,757.00	-0.18	-0.34	-1.14	-1.65
Variation Consumer price index	-	0.26	0.56	-0.30	0.52
Households' welfare	-	-0.40	-0.79	-0.84	-2.02
Nominal GDP	630,263.00	-0.16	-0.05	-0.55	-0.77
Real GDP	630,263.00	-0.30	-0.31	-0.28	-0.89

Demand side aggregate variables

(In percentage of GDP)

	Base year	S1	S2	S3	S4
Private consumption	**57.91**	**57.91**	**57.75**	**57.57**	**57.40**
Total private investment	**22.61**	**22.64**	**22.55**	**22.84**	**22.81**
Non-residential private investment	16.62	16.65	16.58	16.89	16.87
Agriculture products	0.08	0.08	0.08	0.08	0.08
Machinery and mechanical products	5.20	5.21	5.19	5.28	5.28
Transport equipment	2.38	2.39	2.38	2.42	2.42
Other constructions	4.87	4.88	4.86	4.95	4.95
Other products	4.08	4.09	4.07	4.15	4.14
Residential private investment	5.99	5.99	5.54	5.96	5.51
Public consumption	**18.05**	**18.09**	**18.04**	**18.13**	**18.14**
Public investment	**3.22**	**3.23**	**3.26**	**3.23**	**3.28**
EU current balance	**1.06**	**1.03**	**1.00**	**1.05**	**0.96**
ROW current balance	**2.96**	**3.07**	**2.88**	**2.94**	**2.97**

S1: Taxes on products: Extraction of energetic products, etc.: 10.5 %; Food, beverages and tobacco: 13.08 %.

S2: VAT: 12.50 %.

S3: Income tax on households: 7.2 %.

S4: S1+S2+S3.

The effects on public revenues are noticeable but small. The percentage of taxes on products over GDP goes up from 4.41 to 4.60 percent. Employing the 2010 GDP figure, 1,062,591 million, the estimated increase is 2,018.92 million, a figure lower than the Government estimate, 2,317 million, presumably obtained by applying the new tax rates to the old bases. However, the results in Table 1-3 indicate that neither prices nor quantities remain constant after the tax reform. It is worth noticing that the public deficit falls less than the increase in taxes on products' revenues, because the ratios of several current expenditures items (unemployment benefits, other social benefits and current transfers, etc.) over GDP go up.

The increase in taxes on products raises a bit the unemployment rate (0.27 pp) and lowers employment (0.31 %) and real GDP (0.30 %). In sum, raising taxes on oil and tobacco has a noticeable effect on production and consumer prices of a few commodities and negligible effects on the rest. Production of sectors directly affected by the increase in tax rates fall while other sectors' output register either negligible changes or even some advances in the case of investment oriented sectors. The public deficit far falls less than the increase in revenues from taxes on products, and there is a negative although limited impact on unemployment, employment and GDP.

Effects of an increase in VAT rates

The effect of a 12.5 % increase in all effective VAT rates reduces domestic and total prices in Table 1, due again to the fall (0.8 %) of the price of capital services. However, consumer prices in Table 2 increase in all but a few exempted sectors (Market education and Health care, and the three public service sectors). In a few cases, the increase in consumption prices exceeds 1 %, although the overall impact measured by the CPI is 0.56 %. Changes in production levels depend on three factors: the increase in consumer

prices, the change in households' income and the effect of the reduction in the public deficit on private investment. The increase in consumer prices and the fall in employment and household income reduce domestic production levels, while the reduction of the public deficit softens those impacts in investment oriented sectors. As Table 3 makes clear the reduction in production levels is larger in industrial consumption oriented sectors ('Textiles and dressing', 'Leather products', 'Other Manufacturing', 'Electricity, gas and water', etc.) and in private non exempted services (Wholesale trade, Accommodation and catering, etc.) than in investment oriented sectors ('Non-metallic mineral products', 'Metallurgy and metal products', 'Mechanical machinery and equipment', etc.).

Under the new VAT rates, the ratio of VAT revenues over GDP raises 0.62 pp, VAT revenue goes up 11 % and total revenues increase 1.08 %. Multiplying 0.62 by the 2010 GDP, VAT revenues go up by 6,588.06 million, a figure that considerably larger than the 5.150 million announced by the Government.[10] Notice that the reduction of the public deficit, 0.29 pp., is less than half the increase in VAT revenues due to general equilibrium effects. The VAT reform raises the unemployment rate 0.58 pp and reduces employment and GDP by 0.67 and 0.31 percent, respectively. The fall in production levels and employment and the increase in consumer prices reduces the GDP shares of other taxes (income, social security contributions and taxes on products other than VAT) and increases those of public expenditures (unemployment and other social benefits, current transfers and public investment in other constructions).

[10] The overshooting may be caused by having increased all effective VAT rates 12.5 %, the same amount that the nominal normal VAT rate. Although ruling out tax evasion may be an acceptable assumption in the case of excise taxes, given the strict control exercised by the Government over the production and distribution of oil and tobacco products, it is unrealistic to adopt the same assumption in the case of the VAT.

Effects of an increase in households' income tax rate

The increase in the personal income tax reduces production prices a bit less than in the VAT simulation. That is no surprise since the equilibrium price of capital services falls 0.6 % now. In contrast with the VAT case, however, the reductions in production prices are translated into consumer prices and the CPI falls 0.30 %.

The reduction of disposable income reduces consumption and savings. However, this effect is to some extent counteracted by the reduction in consumer prices and the reduction in the public deficit. This explains the differences observed in production levels with the VAT previous simulation: the fall is considerably smaller in consumption oriented sectors and even there is an increase in production in some investment oriented sectors. Personal income revenues over GDP increase 0.52 pp. as a result of the elimination of the tax rebate. Multiplying 0.52 by the 2010 GDP, the estimated increase in revenues is 5,525.47 millions, a figure not too far from the 5.700 million advanced by Government officials

General equilibrium effects are again responsible for other things not being equal. Notice that the reduction in the public deficit (0.32 pp) is also in this case well below the increase in the personal income tax share. The fall in production level and the increase in the real wage raises 0.41 percentage points the unemployment rate and reduces 0.48 % employment and 0.28 % GDP. On the revenue side, there is a small fall in the share of VAT revenues and on the expenditure side the share of public consumption, unemployment and other social transfers and current transfers go up.

Effects of an increase in taxes on products, VAT rates and the personal income tax

Column S4 in Tables 1-5 includes the results obtained jointly simulating the three tax reforms just discussed. Production prices fall in all sectors except in 'Extraction of

energetic products, coke and refined petroleum' and 'Food, beverages and tobacco', the two sectors directly affected by the increase in oil and tobacco tax rates. Notwithstanding the fall in production prices, consumption prices of manufactures and not exempted service products go up driven by the increase in VAT rates. The CPI increases 0.52 %. Domestic production levels fall in all sectors, except 'Mechanical machinery and equipment' and 'Manufacture of electrical machinery and precision equipment', being noticeable the reduction in 'Extraction of energetic products, coke and refined petroleum', 7.96 %, and 'Food, beverages and tobacco', 2.19%.

The increase in the joint share over GDP of the personal income tax, VAT and taxes on products, 1.24 pp, is a bit lower than the sum of the increases obtained for each of them in the individual simulations, 1.33 pp. Multiplying 1.24 by the 2010 GDP, the estimated increase in revenues caused by the simultaneous increase in all rates is 13,176.13 million, a figure very similar to the figure obtained by adding up the increases estimated ex-ante by the Government in the three instances (13.167). Notice again that, the reduction in the public deficit estimated in the joint simulation, 0.66 pp, is almost half the foreseen increase in revenues. As indicated in other simulations, changes in prices and production levels explain the fall of other revenue shares and the increase of public consumption and expenditure shares in Table 4. The changes of the main macroeconomic variables in Table 5 sum up the situation: The unemployment rate increases 1.25 pp and employment and real GDP fall 1.45 and 0.89 percent, respectively

The sensitivity of the results has been tested simulating the tax policies for η =0.9 and η=1.5. The lower the value of η, smaller are the fall in domestic production, the increase in consumption prices and the fall production levels. Public revenues increase a bit more and public expenditures a bit less. However, the change in the public

surplus is just 0.07 pp, or 743.8 million using the 2010 GDP. Changes in the unemployment rate, employment and GDP growth rate are also small.

4. Conclusions

This article has presented the effects of simulating three permanent tax rate increases implemented by the Spanish Government in the second semester of 2009 and 2010 to reduce the public deficit that reached an all times record (11.1 % of GDP) in 2009. Taxes on oil products and tobacco were increased in June 2009; the normal and reduced VAT rates were increased in July 2010 and a 400 EUR deduction was eliminated in 2010, raising the effective personal income tax rate. The results obtained in each simulation indicate that the three policies increase revenues in amounts not far from those foreseen by the Government, but the reduction achieved in the public deficit is considerably smaller than one might have advanced in view of the increase in revenues. The reason being that the policies implemented change prices and quantities, modify tax bases and revenues, and increase government expenditures and transfers. In the three scenarios, the unemployment rate goes up and aggregate employment and GDP fall.

Those changes are quite significant when the three policies are jointly simulated. As expected, the GDP shares of taxes on products other than VAT, VAT and personal income go up, although a bit less than in the individual simulations. The total increase in revenues (1.4 pp) is also line with the figures expected by the Government, but the reduction achieved in the public deficit (0.7 pp) is only half that figure. Considering that the observed ratio of the public deficit to GDP fell just 1.8 pp in 2010 (from 11.1 to 9.3 percent), the result of the joint simulation suggest that the task rate hikes implemented in 2009-2010 account for only 38.9 % of the reduction in the public deficit in 2010.

The main policy implication that can be extracted from the tax simulations discussed is that further substantial spending cuts and tax increases will be required in the next few years to bring down the ratio of the public deficit over GDP to 6 % in 2011, 4.5 % in 2012 and 3 % in 2013, as accorded with EU authorities. On the expenditure side, the Spanish government may continue cutting down education and health programs, or face the need to reform the unemployment benefit system that has channeled more than 120.000 million to the unemployed in 2009-11, a generous system that may be behind the anomalous increase of the official unemployment rate in Spain that rose from 8.01 % in the third quarter of 2007 to 21.03 % in the second semester of 2011.

On the revenue side, the government needs to increase the efficiency of the fiscal system highly dependent on labor income taxes and VAT revenues from real estate transactions and automobile sales in the boom years (1996-2007). Automatic stabilizers may explain that fiscal revenues fall more than nominal GDP in recession times, but not to the extent observed in Spain. Notice that although the Government raised substantially taxes on products, VAT and personal income taxes in 2009-2010, the revenues of all public administrations in 2010 were still 53,311 million inferior to those in 2007. Since nominal GDP was almost the same (1,062,591 million in 2010 and 1,053,057 million in 2007), and the labor income share fell 2 pp. in the interim, it is hard to escape to the conclusion that non-labor income is not adequately taxed and there is widespread VAT fraud in many sectors. A profound reform is needed to increase the revenue efficiency of the Spanish fiscal system whose limitations have been exposed by the Great Recession.

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Corresponding author:

María Teresa Álvarez-Martínez

Rutgers, The State University of New Jersey

33 Livingston Avenue, Room 493

New Brunswick, NJ 08901

p. 848-932-2377 f. 732-932-2363

mta60@rci.rutgers.edu