

## **An AGE assessment of external and domestic shocks in Spain**

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### Abstract

After many years of growth, the Spanish economy is suffering the most severe and prolonged recession since there is reliable national accounts records. 2009 ended up with an unemployment rate over 18 % and a public deficit GDP ratio above 11 %. The main goal of this paper is to simulate the effects of external (fall in exports and tourism flows) and internal shocks (fall in construction investment) on the Spanish economy. The simulations are carried with a disaggregated applied general equilibrium model calibrated to a 2000 social accounting matrix (SAM) elaborated by authors under the neoclassical and the Keynesian closure rule.

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## **1. Introduction**

The main goal of this article is to present the results of some simulations performed with an applied general equilibrium (AGE) model to assess the impact of external and domestic shocks that struck the Spanish economy down in 2008-09 abruptly ending to twelve years of sustained economic growth.

AGE multisector models have been employed to assess the impact of changes in exogenous variables (endowments, exports, government expenditures, etc.) and parameters (tax rates, subsidies, etc.) on equilibrium prices and quantities. They provide valuable quantitative insights on changes in the allocation of resources among sectors, household welfare and major economic aggregates. However, the results drawn from the simulations are quite sensitive to the closure rule employed. In this article, some simulations are performed using the neoclassical or the Keynesian closure rules or both.

The neoclassical closure rule assumes that the value of private aggregate investment is determined by the value of household savings, the government deficit and the current account surplus of foreign sectors. In this setting, a negative external shock from the domestic viewpoint, such as a fall in exports, sets up an implausible investment boom in the economy. Under the Keynesian closure rule, aggregate investment is arbitrarily fixed and it is the sum of the value of private savings, the government deficit and the current account deficit that adjusts to equal the value of investment when there is a negative external shock adjusts. In this case, an investment boom is ruled out by hypothesis and the external shock increases the unemployment rate to reduce the value of private savings.

The Keynesian closure rule has been rightly criticized for decades. No economist can feel comforted accepting that investment is exogenously determined by the “animal spirits”, as Keynes’ put it. However, the neoclassical closure rule leads to

results completely at odds with intuition and observations (see, Polo and Valle, 2008). Moreover, Polo and Viejo (2009) attempt to replicate economic observations with a multisector model of Spain suggests that the neoclassical closure rule can give acceptable results in the medium run but misses completely the effects of economic recessions.

The paper is organized as follows. The next section describes the current economic situation in Spain. Section 3 depicts the main features of the AGE model and section 4 presents the simulations scenarios and the results under the neoclassical closure. The results of the same simulations and two additional scenarios under the Keynesian closure are presented in section 5. Finally, section 6 gives some conclusions.

## **2. A bit of background**

Spain was for more than a decade the economic wonder of European countries. GDP grew at an amazing 3.7 percent average rate from 1996 until 2007 and employment jumped from 12.5 millions in 1995 to an impressive 20.5 millions in the third quarter of 2007<sup>2</sup>. In September, the President of the Government announced proudly that Spain “had entered in the Champions League of the world economy”. A few months later, he proudly announced that having overtaken Italy in per capita income, France was the next target. All his optimistic plans and promises - included the one of reaching full employment in the current legislature- fell into oblivion a few months later. The growth rate fell to 0.9 percent in 2008 and to -3.6 percent in 2009, by far the largest negative value ever recorded since the National Statistic Institute started publishing national accounts figures in the 50’s.

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<sup>2</sup> Figures are not strictly comparable due to methodological changes introduced in the Active Population Survey (Encuesta Población Activa) since 1995.

During the second semester of 2008, most advanced economies plunged into recession as financial instability spread out throughout the world. The financial turmoil sparked by defaults of subprime mortgages in the US and other non orthodox financial practices in most developed countries left not only banks and other financial entities exposed to bankruptcy but it stopped the flow of credit from financial institutions to non financial businesses and families. The Federal Reserve, the European Central Bank and other central banks reduced interest rates to minimums and eased credit facilities while the Governments created emergency funds to rescue banks in distress, buying assets overvalued in their balance sheets and backing new debt issues. As many businesses closed down and unemployment started rising, public expenditures and transfers increased fast while tax revenues plummeted leaving the governments with huge deficits to finance.

Spain had lived above its means since at least 2000 but the situation became dramatic at the height of the boom when the current account deficit reached 10.02 percent of GDP in 2007. During those years, financial institutions, non financial firms and families became used to finance a growing share of domestic demand indebting themselves with non residents. Unfortunately, most of those external resources were dedicated to finance residential investment and other type of constructions. For years, more lodgings were constructed in Spain than in Germany, France and Italy together, despite the fact that Spain had one of the lowest population growth rates in the EU. In 2007, gross fixed capital formation reached 30.7 percent of GDP but residential and non residential construction absorbed 58 percent of that total. Any objective observer could foresee that non residents would not be indefinitely willing to finance construction investment in Spain and that any change in the climate of world financial markets might

bring to a stop the growth process. That is what happened in the second semester of 2008.

### 3. The model

The AGE model used in this study is a standard static model. These models can be defined as a set of equations that captures the optimization behavior of all agents within the economy taking into account the influence of relative prices in agents' decisions. In what follows we present the main features of the AGE model elaborated for the Spanish economy in 2000 and closure rules.

#### *Agents and commodities*

In this model, there are thirty domestic producers and thirty consumption commodities, one representative resident household, the government, two non-residents consumers, from the EU and the ROW, and two foreign sectors, the EU and the ROW. There are two productive factors, labor and capital, and twelve private and public capital goods.

#### *Production technology*

The total production of commodity  $i$  ( $Y_i$ ) is a nested constant returns to scale production technology. At the first level total production is a Constant Elasticity of Substitution (CES) aggregate of domestic production,  $Y_{di}$ , imports from the EU,  $Y_{eui}$ , and imports from the ROW,  $Y_{rowi}$ .

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

Where  $\delta_{di}$ ,  $\delta_{eui}$  and  $\delta_{rowi}$  are, respectively, the domestic and foreign distributive parameters and  $\rho_i$  is the parameter that determines the degree of substitution between domestic products and imports (Armington, 1969).

In the second level, domestic production combines intermediate inputs and value added in fixed proportions.

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

Where  $X_{ji}$  ( $V_i$ ) is the quantity of the input  $j$  (value added) used in the production of  $i$  and  $a_{ji}$  ( $v_i$ ) is the corresponding technical coefficient (unitary requirement of value added). Finally, value added is obtained as a Cobb-Douglas combination of labor ( $L_i$ ) and capital ( $K_i$ ).

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

where  $\gamma_i$ ,  $\beta_{li}$  and  $(1-\beta_{li})$  are, respectively, the scale parameter and the labor and capital elasticity.

Firms minimize production costs subject to their value added constraint at the lowest level in the nesting.

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

Where  $w$  and  $r$  are the prices of labor and capital services and  $\tau_i^{ssce}$  and  $\tau_i^{ssch}$  are the social security contribution rates of employers (SSCE) and employees (SSCH). The price of value added that minimizes costs is:

$$p_{vi}^* = w \left( 1 + \tau_i^{ssce} + \tau_i^{ssch} \right) \frac{L_i^*}{Y_i} + r \frac{K_i^*}{Y_i}$$

Where  $L_i^*$  and  $K_i^*$  are the solution of the minimization problem of firms. Additionally, the intermediate demand and value added that minimize production costs are given by:

$$X_{ji}^* = a_{ji} Y_{di}, \quad V_i^* = v_i Y_{di}$$

And the price of domestic commodities is:

$$p_{di}^* = \left( \sum_j^{30} p_j^* a_{ji} + p_{vi}^* v_i \right) \left( 1 + \tau_i^p + \tau_i^{pr} - S_i^p - S_i^{pr} \right)$$

Where  $\tau_i^p$  and  $\tau_i^{pr}$  are, respectively, the taxes rates on production and products and  $S_i^p$  and  $S_i^{pr}$  their corresponding subsidies. Firms minimize the cost of producing  $i$

$$p_{di}^* Y_{di} + p_{eui}^* Y_{eui} + p_{rowi}^* \left( 1 + \tau_i^{row} \right) Y_{rowi} \quad \text{s.t.} \quad Y_i = \phi_i \left( \delta_{di} Y_{di}^{\rho_i} + \delta_{eui} Y_{eui}^{\rho_i} + \delta_{rowi} Y_{rowi}^{\rho_i} \right)^{1/\rho_i}$$

Where  $p_{eui}^*$  and  $p_{rowi}^*$  are composite prices

$$P_{fi}^* = \sum_{i=1}^{30} P_i^* \xi_i \quad f = eu, row$$

And  $\xi_i$  is the commodity  $i$  export share on total exports. Then, the price that maximizes profits is:

$$P_i^* = P_{di}^* \frac{Y_{di}^*}{Y_i^*} + P_{eui}^* \frac{Y_{eui}^*}{Y_i^*} + P_{rowi}^* (1 + \tau_i^{row}) \frac{Y_{rowi}^*}{Y_i^*}$$

Where  $Y_{di}^*$ ,  $Y_{eui}^*$  and  $Y_{rowi}^*$  are determined in the cost minimization program of firms.

The thirty consumption commodities are produced with fixed proportions of total production. The production function can be defined as:

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

Where  $Z_{ic}$  is the quantity of commodity  $i$  used to produce the consumption commodity  $c$ , and  $z_{ic}$  is the unitary requirement. Consumption is taxed with value added tax ( $\tau_c^{VAT}$ ) so the price is

$$P_c^* = \left( \sum_{i=1}^{30} P_i^* z_{ic} \right) (1 + \tau_c^{VAT})$$



## Households

The representative household maximizes the utility derived from consumption and savings by means of a Cobb-Douglas function:

$$U(C, S) = \prod_{c=1}^{30} C_c^{\alpha_c} S^{1 - \sum_{c=1}^{30} \alpha_c}$$

Where  $C_c^{\alpha_c}$  is the consumption of consumer commodity  $c$  and  $S^{\alpha_s}$  is saving.  $\alpha$ 's are the share parameters of consumption and savings that add up to one. Households' gross income stem from the sale of labor services in the domestic economy,  $(\bar{L}_h^{in})$ , in the EU,  $(\bar{L}_h^{eu})$  and in the Rest of the World  $(\bar{L}_h^{row})$ ; the sale of capital services in the domestic economy,  $(\bar{K}_h)$ ; unemployment benefits; the share in SSCE revenues; transfers from the corporate sector; other current transfers; property incomes; welfare benefits; and unemployment benefits;

$$GI_h = w(1 - u_l)\bar{L}_h^{in} + w^{eu}\bar{L}_h^{eu} + w^{row}\bar{L}_h^{row} + r\bar{K}_h + PSCEC_h \cdot SCEC \\ + p_c(ADJ + TRR_h + PIR_h + BFR_h) + \mu \cdot w \cdot u_l \cdot \bar{L}_h^{in}$$

Where  $u_l$  is the unemployment rate,  $PSCEC_h$  is the share of households in social security contributions of employers revenues, which is  $SCEC$ ,  $ADJ$  are the transfers due to the adjustments for the change in net equity of households in pension funds reserves,  $TRR$  current transfers,  $PIR$  property income revenues and  $BFR$  are the welfare

benefits other than social transfers in kind, valued all them with a consumer price index.

Finally,  $\mu$  is the proportion of the wage rate paid to unemployed.

Disposable income,  $DI_h$ , equals  $GI_h$  minus personal income tax,  $\tau^{iph}$ , social contributions paid by self-employees,  $\tau^{scs}$ , which depend on households labor incomes and several transfers paid by households, as current transfers  $TRP$ , property income  $PIP$ , welfare benefits  $BFP$ , and residential consumption in the EU,  $RC_{eu}$ , and the ROW,  $RC_{row}$ , valued with a consumer price index.

$$DI_h = GI_h(1 - \tau^{iph}) - \left[ \left( w_l (\bar{L}_h^m (1 - u_l)) + w_l \bar{L}_h^{eu} + w_l \bar{L}_h^{row} \right) \tau^{scs} \right] - p_c (TRP_h + PIP_h + BFP_h + RC_{eu} + \cdot RC_{row})$$

Consumption and savings demands are the solution to the maximization problem of households:

$$\text{Max} \prod_{c=1}^{30} C_c^{\alpha_c} S^{1 - \sum_{c=1}^{30} \alpha_c} \quad \text{s.t.} \quad DI = \sum_{c=1}^{30} p_c C_c + p_s S$$

Where  $p_s$  is a price index of investment goods

$$p_s = \sum_{i=1}^{30} \theta_i p_i$$

Moreover, there are six private capital goods and one of them is the residential investment. In this model households' invest in residential capital in a fix proportion of their savings,  $S_{hri}$ , such as:

$$p_{ri}RI_h = p_s S_{hri} S$$

And the price of private residential investment  $p_{ri}$  can be defined as the price of construction,  $p_{co}$ , plus the VAT rate:

$$p_{ri} = p_{co}(1 + \tau^{vat})$$

### *Government*

The Government collects taxes from labor, income, production and consumption, which together with capital income and transfers finance public expenditure. Government revenues are used to pay unemployment benefits and other transfers, public consumption and investment in six capital goods: Agricultural products, Machinery and mechanical products, Transport equipment, Residential investment, Other constructions and Other products. Consumption and public investment are held constant, and because prices, revenues and some expenditure are endogenous, also is the budget surplus.

### *Foreign sector*

There are two foreign sectors, the EU and the ROW, which revenues stem from imports, labor income and transfers from residential sectors. The EU also obtains incomes from their share in tax revenues. These incomes are used to pay exports, income payments to residents and transfers, including in the case of the EU the payment of subsidies on products and production. Since imports and prices are endogenous, the current account balance is endogenous while the level of exports and transfers are exogenously fixed.

### *Productive factors market*

Labor and capital demanded by producers must be equal to supply in absence of price restrictions. However, in this model there is a reaction equation of real wage to unemployment rate, which can be interpreted as a restriction on prices.

$$\frac{w(1 - \tau^{iph})}{P_c} = k_l(1 - u)^{\frac{1}{\eta_l}}, \quad \eta_l > 0$$

Where  $\frac{w}{P_c}$  is the real wage,  $\tau^{iph}$  is the income tax rate paid by households,  $k_l$  is a scale parameter,  $u$  is the unemployment rate and  $\eta_l$  is the elasticity parameter of the real wage to unemployment. This equation is included in the model only when private investment is endogenous.

### *The neoclassical closure*

The closure rule used in each model is a key question that determines the results. The neoclassical closure assumes that private investment is endogenously determined by changes in domestic and foreign savings and the current account deficit that are endogenous. Public investment and exports are fixed. This is the closure rule commonly used to analyze fiscal policies issues (Polo and Sancho, 1993a, 1993b, Kehoe, Polo and Sancho, 1995, Cardenete and Sancho, 2003, Fernández and Polo, 2004, and Sancho, 2004). Under this closure, Walras' Law is satisfied and one market clearing equation is implied by the others. In this case, equilibrium prices are determined up to a scalar but since behavioral relations depend only upon relative prices they can be calculated once a commodity is chosen as the *numeraire*. The version of the neoclassical model used here includes a real wage-unemployment relation that captures frictions in the labor market whereby labor endowment may not fully employed and the unemployment rate may change in response to a shock. In this setting, a negative external shock from the domestic viewpoint, such as a fall in exports, sets up an implausible investment boom in the economy. Of course, since private investment is endogenous it makes no sense to simulate a fall in investment demand.

### *The Keynesian closure*

The Keynesian closure assumes that private investment is exogenous and the value of private savings, public deficit and the current account adjusts to match the value of private investment. In this case, the real wage- unemployment equation present in the neoclassical closure is removed from the model and the unemployment rate adjusts the value of the sum of private savings, public deficit and current account balances to that of private investment. The wage rate is exogenously fixed to solve the model.

### *Equilibrium*

The equilibrium conditions depend on the closure rule chosen. Under the neoclassical closure, where private investment is endogenous, we assume that all transfers, public consumption and investment and exports are exogenous. Then, the equilibrium of this economy can be defined as a set of prices  $(\bar{p}_i, \bar{p}_{di}, \bar{p}_c, \bar{w}, \bar{r})$ , production plan for producers  $(\bar{Y}_i, \bar{Y}_{di}, \bar{Y}_{eui}, \bar{Y}_{rowi}, \bar{C}_c, \bar{X}_{ji}, \bar{V}_i, \bar{L}_i, \bar{K}_i)$ , consumption-savings plan for the representative household  $(\bar{C}, \bar{S})$ , an unemployment rate  $\bar{u}$ , a public deficit and a current account deficit such as:

- Production maximizes profits
- Consumption and savings maximize households welfare
- All commodity markets clear
- The capital markets clear
- Labor and capital demands equal effective supply
- Public deficit equals the difference between revenues and expenditures
- The current account deficit satisfies the foreign sector equation
- And under the neoclassical closure, private investment is determined by domestic and foreign savings.

### *Calibration of the model*

The 2000 SAM for the Spanish economy elaborated by the authors is the database used to specify the parameters and fixed variables of the model. This is a 128x128 square matrix with one representative household, two non-residents consumers, from the EU

and the RoW, Government, Corporations, two foreign sectors, thirty productive sectors and twelve public and private capital goods. In this model, all prices are equal to one in the base year and all the flows in the SAMSP-00 satisfy the equilibrium conditions. The elasticities of substitution between domestic production and imports have been taken from Blake (2000). Finally, the elasticity of real wage to unemployment is 1.2, derived from the Phillips curve estimated by Andrés et al. (1988) for Spain.

#### **4. An evaluation of external shocks: neoclassical closure rule**

The international recession caused a substantial fall in international tourism arrivals and expenditure as well as a reduction in exports of goods and non touristic services. In this section we explain how to calculate the percentage variation used to update the exogenous variables. Then, we simulate individual and jointly the effects of reducing non-residents consumption and exports.

##### **4.1 Simulation scenarios.**

The first simulation is motivated by the sharp drop of tourism in 2009, around 11% according to FRONTUR<sup>3</sup>, and consequently in tourism expenditure, around 8.9% according to EGATUR<sup>4</sup>. The global economic recession reduces inbound tourism receipts but also domestic tourism. This fall basically affects tourism-dependent sectors, for example hotels, restaurants or travel agencies, but also other sectors such as Transport and communications, Wholesale trade and retail trade, due to direct and indirect linkages, and above all labor.

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<sup>3</sup> FRONTUR is the acronym of Spanish border Survey of inbound tourism

<sup>4</sup> EGATUR is the acronym of Spanish tourism expenditure Survey for residents and non-residents

Table 1 shows the chain-volume index of non-residents consumption provided by National Accounts from the third quarter of 2007 to the second quarter of 2009. The change in the four quarter average index is 8.75 percent, a value in line with the other estimates. In these simulations, we reduce non-residents consumption by 9%.

<b>Table 1. Non-residents consumption expenditure</b>	
(Chained-linked volume index)	
<b>Quarter</b>	
Second 2009	88.74
First 2009	53.27
Fourth 2008	70.37
Third 2008	140.29
<b>Average index 2009-08</b>	<b>88.17</b>
Second 2008	97.59
First 2008	63.47
Fourth 2007	78.94
Third 2007	146.48
<b>Average index 2008-07</b>	<b>96.62</b>
<b>Variation average index 2009-08 over 2008-07</b>	<b>-8.75</b>
Source: Quarterly National Accounts (INE)	

The international recession has also caused an important fall in exports of goods and non-tourists services. Table 2 presents the values of the volume-chain index for exports of goods and services provided by the Quarterly National Accounts. The variations of the average index from 2009-08 over 2008-07 for both exports and services have been aggregated using the weights reported in the table to obtain the 9.4 aggregate falls. In the simulations we use 9.5 percent.



<b>Table 2. Exports of goods and non-touristic services</b>		
(chained-linked volume index)		
	<b>Exports of goods</b>	<b>Exports of non-touristic services</b>
<b>Quarter</b>		
Second 2009	120.26	147.78
First 2009	113.68	155.06
Fourth 2008	121.18	171.90
Third 2008	136.51	179.66
<b>Average index 2009-08</b>	<b>122.91</b>	<b>163.60</b>
Second 2008	144.17	174.62
First 2008	140.53	166.61
Fourth 2007	133.37	162.28
Third 2007	131.88	184.24
<b>Average index 2008-07</b>		
<b>Variation average index 2009-08 over 2008-07</b>	<b>-10.60</b>	<b>-4.85</b>
<b>Weights</b>	<b>0.77</b>	<b>0.23</b>
<b>Aggregate weighted variation</b>	<b>-9.40</b>	
Source: Quarterly National Accounts (INE)		

## 4.2 The results

A fall in tourism expenditures has direct effect on the sectors that produce goods and services for tourists, hotels, apartments, car rentals, restaurants, travel agencies, etc., and indirect effects on other sectors that produce goods and services for touristic sectors. Moreover, the fall in income in all these sectors affects to all sectors through expenditure and saving decisions. Similar effects result from a fall in exports of goods and non-touristic services.

The results of the simulations appear in Tables 3-9. Tables 3-5 show the variation in domestic and total production prices and consumption prices; Tables 6-7 report the changes in domestic and total production; and Tables 8-9 information on public revenues and expenditures and aggregate variables. All tables include three

columns. Columns S1 and S2 report the results of the fall in non-residents consumption and exports, respectively; and column S3 the joint effect of both changes. Tables 8 and 9 include a *Base year* column with the values of the variables before the simulation.

The fall in non-residents consumption and exports has a negative impact on sectors that produce touristic services and private goods and services for export, respectively. In the case of a 9.0 percent fall in non-residents demand (see, column S1 in Table 6), Transport and Communications, Accommodation and catering, Leather products and Other activities and associative market services are the sectors most affected by the contraction of non-residents demand. There are, however, other sectors (Construction, Manufacture of electrical machinery, Mechanical machinery and equipment, etc.) where output does not fall or even increases.

The reallocation of resources among sectors is due to the neoclassical closure rule that boosts private investment when there is an improvement in the current account of the external sectors, other things equal. After a fall in non-residents consumption, for instance, the current account surplus of the EU and the ROW show a joint improvement of 0.57 percentage points (pp) over GDP that almost matches the 0.55 increase in the share of private investment over GDP. The difference between the two figures is explained by the slight worsening of the public surplus, -0.14 in the base year and -0.16 in the simulation.

The 9.5 percent fall in exports of goods and non-touristic services has even more pronounced effects on the reallocation of resources among sectors. Export oriented sectors (Leather products, Chemical products, Textile and dressing, Manufacture of vehicles, Agriculture, Transport and communications, etc.) are those whose production decreases most, while investment oriented sectors are again the winners. The

reallocation of resources follows the same general pattern, although sectors producing tourists' services are unaffected in this case.

The effects on prices (Tables 3-5), government receipts and expenditures (Table 8) and most aggregate variables (see, Table 9) are negligible. This is not surprising since the equilibrium prices of labor and capital do not change either. The only sensible change in the aggregate variables is private investment that increases, as indicated above, almost the same percentage point that increases the current account surplus of the EU and ROW.

**Table 3. Variation in domestic production prices**

(In percentage)

	<b>Sector</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>
II1	Agriculture, fishing and aquaculture	-0.04	-0.10	-0.14
II2	Extraction of other mining and quarrying	-0.03	-0.08	-0.11
II3	Extraction of energetic products, coke and refined petroleum	-0.03	-0.08	-0.11
II4	Electricity, gas and water	-0.03	-0.09	-0.13
II5	Food, beverages and tobacco	-0.03	-0.08	-0.11
II6	Textile and dressing	-0.03	-0.07	-0.10
II7	Leather products	-0.03	-0.07	-0.10
II8	Wood	-0.03	-0.07	-0.10
II9	Paper, publishing and printing	-0.03	-0.07	-0.10
II10	Chemical industry, rubber and plastic products	-0.03	-0.07	-0.10
II11	Non-metallic mineral products	-0.03	-0.07	-0.10
II12	Metallurgy and metal products	-0.03	-0.07	-0.10
II13	Mechanical machinery and equipment	-0.03	-0.07	-0.09
II14	Manufacture of electrical machinery and precision instruments	-0.03	-0.07	-0.09
II15	Manufacture of vehicles and other transport material	-0.03	-0.07	-0.09
II16	Other manufacturing industries	-0.03	-0.07	-0.09
II17	Construction	-0.02	-0.06	-0.09
II18	Wholesale trade and retail trade	-0.03	-0.08	-0.10
II19	Accommodation and catering	-0.03	-0.07	-0.10
II20	Transport and communications	-0.03	-0.08	-0.11
II21	Financial intermediation	-0.02	-0.07	-0.09
II22	Real estate activities	-0.03	-0.09	-0.12
II23	Market Education	-0.02	-0.05	-0.07
II24	Market Healthcare and Social services	-0.03	-0.07	-0.09
II25	Other activities and associative market services	-0.03	-0.08	-0.11
II26	Households which employ household personnel	0.00	0.00	0.00
II27	Public Administration	-0.02	-0.04	-0.06
II28	Non market Education	-0.01	-0.02	-0.02
II29	Non market healthcare and Social services	-0.01	-0.03	-0.04
II30	Other activities and associative non market services	-0.02	-0.06	-0.08
S1: 9% fall in non-residents consumption demand				
S2: 9.5% fall in exports				
S3: S1+S2				

**Table 4. Variation in total production prices**

(In percentage)

	<b>Sector</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>
II1	Agriculture, fishing and aquaculture	-0.04	-0.10	-0.13
II2	Extraction of other mining and quarrying	-0.03	-0.08	-0.11
II3	Extraction of energetic products, coke and refined petroleum	-0.03	-0.08	-0.11
II4	Electricity, gas and water	-0.03	-0.09	-0.13
II5	Food, beverages and tobacco	-0.03	-0.08	-0.11
II6	Textile and dressing	-0.03	-0.07	-0.10
II7	Leather products	-0.03	-0.07	-0.10
II8	Wood	-0.03	-0.07	-0.10
II9	Paper, publishing and printing	-0.03	-0.07	-0.10
II10	Chemical industry, rubber and plastic products	-0.03	-0.07	-0.10
II11	Non-metallic mineral products	-0.03	-0.07	-0.10
II12	Metallurgy and metal products	-0.03	-0.07	-0.10
II13	Mechanical machinery and equipment	-0.03	-0.07	-0.10
II14	Manufacture of electrical machinery and precision instruments	-0.03	-0.07	-0.10
II15	Manufacture of vehicles and other transport material	-0.03	-0.07	-0.10
II16	Other manufacturing industries	-0.03	-0.07	-0.09
II17	Construction	-0.02	-0.06	-0.09
II18	Wholesale trade and retail trade	-0.03	-0.08	-0.10
II19	Accommodation and catering	-0.03	-0.07	-0.10
II20	Transport and communications	-0.03	-0.08	-0.11
II21	Financial intermediation	-0.03	-0.07	-0.09
II22	Real estate activities	-0.03	-0.09	-0.12
II23	Market Education	-0.02	-0.05	-0.07
II24	Market Healthcare and Social services	-0.03	-0.07	-0.09
II25	Other activities and associative market services	-0.03	-0.08	-0.11
II26	Households which employ household personnel	0.00	0.00	0.00
II27	Public Administration	-0.02	-0.04	-0.06
II28	Non market Education	-0.01	-0.02	-0.02
II29	Non market healthcare and Social services	-0.01	-0.03	-0.04
II30	Other activities and associative non market services	-0.02	-0.06	-0.08
S1: 9% fall in non-residents consumption demand				
S2: 9.5% fall in exports				
S3: S1+S2				

**Table 5. Variation in consumer prices**

(In percentage)

	<b>Sector</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>
II1	Agriculture, fishing and aquaculture	-0.04	-0.10	-0.13
II2	Extraction of other mining and quarrying	-0.03	-0.08	-0.11
II3	Extraction of energetic products, coke and refined petroleum	-0.03	-0.08	-0.11
II4	Electricity, gas and water	-0.03	-0.09	-0.13
II5	Food, beverages and tobacco	-0.03	-0.08	-0.11
II6	Textile and dressing	-0.03	-0.07	-0.10
II7	Leather products	-0.03	-0.07	-0.10
II8	Wood	-0.03	-0.07	-0.10
II9	Paper, publishing and printing	-0.03	-0.07	-0.10
II10	Chemical industry, rubber and plastic products	-0.03	-0.07	-0.10
II11	Non-metallic mineral products	-0.03	-0.07	-0.10
II12	Metallurgy and metal products	-0.03	-0.07	-0.10
II13	Mechanical machinery and equipment	-0.03	-0.07	-0.10
II14	Manufacture of electrical machinery and precision instruments	-0.03	-0.07	-0.10
II15	Manufacture of vehicles and other transport material	-0.03	-0.07	-0.10
II16	Other manufacturing industries	-0.03	-0.07	-0.09
II17	Construction	-0.02	-0.06	-0.09
II18	Wholesale trade and retail trade	-0.03	-0.08	-0.10
II19	Accommodation and catering	-0.03	-0.07	-0.10
II20	Transport and communications	-0.03	-0.08	-0.11
II21	Financial intermediation	-0.03	-0.07	-0.09
II22	Real estate activities	-0.03	-0.09	-0.12
II23	Market Education	-0.02	-0.05	-0.07
II24	Market Healthcare and Social services	-0.03	-0.07	-0.09
II25	Other activities and associative market services	-0.03	-0.08	-0.11
II26	Households which employ household personnel	0.00	0.00	0.00
II27	Public Administration	-0.02	-0.04	-0.06
II28	Non market Education	-0.01	-0.02	-0.02
II29	Non market healthcare and Social services	-0.01	-0.03	-0.04
II30	Other activities and associative non market services	-0.02	-0.06	-0.08
	Consumption Prices Index (CPI)	-0.03	-0.07	-0.09
S1: 9% fall in non-residents consumption demand				
S2: 9.5% fall in exports				
S3: S1+S2				

**Table 6. Variation in domestic production**

(In percentage)

	<b>Sector</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>
II1	Agriculture, fishing and aquaculture	-0.13	-1.87	-2.00
II2	Extraction of other mining and quarrying	0.65	0.02	0.67
II3	Extraction of energetic products, coke and refined petroleum	-0.21	-1.68	-1.89
II4	Electricity, gas and water	0.01	-0.39	-0.38
II5	Food, beverages and tobacco	-0.29	-1.28	-1.57
II6	Textile and dressing	-0.09	-1.85	-1.94
II7	Leather products	-0.48	-3.10	-3.58
II8	Wood	0.41	0.11	0.52
II9	Paper, publishing and printing	0.08	-1.19	-1.11
II10	Chemical industry, rubber and plastic products	0.08	-2.42	-2.35
II11	Non-metallic mineral products	0.69	0.91	1.60
II12	Metallurgy and metal products	0.72	-0.35	0.37
II13	Mechanical machinery and equipment	1.06	1.38	2.44
II14	Manufacture of electrical machinery and precision instruments	1.05	1.64	2.69
II15	Manufacture of vehicles and other transport material	0.65	-1.88	-1.23
II16	Other manufacturing industries	0.53	0.81	1.34
II17	Construction	1.05	4.00	5.05
II18	Wholesale trade and retail trade	0.15	-0.98	-0.83
II19	Accommodation and catering	-1.01	0.00	-1.01
II20	Transport and communications	-1.47	-1.63	-3.10
II21	Financial intermediation	-0.21	-0.63	-0.84
II22	Real estate activities	0.42	1.21	1.62
II23	Market Education	0.02	-0.06	-0.05
II24	Market Healthcare and Social services	-0.21	-0.04	-0.25
II25	Other activities and associative market services	-0.43	0.22	-0.21
II26	Households which employ household personnel	-0.07	-0.03	-0.10
II27	Public Administration	0.00	0.00	0.00
II28	Non market Education	0.00	0.00	0.00
II29	Non market healthcare and Social services	0.00	0.00	0.00
II30	Other activities and associative non market services	0.00	0.00	0.00
S1: 9% fall in non-residents consumption demand				
S2: 9.5% fall in exports				
S3: S1+S2				

**Table 7. Variation in total production**

(In percentage)

	<b>Sector</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>
II1	Agriculture, fishing and aquaculture	-0.13	-1.88	-2.01
II2	Extraction of other mining and quarrying	0.65	0.02	0.67
II3	Extraction of energetic products, coke and refined petroleum	-0.21	-1.69	-1.90
II4	Electricity, gas and water	0.01	-0.39	-0.38
II5	Food, beverages and tobacco	-0.29	-1.28	-1.57
II6	Textile and dressing	-0.09	-1.84	-1.93
II7	Leather products	-0.48	-3.10	-3.58
II8	Wood	0.41	0.11	0.52
II9	Paper, publishing and printing	0.08	-1.19	-1.11
II10	Chemical industry, rubber and plastic products	0.08	-2.42	-2.34
II11	Non-metallic mineral products	0.69	0.91	1.60
II12	Metallurgy and metal products	0.73	-0.35	0.38
II13	Mechanical machinery and equipment	1.06	1.39	2.45
II14	Manufacture of electrical machinery and precision instruments	1.05	1.65	2.70
II15	Manufacture of vehicles and other transport material	0.65	-1.87	-1.22
II16	Other manufacturing industries	0.53	0.81	1.34
II17	Construction	1.05	4.00	5.05
II18	Wholesale trade and retail trade	0.15	-0.98	-0.83
II19	Accommodation and catering	-1.01	0.00	-1.01
II20	Transport and communications	-1.47	-1.63	-3.10
II21	Financial intermediation	-0.21	-0.63	-0.84
II22	Real estate activities	0.41	1.21	1.62
II23	Market Education	0.02	-0.06	-0.05
II24	Market Healthcare and Social services	-0.21	-0.04	-0.25
II25	Other activities and associative market services	-0.43	0.22	-0.21
II26	Households which employ household personnel	-0.07	-0.03	-0.10
II27	Public Administration	0.00	0.00	0.00
II28	Non market Education	0.00	0.00	0.00
II29	Non market healthcare and Social services	0.00	0.00	0.00
II30	Other activities and associative non market services	0.00	0.00	0.00
S1: 9% fall in non-residents consumption demand				
S2: 9.5% fall in exports				
S3: S1+S2				



**Table 8. Public revenues and expenditures**

(In percentage of GDP)

	<b>Base year</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>
<b>Total revenues</b>	<b>52.92</b>	<b>52.91</b>	<b>52.90</b>	<b>52.88</b>
Property income	1.17	1.17	1.17	1.17
Total income tax	10.15	10.16	10.15	10.15
Income tax (households)	6.95	6.95	6.95	6.95
Income tax (corporate)	3.20	3.20	3.20	3.20
SSCE	9.51	9.52	9.52	9.53
SSCH	1.92	1.93	1.93	1.93
SSCS	1.11	1.11	1.11	1.11
Current transfers	16.08	16.09	16.08	16.08
Taxes on production	1.25	1.25	1.25	1.25
Taxes on imports	0.02	0.02	0.02	0.02
VAT	5.68	5.64	5.68	5.64
Taxes on products	4.41	4.41	4.38	4.38
Capital	1.62	1.62	1.62	1.62
<b>Total current expenditures</b>	<b>49.84</b>	<b>49.84</b>	<b>49.81</b>	<b>49.81</b>
Public consumption	18.05	18.06	18.05	18.05
Property income	3.27	3.27	3.26	3.26
Unemployment benefits	1.97	1.97	1.96	1.96
Other social benefits	9.68	9.68	9.67	9.67
Current transfers	15.75	15.75	15.74	15.74
Subsidies on production	0.63	0.63	0.63	0.63
Subsidies on products	0.50	0.50	0.49	0.49
<b>Public investment</b>	<b>3.22</b>	<b>3.22</b>	<b>3.22</b>	<b>3.22</b>
Non residential public investment	3.10	3.10	3.09	3.09
Agriculture products	0.00	0.00	0.00	0.00
Machinery and mechanical products	0.48	0.48	0.48	0.48
Transport equipment	0.07	0.07	0.07	0.07
Other constructions	2.32	2.32	2.32	2.32
Other products	0.23	0.23	0.23	0.23
Residential public investment	0.13	0.13	0.13	0.13
<b>Public surplus</b>	<b>-0.14</b>	<b>-0.16</b>	<b>-0.12</b>	<b>-0.14</b>
S1: 9% fall in non-residents consumption demand				
S2: 9.5% fall in exports				
S3: S1+S2				

**Table 9. Aggregate variables**

<b>Main aggregates and welfare index</b>				
	<b>Base year</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>
Unemployment rate (%)	13.87	13.84	13.80	13.78
Employment growth rate	-	0.03	0.08	0.10
Variation of households' net disposable income	411,757.00	-0.01	-0.03	-0.04
Variation of consumer price index	-	-0.03	-0.07	-0.09
Households' welfare	-	0.02	0.05	0.06
Nominal GDP	630,236.00	-0.04	-0.02	-0.06
Real GDP	630,236.00	-0.01	0.05	0.03
<b>Demand side aggregate variables</b>				
(In percentage of GDP)				
	<b>Base year</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>
<b>Private consumption</b>	<b>57.91</b>	<b>57.93</b>	<b>57.91</b>	<b>57.93</b>
<b>Total private investment</b>	<b>22.61</b>	<b>23.16</b>	<b>24.69</b>	<b>25.24</b>
Non residential private investment	16.62	17.17	18.70	19.25
Agriculture products	0.08	0.08	0.09	0.09
Machinery and mechanical products	5.20	5.37	5.85	6.02
Transport equipment	2.38	2.46	2.68	2.76
Other constructions	4.87	5.04	5.48	5.65
Other products	4.08	4.22	4.59	4.73
Residential private investment	5.99	5.99	5.99	5.99
<b>Public consumption</b>	<b>18.05</b>	<b>18.06</b>	<b>18.05</b>	<b>18.05</b>
<b>Public investment</b>	<b>3.22</b>	<b>3.22</b>	<b>3.22</b>	<b>3.22</b>
<b>EU current balance</b>	<b>1.06</b>	<b>1.52</b>	<b>2.52</b>	<b>2.99</b>
<b>ROW current balance</b>	<b>2.96</b>	<b>3.07</b>	<b>3.58</b>	<b>3.68</b>
S1: 9% fall in non-residents consumption demand				
S2: 9.5% fall in exports				
S3: S1+S2				

## 5. External and domestic shocks: Keynesian closure

In this section, private investment is exogenously fixed and the unemployment rate adjusts to match the sum of private savings, public deficit and current account surplus to the value of private investment.

### 5.1 Simulation scenarios

In addition to the three scenarios (S1: 9 percent fall in non-residents consumption; S2: 9.5 percent fall in exports of goods and non-touristic services; and S3: the joint effect of both shocks) simulated in Section 4, this section includes a domestic shock to private investment. As Table 10 makes clear, the average index of gross fix capital formation suffered a serious fall from 2007-08 until 2008-09 that can not be explained with an AGE model with neoclassical closure as the one employed in Section 4

<b>Table 10. Gross fix capital formation</b>						
(Chained-linked volume measures)						
	<b>Agriculture and fishing products</b>	<b>Metallic products and machinery</b>	<b>Transport equipment</b>	<b>Residential investment</b>	<b>Other Buildings and structures</b>	<b>Other products</b>
<b>Quarter</b>						
Second 2009	48.54	108.49	131.84	118.78	150.71	144.3
First 2009	28.21	100.72	137.28	100.48	133.31	113.3
Fourth 2008	50.28	125.43	112.5	132.55	138.33	143.92
Third 2008	28.92	117.79	113.75	131.04	149.68	120.45
<b>Average index 2009-08</b>	<b>38.99</b>	<b>113.10</b>	<b>123.84</b>	<b>120.71</b>	<b>143.01</b>	<b>130.49</b>
Second 2008	55.42	156.21	169.09	157.27	150.39	173.59
First 2008	34.68	136.39	167.19	132.73	133.04	133.55
Fourth 2007	101.89	141.32	142.18	163.8	142.29	163.66
Third 2007	46.83	115.19	124.28	148.77	149.92	124.65
<b>Average index 2008-07</b>	<b>59.71</b>	<b>137.27</b>	<b>150.68</b>	<b>150.64</b>	<b>143.91</b>	<b>148.86</b>
<b>Variation average index</b>	<b>-34.70</b>	<b>-17.61</b>	<b>-17.81</b>	<b>-19.87</b>	<b>-0.63</b>	<b>-12.34</b>
Source: Quarterly National Accounts						

Since the SAMSP-00 includes the same six capital goods in Table 10, the impact of a reduction in private investment can be simulated adopting the Keynesian closure rule. Although the fall in gross investment reported in the last row of Table 10 does not distinguish private and public investment, those numbers have been used to approximate the fall in private investment during the recession 2008-09.

## **5.2 The results**

Tables 11-17 present the results of simulations S1 and S2 corresponding to external shocks and simulation S4 to the domestic (investment) shock. They also include in column S4 the combined effect of external shocks and the joint effects of both external and domestic shocks in column S5.

Under the Keynesian closure, domestic, total and consumer prices register sensible falls. In simulations S1-S3, those falls are between 20-30 times those obtained with the neoclassical closure. In the new equilibrium, private savings are downward adjusted to counteract the increase in foreign savings caused by the external shock. Household income, consumption and savings fall and the proportion of labor endowment unemployed increases. Since the wage rate is fixed, full employment of capital requires a sensible fall in the price of capital services, the price of value added, domestic prices, total prices and consumer prices. Therefore, price falls are more intense in capital intensive sectors. The pattern of price effects when private investment falls (column S4) is quite similar.

Domestic (and total) production falls (see, Tables 14-15) in all private sectors of the economy. Comparing the results of external shocks (columns S1-S3) with those obtained with the neoclassical closure, the major differences are observed in the investment oriented sectors that register positive increases in Table 6 and substantial

falls here. On the other hand, differences are smaller in export oriented sectors that register the largest fall in Table 6. The explanation of the different effect on investment oriented sectors is due to the fact that the investment boom set in motion by the increase in the current account surplus with the neoclassical closure is counteracted by a fall in the value of private savings and an increase in the public deficit with the Keynesian closure. The impact of a fall in investment reduces activity levels of all sectors, although losses are relatively minor (0.5-2.0 percent) in export oriented sectors and pretty big (5.0-9.0 percent) in investment oriented sectors

The effects on the public surplus (Table 16) are bigger than in simulations under the neoclassical closure. Revenues and current expenditures fall less than GDP but since revenues fall more than expenditures, the deficit goes up. In the joint simulation of external and domestic shocks (column S5), the public deficit increases 2.82 percentage points. This is so even assuming that benefits and cover rates for unemployed remain constant and other benefits and government transfers are adjusted using the CPI which in this simulation is -5 %.

The results on aggregate variables are reported in Table 17. The more striking results are the contraction of real GDP, the fall in employment and the increase in unemployment rates. It can be seen that in simulation S5, that unemployment rate increases 7.13 percentage points and employment and GDP fall 8.28 and 4.49 percent, respectively. These figures are larger than those calculated from the Active Population Survey and the Quarterly National Account. Using the average unemployment rates, employment figures and GDP volume index from the third quarter of 2007 till the second quarter of 2008 and from the third quarter of 2008 till the second quarter of 2009, the unemployment rate increased 5.96 percentage points and employment and GDP fell 4.37 and 2.21 percent, respectively.

There are at least two good reasons to account for those differences among observed figures and simulated results. First, the impact of external and domestic shocks is not expected to be simultaneous with the shocks. It may take some time until the new equilibrium is reached. Actually, employment and GDP fell 6.1 and 3.6 percent, respectively, in 2009. Second, the government increased public investment and unemployment benefits in 2009. Thus, observed falls in employment and GDP should be less than those estimated in the simulations.

The external shocks increase the current account surplus of both the EU and the ROW, although the effects are smaller than under the neoclassical closure. On the other hand the investment shock reduces the surplus of the EU and ROW, although the improvement 0.98 pp is quite modest in comparison with the fast improvement of the current surplus in 2009, 4.26 pp. There is, however, a great deal of uncertainty about the estimation of the external surplus that plays a crucial role to underestimate the fall of GDP in 2009.

The Keynesian closure seems a better approximation to study shocks on private investment, consumption and exports because prices and production react to changes in final demand and results are not distorted by an implausible boom in investment. Moreover, since private savings are adjusted to shocks in final demand, unemployment rates grow more than with the neoclassical closure where real wage reacts to unemployment rates. The higher number of unemployed increases public expenditure in unemployment benefits, and consequently public deficit. These results describe much better the economic situation in Spain and suggest that closure rules are a key issue that deserves careful analysis in AGE models.

**Table 11. Variation in domestic production prices**

(In percentage)

	<b>Sector</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>S4</b>	<b>S5</b>
II1	Agriculture, fishing and aquaculture	-0.73	-2.71	-3.42	-3.69	-7.02
II2	Extraction of other mining and quarrying	-0.56	-2.08	-2.63	-2.84	-5.42
II3	Extraction of energetic products, coke and refined petroleum	-0.58	-2.16	-2.74	-2.95	-5.64
II4	Electricity, gas and water	-0.66	-2.48	-3.13	-3.38	-6.44
II5	Food, beverages and tobacco	-0.57	-2.14	-2.71	-2.92	-5.58
II6	Textile and dressing	-0.50	-1.87	-2.37	-2.55	-4.89
II7	Leather products	-0.50	-1.89	-2.38	-2.57	-4.92
II8	Wood	-0.51	-1.91	-2.41	-2.60	-4.98
II9	Paper, publishing and printing	-0.52	-1.96	-2.48	-2.67	-5.11
II10	Chemical industry, rubber and plastic products	-0.52	-1.96	-2.48	-2.67	-5.11
II11	Non-metallic mineral products	-0.53	-1.97	-2.49	-2.69	-5.15
II12	Metallurgy and metal products	-0.50	-1.89	-2.38	-2.57	-4.92
II13	Mechanical machinery and equipment	-0.48	-1.80	-2.28	-2.46	-4.71
II14	Manufacture of electrical machinery and precision instruments	-0.49	-1.85	-2.33	-2.52	-4.82
II15	Manufacture of vehicles and other transport material	-0.49	-1.85	-2.34	-2.52	-4.83
II16	Other manufacturing industries	-0.49	-1.82	-2.30	-2.48	-4.75
II17	Construction	-0.45	-1.68	-2.13	-2.29	-4.40
II18	Wholesale trade and retail trade	-0.54	-2.03	-2.57	-2.77	-5.30
II19	Accommodation and catering	-0.54	-2.00	-2.53	-2.73	-5.23
II20	Transport and communications	-0.60	-2.23	-2.82	-3.04	-5.80
II21	Financial intermediation	-0.48	-1.79	-2.26	-2.44	-4.68
II22	Real estate activities	-0.63	-2.34	-2.95	-3.18	-6.08
II23	Market Education	-0.39	-1.44	-1.83	-1.97	-3.78
II24	Market Healthcare and Social services	-0.48	-1.80	-2.27	-2.45	-4.70
II25	Other activities and associative market services	-0.56	-2.09	-2.64	-2.85	-5.45
II26	Households which employ household personnel	0.00	0.00	0.00	0.00	0.00
II27	Public Administration	-0.29	-1.10	-1.40	-1.51	-2.89
II28	Non market Education	-0.11	-0.41	-0.52	-0.56	-1.08
II29	Non market healthcare and Social services	-0.21	-0.78	-0.99	-1.07	-2.05
II30	Other activities and associative non market services	-0.41	-1.55	-1.96	-2.11	-4.04
S1: 9 % fall in non-residents consumption demand						
S2: 9.5 % fall in exports						
S3: S1+S2						
S4: Investment shock: products agriculture: -34.7 %; Machinery: -17.61%, Transportation equipment: -17.81% ; Residential investment: -19.87 %; Other constructions: -0.63 %; and Other products: -12.34 %.						
S5: S1+S2+S4						

**Table 12. Variation in total production prices**

(In percentage)

	<b>Sector</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>S4</b>	<b>S5</b>
II1	Agriculture, fishing and aquaculture	-0.71	-2.63	-3.32	-3.58	-6.82
II2	Extraction of other mining and quarrying	-0.55	-2.07	-2.61	-2.82	-5.39
II3	Extraction of energetic products, coke and refined petroleum	-0.57	-2.11	-2.67	-2.88	-5.51
II4	Electricity, gas and water	-0.66	-2.48	-3.13	-3.37	-6.44
II5	Food, beverages and tobacco	-0.57	-2.13	-2.69	-2.90	-5.55
II6	Textile and dressing	-0.51	-1.91	-2.41	-2.60	-4.98
II7	Leather products	-0.51	-1.91	-2.41	-2.60	-4.98
II8	Wood	-0.52	-1.93	-2.44	-2.63	-5.03
II9	Paper, publishing and printing	-0.53	-1.97	-2.49	-2.68	-5.14
III10	Chemical industry, rubber and plastic products	-0.53	-1.98	-2.50	-2.70	-5.16
III11	Non-metallic mineral products	-0.53	-1.98	-2.50	-2.70	-5.16
III12	Metallurgy and metal products	-0.51	-1.92	-2.42	-2.61	-5.00
III13	Mechanical machinery and equipment	-0.51	-1.89	-2.39	-2.58	-4.94
III14	Manufacture of electrical machinery and precision instruments	-0.52	-1.93	-2.44	-2.63	-5.03
III15	Manufacture of vehicles and other transport material	-0.51	-1.92	-2.42	-2.61	-5.00
III16	Other manufacturing industries	-0.49	-1.85	-2.34	-2.52	-4.82
III17	Construction	-0.45	-1.68	-2.13	-2.30	-4.40
III18	Wholesale trade and retail trade	-0.54	-2.03	-2.57	-2.77	-5.30
III19	Accommodation and catering	-0.54	-2.00	-2.53	-2.73	-5.23
II20	Transport and communications	-0.59	-2.21	-2.80	-3.02	-5.77
II21	Financial intermediation	-0.48	-1.80	-2.28	-2.46	-4.72
II22	Real estate activities	-0.62	-2.31	-2.92	-3.15	-6.02
II23	Market Education	-0.39	-1.44	-1.83	-1.97	-3.78
II24	Market Healthcare and Social services	-0.48	-1.80	-2.27	-2.45	-4.70
II25	Other activities and associative market services	-0.56	-2.09	-2.64	-2.84	-5.44
II26	Households which employ household personnel	0.00	0.00	0.00	0.00	0.00
II27	Public Administration	-0.29	-1.10	-1.40	-1.51	-2.89
II28	Non market Education	-0.11	-0.41	-0.52	-0.56	-1.08
II29	Non market healthcare and Social services	-0.21	-0.78	-0.99	-1.07	-2.05
II30	Other activities and associative non market services	-0.41	-1.55	-1.96	-2.11	-4.04
S1: 9 % fall in non-residents consumption demand						
S2: 9.5 % fall in exports						
S3: S1+S2						
S4: Investment shock: products agriculture: -34.7 %; Machinery: -17.61%, Transportation equipment. -17.81% ; Residential investment: -19.87 %: Other constructions: -0.63 %; and Other products: -12.34 %.						
S5: S1+S2+S4						



**Table 13. Variation in consumer prices**

(In percentage)

	<b>Sector</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>S4</b>	<b>S5</b>
II1	Agriculture, fishing and aquaculture	-0.71	-2.63	-3.32	-3.58	-6.82
II2	Extraction of other mining and quarrying	-0.55	-2.07	-2.61	-2.82	-5.39
II3	Extraction of energetic products, coke and refined petroleum	-0.57	-2.11	-2.67	-2.88	-5.51
II4	Electricity, gas and water	-0.66	-2.48	-3.13	-3.37	-6.44
II5	Food, beverages and tobacco	-0.57	-2.13	-2.69	-2.90	-5.55
II6	Textile and dressing	-0.51	-1.91	-2.41	-2.60	-4.98
II7	Leather products	-0.51	-1.91	-2.41	-2.60	-4.98
II8	Wood	-0.52	-1.93	-2.44	-2.63	-5.03
II9	Paper, publishing and printing	-0.53	-1.97	-2.49	-2.68	-5.14
II10	Chemical industry, rubber and plastic products	-0.53	-1.98	-2.50	-2.70	-5.16
II11	Non-metallic mineral products	-0.53	-1.98	-2.50	-2.70	-5.16
II12	Metallurgy and metal products	-0.51	-1.92	-2.42	-2.61	-5.00
II13	Mechanical machinery and equipment	-0.51	-1.89	-2.39	-2.58	-4.94
II14	Manufacture of electrical machinery and precision instruments	-0.52	-1.93	-2.44	-2.63	-5.03
II15	Manufacture of vehicles and other transport material	-0.51	-1.92	-2.42	-2.61	-5.00
II16	Other manufacturing industries	-0.49	-1.85	-2.34	-2.52	-4.82
II17	Construction	-0.45	-1.68	-2.13	-2.30	-4.40
II18	Wholesale trade and retail trade	-0.54	-2.03	-2.57	-2.77	-5.30
II19	Accommodation and catering	-0.54	-2.00	-2.53	-2.73	-5.23
II20	Transport and communications	-0.59	-2.21	-2.80	-3.02	-5.77
II21	Financial intermediation	-0.48	-1.80	-2.28	-2.46	-4.72
II22	Real estate activities	-0.62	-2.31	-2.92	-3.15	-6.02
II23	Market Education	-0.39	-1.44	-1.83	-1.97	-3.78
II24	Market Healthcare and Social services	-0.48	-1.80	-2.27	-2.45	-4.70
II25	Other activities and associative market services	-0.56	-2.09	-2.64	-2.84	-5.44
II26	Households which employ household personnel	0.00	0.00	0.00	0.00	0.00
II27	Public Administration	-0.29	-1.10	-1.40	-1.51	-2.89
II28	Non market Education	-0.11	-0.41	-0.52	-0.56	-1.08
II29	Non market healthcare and Social services	-0.21	-0.78	-0.99	-1.07	-2.05
II30	Other activities and associative non market services	-0.41	-1.55	-1.96	-2.11	-4.04
	Consumer Prices Index (CPI)	-0.48	-1.80	-2.27	-2.45	-4.69
S1: 9 % fall in non-residents consumption demand						
S2: 9.5 % fall in exports						
S3: S1+S2						
S4: Investment shock: products agriculture: -34.7 %; Machinery: -17.61%, Transportation equipment.-17.81%; Residential investment: -19.87 %; Other constructions: -0.63 %; and Other products: -12.34 %.						
S5: S1+S2+S4						

**Table 14. Variation in domestic production**

(In percentage)

	<b>Sector</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>S4</b>	<b>S5</b>
II1	Agriculture, fishing and aquaculture	-0.18	-2.06	-2.24	-0.48	-2.70
II2	Extraction of other mining and quarrying	-0.16	-3.08	-3.24	-5.15	-8.37
II3	Extraction of energetic products, coke and refined petroleum	-0.40	-2.39	-2.78	-1.10	-3.86
II4	Electricity, gas and water	-0.32	-1.64	-1.95	-1.87	-3.80
II5	Food, beverages and tobacco	-0.37	-1.58	-1.95	-0.48	-2.40
II6	Textile and dressing	-0.31	-2.68	-2.98	-1.19	-4.14
II7	Leather products	-0.62	-3.62	-4.24	-0.77	-4.97
II8	Wood	-0.28	-2.52	-2.79	-4.19	-6.95
II9	Paper, publishing and printing	-0.28	-2.58	-2.85	-1.81	-4.63
II10	Chemical industry, rubber and plastic products	-0.25	-3.68	-3.93	-1.90	-5.80
II11	Non-metallic mineral products	-0.17	-2.38	-2.55	-5.76	-8.29
II12	Metallurgy and metal products	-0.19	-3.83	-4.01	-5.24	-9.22
II13	Mechanical machinery and equipment	-0.22	-3.47	-3.68	-6.94	-10.57
II14	Manufacture of electrical machinery and precision instruments	-0.22	-3.21	-3.43	-6.96	-10.34
II15	Manufacture of vehicles and other transport material	-0.15	-4.90	-5.04	-4.29	-9.30
II16	Other manufacturing industries	-0.24	-2.16	-2.40	-4.19	-6.55
II17	Construction	-0.14	-0.57	-0.71	-8.16	-8.85
II18	Wholesale trade and retail trade	-0.29	-2.66	-2.94	-2.50	-5.41
II19	Accommodation and catering	-1.15	-0.51	-1.66	-0.76	-2.38
II20	Transport and communications	-1.78	-2.80	-4.58	-1.75	-6.32
II21	Financial intermediation	-0.56	-1.94	-2.49	-1.86	-4.32
II22	Real estate activities	-0.32	-1.60	-1.91	-3.22	-5.11
II23	Market Education	-0.21	-0.90	-1.10	-1.22	-2.29
II24	Market Healthcare and Social services	-0.38	-0.65	-1.02	-0.88	-1.87
II25	Other activities and associative market services	-0.70	-0.81	-1.50	-1.25	-2.72
II26	Households which employ household personnel	-0.70	-2.42	-3.11	-3.42	-6.42
II27	Public Administration	0.00	0.00	0.00	0.00	0.00
II28	Non market Education	-0.03	-0.11	-0.13	-0.15	-0.28
II29	Non market healthcare and Social services	0.00	-0.01	-0.01	-0.02	-0.03
II30	Other activities and associative non market services	-0.01	-0.03	-0.04	-0.04	-0.08
S1: 9 % fall in non-residents consumption demand						
S2: 9.5 % fall in exports						
S3: S1+S2						
S4: Investment shock: products agriculture: -34.7 %; Machinery: -17.61%, Transportation equipment: -17.81%; Residential investment: -19.87 %; Other constructions: -0.63 %; and Other products: -12.34 %.						
S5: S1+S2+S4						

**Table 15. Variation in total production**

(In percentage)

	<b>Sectors</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>S4</b>	<b>S5</b>
II1	Agriculture, fishing and aquaculture	-0.23	-2.24	-2.47	-0.74	-3.18
II2	Extraction of other mining and quarrying	-0.17	-3.11	-3.28	-5.20	-8.46
II3	Extraction of energetic products, coke and refined petroleum	-0.43	-2.53	-2.95	-1.29	-4.22
II4	Electricity, gas and water	-0.32	-1.64	-1.96	-1.88	-3.81
II5	Food, beverages and tobacco	-0.38	-1.61	-1.99	-0.51	-2.47
II6	Textile and dressing	-0.28	-2.56	-2.84	-1.03	-3.84
II7	Leather products	-0.59	-3.52	-4.10	-0.62	-4.70
II8	Wood	-0.27	-2.47	-2.74	-4.13	-6.84
II9	Paper, publishing and printing	-0.28	-2.55	-2.83	-1.77	-4.57
II10	Chemical industry, rubber and plastic products	-0.24	-3.63	-3.87	-1.83	-5.68
II11	Non-metallic mineral products	-0.17	-2.37	-2.53	-5.74	-8.26
II12	Metallurgy and metal products	-0.17	-3.75	-3.91	-5.13	-9.01
II13	Mechanical machinery and equipment	-0.14	-3.21	-3.35	-6.59	-9.93
II14	Manufacture of electrical machinery and precision instruments	-0.16	-2.98	-3.14	-6.66	-9.78
II15	Manufacture of vehicles and other transport material	-0.10	-4.74	-4.84	-4.08	-8.90
II16	Other manufacturing industries	-0.22	-2.08	-2.29	-4.08	-6.35
II17	Construction	-0.14	-0.57	-0.71	-8.16	-8.84
II18	Wholesale trade and retail trade	-0.29	-2.66	-2.94	-2.50	-5.41
II19	Accommodation and catering	-1.15	-0.51	-1.66	-0.76	-2.38
II20	Transport and communications	-1.79	-2.83	-4.61	-1.79	-6.39
II21	Financial intermediation	-0.55	-1.91	-2.46	-1.82	-4.25
II22	Real estate activities	-0.33	-1.64	-1.97	-3.28	-5.22
II23	Market Education	-0.21	-0.90	-1.10	-1.22	-2.29
II24	Market Healthcare and Social services	-0.38	-0.65	-1.02	-0.88	-1.87
II25	Other activities and associative market services	-0.70	-0.82	-1.51	-1.26	-2.74
II26	Households which employ household personnel	-0.70	-2.42	-3.11	-3.42	-6.42
II27	Public Administration	0.00	0.00	0.00	0.00	0.00
II28	Non market Education	-0.03	-0.11	-0.13	-0.15	-0.28
II29	Non market healthcare and Social services	0.00	-0.01	-0.01	-0.02	-0.03
II30	Other activities and associative non market services	-0.01	-0.03	-0.04	-0.04	-0.08
S1: 9 % fall in non-residents consumption demand						
S2: 9.5 % fall in exports						
S3: S1+S2						
S4: Investment shock: products agriculture: -34.7 %; Machinery: -17.61%, Transportation equipment: -17.81% ; Residential investment: -19.87 %; Other constructions: -0.63 %; and Other products: -12.34 %.						
S5: S1+S2+S4						

**Table 16. Public revenues and expenditures**

(In percentage of GDP)

	<b>Base year</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>S4</b>	<b>S5</b>
<b>Total revenues</b>	<b>52.92</b>	<b>53.02</b>	<b>53.36</b>	<b>53.46</b>	<b>53.59</b>	<b>54.15</b>
Property income	1.17	1.17	1.19	1.19	1.20	1.22
Total income tax	10.15	10.18	10.24	10.27	10.29	10.41
Income tax (households)	6.95	6.97	7.03	7.05	7.06	7.16
Income tax (corporate)	3.20	3.21	3.22	3.22	3.23	3.25
SSCE	9.51	9.53	9.54	9.56	9.53	9.58
SSCH	1.92	1.93	1.93	1.93	1.93	1.94
SSCS	1.11	1.11	1.11	1.11	1.11	1.12
Current transfers	16.08	16.16	16.35	16.43	16.49	16.85
Taxes on production	1.25	1.25	1.24	1.24	1.23	1.22
Taxes on imports	0.02	0.02	0.02	0.02	0.02	0.02
VAT	5.68	5.66	5.74	5.72	5.77	5.81
Taxes on products	4.41	4.41	4.38	4.38	4.41	4.38
Capital	1.62	1.62	1.61	1.61	1.61	1.60
<b>Total current expenditures</b>	<b>49.84</b>	<b>50.21</b>	<b>51.21</b>	<b>51.59</b>	<b>51.90</b>	<b>53.73</b>
Public consumption	18.05	18.17	18.50	18.62	18.70	19.29
Property income	3.27	3.28	3.32	3.34	3.35	3.42
Unemployment benefits	1.97	2.09	2.43	2.55	2.66	3.28
Other social benefits	9.68	9.72	9.84	9.88	9.92	10.13
Current transfers	15.75	15.82	16.01	16.08	16.14	16.49
Subsidies on production	0.63	0.63	0.62	0.62	0.63	0.62
Subsidies on products	0.50	0.50	0.49	0.49	0.50	0.50
<b>Public investment</b>	<b>3.22</b>	<b>3.24</b>	<b>3.28</b>	<b>3.29</b>	<b>3.30</b>	<b>3.38</b>
Non residential public investment	3.10	3.11	3.15	3.16	3.17	3.24
Agriculture products	0.00	0.00	0.00	0.00	0.00	0.00
Machinery and mechanical products	0.48	0.48	0.49	0.49	0.49	0.50
Transport equipment	0.07	0.07	0.07	0.07	0.07	0.07
Other constructions	2.32	2.33	2.36	2.37	2.38	2.44
Other products	0.23	0.23	0.23	0.23	0.23	0.23
Residential public investment	0.13	0.13	0.13	0.13	0.13	0.13
<b>Public surplus</b>	<b>-0.14</b>	<b>-0.42</b>	<b>-1.13</b>	<b>-1.42</b>	<b>-1.61</b>	<b>-2.96</b>
S1: 9 % fall in non-residents consumption demand						
S2: 9.5 % fall in exports						
S3: S1+S2						
S4: Investment shock: products agriculture: -34.7 %; Machinery: -17.61%, Transportation equipment: -17.81% ; Residential investment: -19.87 %; Other constructions: -0.63 %; and Other products: -12.34 %.						
S5: S1+S2+S4						

**Table 17. Aggregate variables**

<b>Main aggregates and welfare index</b>						
	<b>Base year</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>S4</b>	<b>S5</b>
Unemployment rate (%)	13.87	14.56	16.52	17.19	17.81	21.00
Employment growth rate	-	-0.80	-3.08	-3.85	-4.57	-8.28
Variation of households' net disposable income	411,757.00	-0.65	-2.44	-3.07	-3.44	-6.40
Variation Consumer price index	-	-0.48	-1.80	-2.27	-2.45	-4.69
Households' welfare	-	-0.11	-0.43	-0.53	-0.71	-1.20
Nominal GDP	630236.00	-0.93	-3.41	-4.32	-4.84	-8.99
Real GDP	630236.00	-0.45	-1.63	-2.08	-2.44	-4.49
<b>Demand side aggregate variables</b>						
(In percentage of GDP)						
	<b>Base year</b>	<b>S1</b>	<b>S2</b>	<b>S3</b>	<b>S4</b>	<b>S5</b>
<b>Private consumption</b>	<b>57.91</b>	<b>58.08</b>	<b>58.50</b>	<b>58.67</b>	<b>58.77</b>	<b>59.56</b>
<b>Total private investment</b>	<b>22.61</b>	<b>22.70</b>	<b>22.92</b>	<b>23.01</b>	<b>20.00</b>	<b>20.35</b>
Non-residential private investment	16.62	16.69	16.87	16.94	13.91	14.19
Agriculture products	0.08	0.08	0.08	0.08	0.05	0.06
Machinery and mechanical products	5.20	5.22	5.28	5.30	4.38	4.47
Transport equipment	2.38	2.39	2.42	2.43	2.00	2.04
Other constructions	4.87	4.89	4.95	4.97	3.82	3.89
Other products	4.08	4.10	4.14	4.16	3.66	3.73
Residential private investment	5.99	6.01	6.05	6.07	6.08	6.16
<b>Public consumption</b>	<b>18.05</b>	<b>18.17</b>	<b>18.50</b>	<b>18.62</b>	<b>18.70</b>	<b>19.29</b>
<b>Public investment</b>	<b>3.22</b>	<b>3.24</b>	<b>3.28</b>	<b>3.29</b>	<b>3.30</b>	<b>3.38</b>
<b>EU current balance</b>	<b>1.06</b>	<b>1.40</b>	<b>2.07</b>	<b>2.42</b>	<b>0.37</b>	<b>1.75</b>
<b>ROW current balance</b>	<b>2.96</b>	<b>3.02</b>	<b>3.39</b>	<b>3.45</b>	<b>2.67</b>	<b>3.17</b>
S1: 9 % fall in non-residents consumption demand						
S2: 9.5 % fall in exports						
S3: S1+S2						
S4: Investment shock: products agriculture: -34.7 %; Machinery: -17.61%, Transportation equipment: -17.81% ; Residential investment: -19.87 %; Other constructions: -0.63 %; and Other products: -12.34 %.						
S5: S1+S2+S4						

## 6. Conclusions

In this paper, we have analyzed the effects of external and domestic shocks that hit the Spanish economy in 2008-09. We simulated the effects of external shocks (a fall in non-residents demand and exports of goods and services other than tourism) using a standard neoclassical applied general equilibrium model with price frictions to account for unemployment. Additionally, we simulated external and demand shocks (a sharp decline in private investment) using an AGE model with a Keynesian closure.

The effects of external shocks are extremely sensitive to the closure rule chosen in the model. An improvement in the current account of the foreign sectors boosts external savings and domestic investment. Thus a negative external shock that reduce exports is compensated by an implausible investment boom. There is a reallocation of factors from the export sectors to investment oriented sectors but public revenues and expenditures, unemployment, employment and GDP are almost unaffected by the shock.

The simulation results are completely different when investment is fixed and unemployment adjusts to match the sum of the value of private savings, the public deficit and the current account surplus to the value of investment. Still negative external shocks also increase the current account surplus of both the EU and the ROW, although not as much as under the neoclassical closure. The main differences are in the remaining variables: prices and production fall substantially, especially in export oriented sectors, increasing the public deficit and unemployment and reducing employment and GDP. The rise in unemployment (3.3 percentage points) and the fall in real GDP (2.08 %) are more consistent with observed values than the “nothing is happening here” message that comes out under the neoclassical closure.

The data presented in Table 10 indicate that investment in capital goods fell dramatically from the third quarter of 2008 until the second quarter of 2009. The collapse of investment can not be accounted for in a neoclassical framework but can be simulated under Keynesian closure. The effects of the negative domestic shock also reduce prices and production levels, especially those of investment oriented sectors, increases the public deficit and the unemployment rate and reduces employment and GDP. Those changes are even greater than in the external shock simulation. Of course, the fall in investment lowers the current account surplus of the EU and the ROW.

It is worthy to compare the results of the joint simulation of negative external and domestic shocks under the Keynesian closure with changes observed in the main macroeconomic variables. In the simulation, the unemployment rate increases 7.13 percentage points and employment and GDP fall 8.28 and 4.49 percent, respectively. Using the average unemployment rates, employment figures and GDP volume index from the third quarter of 2007 till the second quarter of 2008 and from the third quarter of 2008 till the second quarter of 2009, the unemployment rate increased 5.96 percentage points and employment and GDP fell 4.37 and 2.21 percent, respectively. On the other hand, the worsening on the surplus of the EU and ROW predicted by the model, 0.98 percentage points, is much lower than the 4.26 percentage points estimated in the National Accounts.

One is tempted to conclude from this that the model overestimates the effects of the ongoing recession. There are at least two good reasons to account for those differences among observed figures and simulated results. First, the impact of external and domestic shocks is not expected to be simultaneous with the shocks. It may take some time until the new equilibrium is reached. Actually, employment and GDP fell 6.1 and 3.6 percent, respectively, in 2009, closer to the simulation results. Second, the

government increased public investment and subsidies to businesses and extended unemployment and other social benefits in 2009. Thus, observed falls in employment and GDP should be lower than those estimated in the simulations. As to the differences in the current account surplus, we shall indicate that there are reasonable doubts on the magnitude of the improvement of the current account deficit officially estimated in 2009.<sup>5</sup>

The Keynesian closure seems a better approximation to study shocks on exports and it is the only way to account for shocks on private investment. In the first case, prices and production levels react to changes in final demand but the results are not distorted by an implausible boom in investment. Moreover, since private savings are adjusted to shocks in final demand, unemployment rates grow more than with the neoclassical closure where real wage reacts to unemployment rates. The higher number of unemployed increases public expenditure in unemployment benefits, and consequently public deficit. These results describe much better the ongoing situation of Spain and suggest that closure rules are a key issue that deserves careful analysis in AGE modeling.

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<sup>5</sup> The fall in GDP estimated in the National Accounts, 3.6 %, for 2009 is obtained using changes in value added in Agriculture, Industry, Construction and Private and Public services that well below the falls reported by the corresponding activity indicators. In other words, there are indications that the fall in GDP has been underestimated. In that case, it is very likely that the fall in the current account surplus of the EU and ROW had been overestimated to match supply and demand GDP estimates.



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