The Current Account Deficits of South Europe

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Abstract

The first chapter of this thesis focuses on the optimality of the current account deficits of Greece, Portugal, and Spain, which reached their peak during the global financial crisis. In particular, I follow the Engel and Rogers (2006) analysis, which posits a link between the current account deficit of a country and its expected discounted present value of future income share in the world relative to its current share. The analysis shows that while the current account deficits of Greece and Spain in 2008 may be considered an outcome of optimal decisions of households, the Portuguese current account deficit cannot be deemed optimal.

In the second chapter, I consider a sudden stop analysis in a two-country heterogeneous agent-incomplete markets framework in the spirit of Bewley (1986), Huggett (1993), and Guerrieri and Lorenzoni (2017), calibrated to Greece and 14 EU countries. Then, I explore how a sudden tightening of the borrowing constraint in Greece affects its external accounts and consumption along the transition path to the long-run equilibrium. The sudden stop causes a welfare loss for Greece in the short run and decreases wealth inequality.

Keywords: Current account deficit, sudden stop, transition dynamics, South Europe, wealth inequality

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Özet

Bu tezin ilk bölümü küresel finansal kriz döneminde, cari açıkları zirveye ulaşan Yunanistan, Portekiz ve İspanya'nın cari açıklarının optimalitelerine odaklanmaktadır. Özellikle, bir ülkenin cari açığı ile o ülkenin bugünkü payına göre, gelecek gelirinin payının beklenen indirgenmiş bugünkü değeri arasında bir bağlantı olduğunu gösteren Engel ve Rogers'ın (2006) analizini takip ediyorum. Analiz gösteriyor ki Yunanistan ve İspanya'nın 2008 yılındaki cari açık seviyeleri hanehalklarının optimal kararlarının bir sonucu olduğu olarak düşünülebilirse de, Portekiz'in cari açığı optimal kabul edilemez.

İkinci bölümde, ani duruş analizini iki-ülke heterojen ajan-eksik piyasa modelini ,Bewley (1986), Huggett (1993), ve Guerrieri ve Lorenzoni (2017) 'nin modeliyle uyumlu şekilde, Yunanistan ve 14 AB ülkesine kalibre ederek gerçekleştirdim. Sonra, Yunanistan'da ani bir borçlanma kısıtının dış hesapları, tüketimi ve uzun-dönem dengeye götüren bağlantıyı nasıl etkilediğini araştırdım. Ani duruş Yunanistan'da kısa dönemde bir servet kaybına sebep olmuş ve servet eşitsizliğini azaltmıştır.

Anahtar Sözcükler: cari açığı, servet eşitsizliği

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Introduction

In early 2000s, South European countries like Spain, Greece and Portugal experienced significant increase in their current account deficits. Figure 1 illustrates the rapid increase in the current account deficits of Greece, Portugal and Spain, as a percentage of Gross Domestic Product, to an alarming level during the global financial crisis of 2008. Weakening export performance and domestic demand driven boom are two of the main explanations for the rapid increase in current account deficit of Southern Euro area countries (Shambaugh & Kang, 2013). Nevertheless, the export performance of the peripheral countries including Greece, Portugal and Spain has not been found to decline significantly (Gaulier and Vicard, 2012).

While the export performance does not differ much between the peripheral and core countries during the 1999-2008 period, Holinski, Kool and Muysken (2012) observe that the differences in current account imbalances of Euro area member countries increased drastically after the formation of the currency union in 1999, as compared to the pre-Euro period. The peripheral countries including Greece, Portugal, Spain and Ireland accumulated high deficits while the core countries including Germany, France, Austria and the Netherlands accumulated high surpluses since the introduction of the Euro. Holinski, Kool and Muysken (2012) and Kang & Shambaugh (2013) find that the decline in transfers while rising net factor payments have driven the deficits in the Southern countries. In other words, the Southern European countries have been borrowing to make up for the loss in transfers, resulting in an increase in net income payments which further increased the need for borrowing to service the debt.

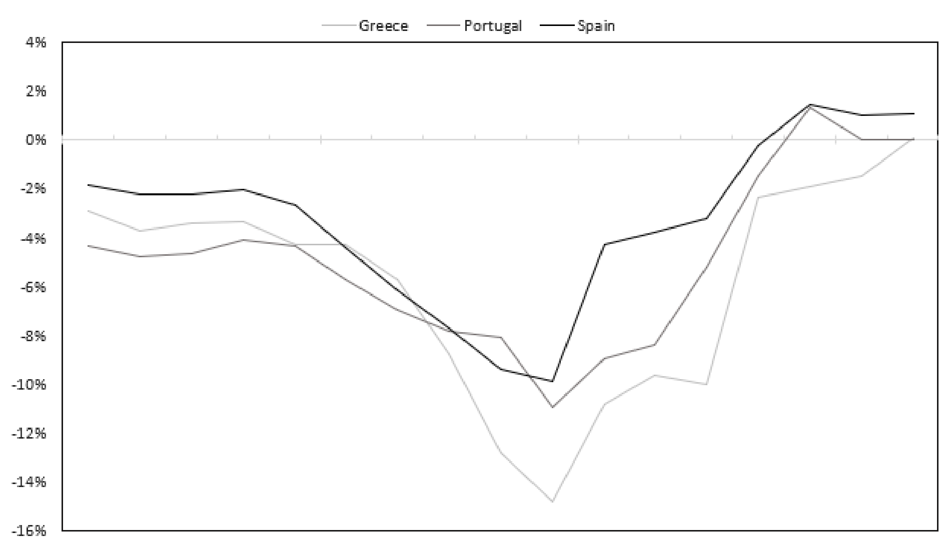


Figure 1: Evolution of Current Account (as % of GDP) of Greece, Portugal and Spain
Source: World Development Indicators and OECD Statistics

On the other hand, Lane and Pels (2012) find the strengthening link between optimistic growth forecasts and current account balances to be a significant factor for explaining the expansion of current account imbalances during 2002-2007. They observe that the optimistic growth forecasts were associated with high investment in construction rather than productive capital which might be the reason of lower than expected realized growth leading to higher current account deficits.

Jaumotte and Sodsriwiboon (2010) argue that current account deficits of Southern Euro area countries in 2008 were not sustainable since they were largely financed by debt instead of foreign direct investment and are invested in nonproductive sector such as construction. Moreover, Arghyrou and Chortareas (2008) also state that the historically high current account deficits of Greece, Portugal and Spain need a policy response as it may lead to excessive borrowing by these countries in the expectation of real income convergence, making the current account deficits unsustainable. However, current account deficit may also indicate the use of international financial market to fund domestic investment which results in higher output and spurs economic growth for the borrowing country (Holinski, Kool and Muysken, 2012). Thus, current account deficit need not be bad news even if it's higher than the historical record.

According to the neoclassical growth model, countries that expect higher income in future periods owing to their higher productivity will borrow and run deficit in the current period to finance investment and higher consumption. Furthermore, they will save less in anticipation of higher future income growth which is expected to repay foreign debt as well as sustain higher consumption levels. Consequently, current account balances will return to balance without the need for intervention. However, the level of current account deficit that can be considered optimal with respect to the theory of intertemporal utility maximization depends on the expected relative growth of the country (Engel & Rogers, 2006).

Engel & Rogers (2006) employ this framework to test the optimality of current account deficit of US using a two-country model. Under plausible assumptions, they derive a direct relationship between the current account deficit relative to the net GDP and the share of the country's net GDP in world's net GDP where "net GDP" is the Gross Domestic Product of a country net of investment and government spending. According to the Engel & Rogers (2006) framework, the current account deficit of a country will be optimal if its share in the world's net GDP is expected to grow in the future; implying that the net GDP of the country grows faster than the rest of the world. Abbasoglu, Imrohoroglu, & Kabukcuoglu (2017) have employed the same framework to test the optimality of the current account deficit of Turkey. They find the current account to net GDP of -6.99% in 2015 to be optimal if the share of Turkey in the world economy grows at rates similar to the past. Furthermore, Abbasoglu, Imrohoroglu, & Kabukcuoglu (2017) find that the current account deficit of Turkey cannot be explained by the optimizing behavior under the Engel and Rogers (2006) framework when it reached its peak value of 15% of net GDP in 2011.

I follow the methodology of Engel and Rogers (2006) to individually test whether the current account deficits of Greece, Portugal and Spain are a result of the optimizing behavior of consumers. I use a two-country general equilibrium model with a representative household for each country where the number of people per household may differ for both countries allowing for different population growth rates. The model implies that the current account of Greece will return to balance in the next 35 to 92 years as the share of Greece's net GDP in the world net GDP increases, by an annual growth rate of 0.35% to 0.76%, to reach its steady state value. The current account deficit of Greece in 2008 can be considered as consistent with the optimizing behavior of its consumers given the past average annual growth rate of 0.71%. Similarly, the net GDP share of Spain is expected to grow by 0.21% to 0.47% per year for the next 42 to 113 years to reach its steady state value of 14-15% of the world's net GDP. which is very close to the average annual growth rate of 0.43% realized by the GDP share of Spain in the past fourteen years. Thus, the current account deficit of Greece and Spain is found be optimal. On the contrary, I find that the current account deficit of Portugal, in 2008, is not optimal because the growth rate implied by the model cannot be justified in the light of past average annual growth of the net GDP share of Portugal.

Furthermore, I also consider the possibility of a sudden stop in the capital inflows for Greece. The capital inflows of Greece have been growing prior to the global financial crisis, as evident in the growing negative net foreign assets position of Greece (See Figure 10). For countries with high current account deficit, a sudden stop of capital inflows can be harmful for the economy as it may lead to the sudden and large reversal of current account deficit (Edwards, 2004), a large drop in output (Gourinchas, Philippon and Vayanos, 2017), decrease in growth (Hutchison, 2006) and a depreciation in the real exchange rate (Milesi-Ferretti and Razin, 2000). Further motivation for this section is being discussed in Part II. Following the approach of Guerrieri and Lorenzoni (2017) in a two-country general equilibrium model, I explore the short-term and long-term impact of a large reduction in the international capital inflows of Greece on aggregate consumption and wealth inequality of both countries. I find that a sudden stop in the international capital inflows of Greece - such that it improves the net foreign assets position of Greece by 50% - leads to a large drop in world interest rate, a sudden decrease of 4.5% in the aggregate consumption of Greece, and a sharp increase of about 4.33% in the consumption of the rest of the world on impact. After the shock is over, the world interest rate slowly approaches its new steady state that is below the level in the initial steady state. In the terminal steady state, the consumption of Greece increases by 1.06% while the aggregate consumption of the rest of the world decreases by 1.01% as compared to the level in the initial steady state. Furthermore, the wealth inequality of Greece, measured by the Gini index, decreases from 30.642 in the initial steady state to 0.3486 in the terminal steady state after the sudden stop in capital inflows of Greece.

The rest of the paper is structured as follows: This paper is divided into two parts. Part I tests whether the current account deficit of Greece, Portugal and Spain in 2008 is optimal based on the methodology in Engel and Rogers (2006). The first section of Part I describes the model along with the key assumptions while the second section describes the data. The third section presents the results of the model and analyses them in the light of data. Part II explores the transition path for Greece after a sudden stop of capital inflows in a two-country heterogeneous agent model using the approach in Guerrieri and Lorenzoni (2017). The introduction of Part II discusses the motivation behind sudden stop analysis for Greece. The first section of Part II describes the model, the second section discusses the details regarding calibration while the third and final section presents the results of the analysis. Finally, conclusion summarizes the results from both parts.

Part I

Engel and Rogers Analysis

Model

In early 2000s, South European countries like Spain, Greece and Portugal experienced significant increase in their current account deficits. In this paper, I aim to assess whether the rising deficit was consistent with the consumers' preferences and optimal choice. In other words, can the high current account deficit be explained by the maximization of lifetime utility of the country's residents?

Following Engel & Rogers (2006), I use a two-country general equilibrium model to test the optimality of current account deficit of South European countries including Spain, Greece and Portugal when it reached its peak, during 2007-08. In this section, I briefly summarize the "Shares" model from Engel & Rogers (2006) which forms the basis of our analysis.

Consider a two-country economy which consists of a representative household for each country where the number of individuals per household may vary for each country.[1]

The lifetime utility of the representative household from country $k \in \{h, f\}$ is given by

$$max_{\{C_t, B_{t+1}\}} \sum_{t=0}^{\infty} \beta^t N_t log(c_t^k)$$

whereas the household budget constraint is given by

[1]Engel & Rogers (2006) express their model in nominal terms where both countries have been assumed to have a common currency. I follow Abbasoglu, Imrohoroglu, & Kabukcuoglu (2017) and express our model in real terms by normalizing the prices. Nevertheless, our countries of interest are indeed a part of a currency union, called European Union. Thus, the assumption of a common currency in our two-country world is also valid.

$$B_{t+1}^k + C_t^k \leq B_t^k(1 + r_t) + Y_t^k$$

given the initial bond holding B_o^k. C_t^k is the total household consumption while c_t^k is the individual (i.e. per member) consumption such that $c_t^k = C_t^k/N_t^k$ where N_t^k represents the number of individuals in a household which may be different for both countries. Furthermore, $\beta\in(0,1)$ is the subjective discount factor, B_t^k represents the bonds held by the residents of country k at the beginning of period t, r_t is the world's real interest rate on bonds and Y_t^k is the country's total output net of investment and government spending.

In any given period, the household member chooses c_t^k, the level of consumption for current period and b_{t+1}^k, the level of bond holding for the next period. In case of borrowing, b_{t+1}^k will be negative. Thus, the problem for the individual is:

$$max_{c_t,b_{t+1}} \sum_{t=0}^{\infty} \beta^t log(c_t^k)$$

such that

$$b_{t+1}^k(1 + g_{t+1}^k) + c_t^k \leq b_t^k(1 + r_t) + y_t^k$$

where the small case letters represent per member value and $(1 + g_{t+1}^k) = N_{t+1}^k/N_t^k$ is the population growth rate which may vary for each country.

Let λ_t be the Lagrange multiplier for of period $t's$ budget constraint. Then, the first-order conditions of the individual problem (ignoring the superscript k) are:

$$\beta^t 1/c_t = \lambda_t \tag{1}$$

$$\lambda_t(1 + g_{t+1}) = \lambda_{t+1}(1 + r_{t+1}) \tag{2}$$

Combining the FOC's, I get the following intertemporal Euler Equation:

$$\frac{c_{t+1}}{c_t}(1 + g_{t+1}) = \frac{c_{t+1}N_{t+1}}{c_t N_t} = \frac{C_{t+1}}{C_t} = \beta(1 + r_{t+1}) \tag{3}$$

Moreover, the period-by-period budget constraint can be consolidated as follows:

$$C_t + \frac{C_{t+1}}{1+r_{t+1}} + \frac{C_{t+2}}{(1+r_{t+1})(1+r_{t+2})} + \cdots \leq B_0(1+r_t) + Y_t + \frac{Y_{t+1}}{1+r_{t+1}} + \frac{Y_{t+2}}{(1+r_{t+1})(1+r_{t+2})} + \cdots \quad (4)$$

Lastly, the following market clearing conditions must hold in equilibrium.

$$C_t^h + C_t^f = Y_t^h + Y_t^f = Y_t^w \quad (5)$$

$$B_t^h + B_t^f = 0 \quad (6)$$

The first condition states that the goods consumed by both countries should equal the total output produced by both countries which equals the total world output (Y_t^w) in any period t. Moreover, the second condition states that the borrowings by both countries in any period t should cancel each other keeping the total world borrowing at zero.

Substituting the Euler equation (3) for both countries h and f in the goods market clearing condition (5), I get the following result:

$$1 + r_t = \frac{Y_t^w}{\beta Y_{t-1}^w} \quad (7)$$

Furthermore, recursively substituting the intertemporal Euler Equation yields the following:

$$C_{t+j} = C_t \beta^j (1+r_{t+1})(1+r_{t+2}) \ldots (1+r_{t+j}) = C_t \beta^j \prod_{s=1}^{j} (1+r_{t+s}) \quad (8)$$

Substituting (7) and (8) in the consolidated budget constraint (4), I get

$$\frac{C_t^k}{1-\beta} = B_t^k(1+r_t) + Y_t^w \left(\frac{Y_t^k}{Y_t^w} + \beta \frac{Y_{t+1}^k}{Y_{t+1}^w} + \beta^2 \frac{Y_{t+2}^k}{Y_{t+2}^w} + \cdots \right)$$

$$= B_t^k(1+r_t) + Y_t^w (\delta_t^k + \beta \delta_{t+1}^k + \beta^2 \delta_{t+2}^k + \cdots)$$

$$= B_t^k(1+r_t) + \frac{Y_t^k}{\delta_t^k} (\delta_t^k + \beta \delta_{t+1}^k + \beta^2 \delta_{t+2}^k + \cdots)$$

where $\delta_t^k = \frac{Y_t^k}{Y_t^w}$ represents country k's output as a percentage of the world's total output in period t. Essentially, δ_t^k represents the "share" of country k in the world net output (GDP) at time t, which is the crucial element of the shares model in Engel & Rogers (2006).

Let $\rho_t^k = (1-\beta)(\delta_t^k + \beta\delta_{t+1}^k + \beta^2\delta_{t+2}^k + \cdots)$ be the present value of the current and future share of country k in the world net GDP. Then, I get

$$C_t^k = (1-\beta)(1+r_t)B_t^k + Y_t^k \frac{\rho_t^k}{\delta_t} \tag{9}$$

The term $\frac{\rho_t^k}{\delta_t^k}$ represents present value of the current and future share of country k in the world net GDP relative to its current share.

By definition, current account (CA) is the sum of a country's net exports (NX) and interest payments on its foreign debt. Thus,

$$CA_t^k = NX_t^k + r_t B_t^k \tag{10}$$

Following Engel & Rogers (2006), I approximate the current account as follows:

$$CA_t^k = NX_t^k + (1-\beta)(1+r_t)B_t^k \tag{11}$$

$$CA_t^k = NX_t^k + r_t B_t^k + (1 - \frac{Y_t^w}{Y_{t-1}^w})B_t^k \tag{12}$$

The last term is the error term in our approximation to the current account balance which is zero if the world net GDP stays constant. As national income is the sum of the country's consumption and net exports, (11) becomes

$$CA_t^k = Y_t^k - C_t^k + (1-\beta)(1+r_t)B_t^k$$

Substituting C_t^k from (9),

$$CA_t^k = Y_t^k - (1-\beta)(1+r_t)B_t^k - Y_t^i \frac{\rho_t^k}{\delta_t^k} + (1-\beta)(1+r_t)B_t^k$$

$$CA_t^k = Y_t^k (1 - \frac{\rho_t^k}{\delta_t^k}) \tag{13}$$

Rearranging

$$\pi_t^k = 1 - \frac{\rho_t^k}{\delta_t^k} \tag{14}$$

where $\pi_t^k = \frac{CA_t^k}{Y_t^k}$ is the ratio of country k's current account to its net GDP which is one of the key variables of interest in our analysis.

Furthermore, Engel & Rogers (2006) consider a simple auto-regressive model for the share of country k in world's net GDP (δ_t^k).

$$\delta_{t+j}^k = \alpha^j \delta_t^k + (1 - \alpha^j)\bar{\delta^k} \tag{15}$$

where $\bar{\delta^k}$ is the steady state share of country k in world's net GDP. The present value of current and future shares (ρ_t^k) then equals to:

$$\rho_t^k = \frac{1-\beta}{1-\alpha\beta}\delta_t^k + \frac{\beta(1-\alpha)}{1-\alpha\beta}\bar{\delta^k} \tag{16}$$

Substituting the above result into (14), I get the following expression:

$$\frac{\bar{\delta}^k}{\delta_t^k} = 1 - \frac{1-\alpha\beta}{\beta(1-\alpha)}\pi_t^k \tag{17}$$

Equation (17) presents the key equation of analysis in our model based on Engel & Rogers (2006) approximation of the current account balance. The left hand side of the identity in (17) is the ratio of the steady state share of country k in the world net GDP to the current GDP share of country k, which is the gross growth achieved by δ_t^k to reach its steady state value. Thus, the result in (17) implies that the growth needed to achieve the steady state GDP share is a linear function of today's current account to net GDP ratio of country k. If I plug the current account to net GDP ratio into (17), I get the growth rate that is needed to reach the country's steady state GDP share. If the current account deficit of country k is optimal, then it will return to balance when the economy reaches the steady state. In other words, the implied growth rate should be realistic enough to show convergence to the steady state in order to establish that the current account deficit of the country is optimal. I use this result in the next section to test the optimality of the current account deficit of Greece, Portugal and Spain in 2008.

Data

In our two-country general equilibrium model, the world is composed of fifteen Euro-zone countries, as used by Mendoza, Tesar, & Zhang (2014), enlisted in Table 1 below. For the sake of simplicity, I refer to this group of fifteen countries as EU-15 throughout the paper. The home country (h) represents the country of interest – i.e. one of Greece, Portugal or Spain- and the foreign country (f) includes all the other fourteen

Euro-zone countries collectively.

Country	Year of Accession in EU	Year of Adopting Euro
Austria	1995	1999
Belgium	1958	1999
Estonia	2004	2011
Finland	1995	1999
France	1958	1999
Germany	1958	1999
Greece	1981	2001
Ireland	1973	1999
Italy	1958	1999
Luxembourg	1958	1999
Netherlands	1958	1999
Portugal	1986	1999
Slovak Republic	2004	2009
Slovenia	2004	2007
Spain	1986	1999

Table 1: List of Countries in the World
Source: European Union

The bilateral trade data among the EU 15 countries has been retrieved from the UN Comtrade database. Figure 2 depicts the trade volume of Greece, Portugal and Spain with EU-15 countries relative to the total trade volume with the world. On average, EU-15 makes up 66% of the total trade volume of Portugal which implies that the fourteen Euro area countries can be easily classified as the major trade partner of Portugal over the period of analysis. Moreover, the EU-15 countries constitute 54.32% of Spain's total trade volume while 50.1% of Greece's total trade volume (expressed as average of year 1995 and 2008). Particularly, the trade of Greece with EU-15 relative to the world has significantly declined from 58.48% in 1995 to 41.73% in 2008. Nevertheless, EU-15 is the major trade partner of Spain and Greece as other European Union countries form the second largest trade partner of Greece and Spain constituting 14.4% of Greece's total trade volume while 10.3% of Spain's total trade volume collectively. Appendix A presents the top ten trade partners of Greece, Portugal and Spain. Furthermore, Holinski, Kool and Muysken (2012) treat euro area as a closed economy to analyze the current account imbalances of euro area countries between 1992 and 2007 because the current account of euro area had remained roughly balanced even though the current account balances of individual countries had diverged during this period. Therefore, I also consider Euro area as a closed economy and confine our analysis to the fifteen Euro area countries as listed in Table 1 above.

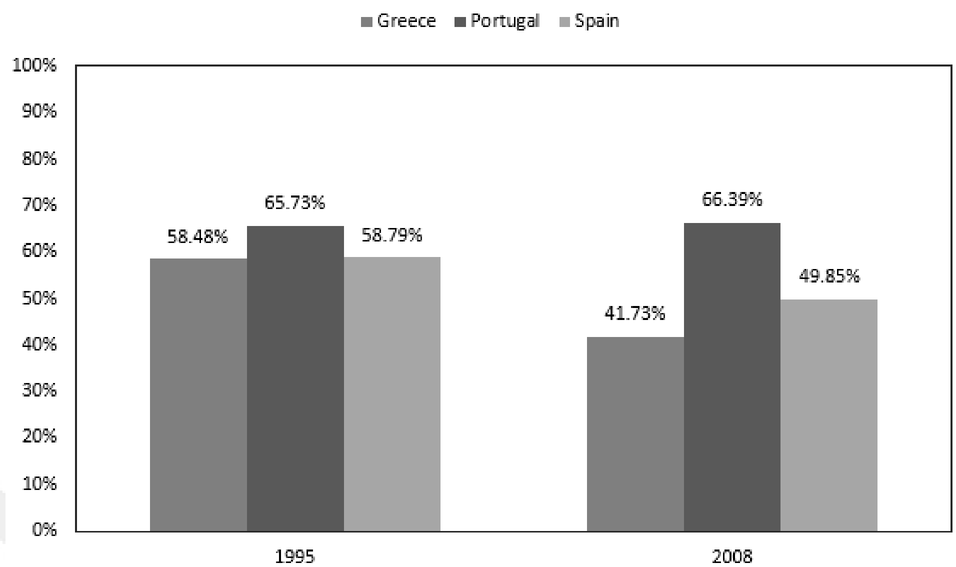
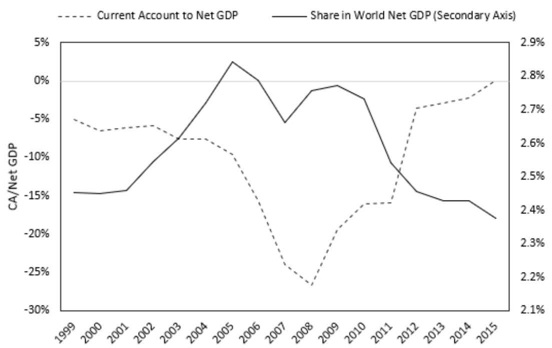


Figure 2: Trade with EU15 relative to the World
Source: UN Comtrade Database

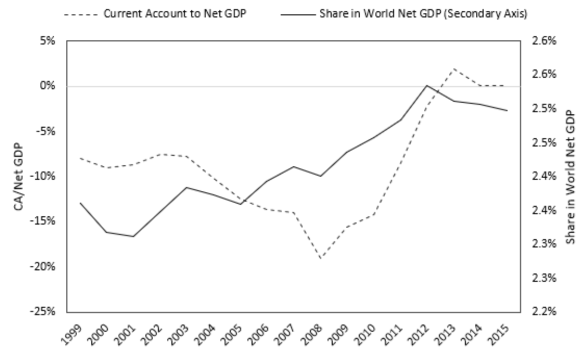
The series for current account balance has been retrieved from the World Bank Database. Furthermore, output of a country measured by the Gross Domestic Product (GDP) is another important variable in our analysis. Since investments and government spending have not been modeled explicitly, I use GDP net of government spending and investments as an empirical counterpart of Y_t^k (Abbasoglu, Imrohoroglu, & Kabukcuoglu, 2017). Net GDP has been calculated by using the share of government spending and investments in GDP from World Development Indicators reported by the World Bank and the annual GDP series measured in PPP constant 2010 international dollars extracted from the OECD Statistics. Moreover, GDP share of a country has been calculated by taking the ratio of that country's Net GDP to the total Net GDP of the fifteen countries in our world.

Results and Analysis

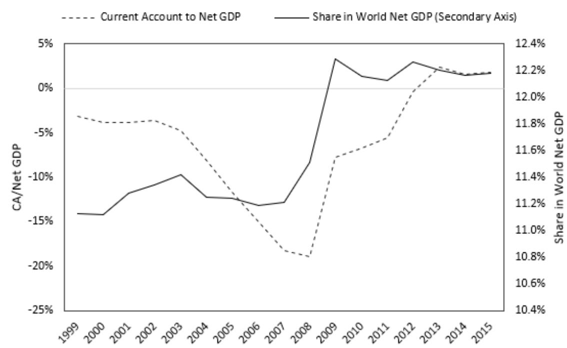
Consistent with our model, Figure 3 illustrates the evolution of current account balance of Greece, Portugal and Spain as a percentage of Net GDP, that is GDP net of Investment and Government Spending. The current account deficit relative to net GDP of all three countries has fallen sharply from 1995 to 2008. The current account to net GDP ratio of Greece in 2008 is 13 times smaller than that in 1995. Moreover, the current account deficit relative to the net GDP of Spain in 2008 is 57 times that of 1995. Furthermore, the current account to net GDP ratio of Portugal fell 188 times from 1995 to 2008. In this section, I test the optimality of the current account deficit of Greece, Portugal and Spain, in the year 2008, using the Engel & Rogers (2006) approach and present the results for each country respectively.



(a) Greece



(b) Portugal



(c) Spain

Figure 3: GDP Share and CA/Net GDP
Source: World Development Indicators and OECD Statistics

Calibration

The intertemporal subjective discount factor of utility from consumption (β) has been assumed as 0.98 which is suitable for Euro area with a one-year bond yield of roughly 2.54% in 2008. The yield from 1 year AAA rated Euro area central government bond dropped in 2008 from 3.6% in first quarter to 2.54% in the fourth quarter. Furthermore, it reached 1.18% in the beginning of 2009. This implies that β ranges from 0.96 to 0.99 for Euro area countries. Therefore, as a test for robustness, I present the results with a lower β equal to 0.96 and a higher beta equal to 0.99 along with the base case of 0.98.

Furthermore, the parameter (α) corresponds to the evolution of the share of a country's net GDP in the world's net GDP (15). Using a simple approximation of (15) by simple linear regression, I obtained an estimate of α ranging from 0.88 for Greece to 0.95 for Portugal. Therefore, the rate of convergence (α) has been assumed as 0.90 in the base case while the sensitivity of alpha has been explored by testing the model for a faster convergence rate of 0.85 and and a slower convergence rate of 0.95. I present the results of all three values of α in the main text while the sensitivity of β has been presented in Appendix B.

Greece

The current account deficit relative to net GDP of Greece had increased from -2.96% in 1990 to -26.68% in 2008. At the same time, the share of Greece in the world net GDP has first grown from 2.53% in 1995 to 2.84% in 2005, and then decreased to 2.76% in 2008 (See figure 3a). In total, the GDP share of Greece has grown by 8.98% over the past 14 years with an average growth rate of 0.71% per year. In this section, I have applied the Engel & Rogers (2006) framework to see whether the current account deficit of Greece in 2008 can be considered as optimal.

Table 2 presents the results of the model as well as the relevant facts from data. With a current account deficit of -26.68% and GDP Share of 2.76% in 2008, the model predicts that the steady state GDP share of Greece is 3.64% of the world's net GDP which is 32.12% higher than its current level. With the rate of convergence of 0.90, this implies that the GDP share of Spain will reach its steady state value in 51 years with an annual growth of 0.55% per year. If the rate of convergence is faster, i.e. 0.85, the share of Greece's net GDP in the world's net GDP would grow by 0.76% per year to reach its steady state value of 3.59% in about 35 years. Similarly, if the rate of convergence is slower than the base case, i.e. 0.95, the share of Greece in the world net GDP would grow by 0.35% per year to reach its steady state value of 3.79% in almost 92 years.

	$\alpha = 0.85$	$\alpha = 0.90$	$\alpha = 0.95$
Current Account Balance (current million USD)		-51,312.80	
Net GDP (Constant 2010 PPP International Dollars)		192,323.04	
CA / Net GDP		-26.68%	
Alpha	0.85	0.90	0.95
Beta		0.98	
Current GDP Share		2.76%	
Steady State Share	3.59%	3.64%	3.79%
Net Implied Share Growth	30.31%	32.13%	37.57%
Years to convergence	35	51	92
Annual Implied Share Growth	0.76%	0.55%	0.35%
Average Annual Share Growth from 1995 to 2008		0.71%	

Table 2: Results for Greece in 2008

Figure 4 illustrates the path followed by the GDP share of Greece as implied by the model. The share of Greece in the world's net GDP grows in the first 35 to 92 years and becomes constant as it achieves its steady state value. As it can be seen, the growth of the GDP share becomes less steep as the rate of convergence increases. Furthermore, Figure 5 presents the path followed by the current account of Greece as a percentage of net GDP after 2008, implied by the model, for the three different rates of convergence.

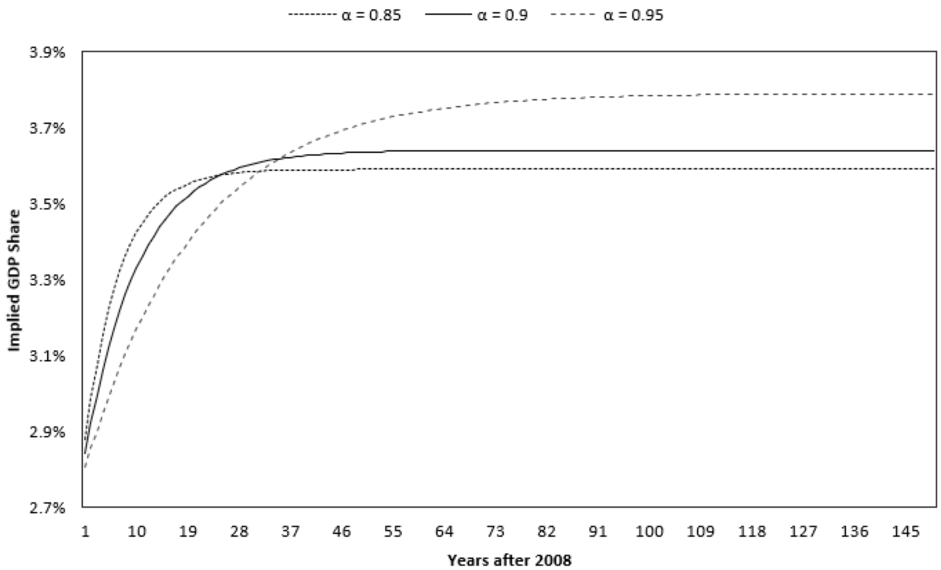


Figure 4: Implied GDP Share of Greece after 2008

In other words, the model implies that the current account of Greece will return to balance in the next 35 to 92 years as the share of Greece's net GDP in the world net GDP increases, by an annual growth rate of 0.35% to 0.76%, to reach its steady state value. The implied GDP share growth for Greece seems plausible given that the net GDP of Greece relative to the world net GDP grew by 0.71% per year on average in the past 14 years. Following Engel & Rogers (2006), if the economy continues to perform as it did in the past, an annual growth rate below 0.71% can be deemed as plausible. However, the faster convergence rate of 0.85 implies that the GDP Share of Greece would grow by 0.76% per year, for another 35 years, which is higher than the realized annual growth rate. Interestingly, if I assume that the GDP share of Greece grows at the same rate as before, i.e. 0.71% per year on average, it will reach its steady state value in 38 years instead of 35 years. In short, I conclude that GDP share of Greece can be reasonably expected to grow at an annual rate between 0.35% and 0.76% based on its past trend, therefore, the current account deficit of Greece in 2008 can be considered as consistent with the optimizing behavior of its consumers.

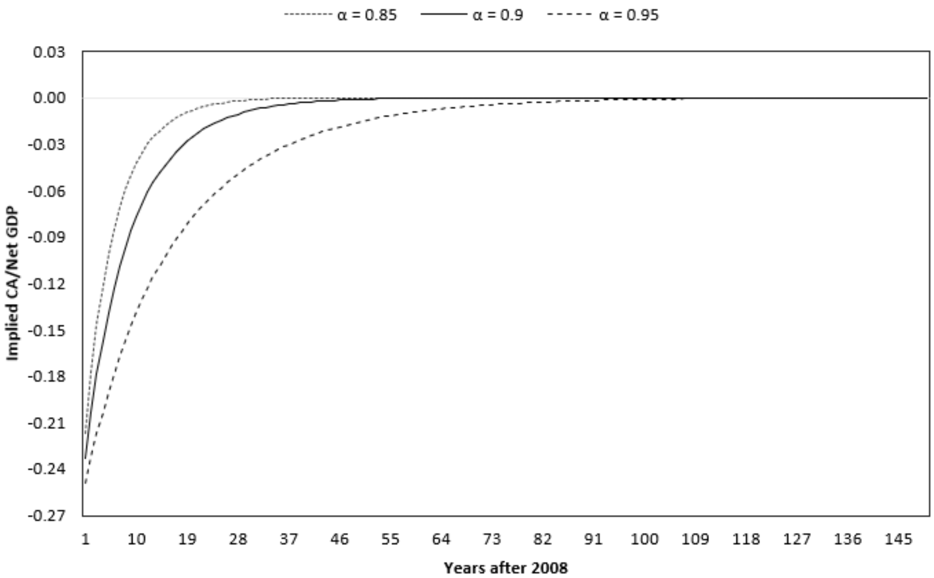


Figure 5: Implied CA to Net GDP of Greece

Portugal

The current account of Portugal was nearly balanced between 1990 and 1995 after which it started declining rapidly. The current account deficit relative to net GDP of Portugal sharply increased by 188 times from -0.10% in 1995 to -19.07% in 2008. The case of Portugal seems the most concerning among the three countries under analysis as the percentage increase in current account deficit relative to net GDP is the largest.

Table 3 presents the results of the Engel & Rogers analysis for Portugal in 2008. If the GDP share of Portugal grows with the rate of convergence of 0.90, the model implies that the GDP share of Portugal would grow by 22.96% if the current account deficit of 19.07% is optimal. This implies that the GDP share of Portugal will reach its steady state value of 2.95% in 46 years with an annual growth rate of 0.45%. Furthermore, with faster convergence rate, i.e. $\alpha = 0.85$, the economy would converge to the steady state in 33 years with an annual growth rate of 0.60%. Similarly, with a slower convergence rate, i.e.$\alpha = 0.95$, the GDP share of Portugal will converge to its steady state value of 2.92% in 83 years by growing at an annual rate of 0.29%.

	$\alpha = 0.85$	$\alpha = 0.90$	$\alpha = 0.95$
Current Account Balance (current million USD)		-31,948.59	
Net GDP (Constant 2010 PPP International Dollars)		167,545.95	
CA / Net GDP		-19.07%	
Alpha	0.85	0.90	0.95
Beta		0.98	
Current GDP Share		2.40%	
Steady State Share	2.92%	2.95%	3.04%
Net Implied Share Growth	21.66%	22.96%	26.85%
Years to convergence	33	46	83
Annual Implied Share Growth	0.60%	0.45%	0.29%
Average Annual Share Growth from 1995 to 2008		0.01%	
Average Annual Share Growth for past 10 years		0.28%	

Table 3: Results for Portugal in 2008

Figure 6 illustrates the model implied path followed by the GDP share of Portugal under the three different values of the convergence rate. Moreover, Figure 7 demonstrates the implied path followed by the current account balance as a percentage of net GDP. The figures show that the current account of Portugal returns to balance in 33 to 83 years as the GDP share approaches its steady state value.

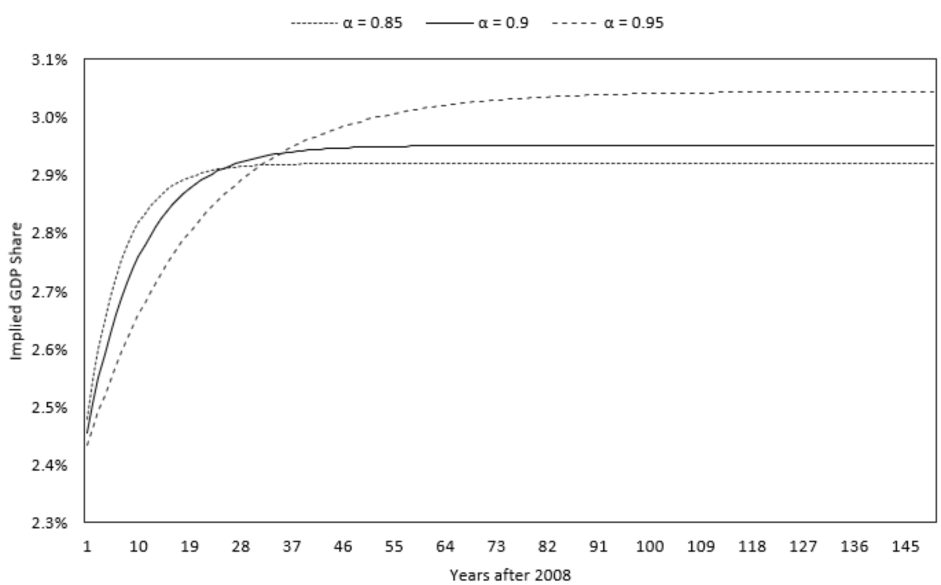


Figure 6: Implied GDP Share of Portugal after 2008

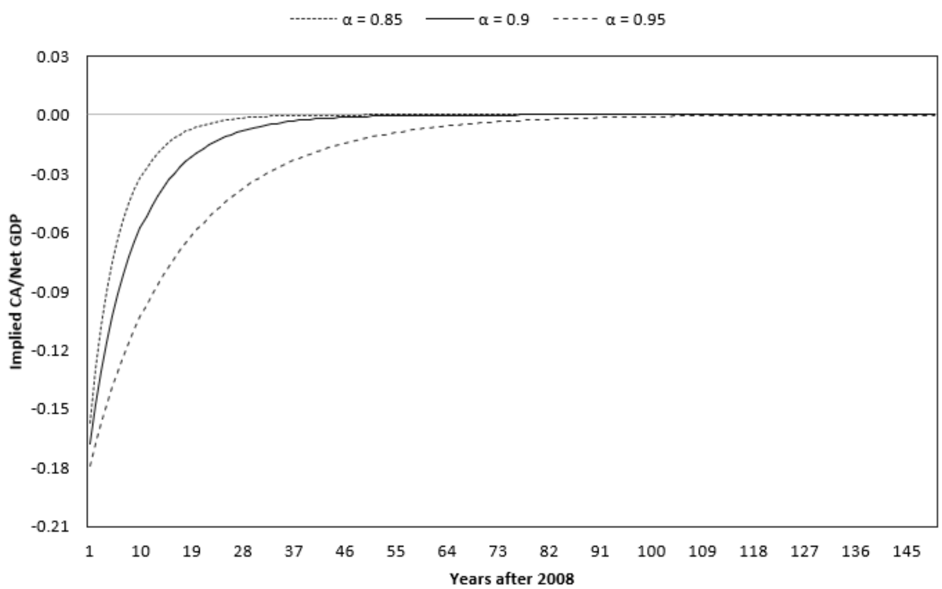


Figure 7: Implied CA to Net GDP of Portugal

The actual share of Portugal's net GDP in the world's net GDP has been following a zigzag pattern over the period of analysis, attaining an average increase of merely 0.01% (See Figure 3b). The highest annual growth rate experienced by the GDP share of Portugal is 1.57% in the year 2003 while the lowest is -2.45% experienced in the year 1997. The model implied annual growth rates of 0.28%, 0.45% and 0.60% with the three different rates of convergence are much higher than the realized average growth rate of 0.01% per year in the past fourteen years, by the GDP share of Portugal. Clearly, the model implied growth rates are overoptimistic for Portugal. Even if I look at the recent ten years, the GDP share of Portugal grew by 0.28% per year on average which is too low as compared to the implied growth rates of 0.45% and 0.60% in the cases with $\alpha = 0.90$ and $\alpha = 0.85$ respectively. However, even though the past growth rate is also higher than 0.29%, the growth rate implied by the model under the slow adjustment scenario (i.e. $\alpha = 0.95$), it is very close.

In short, overall the model implied growth rates cannot be supported by the past movements in the GDP share of Portugal in either of the cases implying that the current account deficit of Portugal cannot be considered optimal. However, looking at the growth over the recent ten years, the current account deficit of Portugal, as a percentage of net GDP - can be considered optimal when the adjustment rate is 0.95 or above. Nevertheless, since the model implied growth rates are for extended period of time in the future, it is more appropriate to consider the longest available time series from the past to reflect long term potential growth in the future. Thus, I conclude that the current account deficit of Portugal as a percentage of net GDP is not consistent with the intertemporal utility maximization theory as the expectation of rise in the net GDP share of Portugal cannot be validated by the data.

Spain

The current account deficit of Spain reached -18.98% in 2008 which is 57 times that in 1995 as a percentage of net GDP. While a 57x increase is an alarming one, it corresponds to the low deficit of merely 0.33% in 1995 to an extent. In other words, it is important to note that the current account balance of Spain worsened drastically - from a nearly balanced position - during the fourteen year period particularly after 1999, which is also the year of introduction of the common currency, Euro. In this section, I test whether the large negative current account to net GDP ratio of Spain, in 2008, is optimal according to the theory of inter-temporal utility maximization under Engel & Rogers (2006) framework. The results of the model have been presented in Table 4.

	$\alpha = 0.85$	$\alpha = 0.90$	$\alpha = 0.95$
Current Account Balance (current million USD)		-152,545.92	
Net GDP (Constant 2010 PPP International Dollars)		803,525.18	
CA / Net GDP		-18.98%	
Alpha	0.85	0.90	0.95
Beta		0.98	
Current GDP Share		11.51%	
Steady State Share	13.99%	14.14%	14.59%
Net Implied Share Growth	21.57%	22.86%	26.73%
Years to convergence	42	61	113
Annual Implied Share Growth	0.47%	0.34%	0.21%
Average Annual Share Growth from 1995 to 2008		0.43%	

Table 4: Results for Spain in 2008

If current account deficit of Spain in 2008 is optimal, the model implies that the current net GDP share of Spain would grow by 22.86% to converge to its steady state value of 14.14% in 61 years. This implies an average annual growth rate of 0.34% for the next 61 years after 2008, given the rate of convergence of 0.90. For a slower convergence rate equal to 0.95, the GDP share of Spain would need to grow by 0.21% per year for the next 113 years to reach the steady state value of 14.59%. This implies a total increase of 26.73% over the next 113 years. Moreover, if the rate of convergence is faster, i.e. 0.85, the GDP share of Spain would grow by 21.57% which will be achieved by an annual growth of 0.47% on average for the next 42 years. The current account will return to balance when the GDP share reaches its steady state value of 13.99%. Figure 8 illustrates the evolution of the net GDP share of Spain after the year 2008. It shows that the GDP share becomes reaches its steady state value and becomes constant after 42 to 113 years.

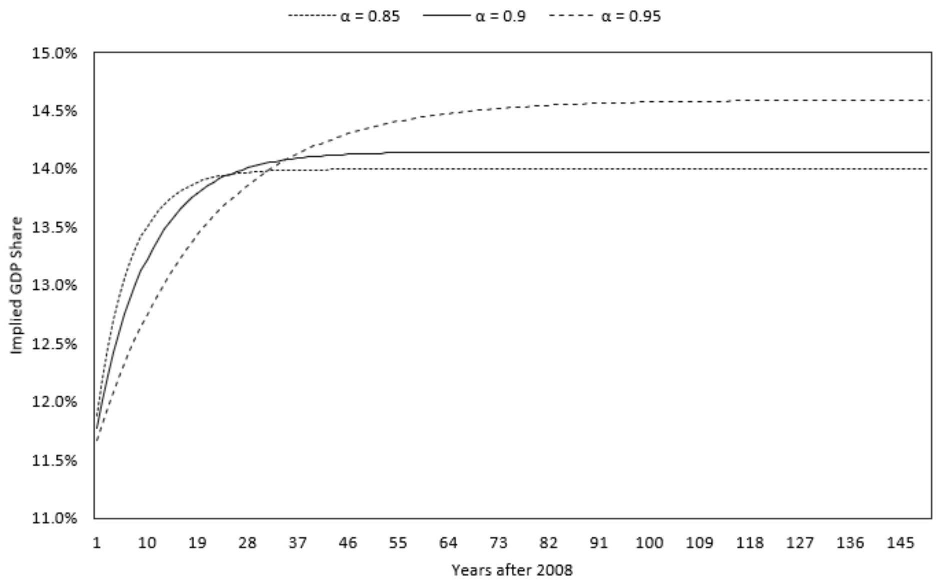


Figure 8: Implied GDP Share of Spain after 2008

Figure 9 illustrates the evolution of current account to net GDP ratio of Spain after the year of analysis implied by the model. It shows that the current account returns to balance as the economy reaches the steady state in 42 to 113 years.

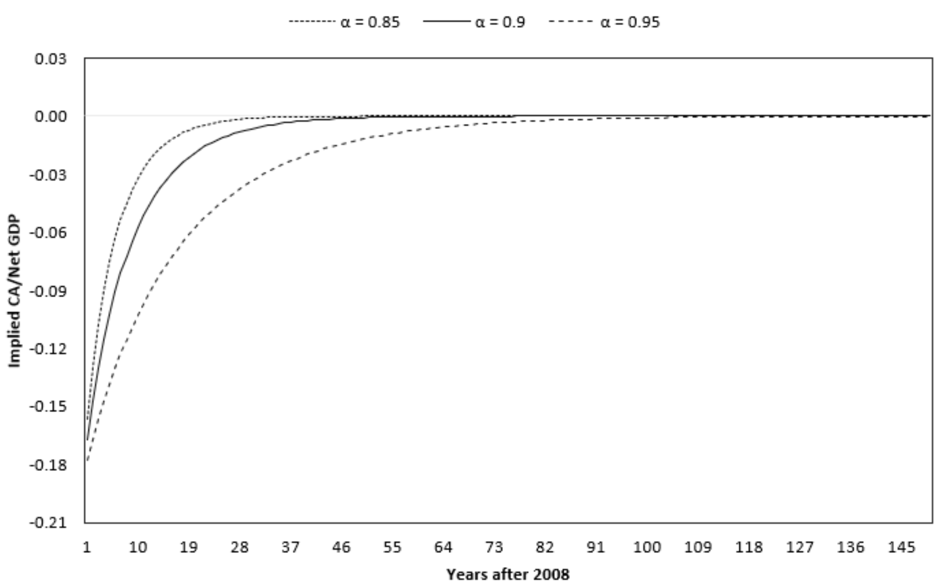


Figure 9: Implied CA to Net GDP of Spain

Depending on the convergence rate, the expected growth implied by the model is 0.21% to 0.47% per year which is very close to the average annual growth rate of 0.43% realized by the GDP share of Spain in the past fourteen years. With the rate of convergence higher than 0.87, the implied annual growth rate for the GDP share is lower than the realized annual growth rate. This implies that the current account deficit of Spain can be easily considered optimal under the convergence rate of 0.9 and 0.95 if the economy grows at a rate similar to the past. Moreover, while 0.47% is higher than the past growth of 0.43%, the net GDP of Spain grew by 2.65% in the year 2008 and showing the potential for an even higher performance than the past in some high performing years. Furthermore, if the GDP share grows by 0.43% annually for the next 45 years instead of the model implied 42 years with annual growth of 0.47%, the current account deficit of Spain relative to the net GDP can be considered optimal even with the faster convergence rate of 0.85. In short, the model suggests that the current account deficit of Spain in 2008 can be considered as optimal according the intertemporal utility maximization by the residents of Spain because they expect the net GDP of Spain to grow faster than the world's net GDP. In other words, they expect the net GDP share of Spain in the world to increase in the long run and reach a higher steady state value of 14-15% the world's net GDP.

Part II

Sudden Stop Analysis

The growing current account deficits of Southern European countries have gained a lot of attention in the literature to see whether large deficits are a sign of danger for the stability of the country. However, current account alone does not provide a complete picture of national financial stability; another important factor is capital flow of funds in the international financial market. The Southern European countries, including Greece, received significant capital inflows from 2002 to early global financial crisis (Merler and Pisani-Ferry, 2012). Figure 10 illustrates the net foreign asset of Greece and other European countries as percentage of net GDP. The growing negative net foreign asset position of Greece indicates the significant capital inflows before 2007. After the year 2009, Greece experienced major capital outflows which resulted in significant reversal of the current account. Merler and Pisani-Ferry (2012) identify the capital outflows of Greece during and after the global financial crisis as a sudden stop according to the methodology intoduced by Calvo, Izquierdo and Mejia (2004).

The current account deficit resulting from an increase in investment or a decrease in savings is not seen to be of concern as it reflects opportunities for new investment (Corden, 1994, p. 92). On the contrary, current account deficit that is financed by portfolio investment is seen as sign of major concern by Fischer in his “Comments on Dornbusch and Werner” (1994, as cited in Edwards, 2004) due to the transitory nature of the portfolio investment. According to Fischer, the portfolio investments can turn rather quickly, leaving the country with large and abrupt current account adjustments (Edwards, 2004). Empirically, sudden stops of international capital inflow have found to be associated with current account reversals, preceding the current account reversals most of the time Edwards (2004). Guidotti, Sturzenegger, Villar, Gregorio and Goldfajn (2004) analysed the size of reduction in capital flow and the size of current account adjustment. They observe that the current account adjustment following the sudden stop episode is fast and relative to the size of the stop of capital flow (Guidotti, et al., 2004). When sudden stop is followed by the current account reversal, current account adjusts upto 10% of GDP on average for a sudden stop of capital inflows of about 13% of GDP on average (Guidotti, et al., 2004). The current account reversal is found to occur in the first year after the sudden stop, with no further adjustment in subsequent years (Guidotti, et al., 2004).

Moreover, Guidotti, et al. (2004) find that the output growth decreases in the second year by almost 1% on average. Interestingly, the decrease in growth in high-income countries is three times larger than the decrease in growth in low income countries (Guidotti, et al., 2004). Edwards (2004) also finds significant negative effects of the current account reversals, accompanied by a sudden stop of capital inflows, on real growth of the economy. Moreover, according to the definition in Gourinchas, Philippon and Vayanos (2017), the sudden stop of capital inflows is also accompanied with a large drop in domestic output. According to Calvo (2001) (as cited in Guidotti, et al., 2004), the reversal of current account deficit following a reduction in capital inflows harms the economy by forcing it to reduce aggregate demand, resulting in a fall in output as well as employment. However, Gourinchas, Philippon and Vayanos (2017) find that after the sudden and large drop, output recovers to its initial level in t+2nd period and it continues to expand. Hutchison (2006) also find that a large negative impact of sudden stop on output growth of the country is short-lived. Nevertheless, they find the reduction in output growth due to sudden stop of capital inflows is much larger as compared to the reduction in growth due to the currency crisis (Hutchison, 2006). While the output growth falls by 2-3% due to currency crisis, sudden stop of capital inflows causes reduction of another 6-8% in the output growth of the country (Hutchison, 2006).

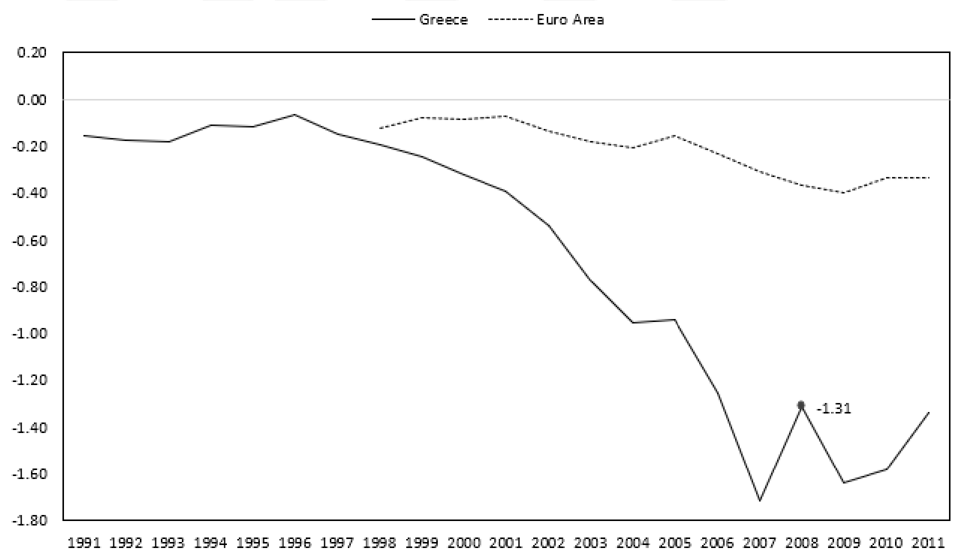


Figure 10: Net Foreign Assets to Net GDP Ratio
Source: Lane and Milesi-Ferretti (2007) and World Development Indicators

In this section, I follow the approach of Guerrieri and Lorenzoni (2017) and extend their model to a two-country open economy model to see the impact of a sudden tightening of the credit constraint of Greece - mimicking a sudden and large reduction in international capital inflows - on the aggregate consumption and wealth inequality of both countries. The two-country world, composed of Greece and other Euro area countries, is in initial steady state where the net foreign assets of Greece amount to -131.31% of net GDP as observed in the data. In period $t + 1$, the borrowing limit faced by the households of Greece increases such that the net foreign assets as a percentage of net GDP of the country increase by 50% of the initial level. Then, I find the transition path from the initial steady state to the new steady state to observe the short-run and long-run impact of the sudden stop of capital inflows in the international financial market faced by Greece. The first subsection elaborates on the model followed by the calibration of necessary parameters. The third subsection discusses the results from the model.

Model

Consider a two-country heterogeneous agent incomplete markets model, similar to the Bewley (1986) and Huggett (1993) frameworks, where households are subject to idiosyncratic shocks to their income and face borrowing constraints. The lifetime utility of a household i in country $k \in \{h, f\}$ is given by:

$$\underset{\{c_{it}^k\},\{b_{it+1}^k\}}{max} E\left[\sum_{t=0}^{\infty} \beta^t \frac{c_{it}^k}{1-\gamma}^{1-\gamma}\right]$$

where β is the subjective discount factor, γ is the coefficient of relative risk aversion and c_{it}^k is the consumption of household i in country k at time t. The household budget constraint is described as follows:

$$b_{it+1}^k + c_{it}^k \leq b_{it}^k (1 + r_t) + y_{it}^k \qquad \forall t = 1, 2, ... \tag{18}$$

where b_{it}^k denotes the bond holding of household i from country k at time t and r_t is the world interest rate at time t. Moreover, y_{it}^k denotes income of household i from country k which follows a Markov chain on the space $\left\{y_1^k, ..., y_S^k\right\}$.[2] The idiosyncratic shock to household income y_{it}^k induces heterogeneity in the model at household level. In addition, households face a credit constraint where the maximum debt of a household in country k must not exceedϕ_t^k in any time period t.

$$b_{it+1}^k \geq -\phi_t^k \qquad \forall t = 1, 2, ... \tag{19}$$

The first order conditions of the household problem yield the following Euler equation for consumption:

$$\left(c_{it}^k\right)^{-\gamma} = \beta\, E\left[(1 + r_{t+1}) \left(c_{it+1}^k\right)^{-\gamma}\right] \tag{20}$$

The aggregate consumption of all households in both countries must equate the aggregate income of both countries, in each time period t.

[2]This is similar to the idiosyncratic shock to labor productivity in Guerrieri and Lorenzoni (2017).

$$\sum_{k=1}^{2}\int_i c_{it}^k = \sum_{k=1}^{2}\int_i y_{it}^k \qquad \forall t = 1, 2, ... \tag{21}$$

$\int_i b_{it+1}^k$ represents the net foreign assets of country k. For asset markets to clear, the total net foreign asset holding of both countries should sum to zero. The asset market clearing condition is stated in (22).

$$\sum_{k=1}^{2}\int_i b_{it+1}^k = 0 \qquad \forall t = 1, 2, ... \tag{22}$$

Equilibrium in this economy is characterized by the interemporal Euler equation (20), the household budget constraint (18) together with the goods and asset market clearing conditions in (21) and (22) respectively.

Calibration

Following Guerrieri and Lorenzoni (2017) approach, I first find the steady state of the economy, named as initial steady state, with the parameters calibrated for the year 2008. Then, I tighten the credit constraint and find a new steady state of the economy and name it as the terminal steady state. Then, I find the transition path from the initial steady state to the terminal one by extending the approach taken by Guerrieri and Lorenzoni (2017) to a two-country economy. The world in this model consists of two countries h and f denoting home and foreign country. Home country is calibrated to Greece whereas foreign country is composed of the remaining fourteen countries in Table 1. I denote the foreign country in the model as Euro Area (EA).

The value of subjective discount factor β is same as the one calibrated in the first section. Therefore, the value of β is 0.98 corresponding to the interest rate of one-year Euro Area bond yield of 2.54% in 2008. Table 1 presents the calibrated value of the parameters. The coefficient of relative risk aversion γ is set at 4 (Guerrieri and Lorenzoni, 2017).

Furthermore, each country is inhabited by heterogeneous agents who differ in their productivity levels. Since labor decision is not included in the model, it is assumed that households earn wages according to their productivity level where wages stay constant throughout the analysis. Following Guerrieri and Lorenzoni (2017), I assume that household productivity follows an AR(1) process in logs with an auto-correlation ρ and variance σ_ϵ^2. The continuous AR(1) wage process of Greece and Euro Area is estimated by a discrete Markov chain by following the methodology in Tauchen (1986). The persistence and variance of the productivity shock have been chosen to match the first-order auto-correlation and standard deviation of the annual net GDP series of Greece and Euro Area respectively where net GDP is constructed from the PPP constant annual GDP series (retrieved from World Development Indicators) as described in the previous section. [3]Net GDP, i.e. GDP net of investment and government spending has been calculated using the WDI series as described in the previous section. The variance of the innovation is calculated by the following formula: $\sigma_\epsilon^2 = \sigma_y^2 \left(1 - \rho_y^2\right)$ where σ_y^2 is the variance and ρ_y is the first-order auto-correlation of the net GDP series. The persistence parameter ρ for the wage process of Greece and Euro Area is estimated as 0.9128 and 0.9361 respectively. Moreover, the variance of the shock σ_ϵ^2 in the wage process is estimated as 0.0087 and 0.0425 respectively for Greece and Euro Area. Using these parameters, I apply the approach in Tauchen (1986) to estimate a 5-state Markov chain to approximate the income process for Greece and Euro Area.

Parameter		Value		Source
		Greece	Euro Area	
Stochastic Discount Factor (β)		0.98		1-year Euro Area bond yield in 2008 equals 2.54%
Coefficient of Relative Risk Aversion (γ)		4		Following Guerrieri and Lorenzoni (2017)
Persistence of productivity shock (ρ)		0.9128	0.9342	Following Durdu, Mendoza and Terrones (2009)
Variance of productivity shock (σ_ϵ^2)		0.0087	0.0425	
Net Foreign Assets to Net GDP		-1.3131	-0.3661	Net Foreign Assets taken from Lane and Milesi-Ferretti (2007)
Borrowing Limit (ϕ)	Initial	1.821	1.50	Chosen to match the net foreign assets to net GDP ratio with data
	Terminal	1.043	1.50	

Table 5: Parameters for calibration

I use the net foreign assets (NFA) reported by Lane and Milesi-Ferretti (2007) in their database for both, Greece and Euro Area, to calibrate the ratio of net foreign assets to net GDP in the model. As a result, the net foreign assets to net GDP ratio of Greece is -131.31% while Euro Area has net foreign assets of -36.61% as a percentage of GDP in the year 2008. For the initial steady state, the borrowing limit of Greece is chosen to match the NFA-to-net-GDP ratio in the model with the NFA-to-net-GDP ratio in the data. In the terminal steady state, the borrowing limit of Greece is chosen such that the NFA-to-net-GDP ratio drops by 50% from -1.31 to -0.66. Even though extreme, the reduction of 50% in capital inflows of Greece, as a percentage of net GDP, is a realistic assumption given the reversal in net foreign assets to net GDP

[3]Durdu, Mendoza and Terrones (2009) calibrate the persistence and variance of the productivity shock for Mexico by the first-order auto-correlation and standard deviation of "Hodrick-Prescott-filtered cyclical component of GDP."

of Greece by 44.53% in 1996 and 38.09% in 1994. This implies a cumulative increase of 64.8% in the NFA / net GDP of Greece over the course of three years from 1994 to 1996. The borrowing limit of Euro Area remains fixed throughout the analysis. Following Guerrieri and Lorenzoni (2017), the decrease in borrowing limit is chosen to occur gradually over 6 periods so that none of the households become bankrupt.

Results and Analysis

Consider that the economy is in the initial steady state at time t = 0 where the parameter for borrowing limit for Greece is ϕ_0^h= 1.821. The parameter for borrowing limit of Greece permanently and gradually falls to ϕ_t^h= 1.043 over the course of six periods. The economy will adjust to reach the new steady state. In this paper, I explore the short-run and long-run impact of the tightening of credit constraint in the international financial market along the transition path taken by the economy to reach the terminal steady state. Table 1 presents a comparison of the key variables in the two steady states. The decrease in the borrowing limit of Greece causes a sudden stop of funds into the country resulting in an increase of 50% in the net foreign asset position as a percentage of GDP. The equilibrium real interest rate of the world decreases from 1.28% in the initial steady state to 0.96% in the terminal steady state. Moreover, aggregate consumption of Greece increased in the terminal steady state. The net foreign asset position of Euro area also worsened as foreign borrowing by the Greeks decreased. Moreover, the aggregate consumption of Euro area slightly decreased as compared to the initial steady state. The transition dynamics of the variables are being discussed next.

Statistic	Initial Steady State		Terminal Steady State	
	Greece	Euro Area	Greece	Euro Area
Parameter for Borrowing Limit ϕ	1.821	1.50	1.043	1.50
Real World Interest Rate r	1.28%		0.96%	
Net Foreign Asset / Net GDP	-1.3131	1.2876	-0.6613	0.6485
Aggregate Consumption	0.9872	1.0405	0.9976	1.0299

Table 6: Comparison of Initial and Terminal Steady States

Transition Dynamics

Figures 11 and 12 illustrate the transition paths taken by the economic variables to reach the terminal steady state for Greece and Euro area respectively. As already mentioned, the reduction in the parameter for borrowing limit of Greece takes place gradually over six periods. As illustrated in the top left panel of Figure 11, the parameter for borrowing limit ϕ of Greece decreases linearly over the first six periods before becoming constant at the new level. The top right panel of Figures 11 and 12 show the response of net foreign asset position to the decrease in borrowing limit of Greece. The net foreign asset position of Greece improves and follows a smooth path to settle at -0.66% of GDP, that is 50% higher than its initial steady state level. Since this is a two country model, the response of the net foreign asset to net GDP ratio of Euro area mirrors the inverse of Greece and decreases from 1.28 to 0.65 (See Figure 12).

As illustrated in the bottom left panel of Figure 11, the world interest rate falls sharply as the borrowing limit of Greece decreases. The decrease in the real interest rate is so large that it becomes negative in the third period. After the borrowing limit becomes constant, the interest rate starts increasing and gradually approaches its new steady state below the level in the initial steady state. The decrease in the world interest rate on impact is due to the sudden decrease in demand for financial assets.

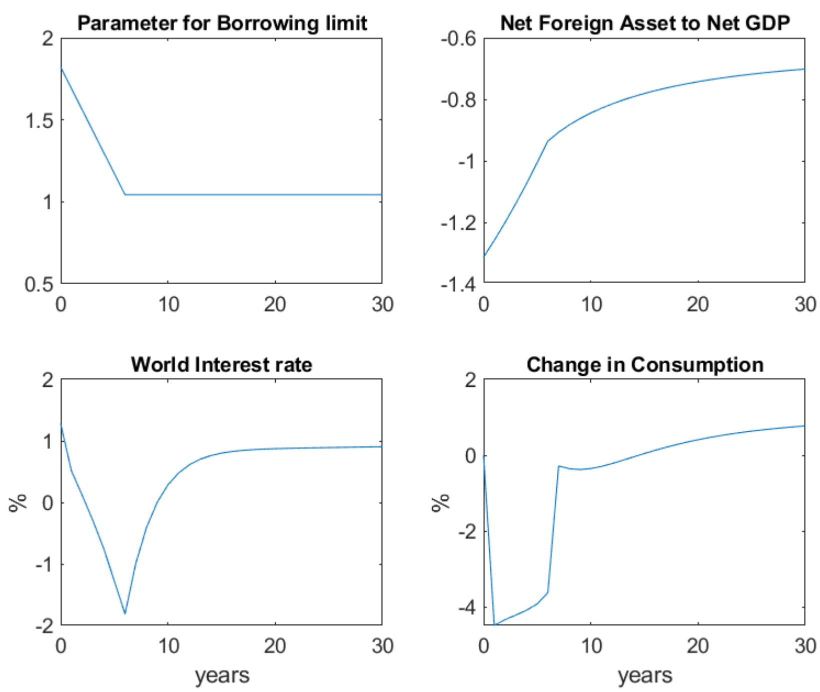


Figure 11: Transition Path for Greece

Since the real interest rate becomes negative due to the decrease in ϕ^{Greece}, it cannot be replicated by the central bank due to the zero lower bound on the nominal interest rate. Guerrieri and Lorenzoni (2017) introduce fixed nominal wages to fix the price level that equates nominal interest rate with the real interest rate, and then introduce zero lower bound on the equilibrium interest rate. They find that the introduction of zero lower bound causes a larger drop in output and the interest rate remains negative longer than it does in the model without the nominal rigidities. Since the model does not have wages or price level and all of the variables are modeled as real variables, this is a limitation of the model that zero lower bound of the nominal interest rate can not been incorporated. Nevertheless, it can be reasonably expected that the economy will behave in a manner similar to the one-country economy in Guerrieri and Lorenzoni (2017), in presence of zero lower bound. The decrease of real interest rate after the shock beyond the zero lower bound will send the economy into a brief recession and the nominal interest rate will be sticky around zero.

Finally, the bottom right panel of Figure 11 illustrates the response of aggregate consumption of Greece relative to the initial steady state. The aggregate consumption of Greece falls by about 4.5 percentage points on impact, remains low while the decrease in ϕ^{Greece} continues and jumps back up, close to the initial steady state, as the borrowing limit becomes constant. It eventually converges to the new steady state that is 1.06% higher than the aggregate consumption of Greece in the initial steady state level.

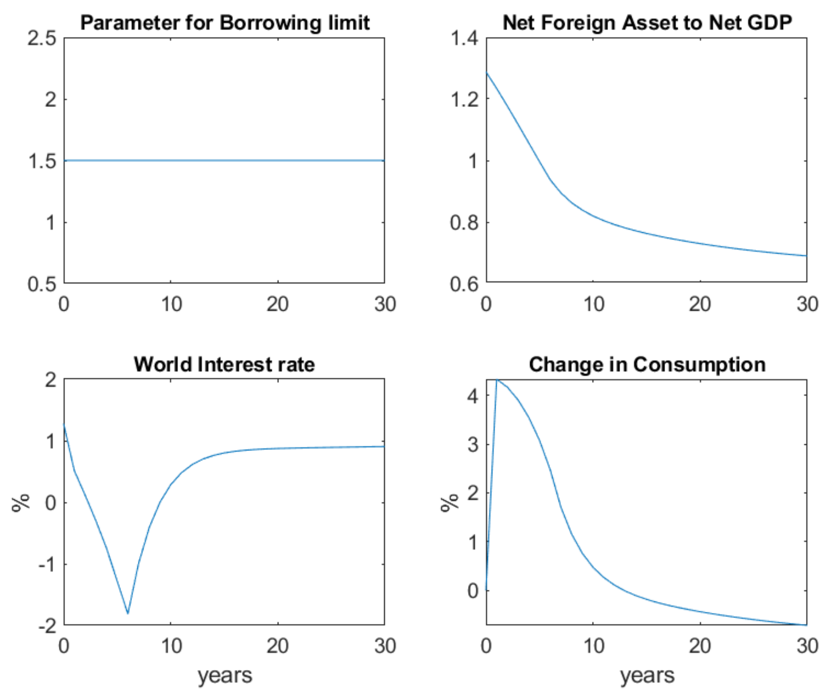


Figure 12: Transition Path for Euro Area

A decrease in borrowing limit gives rise to two opposing effects: income effect and substitution effect. A decrease in the ability to borrow reduces the household income, resultantly, household consumption decreases; this is the income effect. On the other hand, decrease in the borrowing limit decreases the world interest rate which leads to a reduction in the demand for financial assets and thus consumption increases; this is the substitution effect. In other words, households save less and consume more due to substitution effect. Moreover, they borrow less and consume less due to income effect. The response of aggregate consumption of Greece, on impact, is highly negative. Roughly 76% of the Greek population lies below the new borrowing limit in the initial steady state which leads to a considerable welfare loss in the form of a fall in consumption by

4.5% when the borrowing limit increases to its new value. Since households at or below the new borrowing limit are directly affected by the tightening of the credit constraint, income effect dominates and their consumption decreases. After the shock is over, i.e. period 7 onward, the aggregate consumption slowly starts increasing towards a new steady state that is higher than the initial steady state by 1.06%. Thus, there is a slight welfare gain for Greece in the long-run after the recessionary period.

On the contrary, the aggregate consumption of Euro area sharply increases due to the decrease in the borrowing limit of Greece before converging to a level that is 1.01% below the initial steady state. The bottom right panel of Figure 12 illustrates the response of aggregate consumption of Euro area, the foreign country in the model. Since the change in borrowing limit of Greece does not affect the borrowing ability of the households of Euro area, there should be no income effect on the consumption decision of Euro area households. The decrease in the world interest rate causes the Euro area households to decrease savings and increase consumption while the borrowing limit of Greece keeps decreasing. After the shock is over and the borrowing limit becomes constant, the world interest rate starts to increase steadily. The savings by Euro area households also increase with the increase in world interest rate, and thus, consumption decreases. In the terminal steady state, the world interest rate fell from 1.28% in the initial steady state to 0.96%. On the whole, a decrease in interest rate should decrease savings and increase consumption according to the substitution effect. However, the consumption of Euro area households decreased in the terminal steady state indicating some evidence for precautionary savings. Another possible explanation for lower consumption in the terminal steady state arises from potential income effect. The decrease in interest rate also decreases the interest income of the lending households. Since most of the Euro area population is lender, income effect dominates the substitution effect and the aggregate consumption decreases.

	Initial Steady State	Terminal Steady State
Greece (h)	0.3742	0.3486
Euro Area (f)	0.3106	0.3224

Table 7: Wealth Inequality (Gini Coefficient)

The sudden stop in international capital inflows decreases the inequality in wealth of Greece. Table (7) presents the Gini coefficient of wealth for both countries in the initial and terminal steady states. The Gini coefficient of wealth is observed as 56.1% for Greece for the year 2015 (Zucman, 2016). Moreover, Bogliacino and Maestri (2016) report a slight increase in the wealth Gini for Greece from 2012 to 2015. As the model is fairly simple and does not account for all factors affecting the inequality in wealth, it is not able to match the wealth inequality observed in the data. However, a possible explanation of the change in wealth distribution in the model is as follows: Since majority of the Greek population lies below the new borrowing limit in the initial steady state, the increase in borrowing limit seems to move the households closer to each other in the wealth distribution, by decreasing borrowing. Moreover, the decrease in world interest rate seems to help the poor while hurt the rich, bringing them closer to each other in the wealth distribution. Similarly, the decrease in the aggregate consumption following the shock increases the savings of Euro area households. This might move the households further away in their asset holding position, and thus, increasing the inequality in wealth.

Conclusion

Using a two-country general equilibrium model with a representative household for each country, I find that the current account deficits of Greece and Spain are optimal in the year 2008 according to the methodology of Engel and Rogers (2006). Under this framework, the current account deficit of a country would be optimal if the net GDP of the country is expected to grow faster than the net GDP of the world. Synonymously, if the share of the country's net GDP in the world net GDP is expected to grow in future by a certain growth rate, the current account deficit of the country is optimal in the current period. The model returns an implied growth rate for the country's share in world net GDP based on the current share of the country The model implies an annual growth rate of 0.35% to 0.76% of the share of Greece's net GDP in the world net GDP for the next 35 to 92 years to reach a steady state where the current account returns to balance. Since the implied growth rate is lower than or close to the past average growth rate of 0.71% per year, the current account deficit of Greece in 2008 can be considered as optimal under this framework. Similarly, the current account deficit of Spain is concluded as optimal because the model implied growth rate of 0.21% to 0.47% per year in the share of Spain's net GDP for the next 42 to 113 years is lower than or close to the actual annual growth rate of 0.43%. On the contrary, the annual growth in the share of Portugal in the world net GDP implied by the model is 0.28% to 0.60% against the historical growth of only 0.01% per year. Therefore, it has been concluded that the current account deficit of Portugal is not optimal under the Engel and Rogers (2006) framework.

In the second part of the paper, I extend the approach in Guerrieri and Lorenzoni (2017) to explore the impact of a sudden and large reduction of international capital inflows for Greece. The two-country heterogeneous agent incomplete market framework, similar to Bewley (1977) and Huggett (1993), consists of heterogeneous households with five different levels of productivity in each country. Households face a country specific borrowing constraint. The initial steady state of the economy is calibrated to match the net foreign asset position of Greece as a percentage of net GDP. The sudden stop in capital inflows of Greece has been modelled by tightening the borrowing constraint faced by households of Greece. I find that the sudden stop in the capital inflows of Greece causes the world interest rate to decrease sharply in the short-run. After the borrowing limit becomes constant at the new level, the world interest rate increases to its new steady state value which is lower than the initial level of the world interest rate. Moreover, the aggregate consumption of Greece also experiences a sudden and sharp decline of about 4% with the decrease in capital inflows. The aggregate consumption of the rest of the world increases sharply by about 4.5% on impact. After the shock is over, the consumption policy slowly approaches its new steady state. The consumption of Greece increases by 1.06% while the aggregate consumption of the rest of the world decreases by 1.01% in the terminal steady state. The sudden stop decreases the wealth inequality of Greece whereas the wealth inequality of Euro area slightly increases.

References

[1] Abbasoglu, O. F., Imrohoroglu, A., & Kabukcuoglu, A. (2017). Is the Turkish Current Account Deficit Sustainable? Koc University-TUSIAD Economic Research Forum Working Paper Series.

[2] Arghyrou, M. G., and Chortareas, G. (2008). Current account imbalances and real exchange rates in the euro area. *Review of International Economics, 16(4)*, 747-764.

[3] Bewley, T. (1977). The permanent income hypothesis: A theoretical formulation. *Journal of Economic Theory, 16(2)*, 252-292.

[4] Bogliacino, F., & Maestri, V. (2016). Wealth Inequality and the Great Recession. *Intereconomics*, 51(2), 61-66.

[5] Calvo, G. A., Izquierdo, A., and Mejia, L. F. (2004). On the empirics of sudden stops: the relevance of balance-sheet effects (No. w10520). National Bureau of Economic Research.

[6] Corden, W. M. (1994). *Economic policy, exchange rates, and the international system.* University of Chicago Press, 92.

[7] Durdu, C. B., Mendoza, E. G., and Terrones, M. E. (2009). Precautionary demand for foreign assets in Sudden Stop economies: An assessment of the New Mercantilism. *Journal of development Economics, 89(2)*, 194-209.

[8] Edwards, S. (2004). Thirty years of current account imbalances, current account reversals, and sudden stops. IMF staff papers, 51(1), 1-49.

[9] Engel, C., and Rogers, J. H. (2006). The US current account deficit and the expected share of world output. *Journal of monetary Economics, 53(5)*, 1063-1093.

[10] European Union. The Euro. Available at URL: https://europa.eu/european-union/about-eu/money/euro_en#euro

[11] Gaulier, G., and Vicard, V. (2012). Current account imbalances in the euro area: competitiveness or demand shock?. *Quarterly selection of articles-Bulletin de la Banque de France, (27)*, 5-26.

[12] Gourinchas, P. O., Philippon, T., and Vayanos, D. (2017). The analytics of the Greek crisis. NBER Macroeconomics Annual, 31(1), 1-81.

[13] Guerrieri, V., and Lorenzoni, G. (2017). Credit crises, precautionary savings, and the liquidity trap. *The Quarterly Journal of Economics, 132(3)*, 1427-1467.

[14] Guidotti, P., Sturzenegger, F., Villar, A., De Gregorio, J., and Goldfajn, I. (2004). On the Consequences of Sudden Stops [with Comments]. *Economía, 4(2)*, 171-214. Retrieved from http://www.jstor.org/stable/20065461

[15] Holinski, N., Kool, C. J., & Muysken, J. (2012). The impact of international portfolio composition on consumption risk sharing. *Journal of International Money and Finance, 31(6)*, 1715-1728.

[16] Huggett, M. (1993). The risk-free rate in heterogeneous-agent incomplete-insurance economies. *Journal of economic Dynamics and Control, 17(5-6)*, 953-969.

[17] Hutchison, M. M., & Noy, I. (2006). Sudden stops and the Mexican wave: Currency crises, capital flow reversals and output loss in emerging markets. *Journal of Development Economics, 79(1)*, 225-248.

[18] Jaumotte, M. F., & Sodsriwiboon, P. (2010). Current account imbalances in the Southern Euro area (No. 10-139). International Monetary Fund.

[19] Lane, P. R., & Milesi-Ferretti, G. M. (2007). The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970–2004. *Journal of international Economics, 73(2)*, 223-250.

[20] Lane, P. R., & Pels, B. (2012). Current Account Imbalances in Europe. CEPR Discussion Paper No. DP8958. Available at SSRN: https://ssrn.com/abstract=2066331

[21] Merler, S., and Pisani-Ferry, J. (2012). Sudden stops in the Euro area (No. 2012/06). Bruegel Policy Contribution.

[22] Mendoza, E. G., Tesar, L. L., & Zhang, J. (2014). Saving europe?: The unpleasant arithmetic of fiscal austerity in integrated economies (No. w20200). National Bureau of Economic Research.

[23] Milesi-Ferretti, G. M., & Razin, A. (2000). Current account reversals and currency crises: empirical regularities. In *Currency crises* (pp. 285-323). University of Chicago Press.

[24] Shambaugh, J. C., & Kang, J. S. (2013). The Evolution of Current Account Deficits in the Euro Area Periphery and the Baltics: Many Paths to the Same Endpoint. International Monetary Fund.

[25] Tauchen, G. (1986). Finite state Markov-chain approximations to univariate and vector autoregressions. *Economics letters, 20(2)*, 177-181.

[26] Zucman, G. (2016). Wealth inequality. *Pathways - The Poverty and Inequality Report 2016.* Stanford Center on Poverty and Inequality. Retrieved from Stanford website: https://inequality.stanford.edu/sites/default/files/Pathways-SOTU-2016-Wealth-Inequality-3.pdf

Appendix A: Major Trade Partners of Greece, Portugal and Spain

1995		2008	
Trade Partners	Trade Volume rel. to World	Trade Partners	Trade Volume rel. to World
Euro Area (EU15)	58.48%	Euro Area (EU15)	41.73%
European Union excl. EU15	14.56%	European Union excl. EU15	14.33%
USA	3.21%	Russian Federation	6.17%
Russian Federation	2.64%	China	4.04%
Japan	2.09%	USA	3.19%
Switzerland	1.59%	Turkey	3.08%
Iran	1.28%	Iran	2.88%
Turkey	1.17%	Libya	2.30%
Egypt	1.10%	Saudi Arabia	1.78%
Republic of Korea	0.98%	Republic of Korea	1.76%
	87.08%		81.26%

Table A.1: Top 10 Trade Partners of Greece

1995		2008	
Trade Partners	Trade Volume rel. to the World	Trade Partners	Trade Volume rel. to the World
Euro Area (EU15)	65.73%	Euro Area (EU15)	66.39%
European Union excl. EU15	11.94%	European Union excl. EU15	7.36%
USA	3.79%	Angola	2.59%
Switzerland	1.69%	USA	2.26%
Japan	1.62%	Nigeria	1.77%
Brazil	1.24%	Brazil	1.62%
Norway	1.13%	China	1.46%
Republic of Korea	0.85%	Libya	0.98%
Nigeria	0.84%	Singapore	0.88%
Saudi Arabia	0.69%	Algeria	0.86%
	89.51%		86.16%

Table A.2: Top 10 Trade Partners of Portugal

1995		2008	
Trade Partners	Trade Volume rel. to the World	Trade Partners	Trade Volume rel. to the World
Euro Area (EU15)	58.79%	Euro Area (EU15)	49.85%
European Union excl. EU15	10.72%	European Union excl. EU15	9.95%
USA	5.58%	China	4.79%
Japan	2.48%	USA	3.99%
China	1.52%	Russian Federation	2.19%
Switzerland	1.32%	Algeria	1.82%
Algeria	0.98%	Turkey	1.42%
Brazil	0.96%	Japan	1.39%
Russian Federation	0.90%	Morocco	1.37%
Argentina	0.87%	Mexico	1.27%
	89.51%		86.16%

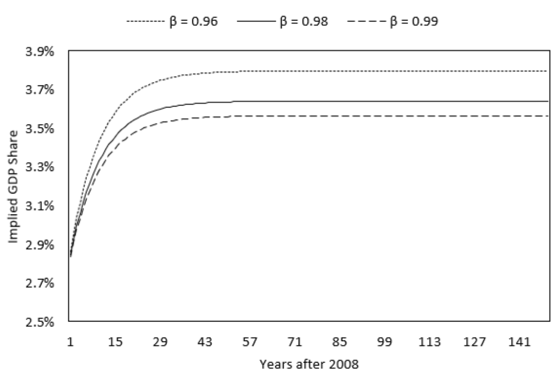
Table A.3: Top 10 Trade Partners of Spain

Appendix B: Sensitivity of Beta

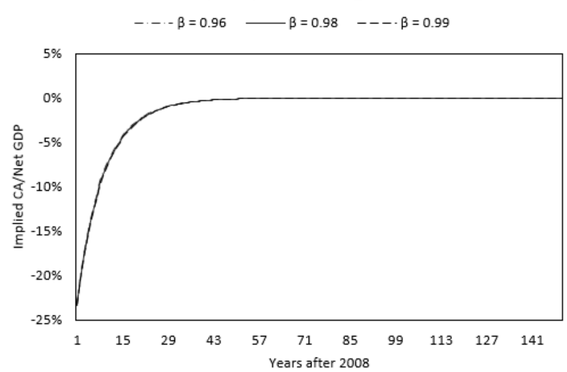
GREECE

	$\beta = 0.96$	$\beta = 0.98$	$\beta = 0.99$
Current Account Balance (current million USD)		-51,312.80	
Net GDP (Constant 2010 PPP International Dollars)		192,323.04	
CA / Net GDP		-26.68%	
Alpha		0.90	
Beta	0.96	0.98	0.99
Current GDP Share		2.76%	
Steady State Share	3.80%	3.64%	3.56%
Net Implied Share Growth	37.80%	32.13%	29.38%
Years to convergence	52	51	50
Annual Implied Share Growth	0.62%	0.55%	0.52%
Average Annual Share Growth from 1995 to 2008		0.71%	

Table B.1: Sensitivity of Greece's Results to Subjective Discount Factor (β)



(a) Implied GDP Share



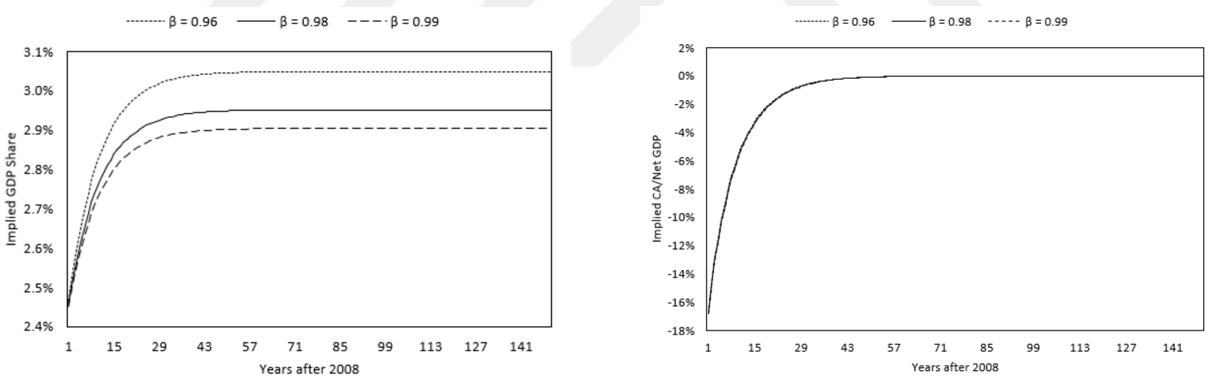
(b) Implied CA to Net GDP

Figure B.1: Sensitivity of Greece's Results to Subjective Discount Factor (β)

PORTUGAL

	$\beta = 0.96$	$\beta = 0.98$	$\beta = 0.99$
Current Account Balance (current million USD)		-31,948.60	
Net GDP (Constant 2010 PPP International Dollars)		167,545.95	
CA / Net GDP		-19.07	
Alpha		0.90	
Beta	0.96	0.98	0.99
Current GDP Share		2.40%	
Steady State Share	3.05%	2.95%	2.90%
Net Implied Share Growth	27.01%	22.96%	20.99%
Years to convergence	48	46	45
Annual Implied Share Growth	0.50%	0.45%	0.42%
Average Annual Share Growth from 1995 to 2008		0.01%	
Average Annual Share Growth for past 10 years		0.28%	

Table B.2: Sensitivity of Portugal's Results to Subjective Discount Factor (β)



(a) Implied GDP Share

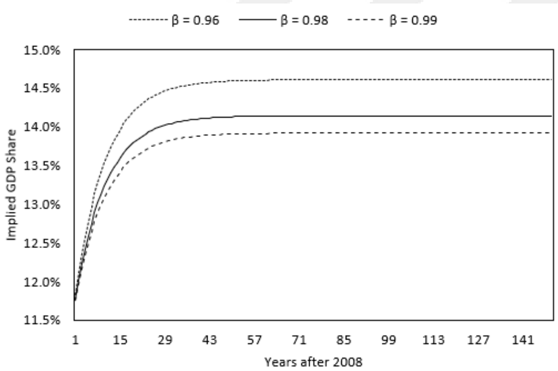
(b) Implied CA to Net GDP

Figure B.2: Sensitivity of Portugal's Results to Subjective Discount Factor (β)

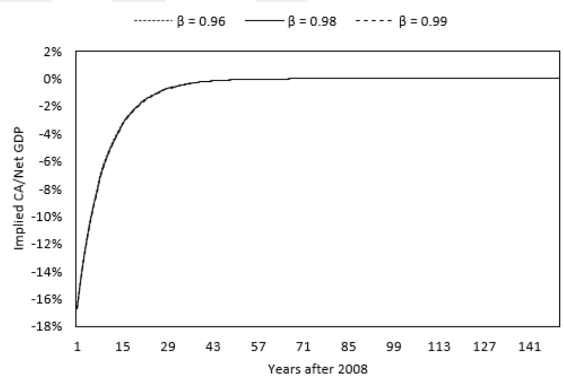
SPAIN

	$\beta = 0.96$	$\beta = 0.98$	$\beta = 0.99$
Current Account Balance (current million USD)		-152, 545.92	
Net GDP (Constant 2010 PPP International Dollars)		803.525.18	
CA / Net GDP		-18.98%	
Alpha		0.90	
Beta	0.96	0.98	0.99
Current GDP Share		11.51%	
Steady State Share	14.61%	14.14%	13.92%
Net Implied Share Growth	26.89%	22.86%	20.90%
Years to convergence	63	61	60
Annual Implied Share Growth	0.38%	0.34%	0.32%
Average Annual Share Growth from 1995 to 2008		0.43%	

Table B.3: Sensitivity of Spain's Results to Subjective Discount Factor (β)



(a) Implied GDP Share



(b) Implied CA to Net GDP

Figure B.3: Sensitivity of Spain's Results to Subjective Discount Factor (β)