The Euro Area Periphery and Imbalances: Is it an Anticipation Story?

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Abstract

This paper investigates the sources of the current account (CA) imbalances experienced within the euro area periphery (Greece, Ireland, Portugal and Spain) before the Great Recession by assessing the role played by anticipated shocks. Since 1996, before the actual introduction of the euro, widening of CA deficits occurred in countries with appreciating real exchange rates and output growing faster than trend. To understand the causes of these patterns, I develop and estimate a small open economy DSGE model encompassing plausible drivers of CA imbalances. Anticipated spread convergence, and not *catching-up*, caused euro area periphery imbalances. Quantitatively, anticipated shocks are important drivers of CA and real exchange rate fluctuations.

Keywords: Current Account, Real Exchange Rate, Anticipated Shocks

JEL Classification: F32, F41, E32

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1 Introduction

Before the Great Recession, euro area countries (EA) experienced large and persistent current account imbalances. The financial crisis and the following Sovereign Debt Crisis revealed that those countries running large deficits were also the ones experiencing stronger economic contractions.[1] This reanimated a still unsettled debate on what are the causes of these imbalances. Blanchard and Giavazzi (2002), during the build up phase, looked at the current account movements in Ireland, Portugal and Greece and assigned to the current and expected productivity differentials (in favor of debtor countries) the root of these movements. Today, many competing explanations emphasize different macroeconomic sources and there is no yet an agreement on a unique narrative. Interestingly, however, all these studies agree that imbalances were related to the construction of the European Monetary Union (EMU) and start their analysis as of 1 January 1999, the birth of the euro.[2]

Nevertheless, current account movements started to materialize earlier, between 1995-1996 (Figure 1(a)). This fact, which has been surprisingly overlooked, motivates this paper and its focus on the role of expectations as sources of current account movements in the euro area. The aim of this paper is twofold: first, to uncover the common causes of the current account imbalances experienced within the euro area periphery before the Great Recession, accounting for the 1996-1999 period; second, to evaluate the plausibility of different narratives and quantify their contribution to current account and real exchange rate fluctuations, using an estimated open economy model and empirical evidence.

Given the importance of the timing, it is essential to revise shortly some salient facts on the build up of the euro area. In June 1989, the European Council decided that the first stage of the economic and monetary union would begin on 1 July 1990. The negotiations outcome was the Maastricht Treaty signed on 7 February 1992, which came into force on 1 November 1993. The years around the treaty (1992-1993) have been tormented for the euro project, with currency crises (Italy and UK) and high uncertainty on people's consensus (e.g. rejection by referendum in Denmark and difficulties in ratification in France). In April 1994 none of the EU Member States satisfied the criteria to be eligible for the monetary union.

[1]See Eichengreen (2010), Giavazzi and Spaventa (2011) and Lane and Milesi-Ferretti (2011) for a connection between imbalances and the depth of the crisis in the euro area periphery.

[2]in 't Veld *et al.* (2014) represents a notable exception, starting the analysis for Spain in 1995.

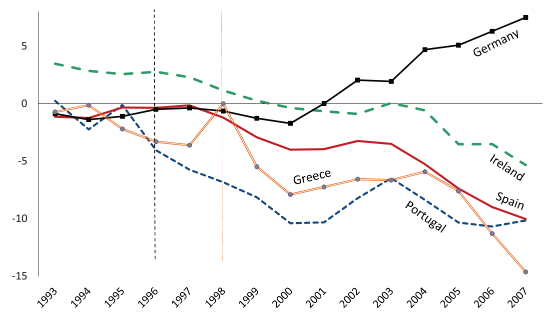
Nevertheless, in June 1995 it was decided that the year 1999 would be the starting date of the common currency and in December 1995 European leaders in Madrid decided to name of the new European currency *the euro*. This is when agents started to believe in the European Monetary Union project and began to act accordingly. Only Greece, among the countries who wanted to enter in 1999, had to postpone the entrance in 2001 as it didn't satisfy the necessary criteria. For Greece, this meant a sudden reversal of expectations and explains why, given my interest on the role of anticipation, Greece will be analyzed separately. The focus of the paper will be on Ireland, Portugal and Spain grouped jointly (henceforth IPS) or taken in isolation.

Three facts are at the core of my analysis. (i) First, diverging current account balances have characterized the EA up to the Great Recession. Since 1996, IPS started to increase current account deficits while other countries, such as Germany and Austria, began to raise surpluses (Figure 1(a)). Greece, because of the unexpected delay in joining the EMU, saw an 'S-pattern' of current account balances. It started by accumulating deficit contemporaneously to IPS, then experienced a sudden re-balance when it became clear that it would not enter in the EMU in 1999, and finally increased persistently its deficit. Interestingly, CA balances within the EA evolved in two phases. An initial one, between 1995 and 2000, where it increased by 179% and a second one, between 2003 and 2007, where it augmented by 59% (Figure 1(e)). (ii) Second, in periods of increasing deficits, GIPS (Greece, Ireland, Portugal and Spain) were growing above historical trend, augmenting investment and experiencing a persistent real exchange rate appreciation with respect to the rest of the EA (Figure 1(b) and 1(d)).[3] (iii) Around 1996 (1998 for Greece), the long term borrowing cost premium that IPS had to pay with respect to the EA core countries started a remarkable decrease, characterized again by two phases.[4] Phase one, from 1995 to 1999, with an almost linear decrease in the spread from 3.9 percent to 0.2 and phase two, from 2002 to 2005, with a smooth decrease from 0.2 to 0.03 (Figure 1(c)).

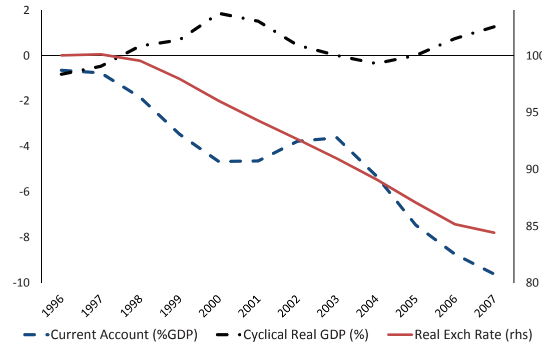
The group of euro area periphery countries often includes Italy. However, the Italian economy didn't behave as other periphery countries in the early stage of the EMU. In

[3]In Greece this joint dynamics started in 1999 - see the online appendix. Portugal stopped growing persistently faster than trend after the year 2000. However, years of increasing current account deficits (1995-2000, figure 1(b)) were the ones characterized by high GDP growth and increasing investments. For a detailed analysis of Portugal see Reis (2013).

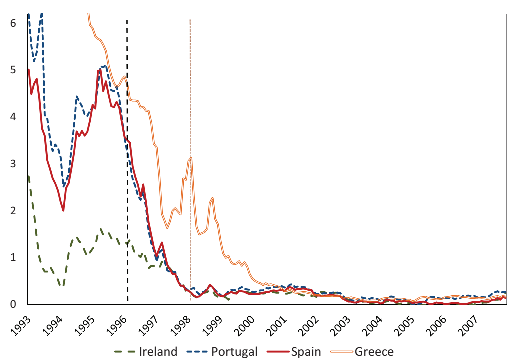
[4]Notice that the two phases are closely mimicking the evolution of the CA dispersion. Long term borrowing premium is measured as the average yield spread that IPS had to pay with respect to Germany on their government bond with a residual maturity of around 10 years on the secondary market. For a detailed analysis of the evolution of spreads in the EA after 1999, see Gilchrist and Mojon (2018)



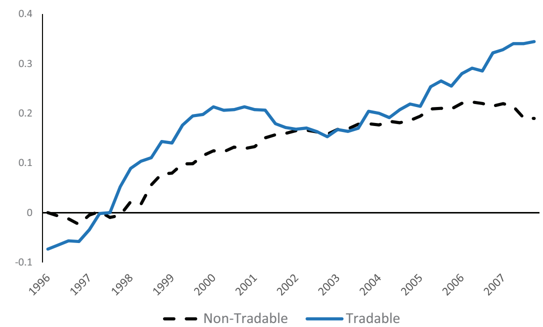
(a) Current Account Dynamics (% of GDP)



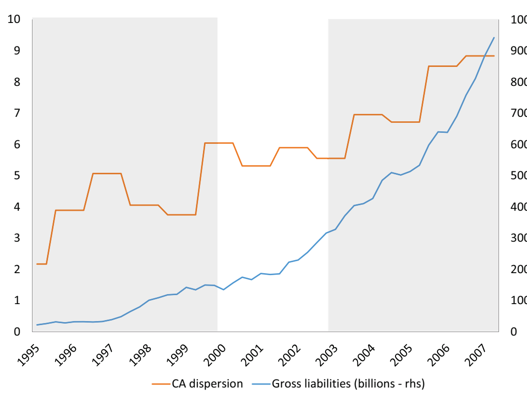
(b) Ireland, Portugal and Spain



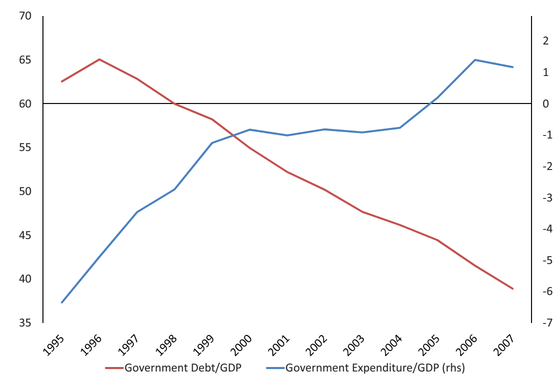
(c) Bond Yield Spread



(d) IPS Investment



(e) CA Dispersion and Gross Capital Flow



(f) Government Debt and Expenditure

Figure 1: (a) Euro area CA (% GDP) from 1993 to 2007 for Austria, Germany, Ireland, Portugal and Spain; (b) CA (% GDP), log deviation of GDP from a deterministic trend (%) and real effective exchange rate (vs. EU-12 countries) for the weighted average of Ireland, Portugal and Spain. As weights annual HICP (Harmonized Index of Consumption Prices) relative household consumption expenditure shares are used. The REER is an index (base year 1996 = 100) represented on the right y-axis. (c) Yield spread of long-term government bonds between Germany and Ireland, Portugal and Spain. The data are based on central government bond interest rates on the secondary market, gross of tax, with a residual maturity of around 10 years. (d) Log deviation of the average Ireland, Portugal and Spain tradable and non-tradable investment from the GDP-implied trend derived in a model consistent way, see section 3.1. (e) EA current account dispersion (standard deviation) and EA total claims in all sectors in millions of US dollars. The shaded area indicate the two periods of increasing dispersion. (f) Total consolidated gross debt at nominal value at the end of the year over GDP and net borrowing/net lending of general government as defined in the ESA 2010. Sources: Eurostat and BIS.

particular, two out of the three common macroeconomic features of GIPS did not materialize in Italy. First, Italy has been a net lender to the rest of the world up to the year 2000 and reached only a maximum CA deficit to GDP of 1.5% in 2006. Second, and more importantly, periods of decreasing current accounts were not, as in GIPS, periods of appreciating real exchange rate and output growing above trend. Given the aim to investigate the existence of a common source of euro area periphery imbalances, I exclude Italy from the analysis.[5]

Motivated by the fact that the current account balance (defined as the change in net foreign assets) captures the *inter-temporal* feature of international trade and that EA imbalances started to widen before the actual introduction of the euro, I investigate the role of anticipated shocks. While these shocks have been extensively studied as drivers of domestic business cycles, only few researches focused on the international setting and none on EA imbalances.[6] This paper contributes to this literature by assessing, qualitatively and quantitatively, the impact of anticipated shocks as sources of current account imbalances. Related to my study, Hoffmann *et al.* (2017) investigate if productivity shocks (modelled as noise shocks) can explain the build-up of US current account imbalances.[7] Focusing on the EA, my paper differs in four aspects: (i) it jointly (and crucially) analyzes the current account with the real exchange rate and GDP; (ii) it considers a broad variety of competing explanations, not only productivity; (iii) it estimates fundamental parameters for the international transmission of shocks, as the trade elasticity and shock persistence (see Corsetti *et al.* (2008)); (iv) it *quantifies* the contribution of anticipated shocks, as news shocks, for current account and real exchange rate fluctuations.

Using a structural open economy estimated model, I take the road started by Blanchard and Giavazzi (2002) and Blanchard (2007) of analyzing the imbalances within the EA. The main idea is that current account imbalances are different depending on their sources (e.g. Giavazzi and Spaventa (2011) and Eichengreen (2010)) but are observationally equivalent if looked separately from international prices and GDP components. I therefore construct

[5]In support of my decision, when re-estimating the model for Italy, I find that the sources of imbalances in Italy are strongly different from the common ones found for the euro area periphery. Results for Italy are available upon request.

[6]See Beaudry and Portier (2014) for a comprehensive review of the literature on news and business cycles, which, on international environments, includes Jaimovich and Rebelo (2008), Corsetti *et al.* (2011), Beaudry *et al.* (2011), Sakane (2013), among others.

[7]Noise shocks are not properly anticipated shocks but Edge *et al.* (2007) show that they can be interpreted as swings in the formation of expectations of long-run productivity growth. This paper focuses on news shocks but results are robust to modeling changes in expectations as noise shocks (see the online appendix). A related work by Nam and Wang (2017) investigate if productivity news shocks can be reconciled with the US terms of trade appreciation.

a theoretical set-up that allows me to evaluate different narratives, starting with growth differentials ("catching-up"), and I focus on those that can explain *jointly* the observed dynamics of the current account, the real exchange rate and GDP. More specifically, I lay out a New Keynesian DSGE small open economy model in a monetary union with two sectors (tradable and non tradable), that combines different features of open economy general equilibrium models.[8] I include unanticipated, one and two-year anticipated innovations for each shock and I estimate it on GIPS data with Bayesian techniques (see An and Schorfheide (2007)). I then analyze the importance of productivity (sector-specific and common labor augmenting), preferences, investment, labor supply, markup, monetary policy and yield spread shocks (anticipated and not, for all structural disturbances), using impulse response functions and variance decompositions. Even if my model is intentionally kept standard and lacks possible amplification mechanisms (e.g. financial frictions, borrowing constraints, non-Ricardian households, etc) I believe it captures well, through the multitude of stylized exogenous fluctuations, the majority of the possible narratives behind imbalances.[9] A prior predictive analysis, along the lines of Geweke (2010) and Leeper *et al.* (2017), shows in fact that all possible narratives are plausible concurrent explanations given the range of prior considered. It will therefore be to the empirical estimation to select and quantify the plausible narratives, assessing if changes in expectations indeed played a role.

The existing literature has emphasized many different macro factors that could be important determinants of EA imbalances. After the catching-up view of Blanchard and Giavazzi (2002), Fagan and Gaspar (2007) and Schmitz and von Hagen (2011) supported the idea that was financial integration that facilitated capital flowing towards country with lower income per capita. Others, however, challenged this narrative by showing that demand shifts toward non-tradable goods (and not competitiveness[10]) were behind these imbalances (Gaulier and Vicard (2012)). Generally, if the GIPS borrowed to increase production in the non-tradable

[8] The model features habit persistence in consumption, nominal and real rigidities, monopolistic competition, tradable and non tradable sector, home bias, variable capital utilization, time varying markups and an incomplete international financial market. Elements of my model are based on Galí and Monacelli (2008), Faia and Monacelli (2008), Rabanal (2009) and Burriel *et al.* (2010).

[9] The mapping between different narratives and the sources of fluctuations included in the model is straight forward: an anticipated increase in productivity can be seen as the driver of a catching up story; the same for an increase in future investment technology. Else, an increase in the demand for non-tradable domestic goods can be seen as an increase in housing demand and finally, a decrease in the cost of borrowing can be depicting a decrease in sovereign risk, a fall in bank intermediation costs or an increase in monetary authority credibility. It is worth mentioning, however, that my framework is not well suited to account for two additional channels: external trade shocks, introduced by Chen *et al.* (2013) and non-goods channels, like transfers and income balances, proposed by Kang and Shambaugh (2013).

[10] For an analysis on the lack of European productivity growth, see Fernandez-Villaverde and Ohanian (2018)

sector they have likely violated their inter-temporal budget constraint (Giavazzi and Spaventa (2011)). Sodsriwiboon and Jaumotte (2010) showed that indeed periphery countries borrowed more than what supported by their economic fundamentals, potentially because of inflation differentials (Polito and Wickens (2014)) or differential in inflation expectations (Bonam and Goy (2019)). In Spain, loosening credit constraints for households and risk-premium shocks explained an important fraction (25%) of net exports, according to in 't Veld *et al.* (2014). Zemanek *et al.* (2009) and Berger and Nitsch (2014) show how capital flew towards countries with higher domestic distortions while Gopinath *et al.* (2017) and Monacelli *et al.* (2018) show how GIPS capital inflows might themselves be responsible for generating distortions.

Financial frictions might have been channeling, in heterogenous ways, common shocks across the euro area. Jaccard and Smets (2019), by noticing that current account imbalances arose among well synchronized economies, show how a common productivity shock can produce trade deficits in countries with larger financial frictions and lower contract enforcement, generating pro-cyclical imbalances.[11] The role of financial frictions in intermediating external flows is highlighted by Hale and Obstfeld (2016), who find a link between EMU banks' lending to GIPS and their borrowing from financial centers, supporting the idea of a preferential channel of EMU core countries in lending to GIPS.[12] On a similar logic, de Ferra (2020) shows how a change in the institutional European framework, generating subsidies for member countries in holding euro-denominated assets, contributed to current account imbalances (up to 40% of the change in the current account balance observed in Germany and Spain) and to the severity of the sovereign debt crisis. Indeed, if real distortions interacted with financial friction in countries without monetary policy independence, this could explain the subsequent heterogeneous propagation of financial shocks in EA countries (see Gilchrist *et al.* (2018) and Gilchrist and Mojon (2018)).

Two main results emerge from my analysis. First, unanticipated and anticipated reductions in international borrowing costs, and not "catching-up", have been the main drivers of the EA periphery imbalances, explaining from a third to half of current account movements. Second, quantitatively, overall anticipated shocks explain a large part of business cycle fluctuations, especially of international variables such as the current account (47 percent) and the real

[11] At business cycle frequency, common technology shock can explain about 25-27% of the standard deviation of trade balance to output ratio. My analysis finds a similar role for productivity, but in my set-up, technology shocks are country specific.

[12] Circumstantial evidence, however, shows that in the period of the build-up of imbalances, 1995-2000, there was not a large increase in gross capital flows (Figure 1(e)) and that productivity was unlikely to be driven by a common process in the EA (Figure 6).

exchange rate (45 percent). Results are robust for Greece, Ireland, Portugal and Spain estimated both jointly or separately, and for a multitude of estimated models (with and without anticipated shocks and government spending[13]) and observable variables considered (with and without consumption and spread series). Identification crucially comes from the joint behavior of macro variables: increasing current account deficits with both increasing consumption and investment (in the tradable and non-tradable sector), growing output and real exchange rate appreciation.

The estimation of the models assign to *negative*, *exogenous* and *far ahead* anticipated movements in yield spreads a crucial role. These were indeed three characteristics of the experienced yield convergence in EA periphery. In section 4.2 and 4.3 I present two results as supportive evidence: first, an important part of the yield spread contraction between 1996-2007 was not driven by macro fundamentals (following De Grauwe and Ji (2013) and Perego (2020) methodology) and that a significant fraction of the unexplained movements was correlated with agent's expectations (i.e. inflation forecast, confidence indicator and trust in institutions); second, the smooth convergence of the IPS long-term yield spread is consistent with a simple expectation hypothesis of the yield structure where agents anticipate a *far ahead* total convergence of rates across EMU countries. This evidence is in line with the existing literature that identify four groups of possible drivers of yield spreads suppression: 1. Fall in policy risk (i.e. delegation to a credible monetary authority (Barro and Gordon (1983), Swanson (2008)) and decreased political risk (Hale and Obstfeld, 2016)); 2. Harmonization of collateral treatment (Buiter and Sibert, 2005) and financial regulations (Kalemli-Ozcan *et al.*, 2010); 3. Fall in exchange rate risk and transaction costs (Martin and Rey, 2004) and (Hale and Spiegel, 2012); 4. Fiscal policy convergence (Swanson, 2008) and (Catao *et al.*, 2017). These plausible causes, with a necessary remark for fiscal convergence, are in large part exogenous to GIPS macroeconomic conditions. As for fiscal convergence, Swanson (2008), Catao *et al.* (2017) and my analysis in section 4.3 show that fiscal budget variables, and fundamentals more generally, can hardly explain more than a small fraction of spreads contraction.

The paper is organized as follows. Section 2 describes the economic environment while

[13] From 1996 to 2007, government debt in GIPS went from 70.5% to 49% of GDP while the average spending decreased from a 5.2% to a 0.2% deficit. In addition, average tax rate evolutions in GIPS were similar to the rest of the EA, acknowledging the large reduction of Irish corporate taxation to 12.5%, which however happened only in 2003. To test for the role of government spending, the baseline model is extended with a government sector consuming only domestically produced goods and re-estimated. Government spending shocks, anticipated or not, were not important drivers of imbalances in GIPS (see section 4.2)

section 3 illustrates the Bayesian estimation of the model (in a common block and country-by-country). Section 4 investigates how structural shocks explain the current account imbalances and examines the importance of anticipated shocks for current account and real exchange rate fluctuations. Estimation results are presented for GIPS and for different specifications of the model. Section 5 concludes.

2 The Model

I build a two-sector New Keynesian Dynamic Stochastic General Equilibrium (DSGE) small open economy model. The domestic economy forms a monetary union with the foreign economy which, for analytical simplicity, represents the rest of the monetary union and it is taken exogenously. Modeling the EA periphery as a small open economy allows me to account for the evidence that IPS together, between 1996 to 2007, represented 13 percent of the total EA zone (using Harmonized Index of Consumer Prices Eurostat weights).

The model has three types of agents: households, final good producers and intermediate firms. The domestic representative household consumes, saves or borrows through domestic and foreign internationally traded bonds and supplies labor. The household owns physical capital, takes investment decisions and decides the amount of the owned capital to be given for production.

The model features variable capital utilization, adjustment cost of capital and preferences introduced by Jaimovich and Rebelo (2009) which can account for aggregate and sectoral co-movement in presence of anticipated shocks.[14] The consumption bundle is produced by perfectly competitive final good producers which aggregate non tradable with a combination of home and foreign tradable goods. There is no perfect substitutability between goods and I allow for home bias, aware that the purchasing power parity will therefore not necessarily be satisfied.

In addition, within each country, there are monopolistically competitive intermediate firms which produce different varieties of tradable and non tradable goods. They produce using labor and capital. These factors of production are freely mobile across sectors but not across countries. There are both common and sector-specific productivity dynamics which allows to generate an economy with permanent inflation differentials across countries and sectors.

[14] Models featuring anticipated shocks sometimes fail to generate the aggregate co-movement between output, consumption, investment and hours worked observed in the data. The main reason is that anticipated changes in income can affect current labor supply.

Prices are not fully flexible and follow Calvo (1983) formulation with indexation.

There is a common monetary authority that fixes the nominal interest rate. The assumption that the domestic economy is small comes at the cost of assuming that the monetary policy is exogenous to the dynamics of the small open economy[15]. The nominal exchange rate is fixed, given the membership in a monetary union. I allow for perfect risk-sharing within countries but incomplete international financial markets with only one internationally traded non-contingent bond. Therefore, household will be able to borrow-lend internationally only through a single bond which pays a spread on the nominal interest rate set by the common monetary authority. Movements in the spread are meant to capture, exogenously, all those changes in agent's borrowing costs due to the evolution of the European institutional framework, allowing me to study the role of the experienced IPS spread convergence (Figure 1(c)).

In the baseline model there is no government. This choice, made for simplicity but relaxed in a robustness check, is supported by two observations. First, government is unlikely to have caused increasing imbalances as its overall debt, from 1996 to 2007, decreased to 40% of GDP (from 67%) and a 5% average government deficit at the beginning of the period moved to a 1.1% surplus. Second, tax rate evolution was similar across all EA countries. Therefore, while specific fiscal policies may have played a role for individual countries' experiences (e.g., Ireland in 2003 decreased corporate taxes to 12.5%), government decisions on spending and taxes are unlikely to have played an important role (confirmed in the robustness section).

In this section I introduce a sketch of the model. Foreign variables are denoted by an asterisk (*). A detailed appendix with the model and the full set of equilibrium conditions, de-trended and log linearized, is available online.

2.1 Domestic Household

The domestic representative household maximizes the present value of her expected lifetime utility:

$$E_t \sum_{s=0}^{\infty} \chi_{t+s} \epsilon_t^d U(C_{t+s}, L_{t+s}). \tag{1}$$

E_t denotes the conditional expectation at date t and U is the instantaneous utility which is a function of final goods' consumption, C, and hours worked, L. χ denotes the household's endogenous discount factor. Agents become more impatient when average de-trended

[15] A semi-open small open economy in which IPS are responsible for 13% of the movements in average inflation has a too large region of model indeterminacy.

consumption, $\overline{C}_t$, increases:[16]

$$\chi_t = 1 \quad \text{and} \quad \forall s \geq 0 \quad \chi_{t+s} = \beta_{t+s-1}\chi_{t+s-1} \quad \text{where} \quad \beta_{t+s-1} \equiv \frac{1}{1+\psi^{\beta}(\log \overline{C}_{t+s-1} - \chi^{\beta})}. \qquad (2)$$

The parameter ψ^{β} determines the importance of average consumption in the discount factor and it is set to a low value in order to reduce the interference with the dynamics of the model, as in Ferrero *et al.* (2010). ϵ_t^D is an intertemporal preference shock with mean unity that obeys $\log \epsilon_t^d = \rho_{\epsilon^d} \log \epsilon_{t-1}^d + \zeta_t^d$. Notice that ζ_t^d, alike all other shocks introduced in the model, is a zero-mean i.i.d. random variable.

Preferences of the household are represented by the following utility function:

$$U(C_t, L_t) = \frac{\left\{(C_t - h^B\overline{C}_{t-1}) - \epsilon_t^L \psi^L L_t^{1+\nu} \Omega_t\right\}^{1-\sigma} - 1}{1-\sigma}, \qquad (3)$$

where

$$\Omega_t = (C_t - h\overline{C}_{t-1})^{\mu} \Omega_{t-1}^{1-\mu} (1+z)^{1-\mu}. \qquad (4)$$

where h^B is the degree of habit persistence in consumption, z is a drift in labor augmenting technology, σ controls the curvature of the utility function, ψ^L is a labor supply preference parameter and ϵ_t^L denotes a labor supply shock with mean unity and law of motion $\log \epsilon_t^L = \rho_{\epsilon^L} \log \epsilon_{t-1}^L + \zeta_t^L$.

Utility depends on consumption at time t, C_t, a portion of average past consumption, $h^B\overline{C}_{t-1}$, and hours worked L_t. Past average consumption is perceived by the maximizing household as independent from his/her own choices. Ω_t controls the wealth effect on labor supply through the parameter $\mu \in [0, 1]$. As μ rises, the wealth elasticity of labor supply increases.[17]

[16]This feature of the model ensures the presence of a stable non-stochastic steady state independent from initial conditions with incomplete financial markets. See Uzawa (1968), Schmitt-Grohé and Uribe (2003) and Bodenstein (2011) for a detailed discussion on the topic. The de-trended average consumption will be treated as exogenous by the representative household.

[17]This preference specification is due to Jaimovich and Rebelo (2009). By changing μ I can account for two important classes of utility functions used in the business cycle literature: King *et al.* (1988) types of preferences when $\mu = 1$ and Greenwood *et al.* (1988) when $\mu = 0$. I use Hoffmann *et al.* (2011) specification, which introduces habit persistence in consumption and a trend in the growth rate of the economy. The inclusion of $(1+z)^{1-\mu}$ allows me to preserve the compatibility with the long run balance growth path for the entire set $\mu \in [0, 1]$.

The representative household faces the following budget constraint:

$$C_t + \frac{B_t}{P_t} + I_t \leq$$

$$W_t L_t + R^W_{t-1} \frac{B_{t-1}}{P_t} + \left(R^k_t u_t - \Psi(u_t)\right) K^p_{t-1} + \int_0^1 \Gamma_{N,t}(i) + \int_0^1 \Gamma_{h,t}(i). \tag{5}$$

$\Gamma_{(N,h),t}(i)$ are real profits of the intermediate monopolistic competitive firms, in both the non tradable (N) and domestic tradable (h) sectors,[18] B_t is an internationally traded asset, W_t is the real wage in terms of the final good price and K^p_t is the physical capital owned by the household which accumulates according to

$$K^p_t = (1-\delta)K^p_{t-1} + \epsilon^I_t \left[1 - \xi\left(\frac{I_t}{I_{t-1}}\right)\right] I_t. \tag{6}$$

I_t is investment in physical capital, δ is the depreciation rate and $\xi(\cdot)$ is an adjustment cost function. $\xi(Z) = \xi'(Z) = 0$ and $\xi''(Z) = \eta_k > 0$, where Z is the economy's steady state growth rate and η_k is the capital adjustment cost elasticity. ϵ^i_t is an investment specific shock with mean unity that evolves according to $\log \epsilon^I_t = \rho_{\epsilon^I} \log \epsilon^I_{t-1} + \zeta^I_t$. The capital utilization rate, u_t, determines the amount of physical capital to be transformed in effective capital, K_t, which is rented to firms at the real rate R^k_t: $K_t = u_t K^p_{t-1}$. $\Psi(u_t)$ in equation (5) is the cost of use of capital in units of consumption. $\Psi(u) = 0$ and $\frac{\Psi'(u)}{\Psi(u)} = \eta_u$ where, in steady state, $u = 1$.

I assume that there is full insurance within but not across countries, as only the domestic financial market is complete. To keep the notation to the minimum and help the exposition, the full portfolio of domestic state-contingent assets is not displayed and I just display B_t, the single non-state contingent internationally traded asset. This bond pays R^W_t, which can be decomposed in the monetary union rate plus a spread. In log deviation from the steady state it can be written as $\widehat{r}^W_t = \widehat{r}_t + \widehat{sp}_t$. The presence of the spread indicates that the domestic household might have to pay a premium, but on average it does not, to borrow from the rest of monetary union.[19] Sp_t is assumed to be exogenous with mean unity and following $\log Sp_t = \rho_{sp} \log Sp_{t-1} + \zeta^{Sp}_t$. The risk-free rate, R_t, is governed by the monetary authority (the European Central Bank, ECB) which targets EA inflation. Given the small open economy assumption, aggregate EA inflation is an exogenous variable.

[18] Shares of the monopolistic firm i are owned by domestic residents in equal proportions and are not traded internationally.

[19] As in McCallum and Nelson (1999), this international risk premium helps explaining the temporary, but persistent, deviations from uncovered interest parity condition observed in IPS.

The monetary policy behavior of the ECB is captured by the following exogenous process: $\log R_t = (1-\rho_r)\log R + \rho_r \log R_{t-1} + \zeta_t^R$

The representative household chooses processes $\{C_t, L_t, B_t, A_t, u_t, K_t^p, I_t\}_{t=0}^{\infty}$ taking as given the set of prices $\{P_t, W_t, R_t^k, R_t, R_t^W\}_{t=0}^{\infty}$ and the initial wealth B_0 and A_0, to maximize equation (1) subject to (2), (3),(4),(5), (6) and the capital utilization equation.

2.2 Final good producer

The final good Y_t^d is produced by a perfectly competitive firm which buys and combines the varieties produced by intermediate firms. The tradable good, which is composed of goods both domestically $Y_{h,t}^d$ and foreign made $Y_{f,t}^d$, is aggregated with a non tradable good $Y_{N,t}^d$ by:

$$Y_t^d \equiv [\gamma_{T,t}^{\frac{1}{\eta}}(Y_{T,t}^d)^{\frac{\eta-1}{\eta}} + \gamma_{N,t}^{\frac{1}{\eta}}(Y_{N,t}^d)^{\frac{\eta-1}{\eta}}]^{\frac{\eta}{\eta-1}}, \qquad \text{where} \quad Y_{T,t}^d \equiv [\gamma_{h,t}^{\frac{1}{\epsilon}}(Y_{h,t}^d)^{\frac{\epsilon-1}{\epsilon}} + \gamma_{f,t}^{\frac{1}{\epsilon}}(Y_{f,t}^d)^{\frac{\epsilon-1}{\epsilon}}]^{\frac{\epsilon}{\epsilon-1}}.$$

where $\eta > 0$ is the elasticity of substitution between tradable and non tradable goods and $\epsilon > 0$ is the one between domestic and imported tradable goods (trade elasticity). $\gamma_{T,t}$, $\gamma_{N,t}$, $\gamma_{h,t}$ and $\gamma_{f,t}$ are respectively the preference shares for tradable as a whole, non tradable, domestic tradable and foreign tradable goods.[20] I allow also for the presence of home bias in tradable goods.

Within each sector the firm aggregates among a continuum of different varieties of goods which are imperfectly substitutable following:

$$Y_{f,t}^d \equiv \left[\int_n^1 (Y_{f,t}^d(i))^{\frac{\phi_t^T-1}{\phi_t^T}} di\right]^{\frac{\phi_t^T}{\phi_t^T-1}}, \; Y_{h,t}^d \equiv \left[\int_0^n (Y_{h,t}^d(i))^{\frac{\phi_t^T-1}{\phi_t^T}} di\right]^{\frac{\phi_t^T}{\phi_t^T-1}}, \; Y_{N,t}^d \equiv \left[\int_0^1 (Y_{N,t}^d(i))^{\frac{\phi_t^N-1}{\phi_t^N}} di\right]^{\frac{\phi_t^N}{\phi_t^N-1}},$$

where $\phi_t^T > 0$ and $\phi_t^N > 0$ are the exogenous random variables that determine the degree of substitutability between varieties produced by intermediate firms. They evolve as follows: $\log \phi_t^T = (1-\rho_{\phi^T})\log \phi^T + \rho_{\phi^T}\log \phi_{t-1}^T + \zeta_t^{\phi^T}$ and $\log \phi_t^N = (1-\rho_{\phi^N})\log \phi^N + \rho_{\phi^N}\log \phi_{t-1}^N + \zeta_t^{\phi^N}$, where ϕ^T and ϕ^N are steady state values, which are assumed to be the same. Hence, the final firm maximizes profits and by doing so, it takes as given the prices of the final good P_t, the consumer price index (CPI), and the price of the inputs.[21]

[20]The shares can vary over time since they include deterministic preference shocks to guarantee the presence of a balance growth path with two sectors growing at different rates (see Rabanal (2009)).

[21]Notice that P_t can also be interpreted as the aggregate demand deflator.

2.3 Intermediate firms

Production in both intermediate sectors is carried out by monopolistically competitive firms which employ both capital, K_t, and hours of labor L_t with the following production function:

$$Y_{j,t} = A_{j,t} K_{j,t}^{\alpha} \left[X_t L_{j,t} \right]^{1-\alpha} . \tag{7}$$

While X_t is the common labor-augmenting technology process, $A_{j,t}$ are the sector specific productivity innovations for the tradable and the non tradable sectors. From this section onwards, to lighten the notation, an indicator $j = \{N, h\}$ is introduced to denote those variables that are referring to both the tradable and the non tradable sector. The common labor-augmenting technology follows $X_t = (1+z)^t \widetilde{X}_t$ where $\log \widetilde{X}_t = \rho_X \log \widetilde{X}_{t-1} + \zeta_t^X$. The trend in labor augmenting technology, z, can be disaggregated between a component common to the entire euro area z^{euro} and a component specific to IPS z^{IPS}: $(1+z)^t \simeq (1+z^{euro})^t (1+z^{IPS})^t$. Sector-specific productivities also have a deterministic trend and an autoregressive process:

$$A_{j,t} = (1+g^j)^t \widetilde{A}_{j,t}, \text{ where } \log \widetilde{A}_{j,t} = \rho_{A_j} \log \widetilde{A}_{j,t-1} + \zeta_t^{A_j} \text{ for } j = N, h \tag{8}$$

where the shocks are *i.i.d.* normally distributed $\zeta_t^{AN} \sim N(0, \sigma_{AN}^2)$, $\zeta_t^{Ah} \sim N(0, \sigma_{Ah}^2)$ and $\zeta_t^X \sim N(0, \sigma_X^2)$. Sectors' specific trends are included to allow the model to capture the different first moments in the tradable and in the non tradable sector that characterized IPS in the early 2000s.[22] These assumptions provide a model-consistent method to detrend the data before proceeding with the estimation.

Following Calvo (1983), intermediate firms are allowed to set prices only with probability $1 - \theta^j$ independently on their previous history. The fraction θ^j of firms that cannot change their price is divided into a fraction φ_j that indexes it to past sector j's inflation, $\Pi_{j,t}$, and the remaining fraction $(1 - \varphi_j)$ that sets it to j's steady state inflation, Π_j. The evolution of the price level in the tradable and non tradable sector can therefore be written as:

$$P_{j,t} = \left\{ (1-\theta^j) P_{j,t}(i)^{1-\phi_t^j} + \theta^j \left[P_{j,t-1} \left(\Pi_{j,t-1} \right)^{\varphi_j} \Pi_j^{1-\varphi^j} \right]^{1-\phi_t^j} \right\}^{\frac{1}{1-\phi_t^j}} \text{ for } j = \{N, h\} \tag{9}$$

where $P_{j,t}(i)$ is the price set in period t by the firm (i) which is allowed to re-optimize its price in sector (j).

[22] A similar approach in open-economy models has been followed by Rabanal (2009) and Kulish and Rees (2017), among others.

Firms solve a two stage problem. In the first stage they minimize the real cost choosing in a perfectly competitive market the quantity of the two factors of production. In the second stage, individual firms in both sectors chose prices $P_{j,t}(i)$ in order to maximize the present discounted sum of future profits constrained by the sequence of demand constraints from final firms and by the fact that only a fraction $(1-\theta_j)$ of firms is allowed to reset freely their prices:

$$\max_{P_t(i)} \sum_{k=0}^{\infty} \theta_j^k E_t \left\{ \frac{\lambda_{t+k}}{\lambda_t} \beta_{t+k-1} \left[\frac{P_{j,t}(i)}{P_{t+k}} \left[\frac{P_{j,t+k-1}}{P_{j,t-1}} \right]^{\varphi^j} \pi_j^{k(1-\varphi^j)} - MC_{j,t+k} \right] Y_{j,t+k}^d(i) \right\} \tag{10}$$

$$\text{s.t. } Y_{j,t}^d(i) = \left(\frac{P_{j,t}(i) \left[\frac{P_{j,t+k-1}}{P_{j,t-1}} \right]^{\varphi^j} \pi_j^{k(1-\varphi^j)}}{P_{j,t+k}} \right)^{-\phi_{j,t+k}^j} Y_{j,t+k}^d. \tag{11}$$

where $MC_{j,t}$ is the real marginal cost.

2.4 Terms of trade, real exchange rate and current account

In this section I introduce some important variables: the terms of trade, the real exchange rate, the relative price of traded and non traded goods and the current account.

The terms of trade is the price of imported over exported goods $S_t \equiv \frac{P_{f,t}}{P_{h,t}}$. Following Faia and Monacelli (2008) the tradable price index over the price of the domestic tradables can be written as a function of the terms of trade and parameters only and the ratio of the CPI index to the price of non tradables thus can be written as a function of the relative price of tradable over non tradable goods ($J_t \equiv \frac{P_{T,t}}{P_{N,t}}$):

$$\frac{P_{T,t}}{P_{h,t}} = g(S_t) = [\gamma_{h,t} + \gamma_{f,t} S_t^{1-\epsilon}]^{\frac{1}{1-\epsilon}} \qquad \frac{P_t}{P_{N,t}} = m(J_t) = [\gamma_{T,t} J_t^{1-\eta} + \gamma_{N,t}]^{\frac{1}{1-\eta}}$$

with $\frac{\partial g(S_t)}{\partial S_t} > 0$ and $\frac{\partial m(J_t)}{\partial J_t} > 0$. The small open economy is part of a Monetary Union, the law of one price holds $P_{f,t}(i) = P_{f,t}^*(i)\ \forall i \in [0,1]$ but the purchasing power parity (PPP) will not be satisfied given the presence of home bias in consumption. The real exchange rate is defined as $Q_t = \frac{P_t^*}{P_t}$ and it can be rewritten as a function of S_t, J_t and exogenous foreign prices:

$$Q_t = \frac{S_t}{g(S_t)} \frac{J_t}{m(J_t)} \frac{P_t^*}{P_{f,t}}, \qquad \text{with } \frac{\delta Q_t}{\delta S_t} > 0 \ \frac{\partial Q_t}{\partial J_t} > 0.$$

Using the budget constraint, I can write the balance of payment condition (as share of mean level of output, Y) as:

$$NX_t + \frac{R_{t-1}Sp_{t-1}B_{t-1}}{YP_t} - \frac{B_t}{YP_t} = 0, \tag{12}$$

where NX_t denotes the real value of net exports as a ratio to steady state GDP and it is equal to

$$NX_t = \frac{J_t}{g(S_t)m(J_t)}\frac{(Y_{h,t} - C_{h,t} - S_tC_{f,t})}{Y}. \tag{13}$$

The current account is the net change in real bond holding scaled by the steady state level of GDP, $CA_t = \frac{B_t}{P_tY} - \frac{B_{t-1}}{P_tY}$ and total GDP is defined as the sum of aggregate demand and net export $Y_t = Y_t^d + NX_t(Y)$.

Finally, it is important to recall that in equilibrium, due to the incompleteness of international financial markets, the risk-sharing equation is violated.[23]

2.5 Equilibrium in a Small Open Economy

In equilibrium intermediate and final goods' markets clear:

$$Y_{N,t} = Y_{N,t}^d \ , \quad Y_{h,t} = Y_{h,t}^d + Y_{h,t}^{d*} \quad \text{and} \quad Y_t^d = C + I + \Psi(u_t)K_{t-1}^p.$$

Also the labor and the capital markets clear, implying: $L_t = L_{N,t} + L_{h,t}$ and $K_t = K_{N,t} + K_{h,t}$.

2.6 Detrending Equilibrium Conditions

The system of equilibrium conditions is non-stationary. The deterministic trends in the sector-specific productivities and in the labor-augmenting technology generate variables that grow as time elapses. To be able to use standard solution techniques, I first need to de-trend the model. I therefore divide those variables that grow in steady state by their trend and generate a new stationary variable, denoted with a tilde (e.g. $\widetilde{Y}_t$). For instance, the production

[23]If the model had perfect financial and insurance markets with constant nominal exchange rate, the risk-sharing condition would be satisfied. This equation states that a benevolent social planner would allocate consumption across countries in such a way that the marginal benefit from an extra unit of consumption equals its marginal costs. With a time separable preferences and CRRA utility function there would be a positive correlation between the relative consumption and the real exchange rate. The data show that this is not always the case (Backus-Smith puzzle, (Backus *et al.*, 1993)). Corsetti *et al.* (2010) provide a comprehensive review of the literature.

in the two sectors, $Y_{N,t}$ and $Y_{H,t}$, can be made stationary as follows:

$$\widetilde{Y}_{N,t} = \frac{Y_{N,t}}{[(1+z)(1+g^N)]^t} = \widetilde{A}_{N,t}\widetilde{X}_t^{1-\alpha}(1+z)^{-\alpha}\widetilde{K}_{N,t}^{\alpha}L_{N,t}^{1-\alpha} \tag{14}$$

and

$$\widetilde{Y}_{h,t} = \frac{Y_{h,t}}{X_t(1+g^h)^t} = \widetilde{A}_{h,t}X_t^{1-\alpha}(1+z)^{-\alpha}\widetilde{K}_{h,t}^{\alpha}L_{h,t}^{1-\alpha}, \tag{15}$$

where $\widetilde{K}_{j,t} = \frac{K_{j,t}}{(1+z)^{t-1}}$ denotes de-trended capital and $\widetilde{A}_{j,t}$ and $\widetilde{X}_t$ are previously defined. Notice that while real aggregate variables grow at rate $(1+z)^t$, sector-specific variables have an additional component introduced by the sector specific deterministic trend $(1+g^j)^t$. Finally, I log linearize the stationary model to the first order around the deterministic steady state (for the details see the online appendix).

2.7 Anticipated shocks

Expectations are key drivers of international flows of capital: international borrowing is based on the expectation of higher future growth (catching-up) while foreign direct investment are driven by expected higher future returns. The current account balance, therefore, defined as the change in net foreign assets, is capturing exactly the inter-temporal feature of international trade. Therefore, an investigation of sources of current account imbalances should not forget swings in conditional expectations; agents' anticipation of the future have consequences on borrowing and lending decisions and, therefore, on country's net foreign asset position. To account for this channel, I include two possible anticipated components in all sources of fluctuation in my model.

Ten shocks drive the model: preference shocks; tradable and non tradable technology shocks; labor augmenting productivity; investment specific shocks; labor supply shocks; tradable and non-tradable mark-up shock; monetary policy and yield spread shocks. For each of these shocks I introduce unanticipated, one year (4) and two years (8) innovations.[24] Medium-term anticipated shocks have been shown to be extremely important for domestic business cycle fluctuations by (Schmitt-Grohé and Uribe, 2012). The choice of two horizon is based on two considerations. First, (Schmitt-Grohé and Uribe, 2012) show that both a short and a longer anticipation are important and second, I wanted a long horizon to account for an anticipation length similar to the one faced by agents at the beginning the monetary

[24] Anticipated innovations in the monetary policy are not included to not overlap with anticipated yield spread shocks.

union integration: in December 1995, agents learned that starting in June 1998, the European Central Bank would be officially created.

Assuming that a general exogenous process follows $\log x_t = \rho_x \log x_{t-1} + \zeta_t^x$, the error term have the structure: $\zeta_t^x = \zeta_{0,t}^x + \zeta_{4,t-4}^x + \zeta_{8,t-8}^x$ where, for example, $u_{4,t-4}^x$ is today's realization of a shock that was acknowledged 4 quarters ago. For a full and detailed account of this method for introducing anticipated shocks, refer to section 3 of Schmitt-Grohé and Uribe (2012).

3 Model Estimation

I calibrate a small subset of parameters and rely on Bayesian techniques to estimate those over which there is both theoretical and empirical controversy. Particular attention is devoted in finding the values of the elasticities and persistence of shocks, which are critical parameters for the theoretical behavior of international variables (see section 4). Interestingly, estimated values for some elasticities (eg. trade elasticity) are found to be much closer to empirical micro-trade estimates than previous open-macro estimates.

This section starts by describing the data, the set of calibrated parameters, the prior distribution and the estimated posterior. Second, I compare the estimation of IPS as a block with a country-by-country analysis (based on same priors) and introduce the results for Greece. Third, I present seven additional specifications of the model and compare them with the baseline: a model (i) without long-run anticipation (ii) without short-run anticipation; (iii) without any anticipated component; (iv) without consumption; (v) with government; (vi) with long-term spread as observable; (vii) (reduced) number of shocks equal to observable variables;

3.1 Data

The sample starts the first quarter of 1996 when the European Council meeting held in Madrid (December 15-16, 1995) decided the exact timeline of the transition and the name of the common currency. In that date, the euro area project became a credible agreement and agents started to act as if they were to be soon part of the EMU.[25]

The last quarter of 2007 is chosen as the end of the sample, before the beginning of the Great Recession. It is important to focus on the pre-crisis period to understand why

[25] See `http://www.europarl.europa.eu/summits/mad1_en.htm`. Note: observations from 1995 are used to start the Kalman recursion but are not considered in the estimation.

imbalances were actually accumulated, without being influenced by the peculiarities of the crisis (and sovereign debt crisis) episode. Understanding the link between the sources of the accumulating imbalances and the crisis is an interesting question per se which will not be addressed in this paper.

The paper proceeds in two steps. (i) First, given that Ireland, Portugal and Spain experienced very similar macroeconomic dynamics, I focus on these three countries jointly to capture the common drivers of imbalances within the euro area periphery. In fact IPS experienced similar dynamics and timing of current account, real exchange rate and GDP during this period, especially during phases of enlarging current account deficits.[26] I construct the IPS block by computing a weighted average using European Central Bank HCPI as weights. The estimation of the IPS block is used as a baseline. As mentioned in the introduction, including Greece in this group would be feasible but somehow problematic. In fact, Greece joined the European Monetary Union later than IPS. This implies that the moment in which agents in Greece internalized the transition to the common currency was likely to be shifted in time. Merging then Greece to the IPS block would unable me to capture the role of expectations in Greece. For this reason the analysis of Greece is kept separated. (ii) Second, I proceed to estimate each country individually and I present the results of these estimations next to the baseline, to allow for comparison.

Italy is also often included among EA periphery countries. However, Italy, is omitted from the analysis as its economy didn't behave as other periphery countries. In particular, two out of the three common macroeconomic features of IPS did not materialize in Italy. First, Italy has been a net lender to the rest of the world up to the year 2000 and reached only a maximum deficit to GDP of 1.5% in 2006. Second, and more importantly, periods of decreasing current accounts were not, as in IPS, periods of appreciating real exchange rate and output growing above trend. Estimation of Italy, alone, are available upon request and confirm that Italy behaved differently from the periphery countries.

The model is estimated using quarterly observations for ten time series: real GDP, real consumption, real investment, average weekly hours worked, current account (% of average GDP), real exchange rate within EA partners, 3-months Euro Interbank Offered Rate for euro area countries, the EA (minus IPS) tradable prices, the EA (minus IPS) non tradable

[26] For example, Portugal, which slowed down after the year 2000, experienced growing GDP, appreciating real exchange rate and current account deficits between 1995-2000 (see Figure 1(b)). For a detailed analysis of Portugal see Reis (2013).

prices and foreign real aggregate demand (minus IPS).[27] Real data and exchange rates are computed using the aggregate demand deflator (nominal domestic demand/real aggregate demand), instead of the GDP deflator, to be model-consistent.

The model implies that all the observable variables are non-stationary. Values of the trends are estimated imposing a trend stationary process to overall GDP and to sector specific output in the tradable and non tradable sector. The values of z, z^*, g^N and g^T are reported in table 1. All variables, with the exception of the nominal interest rate, the current account and the foreign VAR, are taken in log changes and the deterministic trend is accounted in the measurement equations. Current account to average GDP ratio is taken as a year-on-year difference. All details on the data are available in the online appendix.

Following Beltran and Draper (2008), the three foreign variables are following an estimated VAR process outside the model. This is possible given the assumption that IPS are a small open economy and do not affect the rest of the monetary union, implying that the foreign block is exogenous. The observables are assumed to follow the process $F_t^* = AF_{t-1}^* + \zeta_t^{*F}$ where $F_t^* = \left[Y_t^{*d}\ P_{f,t}^*\ P_{N,t}^*\right]'$, ζ_t^{*F} is a vector of iid random errors and A is a 3x3 matrix.

3.2 Calibrated parameters

Table (1) summarizes the values and the sources of the calibrated parameters. I follow Smets and Wouters (2003) for three values: α, the capital share, is set equal to 0.29; the depreciation rate, δ, is 0.025 per quarter, implying a 10 per cent annual depreciation of capital; ρ_r, the degree of interest rate persistence is 0.84.

The discount factor is endogenous: I estimate χ^β and then calibrate ψ in order to ensure that the steady state value of the discount factor is equal to 0.99. At the mean of the prior distribution it will have value $1.99 \cdot 10^{-5}$. I do this to ensure that the endogeneity of the discount factor does not significantly influence the medium term dynamics of the model. The labor supply preference parameter is set in order to ensure a steady state share of hours worked equal to 23.6% per week, based on IPS data.

For the share of tradable and non tradable goods, $\gamma_{N,t}$ and $\gamma_{T,t}$, I use the sectorial decomposition of the GDP in the Eurostat database. In IPS, the average share of non tradable production for the period 1996:2007 is 71 per cent.[28] Focusing on the tradable goods sector I

[27] Regarding the cost of borrowing, only the ECB nominal monetary policy rate R_t is included. For the period 1996-1999 I therefore assume that IPS central banks where already acting as if monetary policy was conducted by a single monetary authority.

[28] The non tradable sector includes: construction; wholesale and retail trade; hotels and restaurants;

Table 1: Calibrated Parameters

Par	Value	Description	Source
ψ^{β}	to set $\beta = 0.99$	Spillover effect of average de-trended consumption on the discount factor	
β	0.99	Discount factor	
σ	1	Curvature of utility	Schmitt-Grohé and Uribe (2012)
ψ^{L}	to set $L = 0.236$	Labor supply preference parameter	Eurostat 1996-2007
α	0.29	Capital Share	Smets and Wouters (2003)
δ	0.025	Depreciation of capital	Smets and Wouters (2003)
$\gamma_{N,t}$	0.71	Non tradable sector share in IPS GDP	Eurostat 1996-2007
$\gamma_{f,t}$	0.34	Average share of Imports on GDP	Eurostat 1996-2007
ρ_r	0.847	AR interest rate	Smets and Wouters (2003)
z	0.92%	GDP trend - IPS	Eurostat 1996-2007
z^*	0.52%	GDP trend - EA minus IPS	Eurostat 1996-2007
$g^{NT} + z$	0.91%	NT sector trend	Eurostat 1996-2007
$g^{T} + z$	0.81%	T sector trend	Eurostat 1996-2007
$\overline{sp}$	0.82%	Spread initial value	Eurostat 1995
$\overline{g}/\overline{y}$	0.179	Gov spending to GDP ratio	Eurostat 1996-2007
Estimated VAR - using Eurostat data 1996-2007 on euro area minus IPS			
a_{11}	0.824	VAR, Y^{*d} to lag Y^{*d}	
a_{12}	0.030	VAR, Y^{*d} to lag P_f^*	
a_{13}	-0.181	VAR, Y^{*d} to lag P_N^*	
a_{21}	0.054	VAR, P_f^* to lag Y^{*d}	
a_{22}	0.902	VAR, P_f^* to lag P_f^*	
a_{23}	0.037	VAR, P_f^* to lag P_N^*	
a_{31}	0.127	VAR, P_N^* to lag Y^{*d}	
a_{32}	0.106	VAR, P_N^* to lag P_f^*	
a_{33}	0.969	VAR, P_N^* to lag P_N^*	
$\sigma_u^{C^*}$	0.27	std Foreign consumption	
$\sigma_u^{\pi_f}$	0.37	std Foreign π_T	
$\sigma_u^{\pi_{N^*}}$	0.30	Foreign π_{NT}	

find that the share of imported goods is around 33.9 per cent for IPS countries, displaying a relevant home bias.

In Table (1) I also report the values of the estimated exogenous VAR used to proxy the behavior of the rest of the monetary union and the values of the estimated deterministic trend using Eurostat data between 1995 and 2007.[29]

3.3 Prior Distributions

Priors, used across all estimations, are summarized in table 2. The two parameters determining the labor supply behavior (μ and v) are both estimated. For μ, which determines the wealth

transport; financial intermediation; real estate; public administration and community services; activities of households.

[29]For the country-by-country estimation, the calibrated parameters are computed using the individual country data and the foreign economy is computed as the euro area minus each individual country. Intuitively, values are in line with those of IPS and are available in the online appendix.

elasticity of labor supply, I impose a uniform prior distribution over the entire interval $[0, 1]$. The prior for v, which is the inverse of the Frisch elasticity when $\mu = 0$, is set to a gamma prior distribution with mean 3.

Some structural parameters are central for shaping the responses of the model to shocks. Trade elasticity, the elasticity of substitution between tradable and non tradable goods and the shocks' persistence are the most important to determine the reaction of the current account and the real exchange rate to productivity shocks (Corsetti *et al.*, 2008). For these, a wide range of values, provided by empirical and theoretical studies, fail to give me a precise and reliable calibration. Therefore I estimate them using the values found by previous studies as references for priors.

The elasticity of substitution between home and foreign produced tradable goods (the trade elasticity ϵ) is a parameter for which the literature provides a large range of estimates. On one side there are micro-trade studies that, using disaggregated data, estimate large values. Cabral and Manteu (2011), among others, find that the average external demand elasticity in the EA periphery is around 4. On the other side the international macroeconomic literature, which relies on aggregated data, finds much lower values. Taylor (1999), for example, estimates a long run elasticity of 0.39. Recent theoretical studies show in fact how implied low trade elasticity help macroeconomic models to overcome the Backus and Smith puzzle (Corsetti *et al.* (2008) and Benigno and Thoenissen (2008)) and allow to better match the volatility of the real exchange rate (Thoenissen (2011)). To capture this uncertainty while assigning slightly more probability on values closer to previous macro-estimates, I set a gamma prior distribution with mean 1.5 and standard deviation of 1.

The other central parameter is the elasticity of substitution between tradable and non tradable goods, η. Although the range of values suggested by previous studies is non trivial, there is more consensus on its actual value than on the trade elasticity. Mendoza (1991), focusing on a set of industrialized countries, finds a value of 0.74, while Stockman and Tesar (1995) estimate a lower elasticity of 0.44. Rabanal and Tuesta (2013), in a model made to understand the role of non tradable goods for the dynamics of the real exchange rate, estimate the parameter to be 0.13. Combining this information I set a gamma prior distribution with mean 0.5 and standard deviation of 0.2.

From the household side, three additional parameters are considered: consumption habit, capital adjustment cost elasticity and capital utilization rate elasticity. As habits in consumption choices can only take values between zero and one, I set a beta prior distribution

Table 2: Prior and Posterior Distribution - Parameters

					IPS		Greece	Spain	Portugal	Ireland
			Prior				Posterior			
		Distr.	Mean	St. Dev	Mean	Lower / Upper	Mean	Mean	Mean	Mean
Estimated Parameters										
μ	Lab supply wealth eff	*Uniform*	0.5	0.20	0.767	0.603 / 0.937	0.901	0.799	0.763	0.759
v	Frisch elast (μ=0)	*Gamma*	3.0	0.5	4.248	3.220 / 5.277	4.817	4.349	4.388	4.261
η	T Vs NT	*Gamma*	0.5	0.2	0.282	0.105 / 0.450	0.502	0.426	0.443	0.304
ϵ	home VS foreign	*Gamma*	1.5	1.0	2.065	1.840 / 2.280	3.127	6.066	3.730	2.622
h	habit formation	*Beta*	0.7	0.1	0.598	0.521 / 0.669	0.524	0.752	0.550	0.746
$\overline{\eta}_v$	Utilization rate elast	*Beta*	0.5	0.1	0.308	0.224 / 0.390	0.181	0.335	0.190	0.157
η_k	Capital adj cost elast	*Gamma*	10.0	5.5	20.06	11.68 / 28.24	7.65	21.48	6.81	1.70
θ	Good elasticity	*Norm*	7.5	1.0	7.819	6.306 / 9.355	7.057	7.816	7.760	7.864
θ_N	NT price rigidity	*Beta*	0.8	0.1	0.788	0.720 / 0.858	0.691	0.816	0.784	0.704
θ_h	T price rigidity	*Beta*	0.8	0.1	0.149	0.107 / 0.183	0.284	0.391	0.193	0.268
ϕ_N	NT indexation	*Beta*	0.5	0.1	0.481	0.399 / 0.564	0.468	0.492	0.459	0.459
ϕ_h	T indexation	*Beta*	0.5	0.1	0.459	0.377 / 0.542	0.467	0.445	0.469	0.468
χ	End discount weight	*Normal*	-500	200	-507.7	-829.2 / -186.3	-506.5	-482.6	-531.6	-524.9
AR Coefficients										
ρ_{A_h}	T Techn	*Beta*	0.5	0.1	0.555	0.388 / 0.719	0.576	0.907	0.702	0.711
ρ_{A_N}	NT Techn	*Beta*	0.5	0.1	0.784	0.702 / 0.871	0.687	0.615	0.728	0.691
ρ_X	Labor Augmenting	*Beta*	0.5	0.1	0.504	0.341 / 0.669	0.501	0.502	0.506	0.502
ρ_ζ	Preference	*Beta*	0.5	0.1	0.493	0.324 / 0.657	0.498	0.596	0.481	0.424
ρ_{ϵ_I}	Invest	*Beta*	0.5	0.1	0.841	0.769 / 0.919	0.441	0.410	0.610	0.502
ρ_{ϵ_L}	Labor	*Beta*	0.5	0.1	0.795	0.700 / 0.894	0.605	0.406	0.802	0.560
$\rho_{\epsilon_r b}$	Risk Prem	*Beta*	0.5	0.1	0.744	0.608 / 0.884	0.671	0.816	0.582	0.727
ρ_θ	NT Markup	*Beta*	0.5	0.1	0.440	0.283 / 0.597	0.353	0.659	0.353	0.548
ρ_ϕ	T Markup	*Beta*	0.5	0.1	0.499	0.332 / 0.665	0.503	0.495	0.500	0.500
Standard Deviation										
$100\sigma_{\zeta^{Ah}_{0,t}}$	T Techn	*IGamma*	0.15	0.15	2.442	1.753 3.089	5.372	1.993	2.194	10.169
$100\sigma_{\zeta^{An}_{0,t}}$	NT Tech	*IGamma*	0.15	0.15	1.601	1.276 1.919	0.145	0.146	0.483	5.826
$100\sigma_{\zeta^{X}_{0,t}}$	Labor Augmenting	*IGamma*	0.15	0.15	0.129	0.048 0.218	0.144	0.146	0.144	0.146
$100\sigma_{\zeta^{\zeta}_{0,t}}$	Preference	*IGamma*	0.15	0.15	0.342	0.038 0.604	0.181	5.459	0.208	9.898
$10\sigma_{\zeta^{I}_{0,t}}$	Invest	*IGamma*	0.15	0.15	0.985	0.524 1.428	4.603	1.510	1.943	0.015
$100\sigma_{\zeta^{L}_{0,t}}$	Labor	*IGamma*	0.15	0.15	0.139	0.045 0.244	0.152	0.125	0.143	0.149
$100\sigma_{\zeta^{r}_{0,t}}$	Int rate	*IGamma*	0.15	0.15	0.202	0.169 0.235	0.203	0.200	0.204	0.202
$100\sigma_{\zeta^{Sp}_{0,t}}$	Yield Spread	*IGamma*	0.15	0.15	0.157	0.047 0.296	0.246	0.130	0.188	0.145
$10\sigma_{\zeta^{\theta_N}_{0,t}}$	NT markup	*IGamma*	0.15	0.15	13.847	5.409 22.394	18.632	18.987	15.134	32.382
$100\sigma_{\zeta^{\theta_T}_{0,t}}$	T markup	*IGamma*	0.15	0.15	0.138	0.046 0.241	0.158	0.141	0.139	0.193
$100\sigma_{\zeta^{Ah}_{4,t}}$	Ant Ah	*IGamma*	0.075	0.075	0.077	0.023 0.143	0.080	0.079	0.077	0.074
$100\sigma_{\zeta^{An}_{4,t}}$	Ant An	*IGamma*	0.075	0.075	0.071	0.023 0.119	3.208	1.509	1.313	0.068
$100\sigma_{\zeta^{X}_{4,t}}$	Ant Labor Augmenting	*IGamma*	0.075	0.075	0.078	0.022 0.147	0.069	0.065	0.066	0.076
$100\sigma_{\zeta^{\zeta}_{4,t}}$	Ant Preference	*IGamma*	0.075	0.075	0.076	0.022 0.139	0.086	0.069	0.356	0.076
$100\sigma_{\zeta^{I}_{4,t}}$	Ant I	*IGamma*	0.075	0.075	0.072	0.023 0.119	0.072	0.070	0.075	0.071
$100\sigma_{\zeta^{L}_{4,t}}$	Ant L	*IGamma*	0.075	0.075	0.079	0.023 0.139	0.072	0.084	0.068	0.068
$100\sigma_{\zeta^{Sp}_{4,t}}$	Ant Yield Spread	*IGamma*	0.075	0.075	0.068	0.023 0.116	0.077	0.067	0.165	0.080
$100\sigma_{\zeta^{\theta_N}_{4,t}}$	Ant NT markup	*IGamma*	0.075	0.075	0.078	0.022 0.141	0.069	0.075	0.073	0.076
$100\sigma_{\zeta^{\theta_T}_{4,t}}$	Ant T markup	*IGamma*	0.075	0.075	0.075	0.023 0.136	0.072	0.073	0.075	0.072
$100\sigma_{\zeta^{Ah}_{10,t}}$	Ant Ah	*IGamma*	0.075	0.075	0.079	0.022 0.132	0.068	0.081	0.102	0.069
$100\sigma_{\zeta^{An}_{10,t}}$	Ant An	*IGamma*	0.075	0.075	0.072	0.023 0.129	0.075	0.072	0.094	0.069
$100\sigma_{\zeta^{X}_{10,t}}$	Ant Labor Augmenting	*IGamma*	0.075	0.075	0.072	0.024 0.126	0.080	0.089	0.073	0.076
$100\sigma_{\zeta^{\zeta}_{10,t}}$	Ant Preference	*IGamma*	0.075	0.075	0.080	0.022 0.139	0.080	0.077	0.074	0.079
$100\sigma_{\zeta^{I}_{10,t}}$	Ant I	*IGamma*	0.075	0.075	0.071	0.023 0.127	0.074	0.070	0.079	0.070
$100\sigma_{\zeta^{L}_{10,t}}$	Ant L	*IGamma*	0.075	0.075	3.506	2.709 4.286	6.430	3.231	3.391	8.937
$100\sigma_{\zeta^{Sp}_{10,t}}$	Ant Yield Spread	*IGamma*	0.075	0.075	0.954	0.351 1.547	1.505	0.936	0.900	3.041
$100\sigma_{\zeta^{\theta_N}_{10,t}}$	Ant NT markup	*IGamma*	0.075	0.075	0.071	0.023 0.125	0.073	0.113	0.073	0.071
$100\sigma_{\zeta^{\theta_T}_{10,t}}$	Ant T markup	*IGamma*	0.075	0.075	0.078	0.022 0.145	0.073	0.070	0.069	0.070
Marginal log Density	Laplace Approximation				1778.956		1441.025	1644.252	1626.220	1309.690
	Modified Harmonic Mean				1688.583		1450.841	1662.972	1638.948	1325.420

NOTE: Posterior estimates of structural parameters are presented at the mean and at the lower and upper bound of the 90% highest posterior density interval.

with mean 0.65 and standard deviation of 0.05. Following Burriel *et al.* (2010), I assume that the capital adjustment cost elasticity, η_k, is normally distributed with mean 10 and a wide standard deviation of 5.5. Finally, for the capital utilization rate elasticity I define a variable $\overline{\eta}_v$ such as $\eta_v = \frac{1-\overline{\eta}_v}{\overline{\eta}_v}$ and estimate the new variable assuming a beta distribution with mean 0.5 and standard deviation 0.1, as in Gertler *et al.* (2008). I additionally estimate the parameter governing the discount factor, χ assuming a prior mean of -500 and a standard deviation of 200.

Focusing on the supply side, I impose an equal markup in the tradable and non tradable sector ($\phi_T = \phi_N = \phi$) of 15 percent, by setting the prior mean of the elasticities of substitution between varieties to 7.5. The dynamics of prices are controlled by the price indexation, φ_j, and the probability of resetting prices, θ_j. I assume the same average duration of prices in the two sectors. The price indexation is set a priori to be equal in the two sector with a beta distribution of mean 0.5 and standard deviation of 0.1.

For the set of priors governing the persistence of shocks I assume for all parameters the same beta distribution with mean 0.5 and standard deviation 0.1, consistent with previous studies. An inverse gamma distribution is imposed to the standard deviation of shocks. In order not to impose to much weight on anticipated shocks a priori, I assume that unanticipated sources of fluctuations explain two third of the total variance of the shocks (Table 2).

Finally, I allow for measurement errors in all the observable equations with the exceptions of nominal interest rate and foreign variables. Similarly to Adolfson *et al.* (2008) I calibrate the variance of each measurement error to 10 percent of the variance of the corresponding observable series.

3.4 Posterior Distribution and Moments

Table 2 presents the posterior mean, standard deviation and 90 percent intervals for the estimated parameters and standard deviations. The statistics are computed using the last fifty percent of one million draws generated with four random walk Metropolis Hastings chains with average acceptance rate close to 27 percent[30].

Interestingly, and differently from the previous estimation performed by Schmitt-Grohé and Uribe (2012), the wealth elasticity of labor supply is estimated to be non negligible, both in the IPS and in the country-by-country analysis. Wealth changes are indeed estimated to be an important driver of labor supply movements. The posterior mean of μ in IPS is 0.77 and 0.9 in Greece and v is estimated to be 4.2 and 4.8 respectively. These two parameters imply a Frisch elasticity of labor supply of 0.17 for IPS and 0.16 for Greece. While these values are low for standard macroeconomic estimations, they are in line with micro evidence (typically between 0.1 and 0.5). One possible explanation is the high estimated elasticity of

[30] 500.000 draws and four chains are used for all the robustness. More draws are used for those countries and models that needed more draws to convergence.

capital adjustment cost, which is 20.1 in IPS and 7.7 in Greece. In fact, a high value insures a positive correlation between consumption and hours worked in response to anticipated shocks independently on the size of the elasticity of the labor supply to wealth changes. Notice that these elasticity, like the one of capital utilization, 0.31, or the habit formation in consumption, 0.6, are in line with previous estimates (e.g. Burriel *et al.* (2010)).

Estimated trade and tradable vs. non tradable elasticities, for all the estimations performed, are also closer to values found in micro-trade studies, compared to previous macro-estimates. First, the posterior mean of the trade elasticity, ϵ, is equal to 2.1 in IPS and 3.1 in Greece. This implies a degree of substitutability between home and foreign produced tradable goods significantly larger than previous macro-findings. It is in fact still below, but not too far, from the estimation results of Cabral and Manteu (2011), which use Euro Area micro-disaggregated data. Second, the elasticity of substitution between tradable and non tradable goods, η, is smaller than ϵ and it is equal to 0.28 in IPS and 0.5 in Greece, in line with micro estimates. Figure 2 shows that data are indeed informative, for both elasticities. In fact, while the prior is skewed towards low values of ϵ, in line with previous macro-findings, the posterior sharply identifies a bigger trade elasticity and the opposite holds true for η. This is confirmed also in the country-by-country estimation.

Elasticities of Substitution

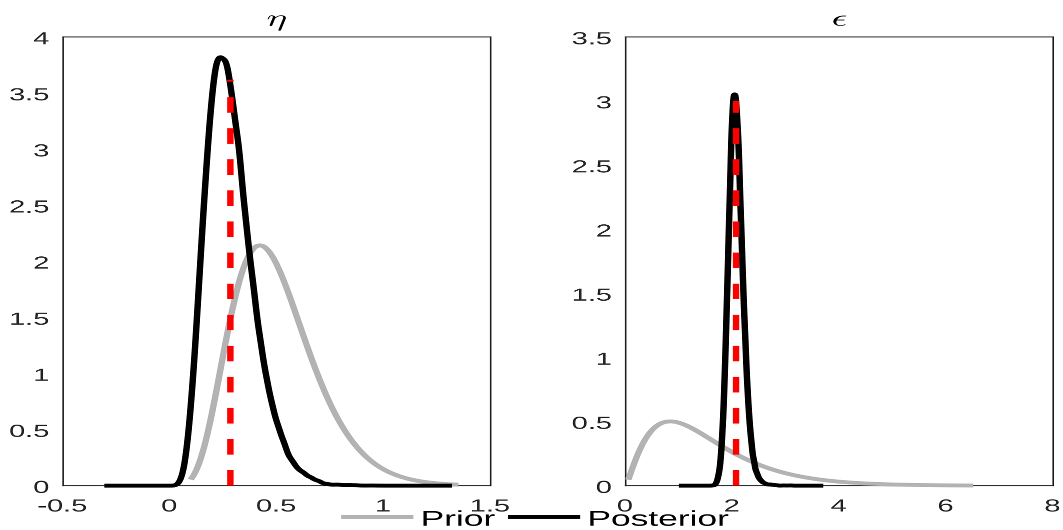


Figure 2: Prior and Posterior densities. Dotted line represent the posterior mean.

Prices are significantly more persistent in the non tradable sector than in the tradable sector, and this have important macroeconomic consequences. Average duration in the non tradable sector is around 5 quarters while in the tradable sector prices change every 4 months.

Past price indexation, on the other hand, is almost identical in both sectors in every country. The estimated elasticity of substitution between varieties in IPS implies a markup of 14.7 percent.

Shocks are not particularly persistent. Focusing on technology, an interesting result is that sector specific shocks are more persistent than common labor augmenting fluctuations. In particular, the estimated process for the productivity shock is significantly more persistent in the non tradable, 0.78, than in the tradable sector, 0.56. Investment and labor are the most persistent fluctuations, with respectively 0.84 and 0.8 autoregressive parameters. Risk premium shock have a persistency of 0.74.

Moving to analyze statistical moments, table 3 compares the first moment, the standard deviation and autocorrelations of the data with the ones implied by the model for IPS, while table A2, in the appendix, focuses on Greece. First moments are compared to steady state values. Given the calibrated deterministic trend, GDP and consumption are matched fairly well. Instead, given that investment was growing twice as fast as output between 1995-2007, the model fails to match investments' average growth; Current account to average GDP is zero in the model while it was strongly negative given the accumulation of imbalances. The steady state real exchange rate is positive in the model, given the higher average growth of IPS with respect to the rest of the EA, but negative in the data.[31] Looking at second moments, the baseline model is predicting higher volatility than in the data, mostly due to the peculiarities of the sample period, but auto- and cross-correlation are fairly well matched to the data. Between 1996 and 2007 variables like consumption, investment and current account had really large and sudden fluctuations. Episodes in which consumption is twice more volatile than output, investment has large short run fluctuations and the current account has large imbalances are often hard to reconcile with open economy models. Aguiar and Gopinath (2007) show how a standard small open economy model without trend growth is unable to match well data moments. The hint that this low performance of the model is related to the high relative volatility of the data comes from the results of a second estimation I performed excluding consumption from the set of observable variables. Column 6 of Table 3 show in fact that, without consumption as an observable, the model matches better the output and investment standard deviations. However, this comes at the cost of the inability of

[31] Results are robust to a different estimation of the model where average productivity growth rate in the tradable sector, non tradable sector and overall economy (from EUKLEMS) are included as deterministic trends in the model. This approach has the advantage of matching well the first moment of relative prices but worsening the match of GDP, consumption and investment first moments. Overall estimation results, available upon request, are however robust.

the model to reproduce the dynamics of the current account to GDP ratio, the main objective of the paper. The same inability to properly match the current account standard deviations is reported in the model including the spread.

Table 3: Data and Model Moments - IPS

	Data		Baseline		No ΔC	w/ gov	w/ spread	Data	Model	No ΔC	w/ gov	w/ spread
	Mean	Std dev	Mean	Std dev	Std dev	Std dev	Std dev	Autocorrelation				
$\frac{CA}{Y_{ss}}$	-5.12	4.18	0.00	5.24	28.76	4.52	69.25	0.87	0.50	0.52	0.52	1.00
Δ ReR	-0.36	0.55	0.39	1.66	1.27	1.52	2.78	0.14	0.19	0.15	0.20	0.63
Δ Y	0.95	0.72	0.92	1.36	0.78	1.13	1.99	0.09	0.02	-0.04	0.03	0.13
Δ C	0.88	0.91	0.92	1.52		1.63	2.68	0.07	0.09		0.13	0.27
Δ I	1.52	1.14	0.92	2.88	1.89	3.12	2.98	0.18	0.31	0.18	0.35	0.50
L	-0.15	1.34	0.00	1.62	4.95	1.70	10.00	0.92	0.41	0.52	0.46	0.99

NOTE: Data: sample period Q1:1996-Q4:2007. Model: theoretical posterior moments. The table shows standard deviation and t-2 autocorrelation for the baseline model, the model without consumption, the model including government spending and the model including the spread series. Variable listed are, in order: current account to average GDP ratio (CA), change in the real exchange rate (Δ ReR), GDP growth (Δ Y), investment change (Δ I), consumption change (Δ C) and hours worked (L). Notice that Current account to GDP ratio is a targeted variable but not included directly as an observable; in fact, the year on year change in the current account to GDP is used as an observable.

Focusing on the three variables of interest (current account, real exchange rate and GDP), Figure 3 shows that the baseline model does a fair job in matching their auto and cross-correlations. In the data and in the model, periods of output above trend are also periods of appreciating real exchange rate and current account deficits. Despite the short length of the data and the simplicity of the baseline model, this can be seen as a validating evidence that the setup is well suited to interpret the data and investigate the sources of imbalances.

While the estimation of IPS all together has the advantage of highlighting the common behavior of those countries, country-specific characteristics might have been important drivers of imbalances. I therefore proceed in estimating the same model, with the same set of priors but different calibration, for Greece, Ireland, Portugal and Spain separately.[32] Results, shown in Table 2, are in line with previous estimation results. Most of estimated parameters are not statistically different across countries and the role of yield spread, as shown in the next section, is confirmed across all periphery countries. The only major difference in the country-by-country estimation with respect to IPS is the capital adjustment cost, technological and investment standard deviation in Ireland. These differences are due to the faster GDP growth and more volatile investment experienced in Ireland.

The estimation results are robust to standard tests and parameters are locally identified at the prior and posterior mean (Iskrev, 2010). For all parameters and standard deviations the

[32]A table summarizing the values of the calibrated parameters for each country is available in the online appendix.

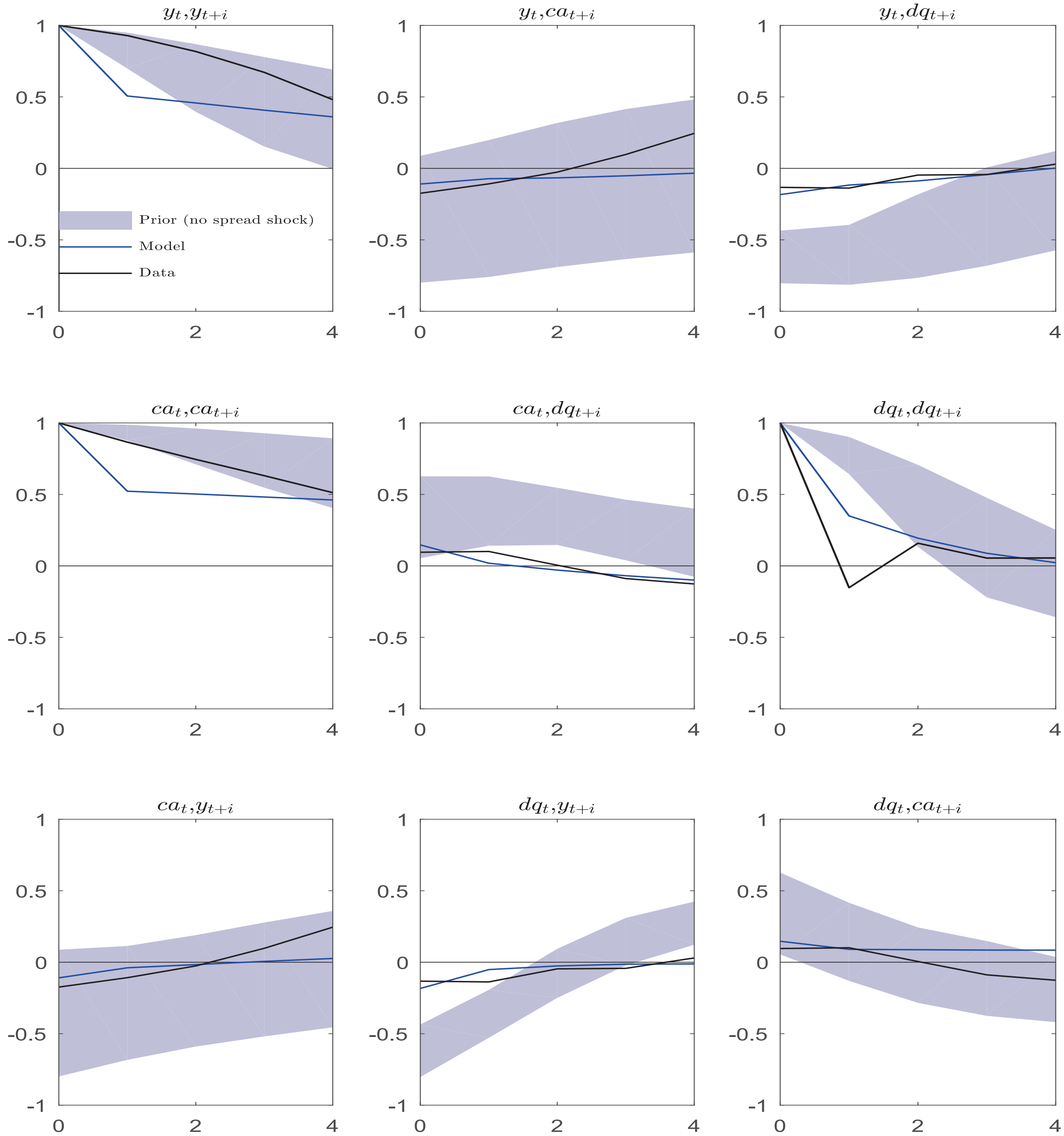


Figure 3: Cross-correlations. The black line is data cross-correlation, the blue line represent the posterior mean cross-correlation and the shadowed area is the 90 percent cross-correlation bands constructed simulating a model without yield spread shocks 20,000 times, each time with a random draw from the parameter's prior distribution (see Section 4.1.1 for details on the prior predictive analysis.

draws of the posterior sampling converge, smoothed shocks are stationary and looking at the prior-posterior distributions I see that data are informative for all parameters (see the online appendix for the diagnostic on the convergence of posterior chains and all prior-posterior plots). The only exception is χ, the parameter governing the endogenous discount factor, for which the data is uninformative and the posterior retrace the prior. This is not surprising as this parameter is chosen ad hoc in the literature and the specific value is not important as long as it ensures the presence of a stable non-stochastic steady state independent from initial conditions. Estimation results are robust if, instead of estimating this parameter, I calibrate it to values proposed in the literature.

A final concern, with news shocks, is on the importance of the prior in posterior inference and on sampling methods that explore the surrounding of the initial value (see Herbst and Schorfheide (2014)). To check the robustness of my results, I re-run the estimation using a slice sampler instead of a Markov Chain sampling method, which doesn't rely on an initial condition (see Neal (2003) and Planas *et al.* (2015)). This sampler as the advantage of performing well in both multi-modal and correlated posterior distributions. Results are robust to this approach and available upon request.

4 What explains current account imbalances in IPS?

Greece, Ireland, Portugal and Spain, from 1996 to 2007, accumulated current account deficit, experienced real exchange rate appreciation and grew above trend (Figure 1(b)). The purpose of this section is threefold: first, to uncover the sources of the current account imbalances experienced in the euro area periphery before the Great Recession through an impulse response analysis; second, to assess the importance of anticipated vs unanticipated shocks for current account, real exchange rate and GDP fluctuations exploiting the estimation results; third, to check if the data support the result of the estimation that a large part of the movements in the spread were negative, exogenous and related to changes in expectations.

As in Giavazzi and Spaventa (2011) and Eichengreen (2010), I have in mind a distinction between types of current account imbalances depending on their underlying source. Some are driven by growth differentials, that allow surplus countries to invest in future growth of the borrowing countries, and others are triggered by other factors, as for example financial factors. Narratives based on expectations, like the catching-up hypothesis or the expected increase in monetary policy credibility, can be tested and challenged with other narratives in my framework. For example: an anticipated increase in productivity can be seen as the driver of a catching up story; the same holds true for an increase in future investment technology. Else, an increase in the demand for non-tradable domestic goods can be seen as an increase in housing demand or finally, a decrease in the cost of borrowing can be depicting a decrease in sovereign risk, a fall in bank intermediation costs or in a change in cross-country credibility in institutions.

In section 4.1 I start by investigating if GIPS current account imbalances were indeed the result of capital flowing towards "catching-up" euro area countries or instead were caused by other factors. I do that by first analyzing in details if unanticipated and anticipated productivity shocks (common or sector specific) are consistent with widening of current account deficits jointly with appreciating real exchange rate and growing GDP. Then, I check if other plausible sources can drive the observed joint dynamics of those three variables. The joint focus on the three variables and the use of an estimated model allow me to distinguish between otherwise observationally equivalent current account deficits. A concern that could be raised here is that the result could be obtained almost by construction given the model features and the set of priors chosen. I therefore provide a prior-predictive analysis to show that the model would be able to explain the joint dynamics of these three variables using a multitude of different shocks, given the set of priors. This allows to interpret the impulse-response analysis given the posterior estimates as an actual test of the data. Next, in section 4.2, I quantify the role of unanticipated and anticipated shocks for a plethora of models. This is done through a variance decomposition analysis by showing the percentage of the variance of each variable explained by each unanticipated and anticipated shock. Finally, in section 4.3 I test two hypothesis: first, if fluctuations of the IPS yield spread were not only due to fundamental macro variables; second, if after accounting for fundamental movements, the unexplained yield was correlated with indicators of changes in expectations.

4.1 Impulse Responses

I study the dynamics of the model in response to a wide range of possible shocks at the posterior mean. I will focus on the model estimated for IPS but the same would hold true for the country specific versions of the model. For every source of fluctuation I consider the unanticipated component but I also allow for the possibility that agents learn in advance that a shock will realize in the future. I refer to these shocks as anticipated shocks.

I consider 10 different sources of fluctuation: sector-specific technologies, labor augmenting technology, preference, investment efficiency, labor supply, sector-specific markups, monetary policy and yield spread. The focus is on the reaction of GDP, current account and real exchange rate. I aim at selecting the shocks capable of generating the experienced contemporaneous movement of those three variables (Figure 1(b)). I start by showing that this exercise is meaningful as the model is *a priori* able to generate the desired joint dynamics of these three variables with a plethora of shocks.

4.1.1 Pior-Predictive Analysis

In order to be selected as a credible driver of the experienced GIPS imbalance, a source hitting these economies should be able to explain, jointly, the current account deficit, the appreciation of the real exchange rate and the output above trend (Figure 1(b)). As it will be clear at the end of this section, the estimation of the model will clearly favor a story: it was an anticipated decrease in the yield spread the main cause of the current account imbalances of GIPS. However, to believe this results presented later, it becomes crucial to show that this is not the only source *a priori* able to generate that joint correlation. In order to test for this I rely on a prior-predictive analysis along the lines of Geweke (2010) and Leeper *et al.* (2017). Detailed explanation of the methodology can be found in those references, but the logic of the exercise is straight forward: by simulating the model using different draws from the prior, I can check if other shocks are potentially able to explain the targeted joint dynamics of imbalances.

Table 4: Prior Predictive Analysis: p-value of joint observed dynamics of CA, RER and Y to a positive shock

A = PR(Y> 0 and ΔRER <0 and CA <0))
B = PR (Y < 0 and Δ RER> 0 and CA > 0)

Type	T Tech (A/B)	NT Tech (A/B)	Lab Tech (A/B)	Demand (A/B)	Lab Sup (A/B)	Invest (A/B)	Mark T (A/B)	Mark NT (A/B)
$u_{0,t}$	0.3 / 88.3	0.2 / 94.1	0.2 / 92.9	98.6 / 0.1	92.8 / 0.2	96.8 / 96.8	0.4 / 0.3	0.8 / 30.5
$u_{8,t}$	43.4 / 15.1	34.8 / 18.4	52.9 / 17.8	12.4 / 73.5	17.8 / 53.0	33.3 / 10.2	68.7 / 2.2	17.3 / 14.2

NOTE: p-value from simulations using 20,000 draws from the prior distribution of the baseline model without yield spread shocks. The response to the impulse is computed as an average of the four quarters after the shock.

I start by drawing from their prior distribution 20.000 set of parameters. Then, with those parameters, I simulate the model and I keep track of two different statistics: (a) the auto- and cross-correlation implied by the model (without spread shocks); (b) the impulse response to all shocks, anticipated or not.[33]. I then keep only those draws, for the impulse-response

[33]In particular, for both statistics, I will use a version of the model in which I completely shut down yield spread movements. This will allow me to concentrate on concurrent explanations from the one selected

analysis, satisfying the joint co-movement of current account, real exchange rate and GDP.

Figure 3 and Table 4 summarize the main result of this exercise.[34] The depicted shadow area in Figure 3 shows that a model without yield spread shocks would still be able to fit quite well the auto- and cross-correlation between CA, REER and Y seen in the data. Interestingly, Figure 3 makes clear that the identification of the plausible sources of imbalances would mostly come from the correlation between GDP and the current account. Confirming this result, Table 4 summarizes the probability that a single *positive* shock generates the joint co-movement of all three variables (average response in the four quarters following the shock) given the priors. Almost all shocks, with the exception of markup unanticipated shock, could account for the joint dynamics. Interestingly, unanticipated positive technology shock could not explain the observed co-movement, but negative shocks could.[35]

The prior predictive analysis confirms that the broad range of priors allows for all possible narratives to be concurrent stories of the accumulated imbalances and only the empirical estimation will be able to select among competing mechanisms. I now move to analysing, in details, the impulse responses given the posterior estimates.

4.1.2 Productivity shocks

In order to highlight some important mechanism common to productivity shocks, I start by analyzing, in details, the reaction of the economy to unanticipated productivity shocks first in the tradable and then in the non tradable sector. This, crucially relying on the estimation of the persistency, trade and tradable vs. non tradable elasticity, allows me to understand how current account and real exchange rate react to productivity shocks. The interaction between the shift in the supply curve, due to the decrease in marginal cost, and the movements in the domestic demand, generated by the change in wealth, will play the most important role.

When tradable technology jumps up (Figure 4), GDP, consumption and investment increase; the positive wealth effect, from the raise in current and future output, drives consumption fluctuations while the improved marginal productivity of capital moves investments. In the intermediate production sector, higher productivity, combined with higher demand for intermediate goods, pushes up firms' demand for labor and capital in the tradable sector,

by the posterior mean but will also allow me to analyze broader model implied moments, as auto- and cross-correlations

[34]In the online appendix all impulse-responses, with their respective simulated 90 percent confidence interval, are displayed.

[35]A positive technology shocks generates a real depreciation which boosts exports, increasing the current account. This, under most parametrization, generates a sufficiently large negative wealth effect that depresses aggregate GDP even if tradable domestic output increases. See the online appendix for all IRFs.

Unanticipated Tradable Productivity Shock

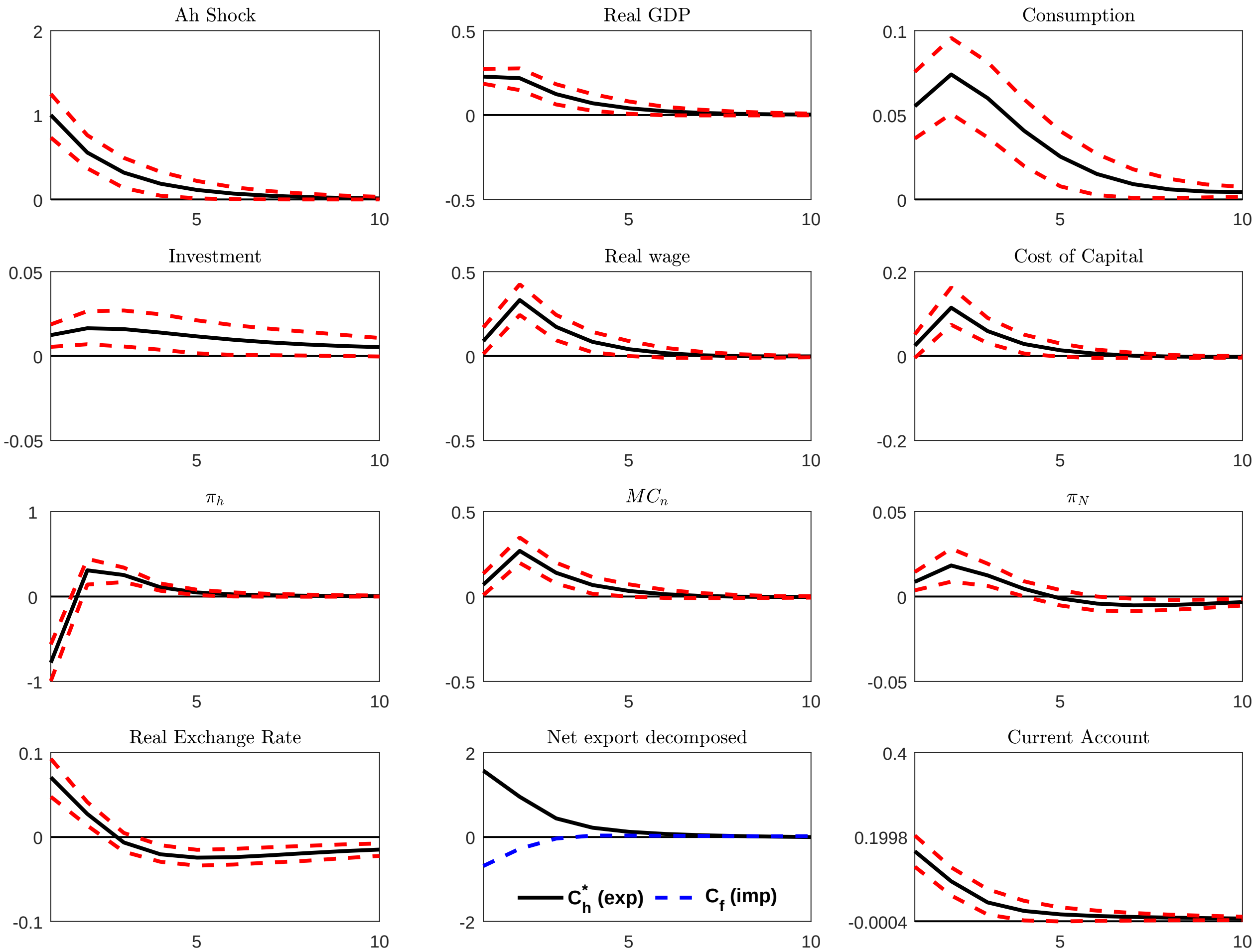


Figure 4: Impulse response to a one percent unanticipated increase in the tradable sector technology, in percent deviation from steady state. Note: an increase in the real exchange rate corresponds to a depreciation.

generating an increase in wages and in the rental rate of capital. While this is not sufficient to increase the cost of production in the tradable sector, it triggers an increase in the marginal cost of the non tradable sector. As a result, non tradable prices increase but, differently from the classical Balassa-Samuelson set up, not sufficiently to compensate the decrease in prices in the tradable sector. The classic Balassa-Samuelson effect does not materialize in this framework as a result of two forces. On the one hand, the fact that prices in the non-tradable sector are stickier makes the increase in non-tradable prices smoother than the fall in tradable prices. On the other hand, the low tradable vs. non tradable elasticity in a world with high trade elasticity explains a higher sensitivity of tradable prices to changes in marginal costs. This leads to a drop in the domestic aggregate price and a real exchange rate depreciation.[36]

[36] Given the estimated trade elasticity, a big part of the increase in production is sold abroad. Therefore, even in the presence of home bias, I will have market clearing in the domestic tradable sector with depreciated

As international competitiveness improves, net export increases, both for an increase in export and a decrease in import, and current account goes on surplus.

Turning to non tradable productivity shocks, similarly to before, current account respond by going on surplus and real exchange rate depreciates (Figure 5). However, differently, GDP only slightly increases and aggregate domestic demand falls on impact. This is due to the fact that the underneath equilibrium dynamics are completely different for the two shocks. Two are the main distinctions: first, all non tradable production has to be consumed domestically and second, prices in the non tradable sector are relatively less flexible. In fact, while consumption and investment augment, the increase in potential non tradable production is not followed by an equivalent increase in non tradable demand. This is due to the price behavior and to the complementarity of non tradable to tradable goods. With full flexibility, prices would sufficiently decrease in order to generate a positive substitution effect towards non tradable goods to clear the higher production. However prices, especially in the non tradable sector, are extremely sticky and therefore non tradable firm decide to lower production by decreasing the demand for capital and labor. This lowers wages and the rental rate of capital with an additional twofold negative effect on non tradable demand: first it decreases the positive wealth effect on consumption (lower wages) and second, it drops the marginal cost in the tradable sector. Because prices in the tradable sector are relatively more flexible, their higher adjustment generates a substitution effect that additionally reduces the demand for non tradable goods. The final equilibrium effect is that on impact production increases in the tradables but decreases in non tradables contemporaneously to a drop in both sector prices. This generates a real exchange rate depreciation and a current account surplus. After the first two quarter, as prices adjust more, both tradable and non tradable sector production increases.

Summarizing, an unanticipated shock both in the tradable and in the non tradable sector cannot match the observed evidence for IPS as it generates a current account surplus and a real exchange rate depreciation. Therefore, not surprisingly, the same result is found in response to a common labor augmenting unanticipated productivity shock. The main idea is that while Balassa-Samuelson sectorial prediction is satisfied (in response to tradable productivity shocks), meaning an increase in the non tradable-tradable price ratio, this is not sufficient to generate a real exchange rate appreciation. I then move to check if anticipated

real exchange rate. This holds true on impact because, in the domestic economy, the positive wealth effect coming from the increase in world demand for domestic goods more than offsets the negative effect due to the terms of trade depreciation.

shocks can instead explain the observed evidence.

TFP shocks

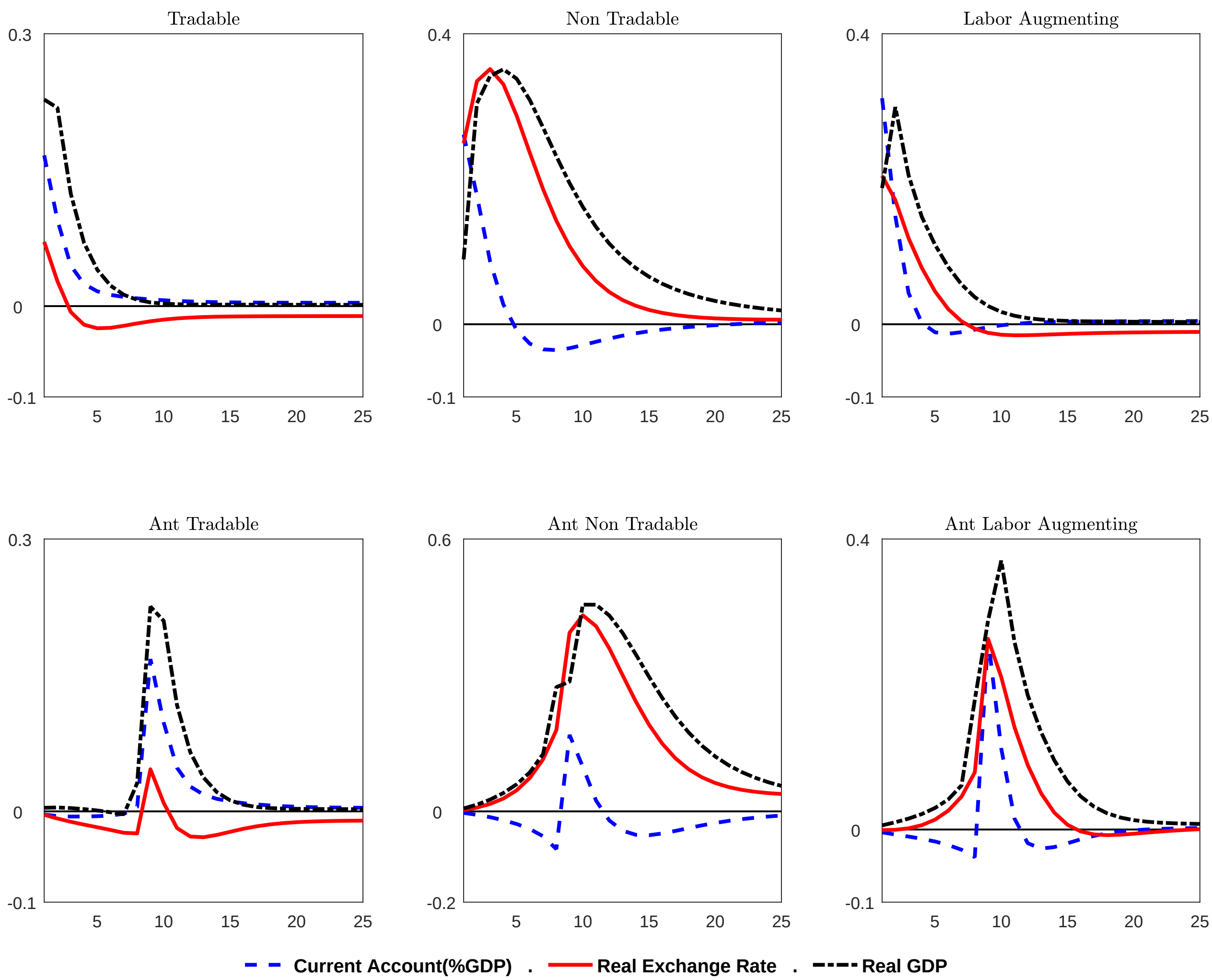


Figure 5: Impulse responses of current account(% of GDP), real GDP and real exchange rate to one percent increase in sector specific and labor augmenting anticipated and unanticipated technology, in percent deviation from steady state. Note: an increase in the real exchange rate corresponds to a depreciation.

Only tradable anticipated productivity shock can temporarily reproduce a GDP increase characterized by real exchange rate appreciation and current account deficit (Figure 5). In fact, before the actual realization of the shock, agents discount the future increase in wealth and smooth consumption. This pushes up home tradable and non tradable goods' prices generating a substitution towards relatively cheaper foreign imports. On one hand the increase in demand generates an increase in GDP, on the other hand the increase in prices leads to a real exchange rate appreciation and a decrease in exports. Increases in imports and decreases in exports lead to a current account deficit. This holds true until the shock actually realizes. Then, the economy follows the dynamic explained previously turning current account into persistent surplus and temporarily depreciated exchange rate. Therefore, to be able to explain GIPS observed evidence in terms of anticipated productivity shock, it is necessary to assume that agents, starting in 1996, were anticipating tradable productivity to increase not earlier than 10 years later or were expecting always larger anticipated shocks in the tradable sector. This is extremely difficult to reconcile with IPS given that they experienced, since 1996, a lowering tradable productivity compared to the rest of the European Monetary Union. Figure (6) shows in fact the relative descending path of tradable (manufacturing) TFP with respect to the EMU using the detailed EUKLEMS database.

IPS (vs. EMU) TFP differential in the manufacturing sector

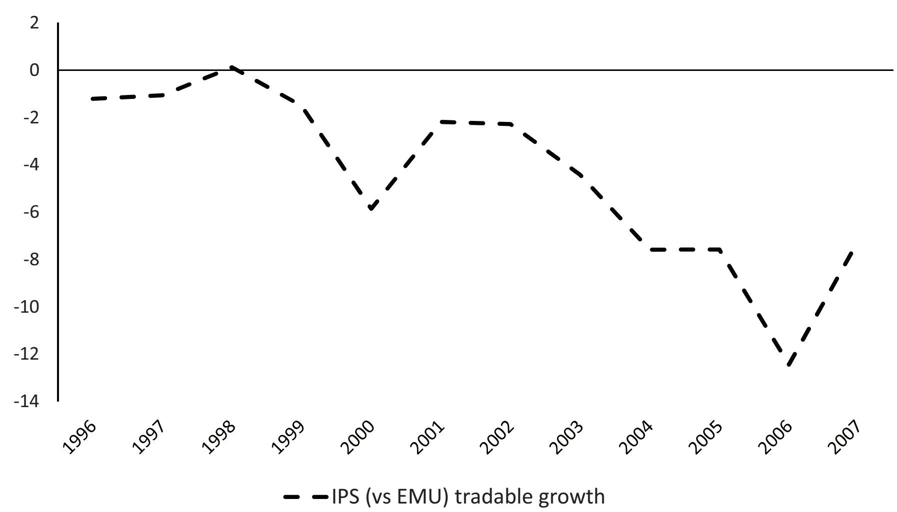


Figure 6: Difference in Total Factor Productivity path in Ireland, Portugal and Spain (Greece not available in EUKLEMS database) with respect to the European Monetary Union in the manufacturing sector between 1995 and 2007. Source EUKLEMS database.

The inability of the estimated model to generate a lasting current account deficit and a real exchange rate appreciation in response to a positive technology shock depends strongly on the estimated values of three parameters: the trade elasticity, the elasticity of tradable and non tradable goods and the persistence of productivity shocks. As clearly explained in Corsetti *et al.* (2008), in presence of really low trade elasticity and home bias, the real exchange rate appreciates and the current account goes on deficit in response to productivity shocks. This is true because an appreciation, and the subsequent increase in wealth, is necessary to trigger a sufficient increase in demand for the home produced tradable goods, which are mostly domestically consumed and not highly substitutable with foreign goods. My model is consistent with this finding if calibrated with parameter values different from the estimated one. In fact, the real exchange rate and the current account change their response to a positive unanticipated tradable productivity shock when I allow the three crucial parameters to vary. First, in order to generate a current account deficit in the presence of high trade elasticity, the model needs to assume high tradable vs. non tradable elasticity. Second, in order to generate an appreciation with higher values of the trade elasticity, it is necessary to assume that productivity shocks are extremely persistent. Third, a low trade elasticity is consistent with an appreciating real exchange rate. This is the reason why it extremely important to estimate these parameters to assess the drivers of international imbalances.[37]

4.1.3 Other shocks

Having shown that none of the productivity shocks included in the model can generate the persistent observed contemporaneous movement of the current account, the real exchange rate and GDP, I study the reaction of the model to all other shocks. Figure 7 highlights the responses to a drop in the yield spread, Sp_t, to an improvement in the investment technology, ϵ^I, to a positive labor supply shock, ϵ_t^L, and finally to a positive demand shock, ϵ^{ζ_t}.

Five shocks generate a simultaneous deterioration of the current account, appreciation of the real exchange rate and increase in GDP: unanticipated and anticipated yield spread drops, unanticipated and anticipated investment efficiency increases and unanticipated positive demand shocks.[38] Unanticipated positive investment specific shock, however, can explain only a short-lived real exchange rate appreciation. Instead, labor supply and anticipated demand shock fail to explain the joint behavior as they respectively imply co-movement between GDP and depreciation and recessionary pressures between the news and the realization of the shock.

Not surprisingly, the dynamics generated by an unanticipated drop in the yield spread and an increase in demand are somehow similar but for one variable, investment. Both shocks lead to an increase in consumption that generates an increase in the demand for both tradable and non tradable goods. This pushes up prices in both sectors (but less than optimally, given the stickiness of prices) and firms respond with an increase in the demand for labor and capital. Wages and the rental rate of capital go up, leading to an increase in marginal costs. The result is an appreciation of the terms of trade and of the real exchange rate. The current account

[37]See the online appendix for a graph summarizing how the current account and the exchange rate change when the trade elasticity and the tradable vs. non tradable elasticity change.

[38]Also monetary policy shock are able to replicate the observed dynamics. The figure however is similar to unanticipated yield spread and it is not going to be shown. Notice that in this small open economy, it is difficult to disentangle between the two shocks a priori. Only through the estimation, thanks to the fact that the ECB rate is included as a data series, the two can be disentangled.

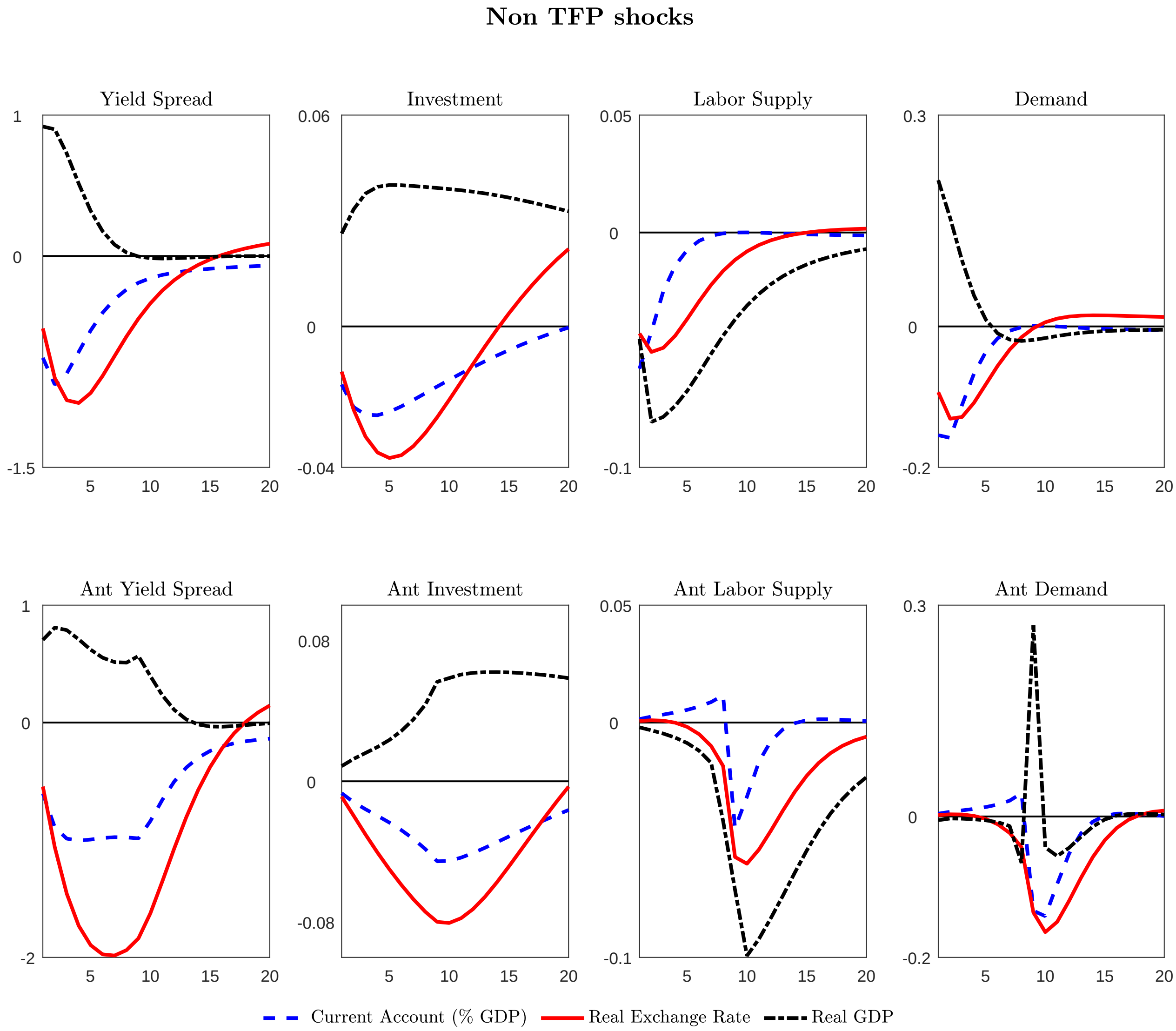


Figure 7: Impulse response of current account(% of GDP), real GDP and real exchange rate to one percent unanticipated and anticipated drop in the yield spread, increase in the investment efficiency, increase in labor supply technology and demand, in percent deviation from steady state. Note: an increase in the real exchange rate corresponds to a depreciation.

deteriorates both because of the increase in demand but also because of the lower price competitiveness of exportable goods. So far the dynamics implied by a decrease in the cost of borrowing and a pure shift in preferences are similar. However, the two shocks imply opposite reactions of real investment: a drop in the cost of borrowing leads to an increase of investments while a demand shock leads to a decrease of it (crowding out). However, and importantly, between 1996 and 2007, IPS experienced a persistent increase in real investment (Figure 1(d)). Both private borrowing and corporate borrowing increased significantly (and above the GDP trend) between 1996 and 2007[39]. This explains both the increase in consumption and strong

[39] A graph showing the dynamics of investment, private and corporate debt is available in the online Appendix

increase in investment, both crucial ingredients for disentangling across possible sources of imbalances [40]

Similarly, an anticipated increase in investment efficiency fails to match the dynamic of one variable, consumption. In this case, the increase in output is entirely driven by the immediate and slow increase in investment which, in the periods between the news and the realization of the shock, results in increasing marginal costs for firms. Firms respond by increasing prices and consumption decreases. Therefore, even though an anticipated investment shock leads to a real exchange rate appreciation and a current account deficit, it cannot be the main driver of the observed imbalances: in IPS periods of current account deficits were often characterized by raising consumption.

Differently, unanticipated and anticipated drops in the yield spread can match contemporaneously the behavior of all macro variables: increasing GDP, raising consumption and investment, current account deficit and real exchange rate appreciation. In fact, a decrease in the yield spread generates a decrease in the cost of borrowing which shifts current aggregate demand through an increase in consumption and investment. This pushes up domestic tradable and non tradable prices and results in a real exchange rate appreciation.[41] The appreciated exchange rate and the increase in import demand turn net exports and current account into deficit. Following the same mechanism, anticipated yield spread shocks imply the same economic response but more persistent in time. This is due the fact that household prefer to adjust smoothly (due to habit persistence and large adjustment costs) and therefore start consuming and investing at the acknowledgment of the news. Therefore, from the impulse response analysis, I conclude that unanticipated and anticipated drops in the yield spread are the only sources that alone could explain the experienced current account imbalances. In line with this result there is the evidence that between 1996 and 2007 IPS experienced a large and unprecedented decrease in the relative cost of borrowing (Figure 1(c)). Notice that this decrease happened in two phases: an abrupt decrease between 1996 and 1997 and a slower but persistent decrease in the period between 2002 and the third quarter of 2006.[42]

[40]For picture legibility, investment responses are shown in the online appendix and not in Figure 7.

[41]This results are in line with empirical estimates of responses of inflation and industrial production to an exogenous increase in the spread (see Gilchrist and Mojon (2018)).

[42]Even though interest rate spread is not among my observable variables in the estimation, the smoothed values of the spread implied by the model does a reasonable job in matching the mean (model 0.87, data 0.51) and the variance (model 0.102, data 0.138) of the observed changes in the spread.

4.2 The importance of anticipated shocks

Anticipated shocks have been estimated to be important drivers of closed-economy business cycle fluctuations (Schmitt-Grohé and Uribe (2012). Here I show that this is the case also in an open economy framework, especially for the accumulation of current account and real exchange rate misalignments: quantitative results are added to the qualitative impulse-response analysis. To check for the role of anticipated yield spread shocks I proceed in three steps. First, I show the role of anticipated shocks for current account, real exchange rate and GDP fluctuations in IPS (Table 5). Second, I present the variance decomposition for IPS, Greece, Ireland, Portugal and Spain, comparing different narratives behind the fluctuations of these macroeconomic variables (Table 6). Third I compare the baseline model with 7 alternative specifications, each one trying to address a possible concern (Table 7).

Table 5: Share of Variance Explained by Anticipated Shocks

Shock	Δ Current Account (% of GDP)	Δ Real Exchange Rate	Δ GDP
Unanticipated	52.10	54.09	64.92
4-Quarters Anticipated	0.66	0.41	0.48
10-Quarters Anticipated	47.24	45.39	34.31

Note: Unanticipated and anticipated shocks grouped by the length of anticipation. The unconditional variance decomposition is computed at the of the posterior distribution.

Table 5 displays the aggregate share of unconditional variance explained by unanticipated and anticipated shocks. The latter is displayed separating the short from the long horizon. Anticipated shocks account for 47 percent of current account movements, 45 percent of real exchange rate fluctuations and 34 percent of GDP growth variability. The role of anticipated shocks is therefore even more pronounced for current account and real exchange rate fluctuations than for GDP growth. The entire role of anticipated shocks is played by the longer term horizon, consistently with the idea that the current account, defined as the change in net foreign asset, captures indeed the (longer) inter-temporal feature of international trade. Swings in expectations are crucial drivers of capital flows and international relative prices.

Moving to more detailed results, Table 6 presents the disaggregated contribution of all shocks to the variance of the three variables in all countries (in the table, dash signs (-) substitute the zeros). Results are pretty robust across euro periphery countries. First, I focus on GDP growth. Five shocks are the main responsible for almost all its fluctuations: unanticipated tradable and non tradable productivity (anticipated in Portugal, Spain and Greece), unanticipated investment specific, anticipated yield spread and tradable markup shocks. On top of some results in line with the literature, such as the importance of investment

Table 6: Unconditional Variance Decomposition

Shocks		Δ Current Account(% GDP)					Δ Real Exchange rate					Δ GDP				
		IPS	GRC	IRL	PRT	SPA	IPS	GRC	IRL	PRT	SPA	IPS	GRC	IRL	PRT	SPA
T tech.	$u_{0,t}^{AH}$	18	20	22	7	13	2	1	2	1	1	22	16	28	33	30
	$u_{4,t}^{AH}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$u_{8,t}^{AH}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Σu^{AH}	18	20	22	7	14	2	1	2	1	1	22	16	28	33	30
NT tech.	$u_{0,t}^{AN}$	19	-	16	-	5	8	-	9	-	1	10	-	15	-	2
	$u_{4,t}^{AN}$	-	19	-	10	14	-	10	-	2	6	-	16	-	14	9
	$u_{8,t}^{AN}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Σu^{AN}	19	19	16	11	19	8	10	9	2	7	10	16	15	14	11
Common L augm	$u_{0,t}^{X}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$u_{4,t}^{X}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$u_{8,t}^{X}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Σu^{X}	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Demand	$u_{0,t}^{\zeta}$	1	-	7	25	-	-	-	2	3	-	1	-	7	13	-
	$u_{4,t}^{\zeta}$	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
	$u_{8,t}^{\zeta}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Σu^{ζ}	1	-	7	25	2	-	-	2	3	-	2	-	7	13	2
Labor supply	$u_{0,t}^{L}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$u_{4,t}^{L}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$u_{8,t}^{L}$	4	3	2	2	3	1	1	-	-	1	2	2	1	3	3
	Σu^{L}	4	3	2	2	3	1	1	-	-	1	2	2	1	3	3
Invest specific	$u_{0,t}^{I}$	3	15	-	1	20	3	5	-	-	8	4	20	-	2	19
	$u_{4,t}^{I}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$u_{8,t}^{I}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Σu^{I}	3	15	-	1	20	3	5	-	-	8	4	20	-	2	19
Monetary Policy	u_t^{r}	5	2	-	2	7	2	1	-	1	3	5	1	-	1	3
Yield spread	$u_{0,t}^{Spread}$	2	2	-	1	1	1	1	-	-	-	2	1	-	-	1
	$u_{4,t}^{Spread}$	-	-	-	1	4	-	-	-	-	3	-	-	-	-	2
	$u_{8,t}^{Spread}$	43	30	43	44	25	44	25	44	22	21	32	13	19	7	9
	Σu^{Spread}	46	32	43	46	30	46	25	44	23	24	34	15	19	7	12
Markup - T	$u_{0,t}^{\theta}$	4	9	10	6	5	36	57	41	68	52	20	30	29	22	19
	$u_{4,t}^{\theta}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$u_{8,t}^{\theta}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Markup - NT	$u_{0,t}^{\phi}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$u_{4,t}^{\phi}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	$u_{8,t}^{\phi}$	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Σu^{I}	4	9	10	6	5	36	57	41	68	52	20	30	29	22	19
Foreign T price	$u_t^{\Pi_T*}$	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1
Foreign NT price	$u_t^{\Pi*}$	-	-	-	-	-	2	-	-	2	3	-	-	-	-	-
Foreign Cons	u_t^{c*}	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Σu^{*}	-	-	-	-	-	2	1	-	2	3	-	-	-	4	1

Note: The unconditional variance decomposition is computed at the mode of the posterior distribution.

specific productivity shocks (Justiniano *et al.* (2010)[43]), I learn that around 17% of GDP growth movements are explained by the reaction of the economy to anticipated shocks in the spread. More than a third of GDP growth fluctuations is explained by TFP shocks. Interestingly, in Greece, 16 % of the fluctuations are explained by anticipated non tradable shocks and 16% by unanticipated tradable shocks.

Current account changes are explained almost entirely by three shocks: 40% by anticipated yield spread, 20% by unanticipated tradable and 20% by non tradable productivity. The exact percentage varies depending on the country, with Ireland and Greece having the largest effect of sectoral productivity (respectively 38 and 39 percent), Portugal having important shifts in demand and Spain having changes in investment efficiency. The remaining part is

[43]However notice that I do not include in the set of observable variables the relative price of investment, which can be a reason of why I find investment specific shocks important for output growth fluctuations.

explained by tradable markups (not surprisingly in Ireland).

In line with the impulse response analysis, anticipated yield spread shocks are selected as the main source the experienced current account deficit. However, interestingly, the variance decomposition analysis helps me to assign to the anticipated component, with respect to the unanticipated one, the main explanatory power of current account fluctuations.

Focusing on the real exchange rate, table 5 shows that anticipated shocks explain almost half of its variability. This is almost entirely imputable to anticipated shocks to the yield spread. In fact, as shown in the impulse response analysis, anticipated decrease in the spread generate persistent real exchange rate appreciations, which matches the observed evidence for IPS. Two are the other sources explaining changes in real exchange rate movements: non tradable productivity and mark-up shock in the tradable sector, which jointly, account for roughly half of the unconditional variance.

I now move to test the robustness of these findings by comparing, in Table 7, the baseline model with respect to 7 other estimated specifications (on IPS data). (1) The model estimated without the short-term anticipation component in all exogenous movements. Results are almost identical to the baseline specification with an almost identical marginal log density (higher Laplace approximation but lower harmonic mean). (2) The model without the long term - 8 quarters - anticipation component. Anticipation becomes relevant only for yield spread shocks. Interestingly, to keep the persistency of yield spread movements, the estimated model increases the autoregressive component of spread fluctuations (see Table A1). (3) The model estimated without any anticipated shocks. The marginal log density falls quite significantly. However, yield spread shocks are still explaining half of the current account fluctuations. (4) The same exact model as the baseline, simply estimated without the consumption series. Results on the role of anticipated shocks and yield spread are basically unaltered. (5) The model in which a government sector, consuming only domestically produced good, is introduced. The government spending, entirely financed by lump-sum taxation on households, moves for exogenous contemporaneous and anticipated fluctuations. The model is estimated on the same set of data as the baseline with an additional one: government expenditure over GDP. The result shows that government spending didn't play an important role in the accumulation of imbalances and that the introduction of government doesn't alter the main role of yield spread. The only important difference is that introducing government spending increases the marginal log density. However, as the data set and model changes, the marginal log density cannot be compared. (6) The model estimated on the same set of variables, adding the yield spread series. The series is computed as the difference between the sovereign cost of borrowing for IPS with respect to Germany on a three-year government bond. Given the first order solution of the model, I introduce the spread $Sp_{t,t+12}$ as an observable following the Expectations Hypothesis:

$$Sp_{t,t+12} = \frac{1}{12} \sum_{j=1}^{12} E_t \left(\widehat{r}^{w}_{t+j} - \widehat{r}_{t+j} \right). \tag{16}$$

The effect of introducing directly the spread series is to increase the marginal log density of the model (but again not comparable as the data set changes) and to give more importance to anticipated yield spread shocks. In this specification they are explaining more than two thirds of the overall unconditional current account variance. However, this version of the model does a poor job in matching current account moments. (7) A model in which the number of shocks, counting each anticipated shocks as one shock, is equal to the number of series. Anticipated shocks are kept only for yield spread and sectorial productivity. Four more series are added: government spending, 3-year yield spread, tradable inflation and non tradable inflation. In this set-up, anticipated yield spread movements explain a third of current account fluctuations.[44]

Summarizing, the results from the variance decomposition analysis confirm and strengthen the qualitative findings and are robust to multiple model specifications. Yield spread shocks are the main driver of the experienced imbalances in IPS. In particular, anticipated long run fluctuations in the risk premium, and not catching-up, are behind the joint dynamics of the current account, the real exchange rate and GDP.

4.3 Yield spread, macro fundamentals and changes in expectations

From the previous qualitative and quantitative analysis, negative, exogenous and anticipated yield spread shocks are shown to be the main drivers of the experienced GIPS current account imbalances. I therefore test if these characteristics, *negative*, *exogenous* and *anticipated*, are present in the yield spread data. I proceed in two steps. First, I run a panel fixed effect regression of IPS yields spread on a set of standard macro fundamentals, following closely the literature (De Grauwe and Ji (2013) and Perego (2020)). This will allow me to estimate

[44] Additional robustness checks, available in the online appendix and upon request, are (i) a model in which anticipated shocks (known with certainty) are considered uncertain: changing from news to noise fluctuations and (ii) the model estimated substituting Jaimovich and Rebelo type of preferences with preferences separable in consumption. Results are robust.

Table 7: Unconditional Variance Decomposition - different models

Shocks		Δ Current Account(% GDP)							
		Baseline	No $u^x_{4,t}$	No $u^x_{8,t}$	No Ant	No Cons	Govt	Spread	Reduced
T tech.	$u^{AH}_{0,t}$	17.7	18.0	17.6	8.5	1.9	32.5	6.5	12.6
	$u^{AH}_{4,t}$	-	/	-	/	4.6	-	-	/
	$u^{AH}_{8,t}$	-	-	/	/	-	-	-	-
	Σu^{AH}	17.8	18.0	17.6	8.5	6.5	32.6	6.5	12.7
NT tech.	$u^{AN}_{0,t}$	18.9	18.8	19.1	21.0	5.2	17.2	8.6	30.8
	$u^{AN}_{4,t}$	0.1	/	-	/	-	0.1	-	/
	$u^{AN}_{8,t}$	-	-	/	/	-	0.1	-	-
	Σu^{AN}	19.0	18.8	19.2	21.0	5.2	17.3	8.6	30.8
Common L augm	$u^{X}_{0,t}$	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	$u^{X}_{4,t}$	0.1	/	0.1	/	0.1	0.1	-	/
	$u^{X}_{8,t}$	0.1	0.1	/	/	0.1	0.1	-	/
	Σu^{X}	0.4	0.3	0.4	0.3	0.5	0.5	0.3	0.3
Demand	$u^{\zeta}_{0,t}$	1.2	1.3	0.1	0.1	25.8	3.0	3.6	6.7
	$u^{\zeta}_{4,t}$	-	/	-	/	-	-	-	/
	$u^{\zeta}_{8,t}$	-	-	/	/	-	-	-	/
	Σu^{ζ}	1.2	1.3	0.1	0.1	25.8	3.0	3.6	6.7
Labor supply	$u^{L}_{0,t}$	-	-	-	4.1	-	-	1.0	2.1
	$u^{L}_{4,t}$	-	/	3.8	/	-	-	-	/
	$u^{L}_{8,t}$	3.9	3.8	/	/	-	4.0	-	/
	Σu^{L}	3.9	3.8	3.8	4.1	-	4.0	1.0	2.1
Invest specific	$u^{I}_{0,t}$	3.0	3.1	3.0	3.3	0.2	3.5	0.5	0.2
	$u^{I}_{4,t}$	-	/	-	/	-	-	-	/
	$u^{I}_{8,t}$	-	-	/	/	-	-	-	/
	Σu^{I}	3.0	3.1	3.0	3.3	0.2	3.5	0.5	0.2
Monetary Policy	u^{r}_{t}	5.1	5.1	4.5	4.5	6.5	3.1	1.1	2.0
Yield spread	$u^{Spread}_{0,t}$	2.0	1.7	10.9	50.6	27.7	2.1	20.4	4.9
	$u^{Spread}_{4,t}$	0.4	/	36.9	/	12.5	0.4	5.4	/
	$u^{Spread}_{8,t}$	43.2	43.8	/	/	12.2	31.5	51.8	26.8
	Σu^{Spread}	45.7	45.5	47.8	50.6	52.4	33.9	77.6	31.7
Markup - T	$u^{\theta}_{0,t}$	3.8	3.9	3.4	6.6	2.5	1.8	0.8	12.4
	$u^{\theta}_{4,t}$	-	/	-	/	-	-	-	/
	$u^{\theta}_{8,t}$	-	-	/	/	-	-	-	/
Markup - NT	$u^{\phi}_{0,t}$	-	-	-	0.9	-	-	-	-
	$u^{\phi}_{4,t}$	-	/	-	/	-	-	-	/
	$u^{\phi}_{8,t}$	-	-	/	/	-	-	-	/
	Σu^{I}	3.8	3.9	3.4	7.4	2.5	1.8	0.8	12.4
Government	$u^{g}_{0,t}$	/	/	/	/	/	0.1	/	1.1
	$u^{g}_{4,t}$	/	/	/	/	/	-	/	/
	$u^{g}_{8,t}$	/	/	/	/	/	0.1	/	/
	Σu^{g}	/	/	/	/	/		/	/
Foreign T price	$u^{\Pi_T *}_{t}$	0.1	0.1	0.1	0.2	0.2	0.1	-	-
Foreign NT price	$u^{\Pi *}_{t}$	-	-	-	-	-	-	-	-
Foreign Cons	u^{c*}_{t}	-	-	-	-	-	-	-	0.2
	Σu^{*}	0.1	0.1	0.1	0.2	0.2	0.2	-	0.2
Marginal log Density	Laplace Approximation	1779.0	1781.7	1778.5	1671.6	1712.1	1840.9	1893.9	-1530.4
	Modified Harmonic Mean	1688.6	1687.5	1682.8	1674.4	1637.6	1855.3	1906.2	-1552.6

Note: The unconditional variance decomposition is computed at the mode of the posterior distribution.

how much of spread movements were exogenous to macro fundamentals and if these residual forces were pushing the spread up or down. Second, I check if these unexplained yield spread movements were indeed significantly correlated with variables capturing future expectations.

For the specification of the linear (and non linear) model connecting fundamentals to the spread, I follow closely the literature and estimate the equations proposed by De Grauwe and Ji (2013):

$$Spread_{i,t} = \alpha + z \times CA_{i,t} + \gamma \times Debt_{i,t} + \mu \times RER_{i,t} + \delta \times Growth_{i,t} + \alpha_{i,t} + u_{i,t}$$

$$Spread_{i,t} = \alpha + z \times CA_{i,t} + \gamma \times Debt_{i,t} + \mu \times RER_{i,t} + \delta \times Growth_{i,t} + \gamma_2 \times (Debt_{i,t})^2 + \alpha_{i,t} + u_{i,t}$$

where *Spread* is the interest rate spread on the 10-year government bond between country i and the euro area weighted average yield (computed by Eurostat), *Debt* is a measure of the government burden (i.e. government debt to GDP ratio or the "fiscal space" measure proposed by Aizenman *et al.* (2013) - government debt to tax revenues) and *CA* is the cumulated current account to GDP position of country i. α is the constant term and $a_{i,t}$ is the country fixed effects. Results are reported using robust standard errors, as standard in the literature.[45] The model is estimated on quarterly data between 1995 and 2007 on Ireland, Portugal and Spain.

Non-fundamental yield spread movements and expectation indices

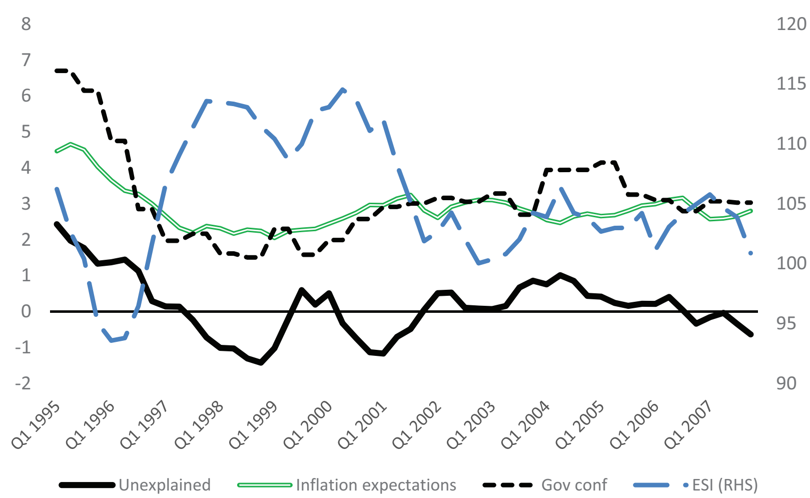


Figure 8: Weighted averages of Ireland, Portugal and Spain. The black line is the residual of the panel estimation 17 and represents the unexplained movements of the yield spread, the blue line is the Economic Sentiment Indicator (ESI) published by the European Commission, the black dotted line is the ifo World Economic Survey lack of lack of confidence in economic policy indicator and the double green line is the 1-year inflation forecast of the Survey of Professional forecast (notice: the value is meaningless, as it was weighted and transformed in an index given confidential data, and only the dynamics should be considered).

The estimation shows three interesting results (see Table A3 in the appendix): first, in the 1995-2007 period, most of the fluctuations of the yield spread were not driven by fundamentals. This can be seen from the low R^2 of the regression. This is particularly low when compared to the R^2 of the same regression, on the same set of countries, in sample starting in 2001 (De Grauwe and Ji, 2013). Second, inflows of capital (negative current account) were the only significantly correlated force with yield spreads during this period. Third, as shown in Figure 8, from Q2-1997 to Q3-1999, the realized spread was lower than the predicted one using fundamentals, implying a negative residual. This means that the non-fundamental

[45] I refer to De Grauwe and Ji (2013) for a detailed explanation of the model and the assumptions.

(exogenous) forces were pushing down the spread, supporting the model prediction of negative shocks.

Then, as shown in Figure 8 and Table A4 in the appendix, I investigate further if the unexplained component of the spread is somehow related to variables capturing economic agents' expectations. Three are the variables considered: (a) the European Commission economic sentiment indicator (ESI) to proxy for the overall sentiment among firms and consumers on expected GDP growth (after having included current GDP growth as a fundamental variable);[46] (b) inflation expectations, using the 1-year ahead inflation forecast in the Survey of Professional Forecaster. This variable is introduced to check the idea that spreads went down as agents understood that delegating the monetary policy to a more hawkish credible central bank would imply lower inflation in the future (Barro and Gordon (1983)); (c) the IFO World Economic Survey indicator of lack of confidence in economic policy to capture the overall sentiment towards institutions. This could be interpreted, with a bit of a stretch, as the inverse of the credibility of the European project. Figure 8 visually shows what Table A4 tests statistically. There is a significant correlation between the non-fundamental driver of yield spread in IPS and these forward looking variables. All variables have meaningful correlations: an increase in inflation expectations is correlated with higher unexplained spreads; a boost in confidence on future GDP growth negatively co-move with the non-fundamental spread and an increase in the lack of credibility in policy institution positively co-move with the "exogenous" spread.

I take this as a preliminary, but convincing, test that between 1996 to 2007 yield spread in IPS were indeed hit by negative, exogenous and anticipated shocks.

5 Conclusions

From 1996 to 2007 Greece, Ireland, Portugal and Spain have experienced three common facts: increasing current account deficits, appreciating real exchange rates and GDP growing above trend (contemporaneously to an increase in investment and consumption). When studying current account balances it is important to remember that those capture inter-temporal features of international trade and, in the EA, they started to arise in 1996, before the actual introduction of the euro. This motivated my interest on the role of expectations as drivers of

[46] The ESI is a weighted average of the balances of replies to selected questions addressed to firms in five sectors covered by the EU Business and Consumer Surveys and to consumers. The sectors covered are industry (weight 40%), services (30%), consumers (20%), retail (5%) and construction (5%).

those imbalances. A small open economy model, estimated for Greece, Ireland, Portugal and Spain from 1996-2007 including anticipated shocks, allows me to compare different narratives assessing the role of expectations.

Qualitatively and quantitatively I show that *anticipated* shocks matter and in particular *yield spread* anticipated (and not) shocks have been, relatively speaking, the main driver of the experienced imbalances in GIPS. The narrative that capital was flowing towards "catching-up" euro area countries with high current or expected productivity growth or that imbalances were caused by simply an increase in demand for periphery goods (e.g. non tradable goods) are not supported by my empirical analysis. The decrease in the international yield spread explains from a third to a half of IPS current account movements, depending on the model specification and the observable variables used.

To conclude, when investigating the sources of current account imbalances in the euro periphery, we should keep in mind two general considerations: first, an important fraction of current account fluctuations is due to shocks involving changes in expectations; second, negative, exogenous and anticipated yield spread movements were the main driver of euro area periphery imbalances.

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Appendix A

All replication codes are available at Mendeley Data:

Siena, Daniele (2020), Replication Codes for The Euro Area Periphery and Imbalances: Is it an Anticipation Story?, Mendeley Data, V1 doi: 10.17632/gc98b4xryz.1 link.

Table A1: Posterior Mean - different models

		sa	No $\zeta_{4,t}$	No $\zeta_{8,t}$	No ant	No cons	Govern	Spread	Reduced
Estimated Parameters									
μ	Lab supply wealth eff	0.767	0.768	0.754	0.743	0.838	0.770	0.600	0.746
v	Frisch elast (μ=0)	4.248	4.252	4.253	4.464	3.908	4.104	4.522	4.103
η	T Vs NT	0.282	0.287	0.280	0.310	0.425	0.303	0.295	0.189
ϵ	home VS foreign	2.065	2.064	2.052	3.299	3.999	1.917	2.209	12.116
h	habit formation	0.598	0.599	0.619	0.648	0.639	0.642	0.745	0.818
$\overline{\eta}_v$	Utilization rate elast	0.308	0.307	0.311	0.347	0.540	0.185	0.200	0.136
η_k	Capital adj cost elast	20.06	20.42	20.89	21.98	4.19	19.52	15.61	9.22
θ	Good elasticity	7.819	7.790	7.750	7.640	6.934	8.140	7.682	8.558
θ_N	NT price rigidity	0.788	0.788	0.786	0.817	0.699	0.817	0.833	0.835
θ_h	T price rigidity	0.149	0.149	0.148	0.222	0.177	0.154	0.137	0.502
ϕ_N	NT indexation	0.481	0.482	0.482	0.485	0.474	0.473	0.498	0.449
ϕ_h	T indexation	0.459	0.460	0.459	0.464	0.475	0.467	0.463	0.455
χ	End discount weight	-507.7	-499.6	-507.5	-505.4	-495.8	-500.2	-441.4	-502.5
AR Coefficients									
ρ_{A_h}	T Techn	0.555	0.554	0.561	0.537	0.535	0.559	0.598	0.986
ρ_{A_N}	NT Techn	0.784	0.786	0.782	0.761	0.753	0.765	0.776	0.826
ρ_X	Labor Augm	0.504	0.502	0.501	0.499	0.508	0.500	0.516	0.504
ρ_ζ	Preference	0.493	0.491	0.499	0.500	0.372	0.475	0.411	0.158
ρ_{ϵ_I}	Invest	0.841	0.840	0.846	0.831	0.484	0.869	0.327	0.509
ρ_{ϵ_L}	Labor	0.795	0.797	0.798	0.722	0.512	0.845	0.912	0.942
$\rho_{\epsilon_r b}$	Risk Prem	0.744	0.743	0.834	0.913	0.982	0.724	0.985	0.914
ρ_θ	NT Markup	0.440	0.444	0.443	0.495	0.398	0.402	0.250	0.905
ρ_ϕ	T Markup	0.499	0.499	0.501	0.565	0.500	0.496	0.504	0.500
Standard Deviation									
$100\sigma_{\zeta^{A_h}_{0,t}}$	T Techn	2.442	2.445	2.467	1.289	0.455	2.942	2.248	2.551
$100\sigma_{\zeta^{A_n}_{0,t}}$	NT Tech	1.601	1.601	1.624	1.624	0.783	1.434	1.569	2.068
$100\sigma_{\zeta^{X}_{0,t}}$	Labor Augm	0.129	0.136	0.136	0.134	0.131	0.137	0.167	0.135
$100\sigma_{\zeta^{\zeta}_{0,t}}$	Preference	0.342	0.368	0.149	0.148	3.079	0.972	2.054	4.680
$10\sigma_{\zeta^{I}_{0,t}}$	Invest	0.985	1.003	1.009	1.069	0.125	0.821	1.313	0.140
$100\sigma_{\zeta^{L}_{0,t}}$	Labor	0.139	0.131	0.143	3.472	0.155	0.149	2.756	2.434
$100\sigma_{\zeta^{r}_{0,t}}$	Int rate	0.202	0.202	0.202	0.203	0.202	0.202	0.203	0.202
$100\sigma_{\zeta^{Sp}_{0,t}}$	Yield Spread	0.157	0.144	0.198	0.410	0.073	0.201	0.132	0.152
$10\sigma_{\zeta^{\theta_N}_{0,t}}$	NT markup	13.847	13.743	13.370	17.364	4.981	17.819	23.823	7.781
$100\sigma_{\zeta^{\theta_T}_{0,t}}$	T markup	0.138	0.144	0.146	7.851	0.148	0.148	0.143	0.153
$100\sigma_{\zeta^{A_h}_{4,t}}$	Ant Ah	0.077	-	0.068	-	0.989	0.080	0.072	-
$100\sigma_{\zeta^{A_n}_{4,t}}$	Ant An	0.071	-	0.072	-	0.070	0.073	0.062	-
$100\sigma_{\zeta^{X}_{4,t}}$	Ant Labor Augm	0.078	-	0.081	-	0.065	0.067	0.065	-
$100\sigma_{\zeta^{\zeta}_{4,t}}$	Ant Preference	0.076	-	0.088	-	0.075	0.069	0.070	-
$100\sigma_{\zeta^{I}_{4,t}}$	Ant I	0.072	-	0.071	-	0.074	0.076	0.068	-
$100\sigma_{\zeta^{L}_{4,t}}$	Ant L	0.079	-	3.558	-	0.078	0.067	0.065	-
$100\sigma_{\zeta^{Sp}_{4,t}}$	Ant Yield Spread	0.068	-	0.616	-	0.049	0.072	0.063	-
$100\sigma_{\zeta^{\theta_N}_{4,t}}$	Ant NT markup	0.078	-	0.078	-	0.078	0.076	0.071	-
$100\sigma_{\zeta^{\theta_T}_{4,t}}$	Ant T markup	0.075	-	0.071	-	0.073	0.065	0.075	-
$100\sigma_{\zeta^{A_h}_{8,t}}$	Ant Ah	0.079	0.073	-	-	0.072	0.075	0.068	0.072
$100\sigma_{\zeta^{A_n}_{8,t}}$	Ant An	0.072	0.074	-	-	0.068	0.070	0.062	0.071
$100\sigma_{\zeta^{X}_{8,t}}$	Ant Labor Augm	0.072	0.068	-	-	0.074	0.067	0.065	-
$100\sigma_{\zeta^{\zeta}_{8,t}}$	Ant Preference	0.080	0.075	-	-	0.074	0.068	0.069	-
$100\sigma_{\zeta^{I}_{8,t}}$	Ant I	0.071	0.087	-	-	0.080	0.069	0.100	-
$100\sigma_{\zeta^{L}_{8,t}}$	Ant L	3.506	3.504	-	-	0.071	3.282	0.078	-
$100\sigma_{\zeta^{Sp}_{8,t}}$	Ant Yield Spread	0.954	0.966	-	-	0.052	1.016	0.226	0.281
$100\sigma_{\zeta^{\theta_N}_{8,t}}$	Ant NT markup	0.071	0.081	-	-	0.077	0.076	0.142	-
$100\sigma_{\zeta^{\theta_T}_{8,t}}$	Ant T markup	0.078	0.081	-	-	0.066	0.073	0.072	-
ρ_G	Gov	*Beta*	-	-	-	-	0.947	-	0.948
$100\sigma_{\zeta^{G}_{0,t}}$	Gov	*IGamma*	-	-	-	-	0.428	-	0.645
$100\sigma_{\zeta^{G}_{4,t}}$	Ant Gov	*IGamma*	-	-	-	-	0.258	-	-
$100\sigma_{\zeta^{G}_{10,t}}$	Ant Gov	*IGamma*	-	-	-	-	0.123	-	-
Marginal log Density	Laplace Approximation	1778.9556	1781.7178	1778.451	1671.562	1712.145	1840.913	1928.989	-1530.374
	Modified Harmonic Mean	1688.5832	1687.5319	1682.774	1674.445	1637.610	1855.250	1936.976	-1552.604

Table A2: Data and Model Moments - Greece

	Data		Model		Model	
	Mean	Std dev	Mean	Std dev	Autocorrelations	
$\frac{CA}{Y_{ss}}$	-7.23	5.35	0.00	8.52	0.68	0.45
Δ ReR	-0.26	1.76	0.43	3.39	-0.18	-0.03
Δ Y	1.16	1.93	0.98	3.52	-0.21	-0.07
Δ C	1.19	1.67	0.98	2.51	-0.18	-0.06
Δ I	1.22	7.01	0.98	9.85	0.11	0.01
L	-0.05	0.69	0.00	2.47	0.61	0.24

NOTE: Sample period Q1:1996-Q4:2007. For computing these moments I generate an artificial sample of the observable variables with same length as my dataset (48 observations) after discarding 100 initial observations. It shows standard deviation and autocorrelation at t-3 for Greece. Variable listed are, in order: current account with respect to steady state GDP ($\frac{CA}{Y_{ss}}$), real exchange rate (ReR), GDP (Y), investment (I), consumption (C), hours worked (L).

Table A3: Spread and macro fundamentals in IPS

	(1)	(2)	(3)	(4)
RER	3.566	4.313	3.368	3.873
	(4.174)	(4.386)	(3.838)	(3.964)
$\sum \frac{CA}{GDP}$	0.00851**	0.00843**	0.00817**	0.00822**
	(0.00143)	(0.00142)	(0.00143)	(0.00165)
ΔY	-0.0260	-0.0308	-0.0215	-0.0291
	(0.0849)	(0.0845)	(0.0821)	(0.0868)
$\frac{GovDebt}{GDP}$	0.0240	0.0601		
	(0.0146)	(0.0503)		
$\left(\frac{GovDebt}{GDP}\right)^2$		-0.000347		
		(0.000481)		
$\frac{GovDebt}{Taxrevenue}$			0.194	0.444
			(0.0737)	(0.221)
$\left(\frac{GovDebt}{Taxrevenue}\right)^2$				-0.0242
				(0.0181)
Observations	156	156	156	156
R-squared	0.412	0.414	0.390	0.395
Number of countries	3	3	3	3
Country FE	YES	YES	YES	YES

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A4: Unexplained Yield spread and expectations' indicators

	(1)	(2)	(3)	(4)
Inflation Expectations	0.513**			0.152**
	(0.200)			(0.0595)
Economic Sentiment Indicator		-0.0357*		0.00296
		(0.0199)		(0.00722)
Lack of confidence in econ policy			0.205*	0.299***
			(0.106)	(0.0864)
Observations	156	156	156	156
Number of countries	3	3	3	3
Time FE	YES	YES	YES	YES
R^2	0.339	0.352	0.519	0.538

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1