Business Cycle Accounting for Peripheral European Economies[1,2]

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The paper analyzes the dynamics of the peripheral European economies using the Business Cycle Accounting methodology before and during what was called the sovereign debt crisis. TFP dynamics and the labor wedge explain most of the dynamics before and during the crisis, while there is some role for the government wedge in the period before the crisis. The bond wedge, corresponding to the risk premium, has a modest contribution, moving counter-cyclically. Additional evidence links the dynamics of the TFP and the labor wedge with changes in the interest rates and a spike in the import prices at the onset of the crisis, corresponding to the general mechanisms of the large capital inflows, in the wake of the euro introduction, followed by sudden stops.

Keywords: GIPS economies, sovereign debt crisis, business cycle accounting.
JEL Classification: E13, E32, F41.

1. Introduction

Following the effects of the Great Recession, the macroeconomic dynamics of the so called Peripheral European economies (GIPS economies, hereafter, i.e. Greece, Ireland Portugal and Spain) have attracted a lot of attention. Previously seen as success stories of rapid economic development, they are viewed now as a matter of great concern. However, the academic literature with respect to the causes of the deep recessions in these economies is still limited.

In this paper I propose the use of the business cycle accounting (BCA) framework to study the dynamics of these economies. Originally proposed by Chari, Kehoe and McGrattan (2007), this approach analyzes business cycles by considering a prototypical model characterized by a number of wedges (in the original paper, TFP, labor, investment and government wedge), which potentially cover a number of more detailed models. The purpose of a business cycle accounting exercise is thus to uncover the main wedges that drive business cycles, although this identification is not unique, as different detailed models can lead to the same wedge.

This framework was applied to a variety of cases, starting with the case studies in the original paper, namely the Great Depression in the United States and the recession in US in the early 1980s. Later case studies include the recession in early 1980 in the United Kingdom (see Kersting, 2008) or the Great Depression in Japan (see Saijo, 2008). A common note of these studies is that the TFP and the labor wedge are the most important drivers of the business cycle.

More recently, the research has been extended to deal with small open economies, typically by considering that households optimally choose the holding of debt/foreign bonds which have an associated wedge. This bond/debt wedge usually reflects the international risk associated to the bonds. One of the first studies in this direction is due to Lama (2012) who applied an extension of the BCA methodology to small open economies in Latin America. Otsu (2010) did a similar work by studying the crisis in the late 1990s in East Asia using the business cycle accounting framework. However, most of this research also identifies the TFP and the labor wedge as the most important factors in the business cycle dynamics of the different studied small open economies. At the same time, it must be pointed out, that these identified wedges could and should correspond to different detailed models as compared to the wedges identified, for example, for the US.

A few recent studies also addressed the issue of how the identified wedges differ for various types of economies. One of them (Cho and Doblas-Madrid, 2013) identified a more significant role for the investment wedges in South-East Asian economies as compared to Western Economies.

As this paper aims at applying the BCA approach to the pre-crisis and crisis period in the GIPS economies, it wants to answer the following research questions. The first one refers to which type of wedges were the main drivers of the recent crisis in the GIPS. A second pertinent question refers to what kind of detailed model could have produced the actual dynamics of the wedges (that is, a well specified model, having certain nominal rigidities and other kinds of frictions and being able to reproduce the corresponding dynamics of the wedges in the prototype model).

This paper finds that the TFP and the labor wedge can explain most of the dynamics of output in these economies before and after the crisis. There is a limited role for the government or the bond wedge. I also find that possible detailed models that capture the changes in the interest rates faced by these economies and in the import prices can explain the role of these two wedges. The labor wedge can be explained through the working capital constraint. An additional analysis of the Portuguese slump between 2000 and 2007 also suggests the misallocation of resources acting through the labor wedge and TFP as potential explanatory factors. Finally, although the topic of the Euro adoption is not discussed directly in this paper, it is however touched with respect to a few key issues. The adoption of the Euro meant for GIPS economies a lower risk and large capital inflows. As it will become evident, this shocks basically worked through the labor wedge and TFP.

2. A Short Introduction to the Crisis in the Peripheral European Economies

Given that the crisis has started rather relatively recently, i.e. 6 years ago, and its effects are still present, the academic literature on this particular topic is limited but rapidly growing. The present crisis is publicly also known as a “sovereign debt crisis”, however, it is in fact a crisis with much deeper roots. This section does not intend to discuss in a thorough manner all the aspects of this crisis, but it rather aims at linking the topic of this paper with the particular features of the crisis that this paper intends to study.

Bibow (2012) pointed to the internal imbalances of the euro area as the real issues at hand, suggesting that the crisis could be described as a “twin banking and balance of payment crisis.” An extensive study by Shambaugh (2012) also suggests a complex picture, and close to the one by Bibow (2012), as he identifies three different crises: a banking crisis, a sovereign debt crisis and a growth crisis.

The paper by Arghyrou and Tsoukalas (2010), although focused on the case of Greece, reached similar conclusions. They found the roots of the crisis in three factors: the deteriorating macroeconomic conditions in Greece up to the point of being incompatible with the EMU requirements, as well as a shift in the expectations of investors with respect to the EMU commitments.

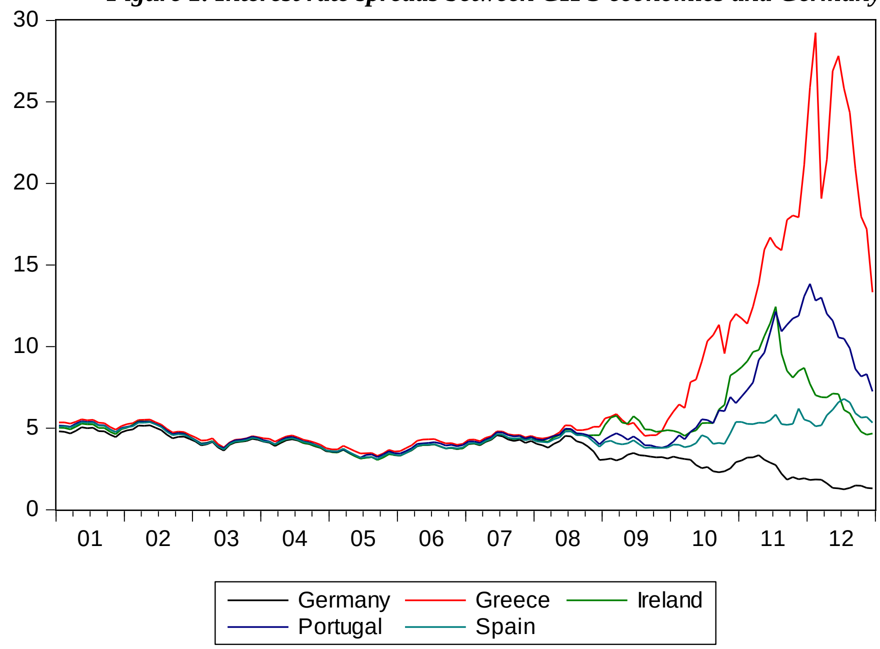
A more comprehensive study was done by Lane (2012). He observed that the growth performance between 1999 and 2007 was also accompanied by a number of aggravating macroeconomic vulnerabilities, a phenomenon also observed, for example by Caruana and Avdjiev (2012). Lane (2012) noticed that the growth period for GIPS economies was characterized by a rapid rise in private credit, which the literature sees as one of the main predictors of a banking crisis, see Gourinchas and Obstfeld (2012).

A related phenomenon is that of current account deficits which were already high by the mid-2000’s, although at the aggregate level of the euro zone, the current account was rather balanced. According to Lane, although such deficits could have positive effects, by reducing the income differences and helping consumption smoothing, they also might be a source of serious macroeconomic problems, as far as they don’t affect future productivity or help the structural adjustments.

Blanchard (2007) also identified potential risks for economies running large current account deficits for longer (such are the GIPS ones), if the increased expenditures on non-tradables can push up the pressure on the tradable sector through higher wages and misallocation of resources away from more productive sectors.

In the following part of this section I present several key statistics regarding the fundamental elements that characterized the pre-crisis and the crisis period in the GIPS economies, focusing on the interest rate spreads, competitiveness, debt and current account deficits (see Figures 1 to 5).

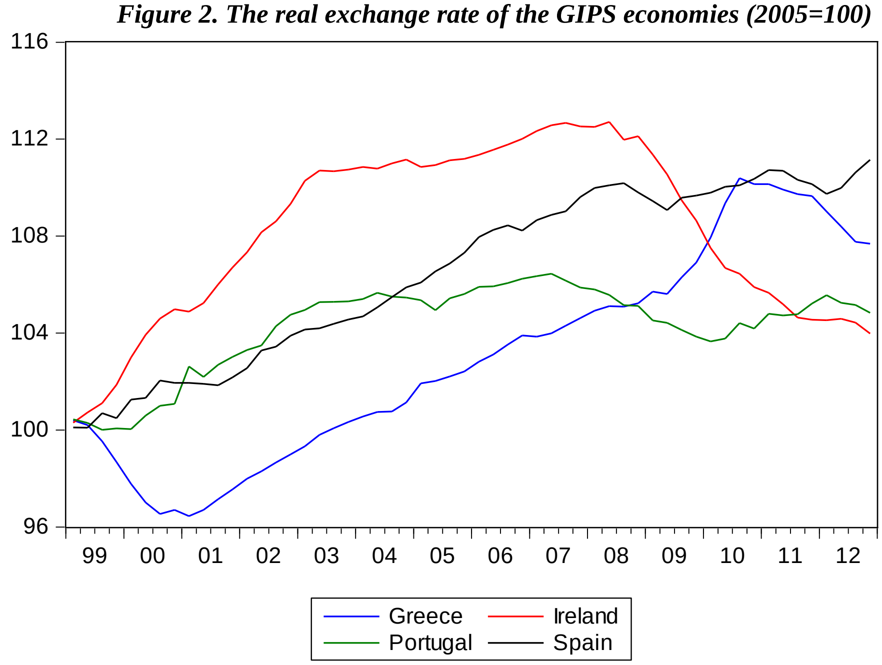
Figure 1. Interest rate spreads between GIPS economies and Germany



Source: ECB and own computations.

Note: long term interest rates.

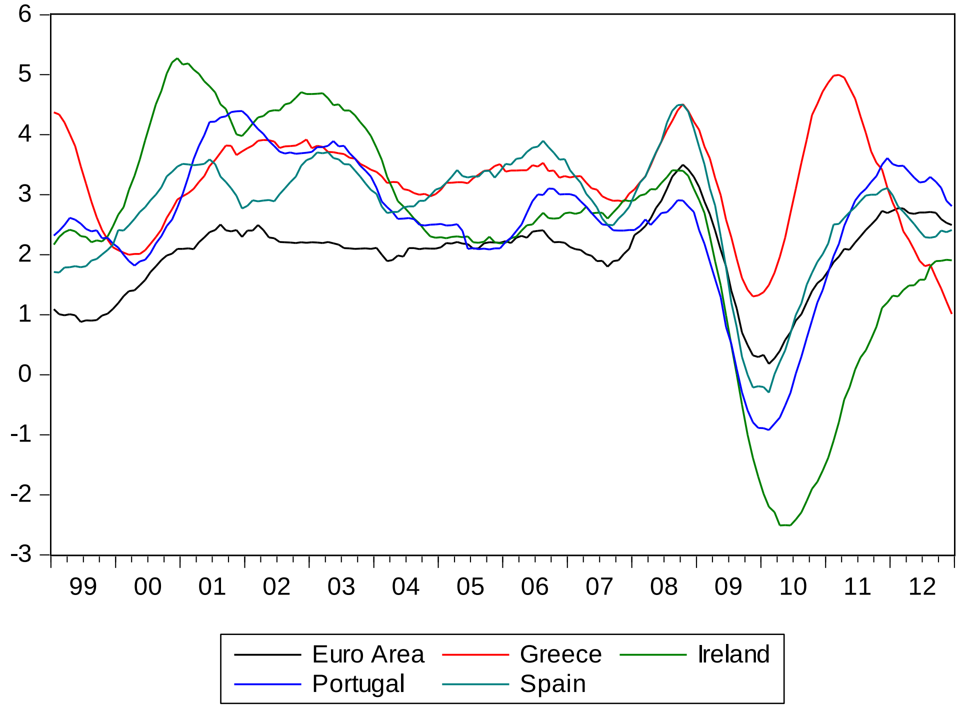
Figure 2. The real exchange rate of the GIPS economies (2005=100)



Source: Eurostat and own computation.

Note: Real effective exchange rates against 17 trading partners (Euro Area), deflated by CPI
A growth indicated an appreciation.

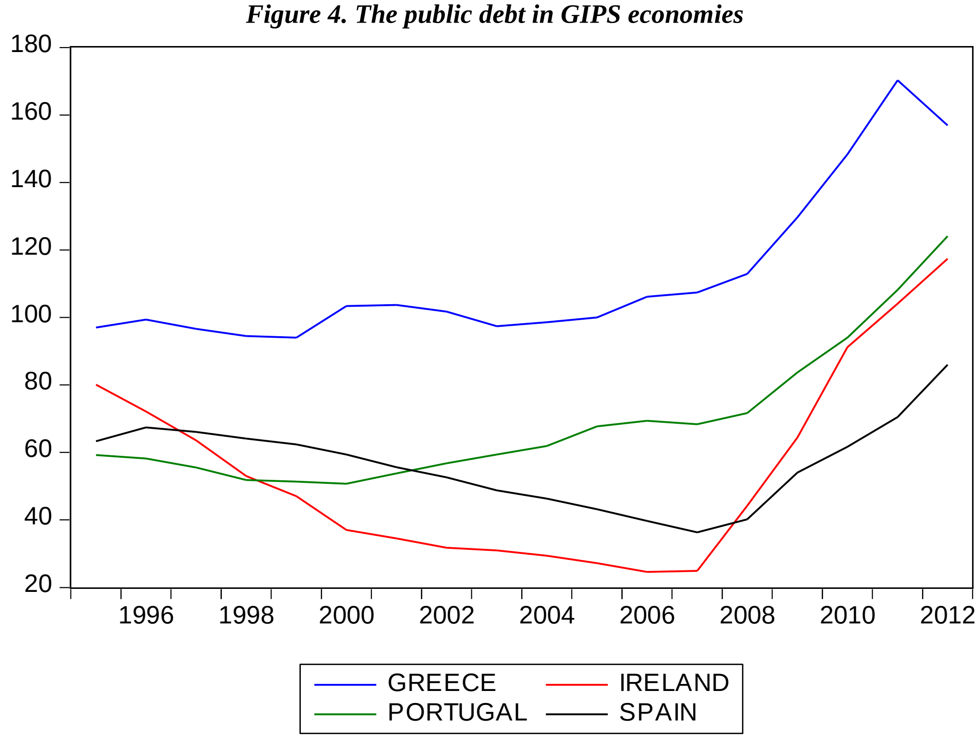
Figure 3. The inflation in GIPS economies and Euro Area (HIPC-based)



Source: Eurostat and own computations.

Note: 12 months moving average

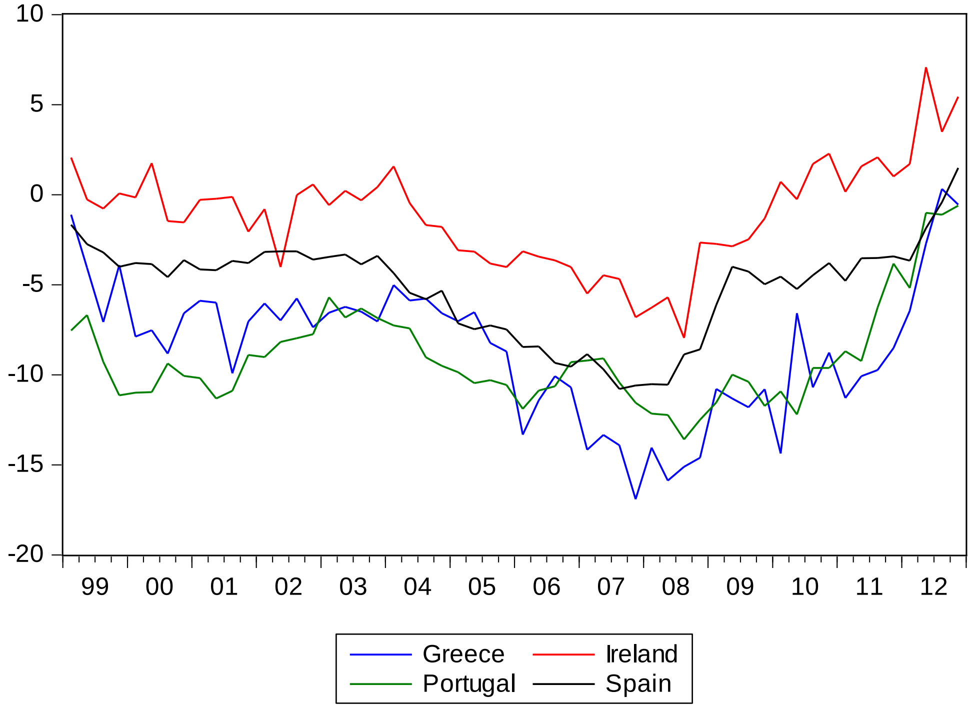
Figure 4. The public debt in GIPS economies



Source: Eurostat and own computations

Note: Public debt stock in percent of GDP

Figure 5. The current account imbalances among the GIPS



Source: Eurostat and own computations
Note: Current account balance in percent of GDP

The above figures 1 to 5, underline some key issues pertaining to the current crisis in the peripheral European economies. The GIPS economies were characterized by large and persistent current account deficits (see Figure 5). During the crisis, the current accounts were adjusted strongly as investors repatriated funds to their country of origin (see Milesi-Feretti and Tille, 2011) and the volume of new credits was reduced massively. Once the economic and financial crisis started, budget deficits went to record negative figures and debt grew in an accelerated manner (though it already had a growing trend for GIPS economies) as troubled banks had to be saved and unemployment increased dramatically, which also went in parallel with an accelerated rise in the interest rates (see Figure 1). Some of the main reasons for these phenomena included the sensitivity of tax revenues to the declines in the construction sector or asset prices, especially for Ireland and Spain (see Lane, 2012), as well as the growing risk associated by the investors with the sovereign bonds due to the falling banking sector (see Mody and Sandri, 2012). Finally, there are clear evidences of a sustained lack of competitiveness. Figure 3 shows that, after joining the Euro Area, the GIPS economies had an accelerated inflation that affected the real effective exchange rates (see Figure 2), and thus the competitiveness of the GIPS economies. This evidence could be further coupled with the high and persistent current account deficits which together constitute potential macroeconomic risks as outlined above.

The above points could be summarized by a series of stylized facts. Such stylized facts were already derived for the pre-crisis period by Fagan and Gaspar (2007).They also showed that these stylized facts can be accounted for by a dynamic equilibrium model a la Blanchard (1985) and Yaari (1965). The following facts are common to all the GIPS economies for the pre-crisis period:

1. A lower interest rate due to the accession to the euro area;
2. Private consumption increased while the rate of savings decreased;
3. Private credit increased leading to an increased indebtedness;
4. The GIPS economies ran large and persistent current account deficits;
5. The real exchange rate appreciated in these countries.

These features are also a common denominator of capital inflows phenomena as documented in the literature (see Mendoza, 2006). A further common feature, except for Portugal, is that between 1999 and 2007, both output and consumption increased.

Once the crisis began, the GIPS economies, including Portugal, were characterized by what can be labeled as a typical sudden stop:

1. The interest rate increased sharply;
2. The current accounts reversed from deficit towards surpluses by the end of the time period in the sample (2012);
3. The real exchange rate depreciated;
4. Private credit has fallen;
5. Output and private consumption decreased.

3. A baseline model

3.1. The model

In this section I start by outlining a benchmark prototype economy which corresponds to the model in Chari, Kehoe and McGrattan (2007). The model relates to a closed economy real business cycle model.

The representative consumer maximizes the lifetime expected utility subject to a budget constraint and a capital accumulation equation:

$$E_t \sum_{t=0}^{\infty} \beta^t U(c_t, l_t) N_t \tag{1}$$

Here β is the discount factor, U is the utility function, c_t is the consumption, l_t is the time worked, while N_t stands for the number of individuals in the economy.

Where the budget constraint is given by:

$$c_t + (1+\tau_{xt})x_t = (1-\tau_{lt})w_t l_t + r_t k_t + T_t \tag{2}$$

Here x_t are the investments, w_t is real wage, r_t the rental price of capital k_t, while T_t is the level of transfers in the economy. Two wedges are introduced here, the investment wedges, τ_{xt}, and the labor wedge, $\tau_{lt.}$

The capital accumulation equation is given by:

$$(1+\gamma_n)k_{t+1} = (1-\delta)k_t + x_t \tag{3}$$

Here, δ stands for the depreciation rate, while γ_n is the growth rate of the economy.

The representative firm maximizes its profits as follows:

$$F(k_t, Z_t l_t) - w_t l_t - r_t k_t \tag{4}$$

Here, the third wedge is introduced, the efficiency wedge Z_t. F stands for the production function of the firm.

The government maintains a balanced budget constraint, namely:

$$g_t + T_t = \tau_{lt} w_t l_t + \tau_{xt} x_t \tag{5}$$

There are four wedges in this model: z_t, an efficiency wedge, τ_{lt}, the labor wedge, τ_{xt}, the investment wedge, as well as the government expenditure wedge g_t. They are assumed to follow AR(1) processes.

I assume the following functional forms for the utility function and the production function. The utility function is specified as follows:

$$U(c,l) = \log(c) + \psi \log(1-l) \tag{6}$$

The parameter ψ is the leisure weight in the utility function.

A standard Cobb-Douglas production function is assumed:

$$F(k,l) = k^{\alpha} l^{1-\alpha} \tag{7}$$

Here, α stands for the capital share while *1-α* is the labor share.

3.2. Data and calibration

In order to estimate and simulate the model, one needs to construct data sets for each economy. The following data were selected from AMECO database:

- GDP, consumption, investment and government expenditures from National Accounts
- Civil employment;
- The population over 15 years of age;
- The capital stock.

Following the usual approach in the literature on business cycle accounting, annual data was used. I focused on a data sample between 1980 and 2013. Although data availability spanned back to 1960, I found rather less informative the earlier years of economic development for the present situation.

Output, consumption, investment, government expenditures and the capital stock were divided by population (over the age of 15) in order to eliminate the influence of population growth. They were also detrended using the average technological (or productivity) growth rate between 1980 and 2013, in order to eliminate the influence of the trend.

As mentioned above, I followed a similar strategy as in Chari et al. (2007) and calibrated the structural parameters. The following set of parameters was calibrated:

$$\Delta = \{\alpha, \beta, \psi, \gamma, \delta\} \tag{8}$$

Except for the capital share, as it is usual in the literature, the calibrations are shown in Table 1. The capital share α was set at 0.4, a rather standard value in line with the literature. The depreciation rate was computed using the capital stock equation and the actual series for capital stock and investments. The leisure weight was derived based on the intra-temporal Euler equation for capital/leisure decision.

Table 1. Calibration of parameters

	Symbol	*Greece*	*Ireland*	*Portugal*	*Spain*
Discount factor	β	0.93	0.94	0.94	0.92
Leisure weight	ψ	3.97	4.18	3.14	4.29
Technological progress growth	γ	0.45	1.12	1.47	1.82
Population growth	η	0.53	1.24	0.33	0.78
Depreciation rate	δ	0.038	0.032	0.057	0.041

Source: Own computations.

3.3. Estimation

Following the literature, the vector Φ is estimated base on the log-linearized decision rules of the prototype economy. The log-linearized version of the model can be written as follows in the state space representation:

$$\begin{aligned} X_{t+1} &= AX_t + B\varepsilon_t \\ Y_t &= CX_t + D\varepsilon_t \end{aligned} \qquad (9)$$

Here the states are collected in the vector X_t:

$X_t = \left[\log\left(\frac{k_t}{k}\right) \right]$, while the control variables are collected in the vector Y_t:

$$Y_t = \left[\log\left(\frac{y_t}{y}\right), \log\left(\frac{c_t}{c}\right), \log\left(\frac{x_t}{x}\right), \log\left(\frac{l_t}{l}\right) \right]$$

The vector ε_t contains the wedges, as follows:

$\varepsilon_t = [z_t, \tau_t^l . \tau_t^x, g_t]$

The model is estimated using the maximum likelihood approach, where the B, C and D matrices depend on the vector ψ. The results of the estimations are provided below, in Table 2.

Table 2. The estimated parameters for the wedges

	Greece	Ireland	Portugal	Spain
Autoregressive parameters				
TFP	0.88 (0.0219)	0.88 (0.0264)	0.86 (0.0246)	0.91 (0.0140)
Labor wedge	0.93 (0.0271)	0.94 (0.0235)	0.87 (0.0379)	0.88 (0.0250)
Investment wedge	0.98 (0.0154)	0.98 (0.0262)	0.97 (0.0307)	0.95 (0.0670)
Government wedge	0.88 (0.0300)	0.93 (0.0227)	0.90 (0.0268)	0.94 (0.0173)
Standard deviations				
TFP	0.0248 (0.0030)	0.0212 (0.0026)	0.0229 (0.0028)	0.0137 (0.0017)
Labor wedge	0.0267 (0.0032)	0.0282 (0.0035)	0.0306 (0.0037)	0.0439 (0.0055)
Investment wedge	0.0101 (0.0013)	0.0129 (0.0016)	0.0095 (0.0013)	0.0050 (0.0007)
Government wedge	0.0164 (0.0021)	0.0142 (0.0017)	0.0138 (0.0017)	0.0108 (0.0013)

Source: Own computations.
In brackets I show the associated standard errors.

The wedges were found to be much more persistent and volatile than the wedges estimated in the literature for developed economies. This finding is similar to that in Lama (2012).

In the following step, one determines the wedges using decision and transition rules based on the solved model. The wedges are computed following a few steps:

1) Assume that the decision and transition rules are already computed:

$$x_{t+1} = A_{1x1}x_t + B_{1x4}\left(z_t, \tau_t^l, \tau_t^x, g_t\right)' \tag{10}$$

$$\left(y_t, l_t, c_t, i_t\right)' = C_{1x1}x_t + D_{4x4}\left(z_t, \tau_t^l, \tau_t^x, g_t\right)' \tag{11}$$

2) It is assumed that the state variables are zero in the initial period such that:

$$x_0 = \left(k_0\right) = 0$$

3) Given the data and the initial value of the state variables, we can compute the first period wedges as:

$$D^{-1}\left(y_0, l_0, c_0, i_0\right)' = \left(z_0, \tau_0^l, \tau_0^x, g_0\right)'$$

4) Given the initial wedges and the initial state variables, we can compute the second period state variables:
   $x_1 = B(a_0, \tau_0^l, \tau_0^k, \tau_0^b)'$
5) We can further compute the second period value of wedges, and so on:
   $(a_1, \tau_1^l, \tau_1^k, \tau_1^k)' = D^{-1}(y_1, l_1, c_1, i_1)' - D^{-1}Cx_1$

The simulation assumes the year 1980 as the initial point and the wedges are determined relative to 1980. For conveniences, when analyzing subsamples, I present the wedges and their contributions relative to the initial year of the subsample. For example, for the 2008 – 2013 sample, the contributions of the wedges are presented relative to the year 2008.

3.4. Results using the baseline model

3.4.1. TFP

TFP appears as one of the main drivers of economic activity both before (see Appendix E), and during the crisis (see Appendix D). Quantitatively, the TFP can explain about half of the variation of output, during and before the crisis, with some variations for each particular case. In the following paragraphs, I try to look at the possible forces behind the changes in TFP.

The finding of TFP as a significant driver of output movements is common in the BCA literature, as in the reference paper by Chari et al. (2007). A few potential explanations were proposed in the literature. Lagos (2005) found that overall productivity (that is, TFP) can be influenced by labor market policies that imply misallocations of labor across firms. Another possibility might come from the mis-measurement of the productivity due to labor hoarding, as suggested by the paper due to Burnside, Eichenbaum, and Rebelo (1993).

Chari et al. (2007) proposed a different approach to this issue. They suggest a framework in which financial frictions act through the allocation of intermediary inputs across heterogeneous firms. In such a detailed model, although financing frictions remain constant, the TFP fluctuates due to changes in the relative distortions.

3.4.2. The labor wedge

The labor wedge appears as the other significant driver. Quantitatively it can explain a large share of the variations in output (when adding the TFP, the two wedges over-explain the rise or fall in output since they also cover the countercyclical behavior of the investment wedge), in many cases more than 50% of GDP.

The interpretation of the labor wedge is as much controversial as the interpretation of the TFP. One strand of research, following Cole and Ohanian (2002), considers that the labor wedge originates from the regulations on the labor market. Hall (1997) showed that job search affected the labor wedge. Alternatively, Parkin (1988) attributed the fluctuations in the labor wedge to the financial shocks.

The paper by Chari et al. (2007) provided an alternative detailed model which corresponded to a prototype model with a labor wedge. The detailed model is a monetary economy characterized by sticky wages. The monetary policy shocks in the detailed economy correspond to shocks to the labor wedge in the prototype economy.

3.4.3. The investment wedge

The investment wedge is not able to explain the movements in output either before or during the crisis, except for the pre-crisis period in Spain. In all other cases, the investment wedge is weakly countercyclical.

Investment wedges correspond to financial frictions. In the paper by Chari et al. (2007), the investment wedge in the prototype economy corresponds to a detailed model with financial frictions as specified by Bernanke, Gertler and Gilchrist (1999).

The small role of the investment wedge is a constant finding in the literature, whether the BCA methodology was applied to the Great Depression in US or other recessions in developed and emerging economies. An exception to this general line is the paper by Cho and Doblas-Madrid (2013) who reported a significant role for the investment wedge in the Southeast Asian economies.

3.4.4. The government wedge

The government wedge simply corresponds to government consumption and is directly measured through government expenditures. No role for the government wedge was identified during the crisis. However, during the pre-crisis period, the government wedge played a modest pro-cyclical role, explaining about 20% to 40% of the variation in output (to be more precise, the output growth, except for Portugal which was in a slump after 2000, see Section 5). Even for the case of Portugal, there is a positive role for the government wedge.

While this section uses a baseline model corresponding to the standard model used in Chari et al. (2007), it would be interesting to find whether opening the economy influences or not the results of this exercise.

4. A small open economy model

4.1. The model

The standard neoclassical framework, as proposed by Chari, Kehoe and McGrattan (2007) is based on the standard real business cycle model which assumes a closed economy. While useful for large economies, and also successfully applied to small open economies, like Otsu (2010) or Lama (2012), it might be asked if this framework is comprehensive enough for the case of the GIPS economies studied here.

Based on the above arguments, the paper also introduces and applies the dynamics of the GIPS economies using a small open economy model in the tradition of Mendoza

(1991) and Schmitt-Grohe and Uribe (2003). Such an approach has also been used by Lama (2012) to account for business cycle dynamics in Latin American economies.

I present in the following paragraph the baseline model to be used in the paper, following Lama (2012) and Mendoza (1991). The representative household maximizes the expected discounted utility given by:

$$E_0 \sum_{t=0}^{\infty} N_t \beta^t U(c_t, l_t) \tag{12}$$

Here N_t is the size of the population, β the typical discount factor, while c_t and l_t are the components of the utility function, consumption and leisure.

The following household constraints are the typical ones for a small open economy.

The budget constraint is given by:

$$(1+n)b_{t+1} + c_t + i_t \leq (1-\tau_{lt})w_t l_t + (1-\tau_{kt})r_t k_t + (1+\tau_{bt})(1+r_t^*)b_t + T_t \tag{13}$$

Where b_t is the international bond, i_t are the investments, k_t is the capital stock, r_t is the rental rate for capital, w_t are the wages, r_t* the international interest rate while T_t the government transfers. The wedges are given by τ_{lt} for the labor wedge, τ_{kt} for the capital wedge as well as τ_{bt} for the bond wedge.

The capital constraint is given by:

$$(1+n)k_{t+1} = (1-\delta)k_t + x_t \tag{14}$$

The curve for the supply of funds for international borrowing:

$$(1+r_t^*) = (1+r^*)\left(\frac{b_t}{b^*}\right)^{\upsilon} \tag{15}$$

The parameter υ describes the elasticity of the interest rate to the bonds.

The problem of the firm is to maximize their profits, namely:

$$\underset{k,l}{Max}\, y_t - w_t l_t - r_t k_t \tag{16}$$

Under the constraint given by the production function.

$$y_t = A_t F\left(k_t, (1+\gamma)^t l_t\right) \tag{17}$$

Here A_t stands for the total factor productivity while γ is the growth rate of technological progress that is labor augmenting.

The government budget policy is presented below:

$$T_t = \tau_{kt} r_t k_t + \tau_{lt} w_t l_t - \tau_{bt}\left(1 + r_t^*\right) b_t \qquad (18)$$

The wedges are specified to follow *AR(1)* processes as in the closed economy model.

The following functional forms are assumed. The utility function is given by:

$$U(c,l) = \log(c) + \psi \log(1 - l) \qquad (19)$$

I assume a standard Cobb-Douglas production function:

$$F(k,l) = k^{\alpha} l^{1-\alpha} \qquad (20)$$

The accumulation process for the capital stock is given by:

$$(1+\gamma) k_{t+1} = (1-\delta) k_t + x_t \qquad (21)$$

Where δ is the depreciation rate, γ the total factor productivity growth.

As for the previous model, I follow the contribution of Chari et al. (2007) and split the parameters into two groups, namely into the deep parameters that characterize the model gathered into the vector Δ (related to technology, preferences and population growth rate), and the parameters that characterize the dynamics of the wedges, namely A and V, gathered into the vector Φ. The vector Δ is calibrated, while the vector Φ is estimated using the maximum likelihood approach.

4.2. Data and calibration

In order to apply this model to the data, I abstract from government expenditures and consider the trade balance with the rest of the world. Thus, there will be some differences between output, investment and consumption corresponding to this model as compared to the initial model. I follow the same procedure and divide these aggregates by the population over 15 years of age and also detrend the series using the average technological growth since 1980.

As for the previous model, I have calibrated only the structural parameters, while the parameters governing the wedges were estimated. The following parameters were calibrated:

$$\Delta = \{\alpha, \beta, \psi, \gamma, \eta, \delta, b/y\} \qquad (22)$$

The calibration for δ is done as for the previous model. The parameter ψ is calibrated based on the steady state optimal intra-temporal allocation between consumption and labor while β is determined using the steady state capital Euler equation.

Table 3. Calibration of parameter

	Symbol	*Greece*	*Ireland*	*Portugal*	*Spain*
Discount factor	β	0.96	0.95	0.95	0.95
Leisure weight	ψ	2.86	3.62	2.39	3.68
Technological progress growth	γ	0.43	2.77	1.86	1.31
Population growth	n	0.52	1.20	0.32	0.76
Investment share	i/y	0.28	0.23	0.27	0.29
Bond holdings over GDP	b/y	-0.34	-0.34	-0.33	-0.24

Source: Own computations.

4.3. Estimation

Table 4. The estimated parameters for the wedges

	Greece	Ireland	Portugal	Spain
Autoregressive parameters				
TFP	0.63 (0.1479)	0.81 (0.0722)	0.87 (0.0536)	0.86 (0.0329)
Labor wedge	0.95 (0.0195)	0.88 (0.0577)	0.95 (0.0288)	0.96 (0.0093)
Capital wedge	0.98 (0.0063)	0.97 (0.0121)	0.97 (0.0157)	0.95 (0.0225)
Bond wedge	0.65 (0.0361)	0.55 (0.0605)	0.54 (0.0773)	0.53 (0.0813)
Standard deviations				
TFP	0.0067 (0.0010)	0.0137 (0.0018)	0.0087 (0.0013)	0.0034 (0.0005)
Labor wedge	0.0174 (0.0024)	0.0241 (0.0031)	0.0175 (0.0023)	0.0167 (0.0021)
Capital wedge	0.0607 (0.0077)	0.0547 (0.0067)	0.0412 (0.0050)	0.0344 (0.0042)
Bond wedge	0.0123 (0.0016)	0.0149 (0.0022)	0.0134 (0.0023)	0.0105 (0.0020)

Source: Own computations.
In brackets I show the associated standard errors.

The results are basically similar with the ones for the baseline model for the first three types of wedges, pointing again to persistent and volatile wedges. The bond wedge is moderately persistent. I also found a capital wedge which is much more volatile than the other wedges.

4.4. Results using the small open economy model

In this section I present the results when only one wedge is used and counterfactual paths for output are obtained for each country. Appendix F shows the results for the crisis period, 2008 to 2013, while Appendix G shows the results for the 1999 to 2007 period.

4.4.1. The Total Factor Productivity

As for the case of the closed economy model, TFP is one of the key drivers of output. It explains most of the dynamics of output for GIPS economies during the crisis period (although its explanatory power declines starting with 2011 for Greece, Ireland and Spain).

For the pre-crisis period, 1999 to 2007, there is some variation for the role of TFP. For Greece, it over-explains the growing output, while for Portugal it tends to predict a much lower output than in reality. For Ireland, although it explains more than 100% of the rise in output, its explanatory power tends to zero after 2004. Finally, for Spain, it predicts a negative detrended output, which goes against the positive developments in the Spanish economy during that period.

As Lama (2012) suggests, changes in TFP in a small open economy might come from variations in the interest rate faced by these economies and in the import prices. Appendix H presents a detailed model due to Christiano et al. (2004) where fluctuations in TFP can be explained from variations in the international interest rates or import prices even if there is no change in the actual productivity.

4.4.2. The labor wedge

For the 2008-2013 period, the contribution of the labor wedge is clearly negative for all cases except Portugal: it explains a large share of the fall in output in each country, i.e. more than 50%. For the pre-crisis period, the results are much more mixed. There are positive contributions of the labor wedge for Ireland, Portugal and Spain, and a negative one for Greece.

I have already mentioned the possible interpretations of the labor wedge in a closed economy model. Three such interpretations were discussed: the regulations on the labor market, as in Cole and Ohanian (2002), financial shocks, as in Parkin (1988) or monetary shocks, as in Chari et al. (2007).

In a small open economy, the labor wedge can also come from a working capital constraint, as in the model by Neumeyer and Perri (2004). Fluctuations in the interest rates faced by these economies can lead to changes in the labor wedge, irrespective of the regulations on the labor market and/or the changes in taxes. At the same time, some of the changes in the labor wedge during the crisis might be associated to changes in the labor market regulation following the austerity measure which led to lower protection for employees, a more flexible wage setting as well as more flexible rules for hiring and firing employees.

4.4.3. The capital wedge

The sources of a capital wedge can either be the taxes on capital income (which are less important for GIPS economies) or the imperfections in financial markets (like borrowing constraints, for example). For the case of the GIPS economies, the capital wedge might be also related to their specific financial problems, like liquidity shortage.

Lama (2012) found a negligible capital wedge in several Latin American economies, suggesting that the financial factors are not relevant for the dynamics of output in small open economies.

I found some evidence in favor of the capital wedge explanatory power. The capital wedge played some role in the contraction of output in Greece (about 10% might be explained through this wedge) and a more consistent role for the cases of Ireland, and Portugal.

4.4.4. The bond wedge

I discuss in this section the impact of including the bond wedge when simulating the model. The origin of this wedge may stem from frictions in international transactions.

Lama (2012) found that the bond wedge generally tends to increase during the recessions a fact attributed to the negative wealth effects associated to it which further make the households poorer and determine them to work more. He also found contractionary effects of the bond wedge for Chile and Mexico which he explained based on a similar reasoning: a lower bond wedge has positive effects on the wealth of the households leading to a decline in the labor supply and a contraction in output.

I found positive effects of the bond wedge during the crisis period (which is associated to a higher bond wedge due to the negative wealth effects). The effect is small in Greece, and corresponds to the last years in the sample, and higher in Portugal and Spain. The higher bond wedge is consistent with the higher risk premium for the GIPS economies.

For the pre-crisis period, 1999 to 2007, I found similar results. For the case of Portugal, I surprisingly found a positive contribution. The result would be expected given the Portuguese slump, however it does not corresponds to the lower sovereign risk generally associated with the group of GIPS economies after accessing the Euro Area. At the same time, a negative contribution for Greece, Ireland and Spain was found, which basically corresponds to positive wealth effects following a lower risk premium in this period.

5. Accounting for the Portuguese Slump: 2000 to 2007

The period between 1999 and 2007, although a growth period for Greece, Ireland and Spain, it has not been so for Portugal. One of the early studies that analyzed this phenomenon for the case of Portugal was done by Blanchard (2007). He emphasized three key macroeconomic developments by that time: low productivity, close to zero economic growth and rising unemployment.

Reis (2013), in his thorough study on Portugal's slump, makes three key arguments about it: that Portugal's performance has been worse than the one in the United States during the Great Depression or the Japanese one during the 1990s; that the slump started once Portugal joined the euro area; and that although capital flew into Portugal, there was no measurable impact on the real economy or productivity. The analysis of Reis (2013) points to the fact that, although Portugal was characterized by the same common features as in the other GIPS economies, it has not enjoyed however an increase in private consumption and output. His explanation resides in the misallocation of resources, which turned mostly towards the non-tradables sector.

In order to explain the Portuguese slump and the crisis afterwards, a stylized model is presented which rests on a few key assumptions. In this model, the credit frictions make capital inflows to be misallocated across firms and sectors. In such a model, capital inflows can lead to lower productivity due to credit market imperfections. A simple model of household consumption and production of tradables leads to a few key features. First, the wage rate is uniquely determined by the foreign interest rate so that shocks in the foreign interest rate affect the output. Second, higher taxes discourage the labor supply. And third, the foreign capital directly goes into the non-tradables sector leading to an exchange rate appreciation. When applied to the slump and the crisis after 2008, the model is able to replicate the key features of the Portuguese economy.

The two prototype models simulated in this paper lead to similar results. The key drivers for the output, both during the slump and the financial crisis are the TFP and the labor wedge. There is a positive role for the government wedge during the slump, like for the other GIPS economies during the 1999 – 2007 period.

When we couple the results in this paper with the model in Reis (2013), we can understand what lies behind the movements in TFP and the labor wedge. Capital inflows into Portugal after 2000 can generate a fall in TFP following a simple mechanism. The new capital will flow into the non-tradables sector, which leads to a fall in the average productivity in the non-tradables sector as well as in the overall economy as lower productivity firms are financed. A pertinent question would be why wouldn't this mechanism apply to the other GIPS economies too? The main reason, as Reis (2013) documents, is the less developed financial market in Portugal. This model is also consistent with the negative contribution of the labor wedge to both the economic slump up to 2007 and the financial crisis starting with 2008. The negative contribution of the labor wedge can originate from the higher taxes as the data suggests, see also Figure 9, at least for the pre-crisis period. It might also originate from shocks in the degree of financial integration and or the level of financial deepening which distort the ratio between the marginal rate of substitution and the marginal product of labor, i.e. the labor wedge, again, see the model by Reis (2013). A detailed model is presented in Appendix J. This does not imply that the misallocation did not affect the TFP too, however the results here show that this model is also consistent with the dynamics of the labor wedge.

6. Further evidences

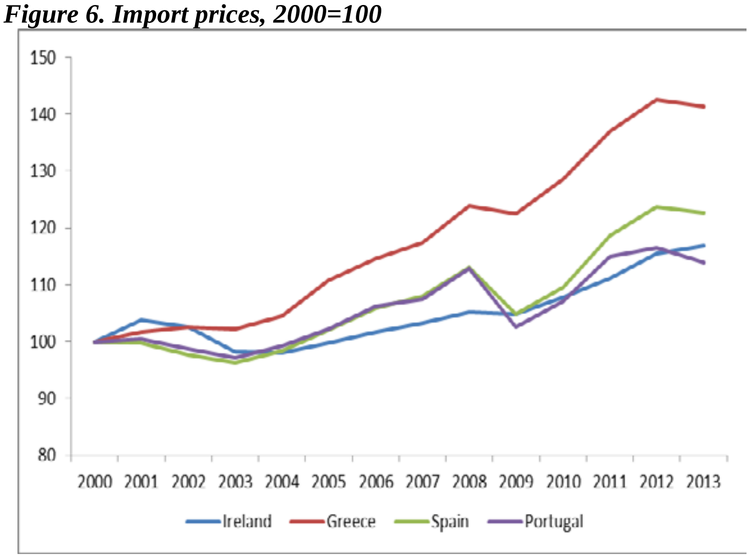
In this section, I present further evidences on the potential drivers of the key wedges for the dynamics of the GIPS economies: TFP and the labor wedge.

6.1. TFP: working capital constraint on imported inputs

One of the possible detailed models that could explain the dynamics of output for the GIPS economies is the already mentioned model by Christiano et al. (2004). The model introduces in a small open economy working capital constraints, which implies that firms have to borrow in advance a fraction of the costs of employment.

Figure 1 already has shown the dynamics of the interest rate, while Figure 6 below presents the dynamics of the import prices with the level of the year 2000 taken as the base year. Two conclusions emerge. First, the import prices cannot explain the positive contribution of labor wedges in the GIPS economies during 1999 to 2007 (except the case of Portugal), and second the import prices rise fast after 2008. When taking into account the fast spike in the interest rates after 2008, the mechanism suggested in Appendix H seems plausible (namely, that a higher interest rate and higher import prices can lead to a drop in TFP, even if the productivity basically remained the same), at least for the crisis period.

Figure 6. Import prices, 2000=100



Source: Eurostat and own computations.

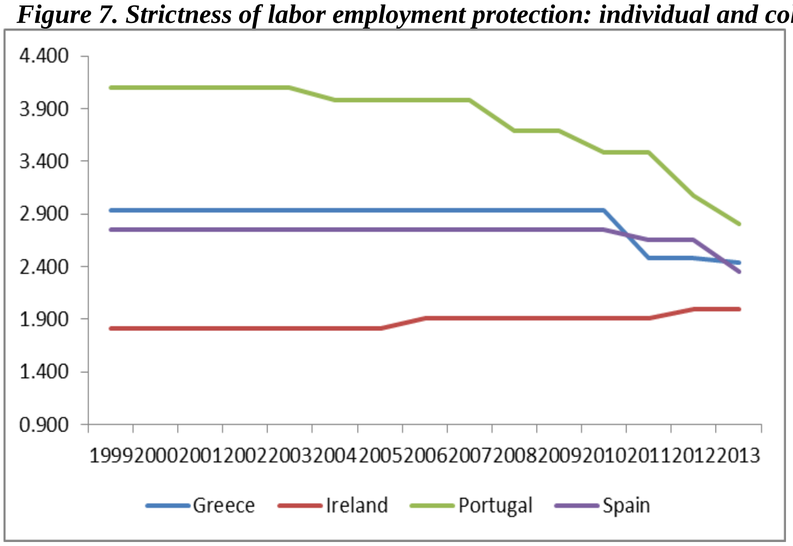
6.2. The labor wedge: the working capital constraint hypothesis

In a small open economy, the labor wedge can come from the working capital constraint for firms. Clearly, following what Figure 1 suggests, such a mechanism is plausible during the crisis period. For the pre-crisis period, at least for Greece, Ireland and Spain, the decreasing interest rate can also, at least partly, explain the positive contribution of the labor wedge. It is also well known that the interest rates spiked during the crisis for these economies, see again Figure 1, making plausible the working capital constraint for the GIPS economies during the crisis period as well.

6.3. The labor wedge: labor market regulations and taxes

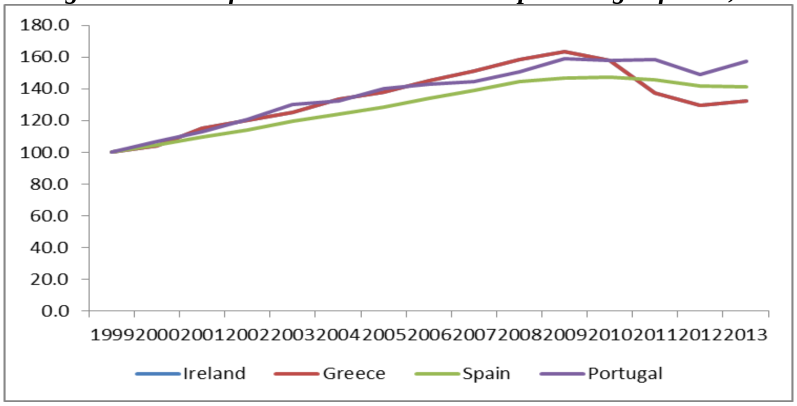
Among the possible explanations for the changes in the labor wedge are also taxes and regulations on the labor market. Figure 7 shows some evidence related to the dynamics of the labor market regulations in GIPS economies, while Figures 8 and 9 show the dynamics of the social contributions and of the collected direct taxes relative to the year 2000. There are hardly any evidences on increases in labor market regulations during the crisis period (on the contrary, they seem to have decreased in most cases), at least in the first part, the most severe one. Neither increases in taxes can explain the variation seen in the labor wedges in the analyzed economies. There is only some evidence on the growth of direct taxes during the second part of the crisis, possibly due to austerity measures.

Figure 7. Strictness of labor employment protection: individual and collective



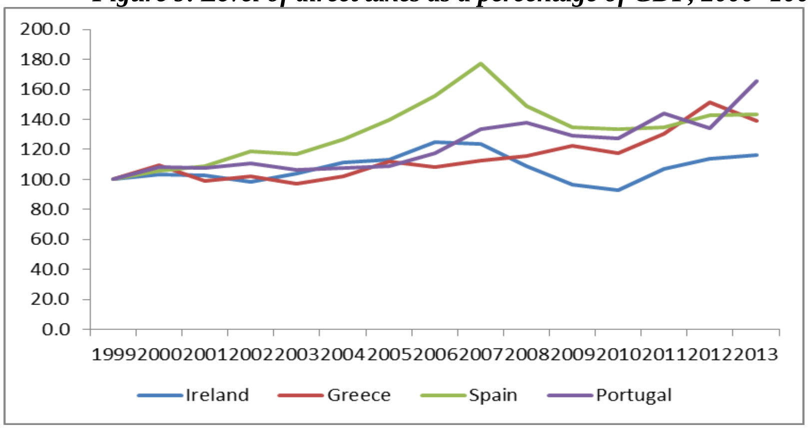
Source: OECD

Figure 8. Level of social contributions as a percentage of GDP, 2000=100



Source: AMECO

Figure 9. Level of direct taxes as a percentage of GDP, 2000=100



Source: AMECO

6. Conclusion

Based on the neoclassical framework, to be more specific, on the "business cycle accounting" approach, this paper showed that it could provide an interpretation of the output drops in the so called GIPS economies during the sovereign debt crisis.

The output was to be driven mostly by TFP and the labor wedge. There are slight contributions by the government wedge, especially during the boom period before the crisis, and by the bond wedge, which moves in a countercyclical manner, in accordance with the theory. Outside evidences on the import prices and the interest rate faced by these economies suggest typical mechanisms for capital inflows followed by sudden stops which could explain the movements in TFP and the labor wedge. The same two forces move the Portuguese economy through the 2000-2007 slump, which I argue that it is consistent with a theoretical model of capital misallocation as in Reis (2013).

Another key issue which is indirectly addressed in this paper is how the Euro adoption by the GIPS economies affected their macroeconomic dynamics. A definitive answer is hard to be reached for now, but an illustration of the mechanism at work can be done through the detailed model in Appendix J. Basically, as Reis (2013) argues, the Euro adoption was similar to a major shock consisting in the large capital inflows into these economies after 1999. This shock worked through the labor wedge, and, depending on the level of financial markets development, it translated into a negative impact on output, for Portugal, and a positive impact, for Greece, Ireland and Spain. Thus, the Euro adoption, although it decreased the perceived risk by investors, it had an ambiguous effect which pretty much depended on the capacity (or on the level of development of domestic financial markets) of each economy to efficiently absorb the large capital inflows.

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Appendix A. The solution for the closed economy model

A.1. The equilibrium conditions

$$y_t = c_t + x_t + g_t$$

$$y_t = k_t^{\alpha}\left(Z_t l_t\right)^{1-\alpha}$$

$$\left(\frac{\psi c_t}{1-l_t}\right) = \left(1-\tau_{l,t}\right)Z_t\left(1-\alpha\right)k_t^{\alpha}\left(Z_t l_t\right)^{-\alpha}$$

$$\left(1+\tau_{x,t}\right)\left(1+\gamma\right)\frac{1}{c_t} = \beta E_t \frac{1}{c_{t+1}}\left[\alpha\left(k_{t+1}\right)^{\alpha-1}\left(Z_{t+1}l_{t+1}\right)^{1-\alpha} + \left(1-\delta\right)\left(1+\tau_{x,t+1}\right)\right]$$

$$\left(1+\gamma\right)\left(1+n\right)k_{t+1} = \left(1-\delta\right)k_t + x_t$$

A.2. The steady state

$$\bar{k} = \left(\frac{\bar{k}}{\bar{l}}\right)\bar{l}$$

$$\bar{c} = \frac{\left(1-\bar{l}\right)}{\psi}\left(1-\tau_l\right)Z^{1-\alpha}\left(1-\alpha\right)\left(\frac{\bar{k}}{\bar{l}}\right)^{\alpha}$$

$$\bar{y} = Z^{1-\alpha}\left(\frac{\bar{k}}{\bar{l}}\right)^{\alpha}\bar{l}$$

$$\bar{x} = \left[\left(1+\gamma\right)\left(1+n\right)-\left(1-\delta\right)\right]\bar{k}$$

Appendix B. The solution for the open economy model

B.1. The equilibrium conditions

$$-\frac{U_{lt}}{U_{ct}} = \left(1-\tau_{l,t}\right)A_t F_{lt}$$

$$U_{ct} = \beta E_t\left[U_{c,t+1}\left(1-\tau_{k,t+1}\right)A_{t+1}F_{k,t+1} + 1-\delta\right]$$

$$U_{ct} = \beta E_t\left[U_{c,t+1}\left(1+\tau_{b,t+1}\right)\left(1+r_{t+1}^*\right)\right]$$

$$(1+n)(1+\gamma)b_{t+1} = \left(1+r_t^*\right) + y_t - x_t - c_t$$

$$y_t = A_t k_t^{\alpha} l_t^{1-\alpha}$$

B.2. The steady state

$$(1-\alpha)\frac{\bar{y}}{\bar{l}}\left(1-\tau_l\right) = \psi\frac{\bar{c}}{1-\bar{l}}$$

$$\bar{y} = Z\left(\frac{\bar{k}}{\bar{l}}\right)^{\alpha}\bar{l}$$

$$1 = \frac{\beta}{1+\gamma}\left(\alpha\left(1-\tau_{k,t}\right)\frac{\bar{y}}{\bar{k}} + 1-\delta\right)$$

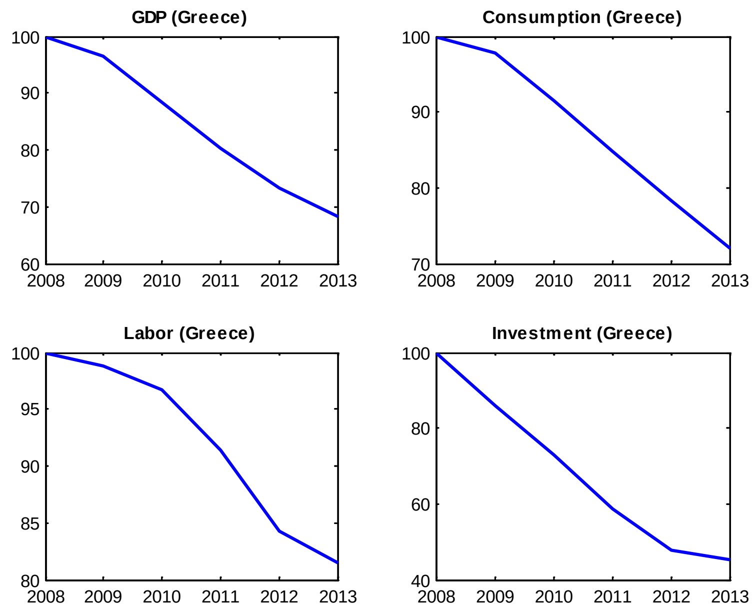
$$1 = \frac{\beta}{1+\gamma}\left(1+\bar{r}^*\right)\left(1+\tau_b\right)$$

$$\frac{\bar{k}}{\bar{y}}\left(\gamma + n + \gamma n + \delta\right) = \frac{\bar{x}}{\bar{y}}$$

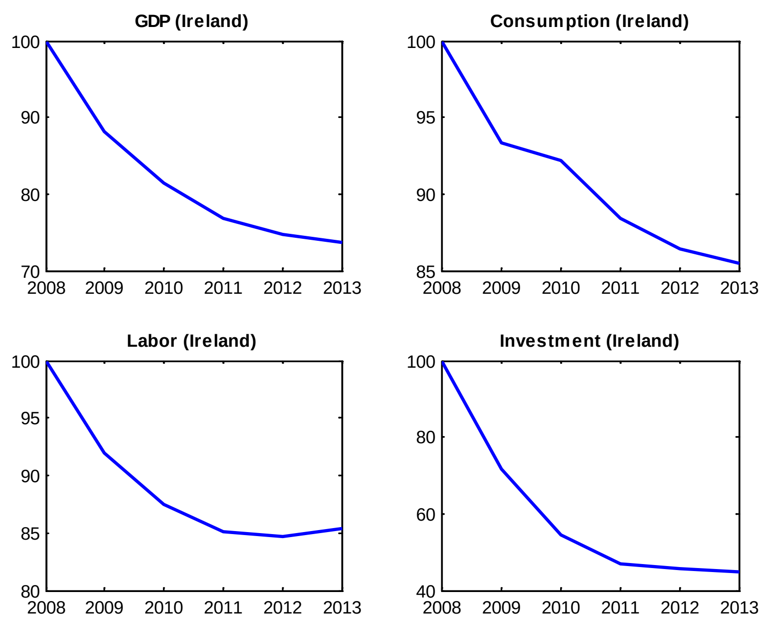
$$\frac{\bar{b}}{\bar{y}}\left(\gamma + n + \gamma n\right) = \frac{\bar{y} - \bar{i} - \bar{c}}{\bar{y}}$$

Appendix C. The data (closed economy)

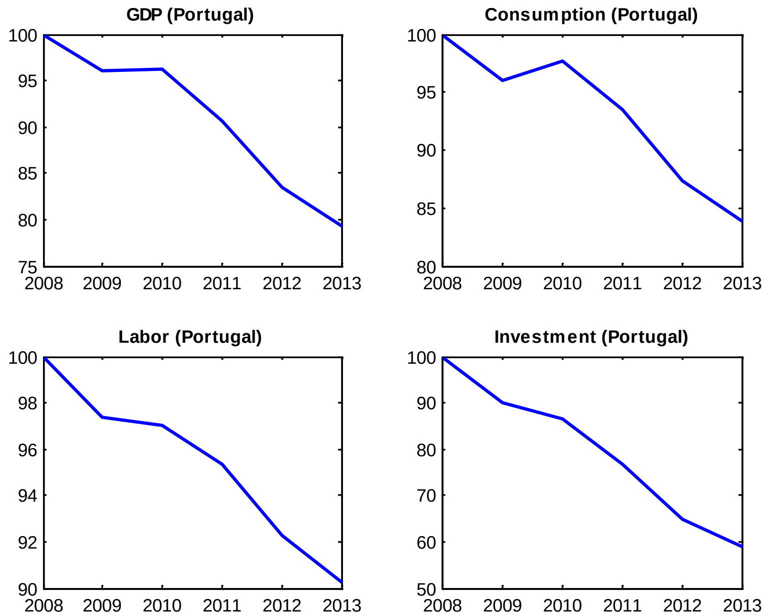
C.1. Case of Greece



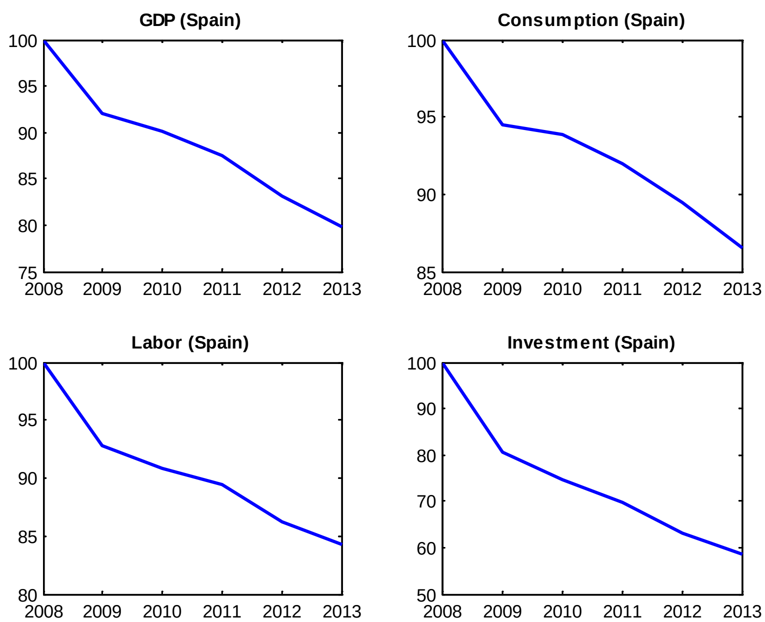
C.2. Case of Ireland



C.3. Case of Portugal

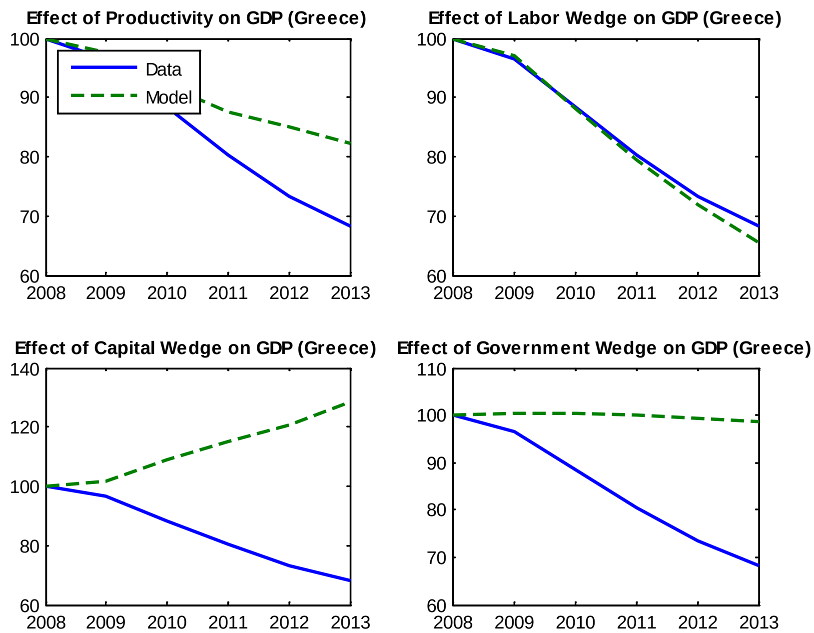


C.4. Case of Spain



Appendix D. Baseline Model - The Contribution of Wedges: 2008-2013

D.1. Case of Greece



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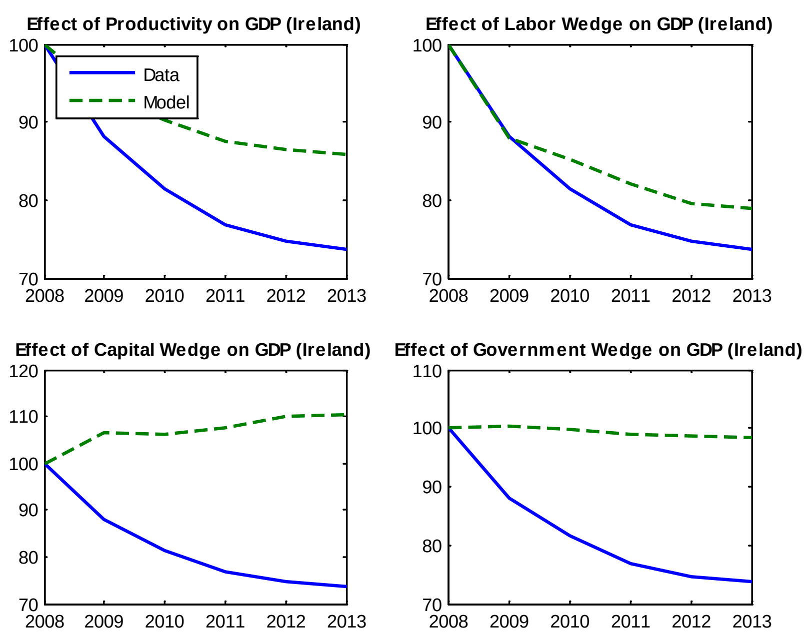
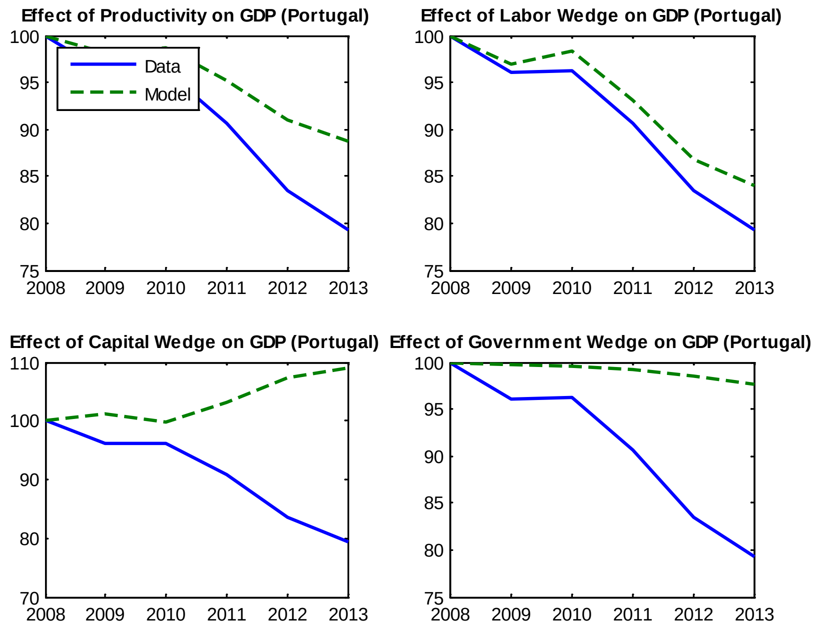
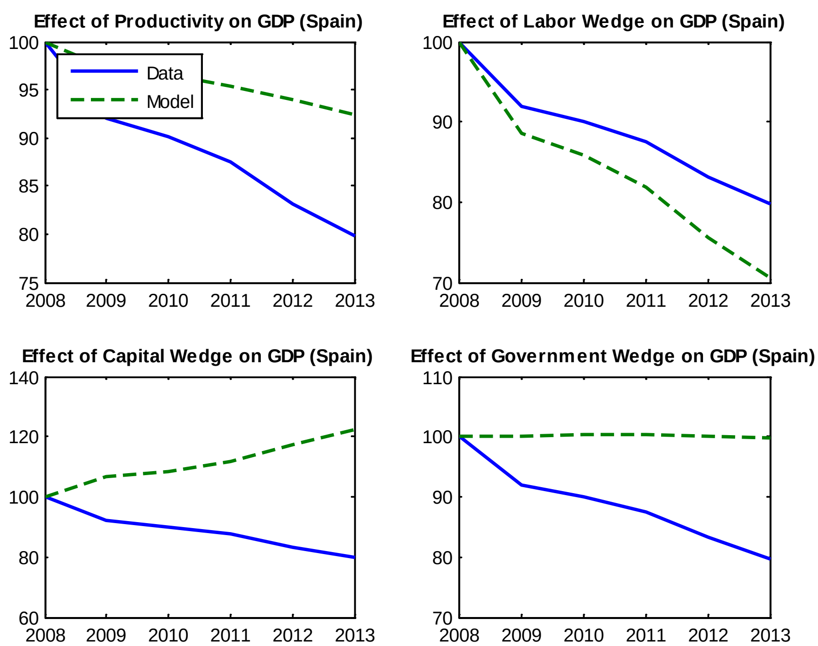


D.3. Case of Portugal

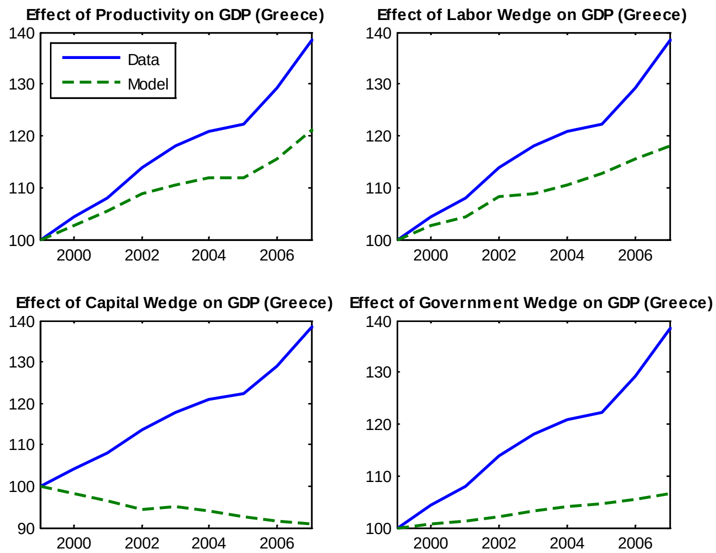


D.4. Case of Spain

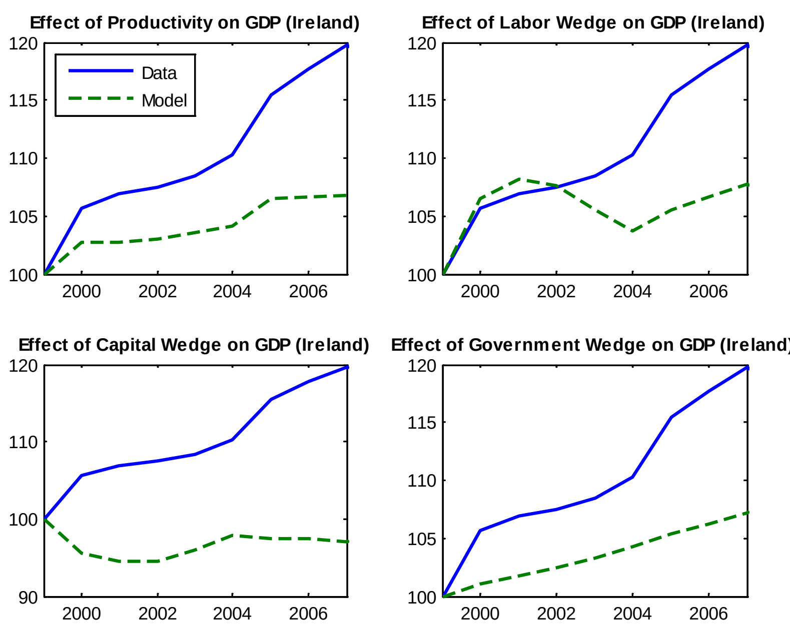


Appendix E. Baseline Model - The Contribution of Wedges: 1999-2007

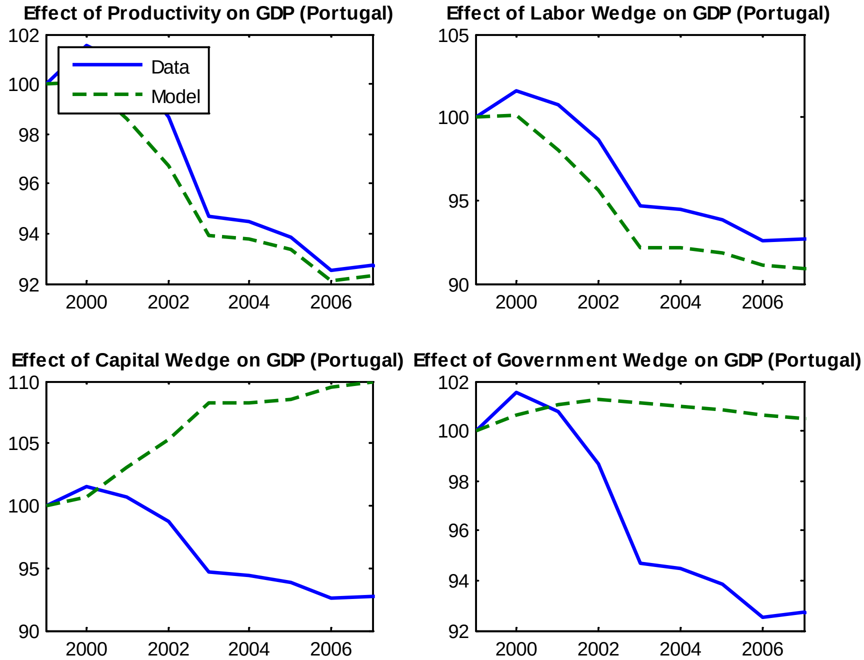
E.1. Case of Greece



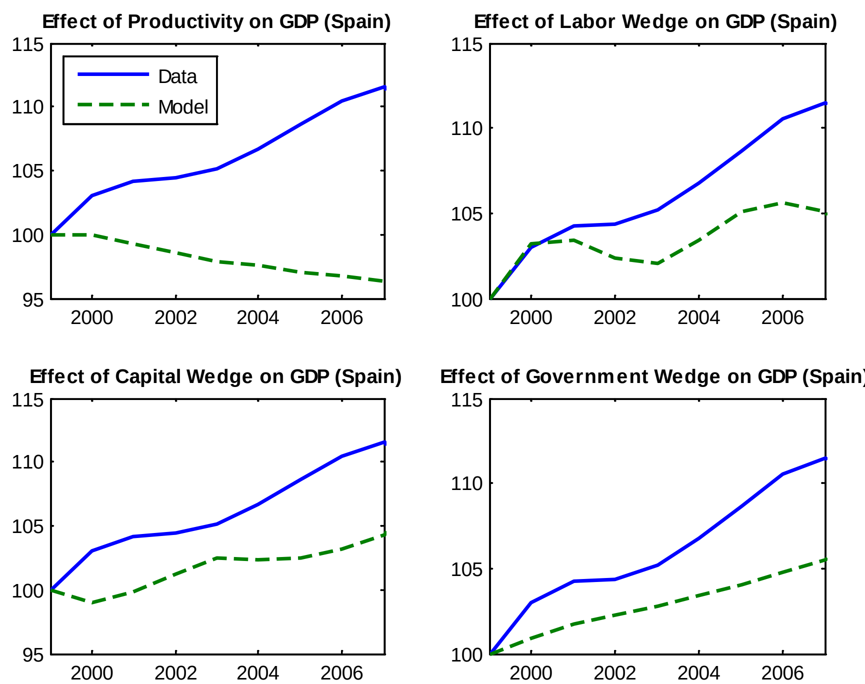
E.2. Case of Ireland



E.3. Case of Portugal

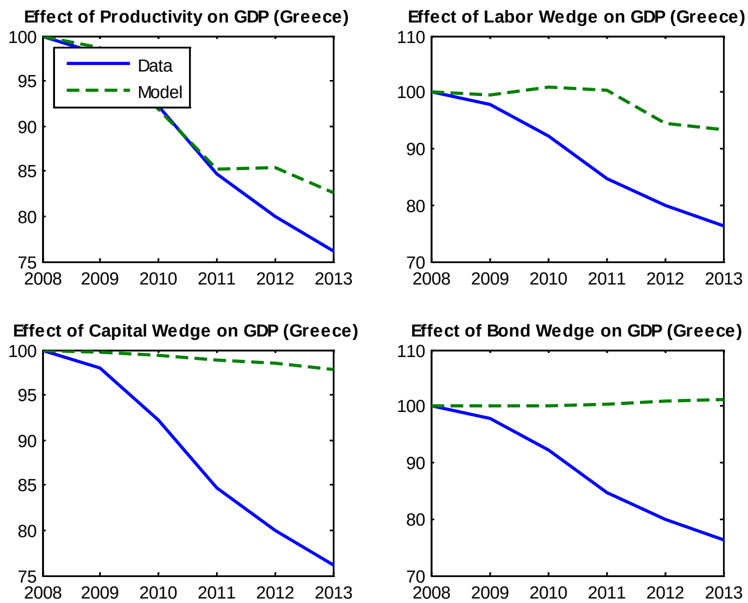


E.4. Case of Spain



Appendix F. SOE Model - The Contribution of Wedges: 2008-2013

F.1. Case of Greece



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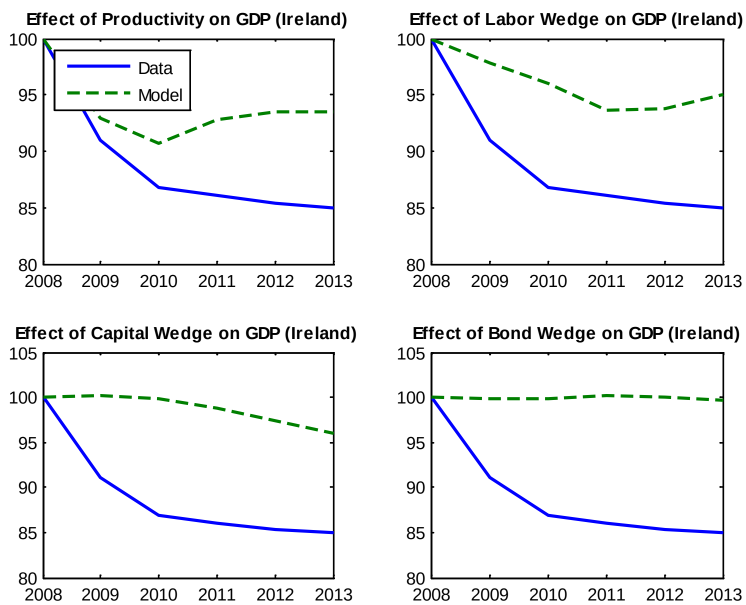
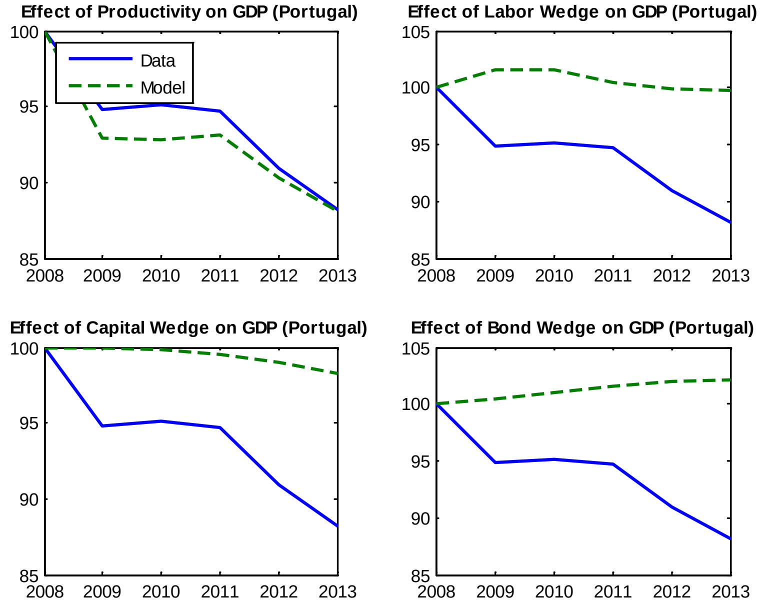
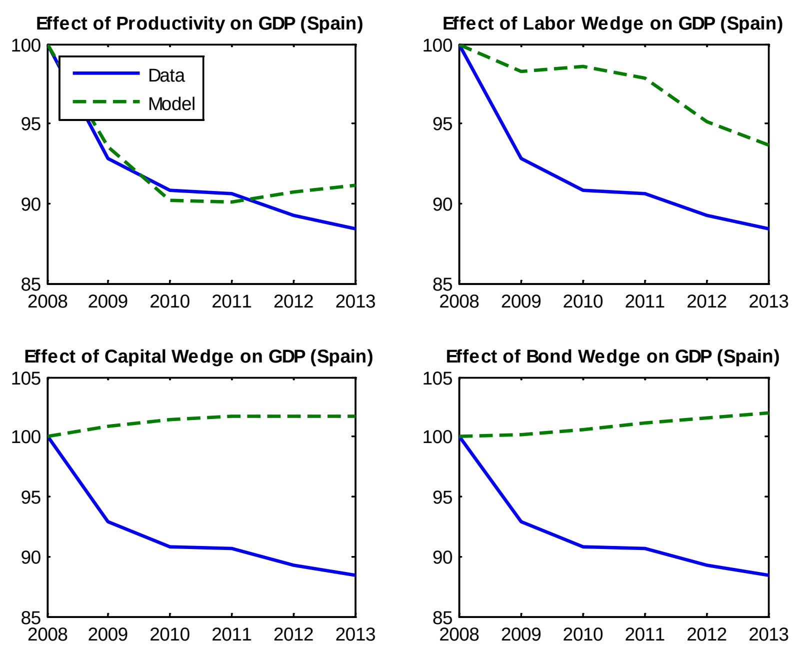


F.3. Case of Portugal

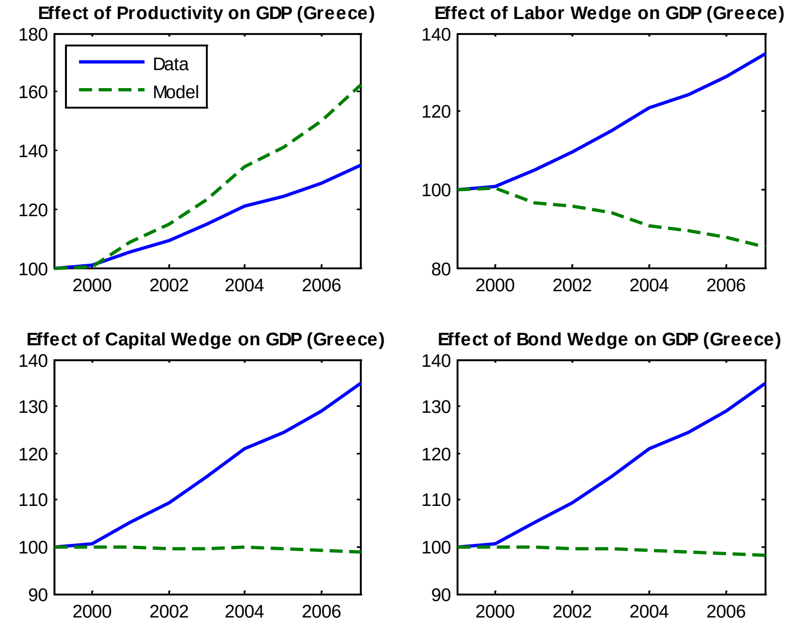


F.4. Case of Spain

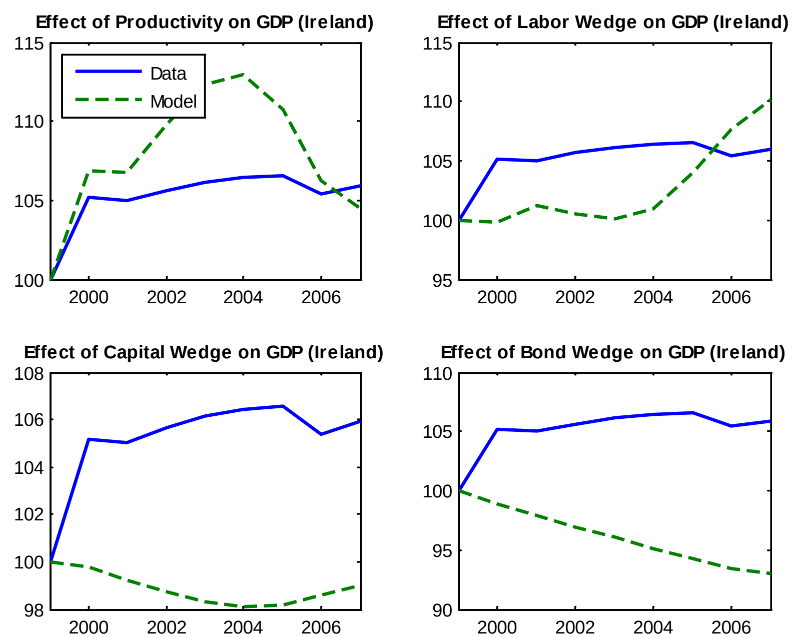


Appendix G. SOE Model - The Contribution of Wedges: 1999-2007

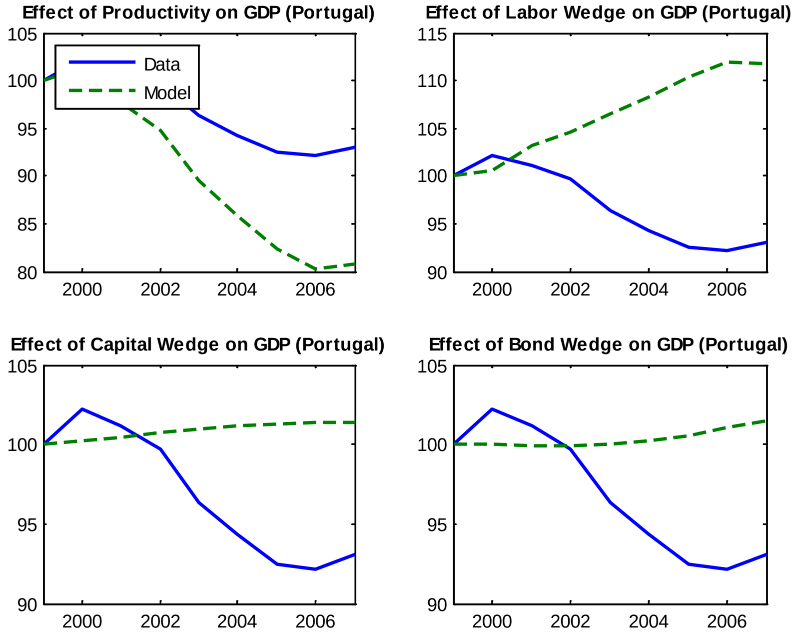
G.1. Case of Greece



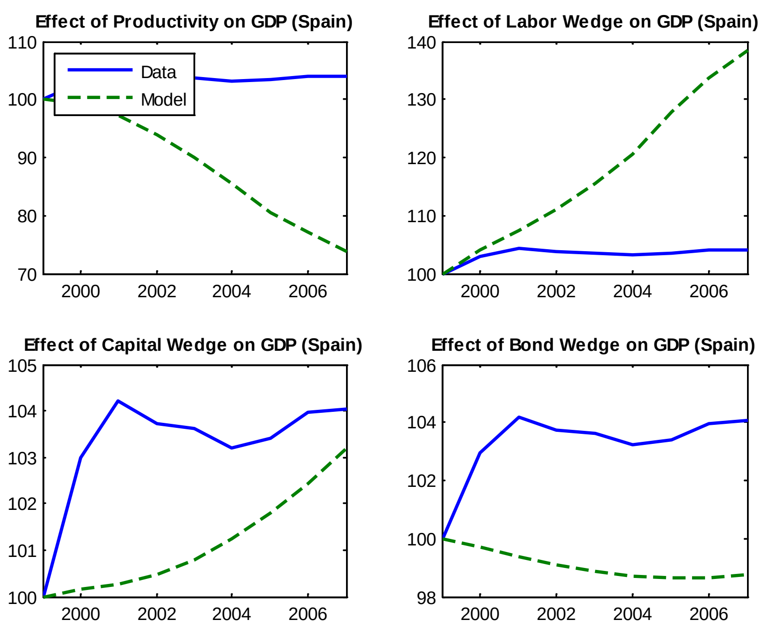
G.2. Case of Ireland



G.3. Case of Portugal



G.4. Case of Spain



Appendix H. A detailed model for TFP fluctuations in small open economy

The presentation here is inspired by the original model in Christiano et al. (2004), following the mappings of the detailed models to a prototype economy as in Chari et al. (2007) or Lama (2012).

The model is based on a domestic producer which uses the inputs from a tradable q_t^T and a non-tradable sector q_t^N to produce a final good:

$$q_t = \left(q_t^T\right)^{\phi}\left(q_t^N\right)^{1-\phi}$$

The final producer maximizes its profits as follows:

$$\max_{q^T, q^N} p_t^i q_q^i - v_t z_{it} - R_t p_t^m m_{it}$$

Here v_t, p_t^m and R_t are the prices of the valued added good, the prices of imported goods and the foreign interest rate.

The value added sector has the following production function:

$$z_t = k_t^{a} l_t^{1-\alpha}$$

The maximization problem of this firm can be written was:

$$\max_{k,l} v_t z_t - w_t l_t - r_t k_t$$

One can write the GDP in this economy as follows:

$$y_t = G\left(R_t, p_t^m\right) k_t^{\alpha} l_t^{1-\alpha}$$

For a particular set of assumptions (the income shares are the same across sectors), then the function G, which corresponds to the TFP in the prototype economy, can be written as:

$$G = \left[\phi^{\phi}(1-\phi)^{1-\phi}\theta^{\theta}\right]^{\frac{1}{1-\theta}}\left(\frac{1}{R_t^*}\right)^{\frac{\theta}{1-\theta}}\left(\frac{1}{p_t^m}\right)^{\frac{\theta}{1-\theta}}\left[1-\theta\left(\frac{\phi}{R_t^*}+\frac{1-\phi}{R_t^*}\right)\right]$$

Appendix I. A detailed model for labor wedge fluctuations in small open economy

One possible source for the labor wedge in a small open economy is the working capital constraint. I sketch here how the working capital constraint generates a labor wedge, following Neumeyer and Perri (2005) who introduced this constraint in a small open economy and Lama (2012) who showed how it corresponds to the labor wedge in a prototype small open economy.

The working capital constraint is related to the fact that firms borrow in advance a fraction θ of their labor costs. The problem of the firm is to maximize the profit given the labor costs, the rental costs of capital and the working capital constraint:

$$\max_{k,l} y_t - w_t l_t - r_t k_t - (R_t - 1)\theta w_t l_t$$

This economy implies the following relationship between the consumption-leisure and the marginal product of labor:

$$-\frac{U_{lt}}{U_{ct}} = \frac{1}{1+\theta(R_t - 1)} A_t F_{lt}$$

Thus, this detailed model maps into the prototype economy if the following relationship is verified:

$$(1-\tau_{lt}) = \frac{1}{1+\theta(R_t - 1)}$$

Appendix J. A detailed model for labor wedge fluctuations due to capital misallocations in a small open economy

In this section, I sketch a small open economy model of capital misallocation in the spirit of Reis (2013). Credit constraints can lead to general misallocation of resources across firms, due to the fact that the best entrepreneurs are unable to raise all the necessary capital to function efficiently and this misallocation works affects the labor wedge. The model in Reis assumes three types of agents: households, entrepreneurs and banks. The representative entrepreneur is the producer in the non-tradables sector. His problem is to choose labor and capital in order to maximize the profit:

$$\max_{k,l} y_t - w_t l_t - r_t k_t - (\frac{d_{t+1}}{r_t} - d_t) - \left(b_t - \frac{b_{t+1}}{r_t^b} \right)$$

Here $y_t = p_t^N a_t k_{t-1}^{\alpha} l_t^{1-\alpha}$ is the production of non-tradables, d_t stands for the holdings of investments in a financial institution with rate of return r_t, while b_t is the borrowing to finance production at interest rate $r_{tb.}$ The entrepreneur faces the following constraint:

$$b_t \leq \phi w_t l_t$$

Following Reis (2013), the parameter φ can be interpreted as capturing the misallocation of resources in the economy which makes more productive firms unable to grow at their potential. In the original specification, Reis assumed the following constraint:

$$b_t \leq \theta[y_t - w_t l_t]$$

Given that the labor gets most of the share of income, the first specification is a reasonable approximation of the second one, provided that $\varphi<1$.

The labor wedge results from the following relationship between the marginal rate of substitution and the marginal product of labor:

$$-\frac{U_{lt}}{U_{ct}} = \frac{1}{1+\phi\lambda_t} y_{lt}$$

Here, λ_t stands for the Lagrangean multiplier associated to the credit constraint.

As in the previous case, this detailed model corresponds to the prototype economy if the following relationship holds:

$$(1-\tau_{lt}) = \frac{1}{1+\phi\lambda_t}$$