Aalto University
School of Business

An Intertemporal Current Account Model for EA-12/ Are recent current accounts imbalances in the EA-12 reasonable in terms of intertemporal consumption smoothing?

Economics

Master's thesis

Samuele Machi

2013

Department of Economics
Aalto University
School of Business

Table of contents

List of Figures

List of Tables

Abstract

In this paper I use an inter-temporal model to analyze the variability of the current accounts (CA) of the 12 countries which have formed the initial European Monetary Union and test whether this approach is successful in accounting for the evolution of the CA imbalances over the last decades. The use of current account balances is assumed to be comparable to the use of savings, so that the main hypothesis is that current account could be used to smooth (national) consumption and its variation would be driven by expectations about future income (net output) and relative prices.

The model that I choose to adopt encompasses sources of external shocks for small economies such as changes of the real interest rate and of the real exchange rate.

This paper finds that, on the one hand, the country specific VAR model passes informal tests such as graphical representations and standard deviation comparisons. On the other hand, although the main formal statistical test (*k-test*) fails for all the 12 countries, the secondary formal test *R-test* can be considered successful in the case of Austria, France, Germany, Ireland and Portugal while the Granger-causality is passed by Austria, Belgium, Netherlands and Spain.

This paper also warns on the validity of the Vector AutoRegressive (VAR) model results for those cases which have proven statistically significant. In fact, analyzing the same set of equations through a Seemingly Unrelated Regression Equations (SURE) system showed important differences in the magnitude, standard deviations and t-statistics of the estimated coefficients.

The paper concludes that an intertemporal approach to current account, executed through VAR modelling, cannot statistically assess the reasonability of recent CA imbalances in the studied countries for the sampled period but informally suggests that the current account of the studied countries behaved as the theoretical model would predict. In order to improve the performance of the model, this study suggests taking into consideration the correlations found among the error terms of the equations estimated from the country specific VAR models.

Keywords: Intertemporal Current Account, EA-12 CA imbalances, VAR, SURE.

1 MOTIVATION, PURPOSE AND CONTRIBUTION OF THIS STUDY

1.1 Motivation of the study

The Current Account (CA) is defined as the difference between exports and imports and therefore expresses the totality of domestic residents' transactions with foreigners in the markets for current goods and services. From this it follows that the current account shapes the evolution over time of a country's stock of net claims on (or liabilities to) the rest of the world and, in turns, it implies the inter-temporal decisions (in terms of saving, investment, fiscal position and so on) of domestic and foreign residents.

Movements in the CA are deeply intertwined with, as well as convey information about, the actions and the expectations of all market participants in an open economy; Aguiar and Gopinath (2005), for example, find that current account and sovereign defaults are positively correlated. This makes the CA an important macroeconomic variable that policy makers focus on, although it never appears as an ultimate policy target or variable: it represents what is often labelled as an "intermediate target". Studying the CA is useful in order to explain its dynamics, to gauge its sustainability and, ideally, to bring about changes through appropriate policy actions.

Historically international economics has struggled to identify a dynamic relationship between changes in the CA positions and movements in the real exchange rate, levels of economic activity, monetary and fiscal positions, and so on through several theoretical approaches. Starting with the static Mundell-Fleming model (1960) to the latest inter-temporal models, more and more attention has been drawn to the idea of "sustainability" over time and to the inter-temporal aspects of the current account imbalances.

Global CA imbalances probably constitute one of the most challenging issues in international macroeconomics today; while the main focus of attention has long been on the American CA deficit and Chinese CA surplus, only lately increasing attention is being paid to European Monetary Union (EMU) countries' CA imbalances.

Interestingly enough, while the aggregate EMU CA balance is close to zero, some EMU countries have exhibited increasingly large CA deficits[1]. Starting from a relatively low deficit in CA in 1999s, by 2005 the CAs of Greece, Portugal, and Spain were in deficits equal to 7.9%, 9.2%, and 7.6% of GDP, respectively (see Figure 2, pp. 11). The CA of France and Italy displayed a similar, though less pronounced, deterioration pattern and, on the contrary, a few

[1] The path has eventually changed and the CA deficit countries not only are improving at a rapid pace but also are close to reach balance (Auer, 2013).

EMU countries such as Finland, the Netherlands, and, most notably, Germany, displayed substantially positive CAs.

Economists have formulated various hypotheses on why those CAs diverged so drastically after the creation of the monetary union and lately started converging again. Those numerous theories, which are briefly presented below, are what makes this issue interesting and have motivated me to investigate "what caused what" and "how it came about".

It is a known fact that the divergence of current account positions and the persistent deficits lead to a massive accumulation of external debt and raise concerns about the creditworthiness of the debtor countries, and explains why the Troika (European Commission, the International Monetary Fund and the European Central Bank) stepped in during the most acute phases of the crisis as a lender of last resort to ensure access to credit, conditional on the implementation of austerity reforms to consolidate the public budget. To avoid contagion to other countries and additional distortions in the common monetary policy, the ECB also purchased government bonds on the secondary market, although this was not justified by its official mandate.

According to Blanchard and Giavazzi (2002) the imbalances might reflect a convergence process between countries with different income level per capita and closely linked in goods and financial markets. They point out that higher integration reduces the costs and risks of borrowing and lending internationally and, by inducing competition across countries, enhances the elimination of internal inefficiencies and stimulates growth. In this view a balanced position might not be required at all in the short run; to the extent that they are the countries with the highest expected rates of return, poor countries should see an increase in investment, while, being countries with better growth prospects, they should also see a decrease in saving. Thus, on both counts, poorer countries should run larger current account deficits, and, symmetrically, richer countries should run larger current account surpluses. It is reasonable, according to this view, to expect poor countries to consume more and save less today in anticipation of higher permanent income tomorrow: investment is expected to exceed savings, implying external deficits in the catching up period (Gourninchas and Rey, 2007).

Therefore CA imbalances might be interpreted as a sign of proper functioning of the integration process and not as an indication of an improper macroeconomic management. Schmitz and vod Hangen (2009) argue that the monetary union has facilitated the allocation of capital by promoting financial integration and reducing costs through the elimination of the exchange rate risk. Some countries, thus, came to experience lower real interest rates and this could have enhanced investment booms and saving busts; in turn, lower income countries got easier access to external financing, causing an increase in the persistence of deficits. Nevertheless Jaumotte and Sodriwibon (2010) maintain that the difference in per capita incomes was not a sufficient condition to claim that the actual borrowing which took place had been indeed optimal, as most of the decline in current accounts in the Southern Europe Area since the mid-1990s reflected a decline in private saving rates, spurred by financial liberalization and increasing dependency ratios. They argue that the decline in current accounts would not have occurred, despite the decrease in saving rates, were it not for EMU and the euro which improved the access to international saving.

Another point to make is about the role of relative prices, i.e. the real exchange rates (RER). Arghyrou and Chortareas (2008) stress the importance of the RER–CA relationship via shifts in competitiveness. Provided that in a common currency union like the EA-12 nominal variations of the exchange rate are not available, fluctuations in the real exchange rate correspond to changes in relative prices and unit labour costs. The basic intuition is that deficit countries have become less competitive because domestic prices have increased more (rapidly) than foreign prices did. This idea boils down to Balassa-Samuelson hypothesis and the “catching up effect”. Additional factors, such as undue nominal wage growth, should be also pointed at as the causes of the loss of competitiveness and overheating problems of the European peripheral debtor countries.

Berger and Nitsch (2010) find that trade imbalances among euro area countries widened considerably with the introduction of the euro. This finding is consistent with indications that pair-wise trade tends to be more balanced when nominal exchange rates are flexible. Those authors also claim that intra-euro area imbalances have become more persistent because of the labor market inflexibility within the EMU. Reviewing the direction of imbalances, Berger and Nitsch affirm that bilateral trade surpluses are decreasing in the real exchange rate, decreasing in growth differentials, and increasing in the relative volatility of national business cycles.

Decressin and Stavrev (2009) claim that their findings are nuanced with respect to current account divergences and the speed of adjustment to shocks but do not point to the real exchange rate as a decisive factor. They insist that current account divergences across euro-area countries have risen since the early 1990s, when the onset of monetary union was still far and the cross-country dispersion of real exchange rate changes had not yet fallen. However, they assert that current account divergences have also risen across the other advanced economies, while the dispersion of their real exchange rate changes has remained broadly unchanged. Also, both before and after monetary union intra euro-area divergences have typically been smaller than those across the other advanced economies. Unlike in the other advanced economies, the size of current account shocks in EMU members has become smaller, consistent with increasing economic integration, although adjustment to these shocks has slowed significantly. These changes occurred mainly before the advent of monetary union and they are robust to conditioning on real exchange rate dynamics. Thus, prima facie, they do not appear related to high intra-area exchange rate rigidity, Decressin and Stavrev (2009) conclude.

Finally, Holinski, Kool and Muysken (2010) report the growing dispersion of external and internal balances between countries in the North and South of the EA over the time period 1992 to 2007. They find a persistent divergence process that appears to have started with the introduction of the common currency and has its roots in the savings and investment behavior of private sectors. They also dismiss the common argument in the literature that imbalances are the temporary outcome of an overall European economic convergence process.

In any case, the current size of the CA imbalances has touched such a level that concerns have been expressed by many economists. The biggest interrogative is whether the actual size of the recent fluctuations can be explained by a proper adjustment to the new economic scenario or is the result of an incorrect adjustment. Have countries like Spain or Greece increased their external indebtedness based on over-optimistic expectations about their future growth? Have they overestimated the positive effects of the common currency? If this were the case, they should experience a painful adjustment soon… and this seems to be the case, as many of those countries have experienced substantial decreases in their economic activity.

The issue is real and in continuous development; it interests all of us because of its implications over policy maker decisions and development of the European Monetary Union.

1.2 Objectives and contribution of the study

This study aims at drawing a picture of the European CA imbalances looking at the main players of this game: Greece, Spain, Italy, Germany, the Netherlands and Finland along with the other countries part of the so called EA-12[2].

The main purpose of the study is to use an inter-temporal model to assess the fluctuations in the CA balances experienced lately by the EMU countries and their feasibility. This study means to contribute to understand the Euro crisis answering the following question:

"Are the current imbalances reasonable in terms of

inter-temporal consumption optimization?"

---

[2] Belgium (BE), Spain (ES), Ireland (IE), Italy (IT), Luxembourg (LU), Netherlands (NL), Germany (DE), Greece (EL), Finland (FI), France (FR), Austria (AT), Portugal (PT).

Are recent CA fluctuations within what should be considered acceptable or have they trespassed the limits? To answer this question, it is necessary to use a specific model which stands as a reasonable benchmark and against which current balances can be compared in order to detect deviations. Using the "Macro-Balance" and "External Sustainability" methodologies from the IMF CGER, Jaumotte and Sodsriwiboon (2010) determined an equilibrium CA and inferred the actual CA gap is out of line with one based on underlying long-term fundamentals. Interested by their results but not satisfied by their conclusions, I decided to dig further in the topic and to test myself whether CA imbalances are indeed not reasonable.

As benchmark model I chose to adopt the one developed by Bergin and Sheffrin (2000): it considers a small open economy where consumers smooth consumption over time. Optimal consumption is based on the expectations of future output and relative prices, while current account balance in every period is the difference between optimal consumption and net output in that period. The model considers time-varying interest rates and real exchange rates (through the difference between traded and non-traded goods). After estimating the optimal CA according to this model, I meant to confront those predicted values with the actual data over the 1980-2009 horizon and then I drew some conclusions.

To my knowledge the latest (and only) attempt to adapt an inter-temporal model to the European CA imbalances dates back to Campa and Gavilán (2011), who, using data up to 2005 and excluding Greece and Luxemburg, performed a simple country by country analysis, taking advantage of VAR models.

This paper aims at going a step further and not only includes the study of the aggregate CA imbalances for the EU-12 through the VAR methodology, but also studies the fit of the country-by-country VAR model to the most recent data from the EA-12 and compares the results of this study with those obtained by jointly estimating EA-12 CA through the SUR methodology.

1.3 Structure of the study

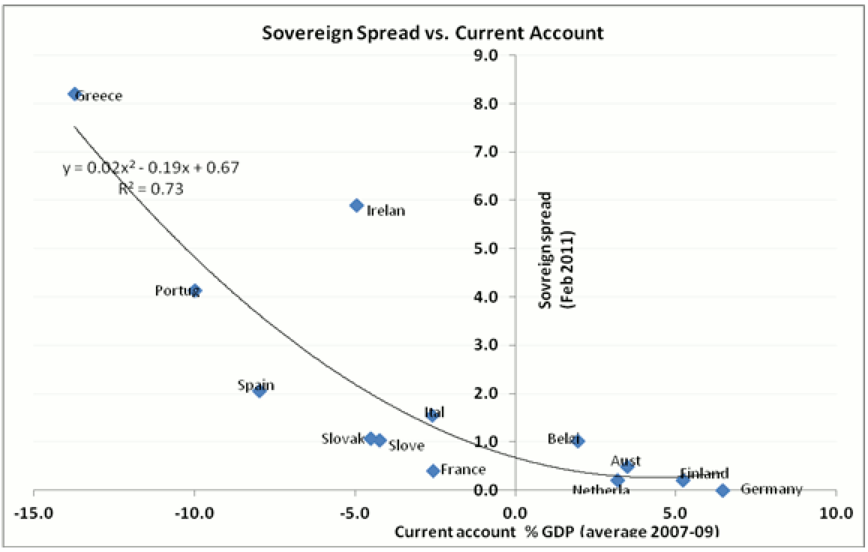
The remainder of this paper is structured as follows: section 2 introduces in more details the economic environment which has awakened my interest in the topic; section 3 reviews the relevant literature about the Inter-temporal Approach in terms of its evolution and extensions. Section 4 sets out the detail of the mathematical model as it was developed by previous literature and with the extensions that I have chosen to follow. Section 5 provides the econometric model used for the empirical analysis. The data and the empirical estimates are contained in sections 6 and 7. Section 8 concludes.

2 THE ISSUE AT STAKE IN THE EUROPEAN MONETARY UNION

The years 2011 and 2012 were characterized by increasing tensions towards the remote but still really terrifying possibility of the break-up of the EMU. Today, although the problems are far from being solved, the reasons of the ongoing crisis have been laid bare. Hidden behind an opaque and heterogeneous fiscal policy and fears of banking crisis, many economists (and in particular Paul Krugman[A]) believe that Euroland's real roots of the sovereign debt crisis are significantly intertwined with the large CA deficits which characterized peripheral European countries[3] since the creation of the Euro and that solutions to the sovereign debt crisis go through balancing those CAs and improving competitiveness in the debtor countries.

2.1 The importance of Current Account in the EMU

"Does external debt matter in a monetary union?" This is what many have being wondering for long before the Eurozone CA imbalances evolved in the severe crisis which threatened the existence of the common European currency. The Eurozone experience clearly shows that public debt alone is not sufficient as an explanation for economic turmoil like that which has shaken European markets. While there are a number of recent and elaborated studies (for example, Gros & Alcidi 2011) which highlight the importance of external debt and external adjustment, a simple look at the strong, no-linear relationship between the sovereign spread and the CA allows us to fast answer that external debt obviously matters. Figure 1, in fact, shows how the sovereign spread clearly soars when the current account becomes more and more negative. As Gros (2011) puts it, the non-linearity of the relationship is due to the positive feedback loop between higher debt and higher risk premium which, consequently, makes debt service pricier.



[3] Also known as "PIGS": Portugal, Ireland, Greece and Spain; or PIIGS: PIGS + Italy.

Figure 1. Relationship between Sovereign Spread and Current Account. Source: Gros 2011.

Such hypothesis about the negative correlation between current accounts and sovereign spreads is also confirmed by the IMF (2010) and Barrios et al. (2009) who found that CA and cross-border bank liabilities are important predictors of CDS spreads and play a major role in determining risk premia, respectively.

Gros (2011) explains that two are the main reasons behind this relationship. The first relates to the rejection of the general assumption that public debt is risk free: in fact, no single member of the EMU has direct access to the printing press. Secondly, Eurozone nations retain the entire sovereignty over the taxation of their citizens and thus the external debt cannot be taxed easily.

2.2 From boom to bust

Gros and Alcidi (2011) explain that the difficulties that peripheral countries are experiencing derive from the *sudden stop* of the large private capital inflows they had received until recently since the first decade after the start of the EMU, which was characterised by a credit boom. The authors assert that the reason why financial markets had provided the peripheral countries with ample financing (until 2008) was that their GDP growths were high in nominal terms while the interest rates were lower, so that public debt sustainability was not an issue. However when the financial crisis broke in, actual and expected growth rate became very small (occasionally even negative) while the market interest rates started to rise.

Figure 2 gives an overview of the CA developments in EA-12 for those countries whose CA most fluctuated since the introduction of Euro.

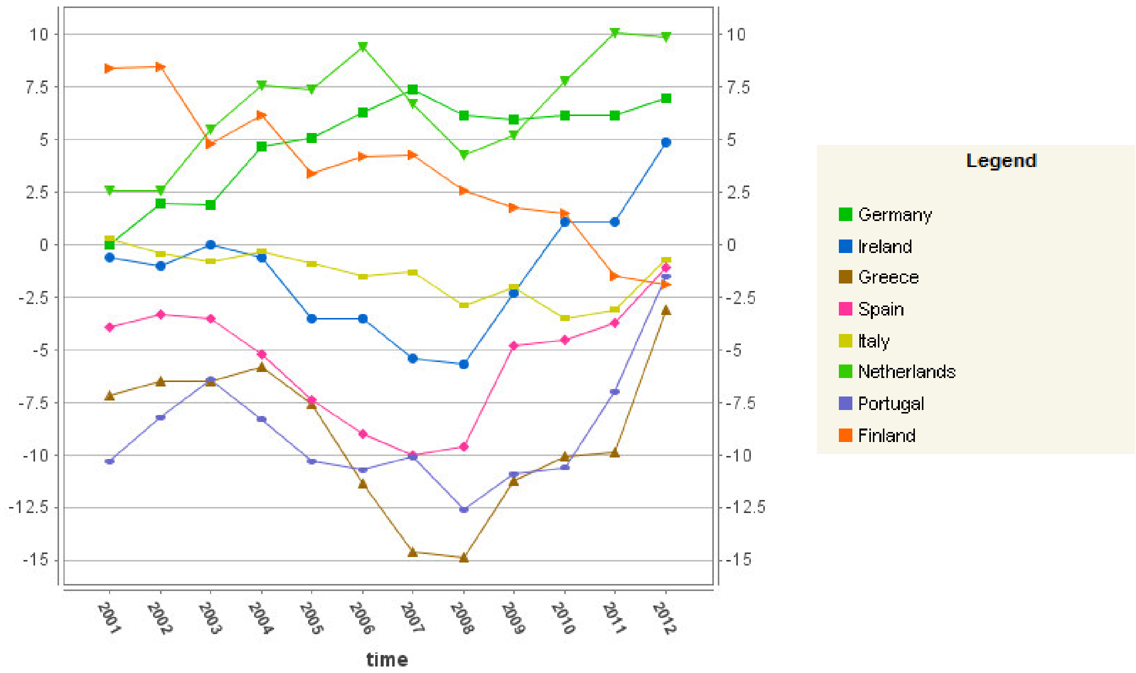


Figure 2 Balance of the CA as % of GDP. Source: Eurostat.

The differences among the countries are huge and reflected the heterogeneous developments in unit labour costs and spending patterns across the currency union. What is worth noting from the above graph is that, since the 2008, the CA of deficit countries has improved sizeably, reaching, in some cases, the balance in the 1st quarter of 2013 (Auer 2013).

Barnes, Lawson and Radziwill (2010) studied the increase in CA imbalances in euro area countries since the early 1990s and suggest that fundamental factors explain a substantial part of the those imbalances; in particular, demographic factors, income and growth differentials as well as the initial net foreign asset position had an impact on the CA, while strong housing investment, associated with unsustainable property booms, was associated with the large Spanish and Irish current account deficits. Interestingly, their research founds that the unexplained component of current account balances was sizeably larger than for earlier periods and while fundamental factors typically explained the sign of the imbalance, they tended to underestimate its size.

These imbalances could have been, then, largely affected by a misalignment of internal real exchange rates which might have caused some countries to cumulate large surpluses while making others collect deficits. But how could we practically explain the fact that unbalances have widened after the creation of the common currency? The most direct explanation is that capital flowed south after the creation the euro and led to overvaluation in southern Europe. The peripheral Eurozone economies in their catching-up phase appeared as a great investment opportunity and, as Jaumotte and Sodsriwiboon (2010) maintain, were characterized by very low private saving rates; so, large capital inflows quickly generated their own fundamentals through high growth rates driven by strong demand for consumption and construction investment, supported by easy credit fed from abroad (Gros and Alcidi 2011). In turn this meant that southern countries imported more than they exported and their current accounts moved into deficit; at the same time domestic asset prices turned higher than foreign ones, and therefore net capital outflows as well as capital account deficit came about.

2.3 A brief comparison to USA and Baltic countries

In this context is worth making a brief comparison with the current account imbalances between American states which are plainly not as dangerous matter as those between European states. Krugman[B] explains this mentioning three main reasons: in the first place, Americans can move to booming states fairly easily and find jobs from there whenever their home state slumps; secondly, the US has a fiscal union which allows the federal government to collect the benefits from any of the booming countries and to transfer tax revenues to slumping states; finally, the US integrated banking system with a single lender of last resort helps keep "local" panic from spreading across the states. It goes without saying that, while the way to financial integration is being followed (ECB 2013), within the EMU labor mobility is really low (The Economist, 2012[C]) and the fiscal union is still a very debatable issue (Milne 2013).

As already mentioned, it is a fact that the current account deficits of Greece, Italy, Spain and Portugal have improved at a rapid pace and are actually close to being balanced. While the size, speed and the uniformity of the current account improvements could indicate an improvement of macroeconomic fundamentals (such as competitiveness), nothing can exclude that the real force behind them is a deep recession which has choked domestic demand through the cuts in private and public spending. The odds are, actually, that these improvements are due to sharply lower private capital inflows rather than improvement in competition, according to a process known as "*sudden stop*" but essentially different from the typical one (Auer 2013).

When the financial crisis broke in late 2007, the risk perception changed dramatically and resulted in a sudden stop of private capital flows. While one of the purposes of having a single currency was to exactly stimulate capital flows and movements of resources from countries with excess savings towards countries with lower financial resources to promote faster growth, the crisis put forward a different interpretation of such imbalances: large and persisting inflows became synonymous of debt in the receiving country and, what is more relevant, it became evident that capital inflows did not necessarily finance productive investments[4] able to ensure future growth and, in turn, the creation of new resources to repay the debt.

[4] Gros and Alcidi (2011) show that inflows often funded consumption and contributed to inflated bubbles.

The economic theory teaches us that in countries with fixed exchange rates sudden stops typically exhaust foreign reserves and force currency depreciation; however what has happened in the Euro Area is something somewhat new: the European periphery countries were not forced to abandon the euro because, among the other reasons, capital transfers from euro-area partners have allowed them to finance current account deficits. Some economists (see Sin 2011, Mayer 2011) argued[5] that public capital replaced private capital: as private capital flows to PIIGS[6] fell, they were replaced by growing liabilities of the central banks of the PIIGS to the European Central Bank (ECB) and the central banks of the other euro-area countries. This flow happened within the Eurosystem's unified interbank payment network for cross border transfers known as TARGET2; in terms of Balance of Payment accounting, this can be thought of as an accumulation of negative balances on the official foreign reserves account of PIIGS. This option was not available to the emerging market countries which experiences currency crisis in the past and has bought PIIGS time to make their external accounts sustainable gradually rather than abruptly in a crisis.

Without these huge transfers the economies of some peripheral countries would have been subject to the same type of more severe *sudden stop* of capital inflows that happened in the Baltic nations, whose banking system did not have access to the refinancing windows of the European Central Bank (ECB). In fact, between 2003 and 2007, large quantities of private capital flowed into the Baltic states to fund consumption and construction bubbles; when the 2007 financial crisis resulted in a sudden stop of capital flows, those economies had to move towards an internal devaluation which caused a dramatic contraction in spending and, in turn, pushed the CA into positive figures (Gros and Alcidi 2011).

3 THE INTERTEMPORAL APPROACH

3.1 Origins of the model

The last decades have been characterized by a new approach that economists have adopted towards the CA balances: the inter-temporal model with consideration on the long-term sustainability (Obstfeld and Rogoff 1996). The idea was that of the permanent income hypothesis in which consumption expenditure depends on the expected permanent income. When the current income varies, so should do the level of saving in order to maintain constant the level of consumption. When we extend this framework to a small open economy, we can see the fluctuation in the current income as the borrowing/lending from/to international markets. This analogy continues with the inter-temporal consumption optimisation behaviour

[5] This is part of a hot debate started in 2011 when huge increases in TARGET2 balances became evident and H.W. Sinn started arguing that the ECB was secretly bailing out governments of the peripheral countries.
[6] Greece, Italy, Ireland, Portugal and Spain

of agents resembling the level of capital that flows in/out of a country under the cover of the current account balance.

If agents were rational, and their saving as well as investment decisions were optimal, the resulting CA balance should be optimal too. What is more, the current account should be inter-temporally solvent, regardless of the position being in deficit, surplus or balanced.

The fact that the current account balance is the outcome of an optimisation implies, on one hand, that there will not be any unsustainable accumulation of foreign liabilities or assets; while on the other hand, it hints that (momentary) imbalances are just the response of economic agents to changes in government expenditure or investment. This approach also suggests that current account balances represent the agent's forecast about the future growth of the economy: agents who expect the economy to grow in the future will borrow more today.

The empirical validity of the model is, however, quite questionable and diverse. In the cross-country context, while Ghosh (1995) and Guest & McDonald (1998) reject the validity of the model in the context of Canada and Australia, respectively, Otto (2003), Agenor (1999), Callen and Cashin (1999) find it consistent with the data from Australia, France and India, respectively.

The intertemporal approach views the current account balance as the result of forward-looking dynamic saving and investment decisions of representative individuals that made forecasts of the relevant variables in a rational expectations context. This type of analysis became more and more common since 1980s, when Buiter (1981) and Sachs (1981a and 1981b), Obstfeld (1982), Greenwood (1983), Svensson and Razin (1983), and Obstfeld and Rogoff, (1994) developed models highlighting such features.

In particular, Lucas's critique (1976) of econometric policy evaluation and his insistence on basing policy analysis in the actual forward looking decision rules of economic agents had suggested that open-economy models might be improved if demand and supply functions had been actually derived from the optimization problems of households and firms rather than defined a priori to match ad hoc econometric specifications (Obstfeld & Rogoff 1994).

On the other side, further developments to an intertemporal approach came from events in the world capital market, above all the current account imbalances following the rapid world oil-price increases of 1973-74 and 1979-80. The divergent patterns of current account adjustments raised the intertemporal problem of characterizing the optimal response to external shocks. Similarly, the explosion in bank lending to developing countries after the first oil shock sparked fears that borrowers' external debt levels might become unsustainable. The need to evaluate developing-country debt levels again led naturally to the notion of an intertemporally optimal current account deficit (Obstfeld & Rogoff, 1994).

This theory, created as a response to precise international events during a certain period of time, could be applied to examine the current Euro Zone sovereign debt crisis. Even if not of the same nature, some of the characteristics of those financial markets turmoil can be seen in the crises that have shaken our global economy in the last decade.

3.2 From theory to practice: Present value models

Recent developments of this literature take advantage of present value (PV) models to test the current account approach. Basically, one variable is written as a linear function of the present discounted value of other variables. In mathematical terms, given two variables x_t and X_t, their relationship can be described as:

$$X_t = \sum_{i=0}^{\infty} \delta^i E_t x_{t+i}$$

where δ is the discount factor and E_t is the mathematical expectation.

Most of the studies on the application of the intertemporal approach rely on the latest theory of time series and on vector auto regressive (VAR) models. This is because one of the VARs most important virtues is that they, through their theoretical model's structure, allow deriving testable hypothesis.

The first articles on the subject date back to the early 90s. In those first versions of the intertemporal model the goal was to extend the idea of Campbell (1987) that consumers "save for a rainy day[7]", to an open economy. A country's current account surplus was equal to the present value of expected future declines in output, net of investment and government purchases (called "the net output"). The analogy to household savings is informative: households save when they expect their future labor income to decline. The new element that was introduced by this type of test was how one proxies for private agents' expectations of future values of the relevant variables. Basically as long as the information set used by the econometrician does not contain all the information available to private agents, then past values of the current account should contain information useful in constructing estimates of agents' expectations of future values of the relevant variables (such as net output, interest rates and the

[7] Campbell(1987) has shown that the standard rational expectations consumption function has the implication that savings increase when expected future labor income is expected to decrease.

real exchange rate). The earlier models considered the international real interest rate to be constant and did not include non-tradables.

The leading paper on the subject is the one by Sheffrin and Woo (1990a) who study the case of Belgium, Canada, Denmark and the UK for the period 1955-1985 using a simple intertemporal open economy model. They discover evidence in favor of the theory only in the case of Belgium. Later on, other case studies were conducted and, among them, those which stand out were made by:

- Otto (1992) who considered the case of US and Canada using quarterly data for the period 1950:1 to 1988:4; the formal restrictions implied by the PV relationship for the current account were rejected, revealing only some "informal" evidence in favor for the US case.
- Ghosh (1995) who studied the case of Japan, Germany, the US, Canada and the UK using quarterly data for the period 1960 : 1 - 1988 : 4. He concluded that the model performed quite well in characterizing the direction and turning points of the current accounts, in spite of the fact that the theory was rejected for all the sample countries by US.
- Manteu (1997), who examined the degree to which the intertemporal approach could explain the behavior of the Portuguese current account in period 1958-1992, found that the formal tests rejected the model while the informal evidence showed that the model was able to track the direction of movements of the actual current account.
- McDermott et al. (1999) who wrote a paper for France using quarterly data for the period 1970: 1 to 1996:4 finding that the model explained the fluctuations of the current account balance fairly well, even for a period during which France experienced large external shocks and there were restrictions on overseas capital transactions.
- Khundrakpam and Ranjan (2008) who employed an inter-temporal model on a constructed private consumption series found that the current account balance in India during 1950 and 2006 was intertemporally solvent.
- Campa and Gavilan (2011) who studied the CA dynamics of 10 European countries over three decades and concluded that the ICA model held for Belgium, France, Italy, Netherlands, Portugal and Spain.

A fairly common thread in the findings was that the actual current account was more volatile than the "theoretical" current account: the exception to the rule was US. As Bergin and Sheffrin

(2000) observe, this was quite surprising given the assumptions of the theory which are more appropriate for small open economies than for big ones. This evidence suggested that, most likely, there were some variables, not included in the model, which should have been taken into account to explain the current account.

Sheffrin and Woo (1990a) put forward an explanation which they later used to develop a new version of the model: small economies may be affected strongly by external shocks not passing through changes in net output (a case actually not taken into account in initial versions of the model). In other terms, the current account behavior of small economies could better be described considering shocks arising in the world in general.

How to capture those shocks in the model? Normally this type of shocks would affect a small economy through fluctuations in the interest rates and exchange rates. This is why Bergin and Sheffrin (2000) developed a model that specifically embraced a moving interest rate and the real exchange rate. The intuition boils down to the fact that an anticipated increase in the relative price of internationally traded goods can raise the cost of borrowing from the rest of the world when interest is paid in units of these goods (Dornbush 1983). In turns, changes in the real exchange rate are supposed to induce substitution in consumption between periods, and thus, can have intertemporal effects on a country's current account similar to those of changes in the interest rate. In addition to these intertemporal effects, exchange rate changes of course can also have more direct intratemporal effects by inducing substitution between internationally-traded goods and non-traded goods at some point in time. Bergin and Sheffrin (2000) tested the model for Australia, Canada and the UK and concluded that the incorporation of these variables may help explain the evolution of the current account, as the model predictions better replicated the volatility of the current account data and better explained historical episodes of current account imbalance. This model was also tested for Chile using quarterly data from 1960:1 to 1999:4, concluding that with the inclusion of both a variable real interest rate and the expected appreciation of the exchange rate, the performance of the model improved a lot over the case where these variables were not included (Landeau, 2002).

Clearly the introduction of those two variables is to be considered an important improvement to the intertemporal theory as it takes into account two possible external shocks which should be quite relevant for small developing economies.

4 THE INTERTEMPORAL MODEL: THE MATHEMATIC FORMULATION

The first step in my study is to find the benchmark scenario with which the actual current account behaviour described by the data shall be compared. I decide to follow Bergin and

Sheffrin (2000) approach, which belongs to the Intertemporal Current Account models. I choose this model because, as mentioned before, it features the simultaneous time-variations of interest rates ad exchange rates and I expect this characteristic to be relevant for my European analysis because the Euro has dramatically affected the evolution of the current account fixing the nominal exchange rates among its member countries and changing significantly the average level of interest rates.

The model considers a small country producing both traded and non-traded goods, and allowed to borrow and lend with the rest of the world at a time-varying real interest rate. The representative household solves an intertemporal maximization problem, choosing a path of consumption and debt that maximizes its discounted lifetime utility:

$$\max E_o \sum_{t=0}^{\infty} \beta^t U(C_{Tt}, C_{Nt}) \tag{1}$$

$$\text{s.t. } Y_t - (C_{Tt} + P_t C_{Nt}) - I_t - G_t + r_t B_{t-1} = B_t - B_{t-1} \tag{2}$$

Consumption of the traded good is denoted C_{Tt} while consumption of the non-traded good is C_{Nt}. Y_t denotes the value of current output, I_t is investment expenditure, and G_t is government spending on goods and services, all measured in terms of traded goods. P_t is the price of non-traded goods in terms of traded goods; B_t is the stock of foreign (external) assets at the beginning of the period. Finally, r_t is the net world real interest rate in terms of traded goods[8]. The left-hand side of this budget constraint may be defined as the current account. Also, it is useful to define total consumption expenditure in terms of traded goods as $C_t = C_{Tt} + P_t C_{Nt}$. Bergin and Sheffrin (2000) assume that the per-period utility function takes the following Cobb-Douglas form:

$$U(C_{Tt}, C_{Nt}) = \frac{1}{1-\sigma}(C_{Tt}^{a} C_{Nt}^{1-\propto})^{1-\sigma}$$

where $\sigma > 0$ but $\sigma \neq 1$ (inverse of the intertemporal elasticity of substitution)

and $0 < \alpha < 1$ (share of consumption of traded goods in total consumption)

From the first-order conditions for this problem one can derive the following Euler equation[9]:

$$1 = E_t \left[\beta^{\gamma} (1 + r_{t+1})^{\gamma} \left(\frac{C_t}{C_{t+1}}\right) \left(\frac{P_t}{P_{t+1}}\right)^{(\gamma-1)(1-\propto)} \right] \tag{3}$$

where $\gamma = 1 / \sigma$

Assuming joint log normality and constant variances and covariances, condition *(3)* can be written in logs:

---

[8] This model assumes Y_t, I_t and G_t are exogeneous.

[9] See Bergin and Sheffrin (2000) for the exact derivation.

$$E_t \Delta c_{t+1} = \gamma E_t r^*_{t+1} \qquad (4)$$

$$\text{where } r_t^* = r_t + \left[\frac{1-\gamma}{\gamma}(1-\alpha)\right]\Delta p_t + constant \qquad (5)$$

Bergin and Sheffrin called r^*_t the "consumption-based real interest rate", being a weighted measure of relative prices (*r* and *P*). Also, please note the notation:

$\Delta c_{t+1} = log\, C_{t+1} - log\, C_t$ and $\Delta P_{t+1} = log\, P_{t+1} - log\, P_t$

The constant term at the end of expression *(5)* will drop out of the empirical model when I later demean the consumption real interest rate.

What does equation *(4)* tell us? It says that the expected changes in consumption are a function of the expected consumption-based real interest rate[10], which, as it is said above, reflects both the interest rate and the change in the relative price of non-traded goods:

1. A decrease in the real interest rate, *r*, makes current consumption less expensive in terms of future consumption and induces substitution toward current consumption with elasticity γ;
2. The relative price of non-traded goods, which basically is an exchange rate, plays a crucial role through the net impact of an intra-temporal and an inter-temporal effect.
    2.1. A change in this exchange rate induces an inter-temporal substitution effect on consumption. If the price of traded goods is temporarily low but expected to decline, then the future repayment of a loan in traded goods has a higher cost in terms of the consumption bundle than in terms of traded goods alone; the consumption-based interest rate *r**, rising above the interest rate *r,* lowers the current total consumption expenditure by elasticity $\gamma\ (1 - \alpha)$.

    2.2. Changing the relative price of non-traded goods causes also an intra-temporal substitution. Again if the price of traded goods is temporarily low relative to non-traded goods, households will substitute toward traded goods by the intra-temporal elasticity (which is 1 under our Cobb-Douglas assumption). The result is an increase in total current consumption expenditure by elasticity $(1\text{-}\alpha)$. This intra-temporal effect will dominate the inter-temporal effect if the inter-temporal elasticity is smaller than unity[11] $(\gamma < 1)$ (Bergin & Sheffrin, 2000).

Now, combining the intertemporal budget constraint *(2)* with *(4)*, I reach the solution of the maximization problem (1):

[10] Following Bergin and Sheffrin (2000) I will use the real exchange rate as proxy for P_t

[11] This is what I will assume in my analysis. I will estimate the model giving three values (0.1, 0.25 and 0.5) to γ.

$$\sum_{t=0}^{\infty} E_0(R_t C_t) = \sum_{t=0}^{\infty} E_0(R_t NO_t) + B_0 \qquad (6)$$

where:

- NO_t is the net output[12] and is defined as $NO_t = Y_t - I_t - G_t$;
- R_t is the market discount factor for date t consumption such that:

$$R_t = \frac{1}{\prod_{j=1}^{t}(1 + r_j)}$$

- The below transversality condition is assumed to be satisfied

$$\lim_{T\to\infty} E_0(R_t B_t) = 0$$

- B_0 is initial net foreign assets

Bergin and Sheffrin (2000) consider a more tractable expression for this inter-temporal budget constraint by log-linearizing *(6)* around the steady state in which net foreign assets are 0. They show[13] that *(6)* will take the form:

$$-\sum_{t=1}^{\infty} \beta^t \left[\Delta no_t - \frac{\Delta c_t}{C} - \left(1 - \frac{1}{C}\right) r_t\right] = no_0 - \frac{c_0}{C} + \left(1 - \frac{1}{C}\right) b_0 \qquad (7)$$

where lower case letters represent the logs of upper case counterparts (except in the case of the world real interest rate[14]) and C is a constant[15] smaller than unity.

Taking expectations of *(7)* and combining it with *(4)* one obtains:

$$-E_t \sum_{i=1}^{\infty} \beta^i \left[\Delta no_{t+1} - \frac{\gamma}{C} r_{t+i}^* - \left(1 - \frac{1}{C}\right) r_t\right] = no_0 - \frac{c_0}{C} + \left(1 - \frac{1}{C}\right) b_0 \equiv CA_t^* \qquad (8)$$

When *C=1* (that is when the steady state around which the linearization takes place is one where net foreign assets are zero), *(8)* simplifies into:

$$-E_t \sum_{i=1}^{\infty} \beta^i [\Delta no_{t+1} - \gamma\, r_{t+i}^*] = no_t - c_t \equiv CA_t^* \qquad (9)$$

Equation *(9)* plays a crucial role in the whole model as it illustrates the consumption feature of current account. In fact, it says that the current account is in deficit when the present discounted value of future net output changes (reduced by the consumption interest rate) is positive; if net output is expected to rise, current account (RHS) falls, ceteris paribus, as the representative household smoothes its consumption. In a similar fashion, the equation says that a rise in the consumption-based interest rate will raise the current account by making the representative

[12] Net out-put is random and the source of uncertainty in the model. See foot note 8.

[13] See Bergin and Sheffrin (2000) for the detailed derivation.

[14] The approximation that *log* $(1+r_t) \approx r_t$ is used.

[15] $C = 1 - B/\sum_{t=0}^{\infty} R_t B_t$ where B is the steady state value of net foreign assets.

agent lower consumption below its smoothed level. It follows that the contemporaneous current account is a predictor of future increases in net output; a country will run a current account surplus only if it expects its net output to be falling in the future or the consumption based interest rate to be rising.

In this model net output plays the role of labor income and the current account the role of savings. For example, if a country is experiencing a temporary productivity increase, the optimal response is to run a current account surplus. This will insure that planned consumption will be smoothed in the economy (Sheffrin and Woo 1990).

5 THE ECONOMETRIC METHOD

5.1 A Framework for testing the model

The methodology that here I present to test relationship *(9)* was developed by Campbell (1987) and Campbell and Schiller (1987) for the permanent income hypothesis.

5.1.1 Granger-causality

A weak implication of equation *(9)* is that current account CA^* should Granger-cause Δno and r^*. In practice this yields that CA^* should have some incremental explanatory power for the future values of Δno and r^*. The intuition behind this result is that CA^* is an optimal forecast for the weighted sum of the future values of the difference between Δno and γr^*, conditional upon the agent's total information set. It is worth noting that *Granger-causality* does not necessarily mean that a cause-effect relationship is established but solely suggests that changes in CA are former to changes in Δno.

5.1.2 R-test

While the formal restrictions in *(4)* look complicated, they actually reduce to a very simple relationship. Sheffrin and Woo (1990) show that testing *(4)* is equivalent to testing the hypothesis that $E(R_t \mid I_{t-1})=0$, where:

$$R_t \equiv CA^*_t - (\Delta no_t - \gamma r^*_t) - (1+r)\, CA^*_{t-1}$$

and where I_{t-1} is any information available at $t-1$

This states that the difference between the forecast and the actual current account is unpredictable, given the relevant information set. I test this assumption constructing R_t first and running appropriate regressions[16] with lagged values of the stationary series Δno, CA^* and r^*, then. The null hypothesis is that the estimated coefficients associated to the independent variables are all zero. This test is known in the ICA literature as "R-Test".

[16] I choose the number of lags according to the order of VAR which best fits the data and I use for the model.

5.2 Vector Auto Regressive model

Testing equation *(9)* means that I want to check whether expected future values of net output and the consumption based interest rate actually determine the current account.

The first step, thus, is to find proxies for these two groups of variables. A simple approach would be to regress each variable of interest (the net output, the real interest rate and the exchange appreciation) on past values of itself. However Ghosh (1995) warns that this procedure is most likely misleading as it does not take into consideration the larger information set that representative household use in creating their expectations.

A more complex, and common, procedure is to project the variables forward on the basis of pasta data through a Vector Auto Regressive (VAR) model where the past values enter into forming expectations. Campbell and Shiller (1987) proposed to consider the term in the squared brackets of *(9)* as a single variable for building expectations: this would yield a two variable VAR model. Bergin and Sheffrin (2000), however, chose to consider $\Delta no_{t+1} and\ \gamma\ r^*_{t+i}$ as two different variables and estimate a three variable VAR.

Under the null hypothesis of *(9)*, the current account itself should incorporate all of the consumers' information on future values of the linear combination of the interest rate, net output and real exchange rate specified in that equation[17]. This leads me to estimate a three-variable VAR to represent consumers' forecasts:

$$\begin{bmatrix} \Delta no \\ CA^* \\ r^* \end{bmatrix}_t = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} \Delta no \\ CA^* \\ r^* \end{bmatrix}_{t-1} + \begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix}_t \tag{10}$$

Equivalently (10) can be written as: $z_t = Az_{t-1} + u_t$, where $E(z_{t+i}) = A^i z_t$. It is worth noting that this can be generalized for higher or lower orders of VAR. For example, in Sheffrin and Woo (1990) the third equation and variable are omitted as interest rates and exchange rates are considered constant.

The data in this VAR is a subset (H_t) of the data (I_t), available to the economic agents and should simply be viewed as a statistical relationship (Sheffrin and Woo 1990).

Expressing the restriction *(9)* using *(10)*, we obtain:

$$hz_t = -\sum_{i=1}^{\infty} \beta^i [g_1 - \gamma g_2] A^i z_t \tag{11}$$

where $g_1 = [1\ 0\ 0\ ]$, $g_2 = [0\ 0\ 1]$ and $h = [0\ 1\ 0]$.

[17] Here the crucial role is played by expectations of the shocks rather than the shocks themselves.

These restrictions are obtained by projecting *(9)* onto the information set, H_t. This yields the restrictions on the VAR given in *(11)*. These restrictions insure that for any z_t, the current account (the left-hand side) equals the opposite of the difference between the expected present value of declines in net output and increase in consumption real interest rate (the right-hand side).

If the VAR is stationary, I can write *(11)* as:

$$CA_t^* = \{-[g_1 - \gamma g_2]\, \beta\, A\, (I - \beta A)^{-1}\}\, z_t \tag{12}$$

With some values for the parameters β, γ and b and the estimated VAR parameters, I obtain a model prediction[18] of the optimal current account variable:

$$\widehat{CA}_t^* = k\, z_t \tag{13}$$

where: $k = -\,[g_1 - \gamma g_2]\, \beta\, \hat{A}\, \left(I - \beta \hat{A}\right)^{-1}$ and $\hat{A}$ is the matrix of estimated parameters from the VAR. Bergin and Sheffrin (2000) note that kz_t is not a forecast of the current account in the conventional sense, but rather a representation of the model's restrictions. What is more, if the restrictions of the theory were consistent with the data (i.e. $\widehat{CA}_t^* = CA_t^*$), then the vector k should equal [0 1 0]. The immediate consequence is that the model can be tested statistically by using the delta method to calculate a χ^2 statistic for the hypothesis[19] that k = [0 1 0]. In other words, if agents have more information about future cash flows (say, a rise in G government spending[20] at t_{+1}) then this information should be reflected in the contemporaneous *CA* (a *CA* surplus at t) as the *CA* at t captures the consumer's best estimate of the PV of future cash flow changes.

To statistical test this, from the estimates of the VAR(1) model one can calculate:

$$k = -(g_1 - \gamma g_2)\beta A(I - \beta A)^{-1} \tag{14}$$

where A is the matrix of parameters from the VAR(1) model, I is an identity matrix, and β and γ are known constants. Then, given the following notation:

$$g_1 = [1,0,0] \text{ and } g_2 = [0,0,1], \text{ so } g_1 - \gamma g_2 = [1,0,0]\ - \gamma[0,0,1] = [1,0,-\gamma] = x$$

One should post-multiply both sides of equation *(14)* by the matrix $(I - \beta A)$:

[18] An informal test will be the graphical comparison of this model with the actual data and the ratio of the standard deviations.

[19] The hypothesis is k = [0 0 1 0 0 0] when the VAR is of the second order and the derivation is shown in Appendix A.

[20] A rise in *G* means a reduction of *NO,* having defined *NO=Y-I-G,* and a negative change in *NO* translates to a positive *CA* according to *(9)*.

$$k(I-\beta A) = -x\beta A(I-\beta A)^{-1}(I-\beta A) = -x\beta A$$

$$kI - \beta kA = -x\beta A$$

$$kI = -\beta kA - x\beta A = -\beta(k+x)A$$

$$(-1/\beta)kI = (k+x)A \qquad (15)$$

Then, keeping in mind that I want to test the hypothesis that the estimated k is equal to the theoretical k = [0 1 0], using this theoretical k in the LHS of equation *(15)*, one gets:

$$\left(-\frac{1}{\beta}\right)kI = \left(-\frac{1}{\beta}\right)k = \left[0, -\frac{1}{\beta}, 0\right] \qquad (16)$$

Similarly, inserting in the RHS of the equation *(15)* the values for x and k, I would obtain:

$$(x+k) = [1, 0, -\gamma] + [0, 1, 0] = [1, 1, -\gamma] \qquad (17)$$

Multiplying equation *(17)* times the A matrix one gets:

$$(x+k)A = [1, 1, -\gamma] \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} =$$

$$[a_{11} + a_{21} - \gamma a_{31}, a_{12} + a_{22} - \gamma a_{32}, a_{13} + a_{23} - \gamma a_{33}] \qquad (18)$$

So the hypothesis to be tested is *(16)=(18)*, that is:

$$[0, -1/\beta, 0] = [a_{11} + a_{21} - \gamma a_{31}, a_{12} + a_{22} - \gamma a_{32}, a_{13} + a_{23} - \gamma a_{33}]$$

In statistical terms, this means that I must set three restrictions to the parameters of the VAR(1) model.

6 THE DATA

6.1 General characteristics

Source: Following the previous papers on the inter-temporal approach, I have used the International Financial Statistics published by the International Monetary Fund as my primary source.

Countries: EA-12.

Period covered: 1980-2009. The period is chosen partly arbitrarily and partly is defined by the availability of data. It is meant to span over a large horizon so to include pre-euro years and the first decade of the euro experience. The upper bond is constrained by the unavailability of data for the real exchange rate after 2009, while the lower bond is arbitrary. However, the horizon is shorter for some countries[21], due to their own more limited data availability. It is also worth mentioning that in the aftermath of the financial crisis (2008-2009), several European countries started experiencing *sudden stops* (Gros and Alcidi 2013) as described in the introduction of this paper*;* this type of episode eludes the assumption of capital mobility and therefore the time period when the *stops* took place should not be included in the analysis.

Periodicity: One of the first challenges is to choose between quarterly and annual data. It has been shown in the literature that the empirical evaluation of inter-temporal current account models using annual data produces misleading results (Campa and Gavilan 2011). I decided not to use annual observations for three reasons: firstly, there is generally larger uncertainty about annual estimates (Bergin and Sheffrin, 2000); secondly, there are concerns about the performance of the empirical method on small samples (Mercereau and Jacques, 2004); finally, annual observations would not allow close analysis of the before and after crisis situations. My main reference, Bergin and Sheffrin, used quarterly data and this is the approach I prefer to follow too: using quarterly seasonally adjusted data. However, as Campa and Gavilán (2011) noted, this would exclude Greece from the analysis as quarterly data (earlier than 2000) are not available for this country. In order to solve this problem and include Greece, I increased the frequency of the earlier-than-2000 Greek data from a low (annual) to a higher (quarterly) level.

6.1.1 Seasonally Adjusted Time series: TRAMO-SEATS method

Seasonality: As previously mentioned, the time series used in this study come from the International Financial Statistics of the IMF. Nonetheless, only some of these series are seasonally adjusted. In particular, while data available for France, Germany, Italy, the Netherlands and Spain are seasonally adjusted, the data for the remaining Austria, Belgium, Finland, Greece, Ireland, Luxemburg and Portugal are not.

This has required me adjust them seasonally. Among the different methodologies available to this scope (X11, X11ARIMA, X12ARIMA,TRAMO-SEATS, …), I chose to use TRAMO (Time series Regression with ARIMA noise, Missing observations, and Outliers) and SEATS (Signal Extraction in ARIMA Time Series). This parametric approach, developed by the Bank of Spain and nowadays largely used across Europe, complies with the recommendations of the European Statistical System[D] (ESS). It has two phases: the first consists of a pre-adjustment step and the second consists of the proper seasonal adjustment.

During the initial phase, there are adjustments for working days based on a regression model. Also, during this step three types of outliers are corrected (additive outlier, transitory change

[21] 1995-2009 for Greece and Luxemburg, 1997-2009 for Ireland, 1989-2009 for Portugal.

and level shift). During this phase different observations are made comparable with respect to their working day structure. Then a linear time series model is fitted to it: the goal is to describe the interdependency apparent on the time axle of observations by means of a mathematical equation.

At this point the actual seasonal adjustment can start. The idea is to compute the adjusted values by taking into consideration not only the value of the trend series at time t but also values before it (t_{-i}) and after it (t_{+i}), as a weighted sum. It is important to keep in mind that the use of weighting coefficients are determined by the time series model chosen, therefore an individual seasonal adjustment formula becomes tailored for each time series that has to be seasonally adjusted[E].

6.1.2 Frequency conversion for Greece

As mentioned earlier, the amount of quarterly data available for Greece is much smaller than for the other European countries taken into consideration in this study. While Campa and Gavilán (2011) prefer to exclude Greece from their research for this reason, I find it too interesting to include Greece in my study (as the development of its Current Account is one of the most interesting in these days of crisis) to drop it so easily.

IFS provide quarterly data starting from the first quarter of 2000 for GDP, Private consumption, public consumption and investment. Interestingly, however, quarterly data are available for imports and exports already since the first quarter of 1980 (starting point of my study temporal horizon).

In order to obtain quarterly data for those time series (*GDP, C, G* and *I*) whose values are missing during the 1980-1999 period, I chose a simple linear interpolation procedure (I assigned each value in the low frequency series to the last high frequency observation associated with the low frequency period, then I placed all intermediate points on straight lines connecting these points) to convert the low frequency data (annual) into higher frequency data (quarterly).

It is obvious that this method does not allow me to recover the true values of the underlying high frequency series and, thus, the results from studying this series should be dealt with carefully.

6.2 Defining the variables

- **Net output**: Following Sheffrin Woo (1990) & Bergin Sheffrin (2000), I subtracted the sum of investment (*gross fixed capital formation*) and government purchases (*public* *final consumption*) from GDP and deflated by GDP 2005 deflator and by national[22] population. Equation *(9)* uses this variable in logged and differenced form.

- **Consumption**: *Private final consumption* (IFS).

- **Current Account**: Following Bergin and Sheffrin (2000), I subtracted the log of consumption, adjusted for population and 2005 GDP deflator, from the log of net output. This method is preferred over the alternative of using the current account data from the balance of payments because the latter procedure requires an arbitrary allocation of the "errors and omissions" into the current account.

- **Consumption based real interest rate**: I computed it using the world real interest rate and the country-specific expected exchange rate series as specified by equation *(5)*.

- **World real interest rate**: I used the anticipated world real interest rate as proxy. This is calculated as the difference between the one year world nominal interest rate and the expected inflation:

    - **One year world nominal interest rate**: I have found two main approaches in the literature. Bergin & Sheffrin (2000) follow the method of Barro and Sala I Martin (1990), collecting data on nominal interest rates for the G-7 economics (Canada, France, Germany, Italy, Japan, United Kigdom and United States): one same interest rate series is used for all the countries. Another possibility consists of using the Short-Term Interest Rate (*IRS*) provided by the OECD Economic Outlook 91[23]: this interest rate differs across countries for the period preceding the introduction of the Euro. I chose the latter approach and annualized the raw data obtained from OECD.

    - **Expected inflation**: Following Barro and Sala I Martin (1990), this is calculated as a forecast using an ARMA model from the Consumer Price Index (2005=100). I used a rolling forecast approach: always adding a new observation

[22] Population data is from the OECD Statistics. The data was annual, therefore I increased its frequency using a linear-match-last method.

[23] The Outlook did not have data for Germany, Ireland and Greece for the periods 1990-1990, 1980-1989 and 1980-1994 respectively. I partially solved the problem retrieving data from the Monthly Monetary and Financial Statistics: that data covered the 1980-1990 period for Germany (NB: this data does not include the Democratic Republic of Germany) and 1984-1989 for Ireland; no additional useful data for Greece was found.

and dropping the oldest one. Therefore all the forecasts[24] are based on the same number of observations (I chose a window of 20 observations, i.e. 5 years).

- **Real exchange rate**: I used as a proxy for P_t, the measure of the real effective exchange rate derived from IFS. In particular, I used the relative unit labor costs, indexed 2005 and seasonally adjusted, for all countries but Greece, for which this seasonally adjusted indicator was not available; therefore, I had to seasonally adjust the data (TRAMO/SEATS) for Greece. Also, data for Portugal, Luxemburg and Greece started in 1984. An ex-ante expected exchange rate appreciation is computed using a rolling AR(1) forecast (with a 20 observations window) for all the countries. This series ends in 2009Q4 for all the countries.

Because I am interested in the dynamic implications of the inter-temporal model, I demeaned[25] the three series, Δno, CA^*, r^*.

6.3 Defining the parameters

Previous literature shows that tests of condition *(9)* are contingent on values for the parameters β (the discount factor), α (the relative share of traded goods in consumption) and γ (the inter-temporal elasticity of substitution).

The discount factor β is easily defined as $\beta=1/(1+\bar{r})$, where $\bar{r}$ is the sample mean for the real interest rate.

Regarding the share of traded goods in private final consumption α, I calculated it using data provided by Eurostat under the input-output tables found in the national workbooks. I used data in NAce rev 1.1 rather than the newer NAce rev 2 because the latter has not yet been adapted by many countries and would have caused problems when comparing the results. I included agriculture, manufacturing, mining, retail and transportation in the traded sector (Nace rev 1.1 codes 1-37, 50-52, 60) and public utilities (such as water and electricity), construction, personal services and banks in the non-traded sector (Nace rev 1.1 codes 40-41, 45, 55, 61-95), and so I simply computed the shares.

---

[24] Using the correlograms of the actual observed inflation, I chose: ARMA(1,2) for Austria & Finland, ARMA(1,1) for Belgium & France, AR(4) Germany & Ireland & Luxemburg, ARMA(2,1) for Greece, ARMA (2,2) for Italy , ARMA (3,3) for the Netherlands and Portugal, AR(2) for Spain.

[25] Sheffrin and Woo (1990) remove the means from their series in order to allow for the possibility that aggregate positive savings can exist with trends in labor income when there is technical progress and younger generations are thereby born with a higher level of permanent income. This allows testing only the dynamic restrictions of the theory.

The inter-temporal elasticity γ was supposed to be the most problematic to compute because there exist a wide range of estimates in the literature and their value depends remarkably on the context and the procedure according to which it is calculated[26]. Given this uncertainty, as Campa and Gavilán (2011) did, while I chose the value 0.25 as the reference value for my work, I also checked how the main results changed when the elasticity was 0.1 or 0.5.

Table 1 shows for each country some descriptive statistics and the data used in the estimation considering $\gamma = 0.25$. The first row reports the sample period used for each country. This is the longest time period for which all the needed information is available and goes from 1980q1 to 2010q1 for the majority of the countries. The exceptions are Greece, Ireland and Luxemburg. For Greece the data starts in 1995 because this is the first year for which I have information about the IRS, for Ireland quarterly data is only available starting in 1997, for Luxemburg in 1995. For Germany the data before 1991 (year of the unification) does not include the figures for the German Democratic Republic. Those particularities for each country certainly could negatively affect the ability of the model to explain the current account fluctuations and will be taken into consideration when drawing the final conclusions.

The share of traded goods (*alpha*) ranges from 0.27 in Ireland and 0.29 in Finland and the Netherlands to 0.39 in Greece, 0.38 in Italy and 0.37 in Portugal; it is interesting to note that the richer European countries do not tend to have a lower share than the relatively poorer countries, as previously noted by Campa & Gavilán (2011). The discount factor (*beta*) does not change much among the countries (the standard deviation is just 0.24%): it is comprised in the interval 0.9910 (Finland) and 0.9978 (Ireland), mainly because the short term interest rates are the same for all the countries since their joining to the Euro. However it is worth noting that the standard deviation of the consumption based interest rate, although still fairly low (0.54%) is more than double the discount factor's one.

On the one hand, large differences exist in the mean values of our measures of the current account among countries[27]: Portugal, for example, shows an average deficit of 0.14 while for Ireland I find a mean surplus of 0.25. On the other hand, the standard deviation for the change in net output is low.

[26] Beaudry and van Wincoop (1996) estimate it to be around the unity while Hall (1988) concludes that it must be really close to zero, for example.

[27] It is fundamental to keep in mind that the averages for different countries span over different time horizons.

Table 1. Descriptive Statistics and key parameter values.

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Luxemburg	Netherlands	Portugal	Spain
Period	1980q1-2010q1	1980q1-2010q1	1980q1-2010q1	1980q1-2010q1	1980q1-2010q1	1995q1-2010	1997q1-2010q1	1980q1-2010q1	1995q1-2010q1	1980q1-2010q1	1980q1-2010	1980q1-2010q1
alpha	0.33	0.31	0.29	0.34	0.35	0.39	0.27	0.38	0.35	0.29	0.37	0.33
beta	0.9943	0.9919	0.9910	0.9926	0.9934	0.9975	0.9978	0.9926	0.9971	0.9930	0.9974	0.9948
Mean CA*	0.0491	0.0537	0.0753	0.0033	0.0600	-0.0999	0.2461	0.0192	0.5057	0.0994	-0.1415	-0.0269
Mean Δno	0.0045	0.0049	0.0055	0.0029	0.0033	0.0046	0.0090	0.0032	0.0081	0.0038	0.0047	0.0039
Mean r	0.0057	0.0082	0.0091	0.0074	0.0067	0.0025	0.0022	0.0075	0.0029	0.0071	0.0026	0.0053
Mean Δp	-0.0038	-0.0017	-0.0026	-0.0020	0.0015	0.0039	-0.0087	0.0024	0.0005	-0.0017	0.0031	0.0017
(1-a)(1-γ)/γ	2.02	2.07	2.13	1.99	1.95	1.83	2.18	1.85	1.96	2.13	1.89	2.00
Mean r*	-0.0020	0.0045	0.0037	0.0035	0.0096	0.0090	-0.0058	0.0121	0.0011	0.0035	0.0110	0.0088

variable	st deviation
alpha	3.774 %
beta	0.243 %
Mean CA*	16.856 %
Mean Δno	0.191 %
Mean r	0.246 %
Mean Δp	0.353 %
Mean r*	0.544 %

comparisons across the 12 countries

Legend

alpha	Relative share of traded goods in private final consumption
beta	Discount factor
CA*	Current Account
Δno	Change in Net Output
r	World real interest rate
Δp	Change in relative price of non-traded goods in terms of traded goods
r*	Consumption based real interest rate

7 EMPIRICAL RESULTS

7.1 Checking the stationarity assumption

Before estimating the VAR model, it is necessary to verify that the variables that I want to use are stationary; those are: the change in net output, the current account, the real interest rate and the appreciation of the real exchange rates.
Tests of the hypothesis are very sensitive to the methods used to handle the evident non-stationarities of the relevant economic time series (current account). Simple detrending can lead to spurious rejections (Mankiw and Shapiro 1985), while first differencing of all variables is inappropriate in systems in which variables are cointegrated (Engle and Granger 1987). Statistical inference of non-stationary regressors is also highly sensitive to incidental parameters (West 1988).

In general the non-stationarity hypothesis is rejected without problems for the consumption real interest rate and for the change in net output. I have encountered more challenges with the stationarity hypothesis of the current account, which is generally rejected in levels by all the tests that I used: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkoski-Phillips-Schimidt-Schin (KPSS)[28]. However it is worth noting that the KPSS null hypothesis (Current Account is stationary) is not rejected for France, Ireland and Italy when using the current account in levels.
The unit root hypothesis is rejected for all the countries (but Finland, France and Luxemburg) when using demeaned values and without the constant. As expected, all the CA series are stationary in first differences.

In order to accept the results of ADF tests, I have studied the error terms and checked whether the assumptions of the Dickey-Fuller test are satisfied. First I looked at the autocorrelations with regards to their significance per lag[29] and then jointly, using Ljung-Box test statistics; then I looked at the normality of the residuals.

The following table (Table 2) shows the details of the above mentioned stationarity tests. In particular it is important to underline that while the share of traded goods changes across countries, the intertemporal elasticity is assumed to be the same for all the countries and equal to 0.25.

---

[28] For KPPS: the null is rejected at 1% for values of LM-Statistic higher than 0.74, at 5% for values between 0.739 and 0.463, at 10% for values between 0.462 and 0.347. For values lower than 0.347, the null hypothesis holds.
[29] If $|\rho| > \frac{2}{\sqrt{T}}$, then the lag is statistically significant and there is no autocorrelation; this means that the process could be White Noise as the assumptions state.

Country	Share of traded goods	Time range	In levels with C			I(1)	Demeaned without C
			ADF	PP	KPSS	ADF	ADF
AUSTRIA	0.33	1980-2010					
Current account			0.390	0.227	**0.457***	**0.00*****	**0.07***
Interest rate			**0.00*****				
Change in net output			**0.00*****				
BELGIUM	0.31	1980-2010					
Current account			0.178	0.254	**0.834*****	**0.00*****	**0.005*****
Interest rate			**0.00*****				
Change in net output			**0.00*****				
FINLAND	0.29	1980-2010					
Current account			0.600	0.569	**0.566****	**0.00*****	0.192
Interest rate			**0.00*****				
Change in net output			**0.017*****				
FRANCE	0.34	1980-2010					
Current account			0.678	0.497	0.262	**0.00*****	0.299
Interest rate			**0.00*****				
Change in net output			**0.00*****				
GERMANY	0.35	1980-2010					
Current account			0.117	0.117	**0.3692***	**0.00*****	**0.023*****
Interest rate			**0.00*****				
Change in net output			**0.00*****				
GREECE	0.39	1998-2010					
Current account			0.310	**0.006*****	**0.628****	**0.009*****	**0.096***
Interest rate			**0.00*****				
Change in net output			**0.00*****				
IRELAND	0.27	1997-2010					
Current account			0.761	0.543	0.131	**0.00*****	**0.023*****
Interest rate			**0.00*****				
Change in net output			**0.00*****				
ITALY	0.38	1980-2010					
Current account			0.263	0.399	0.286	**0.00*****	**0.029*****
Interest rate			**0.00*****				
Change in net output			**0.00*****				
LUXEMBURG	0.35	1995-2010					
Current account			0.6525	0.730	**0.905*****	**0.00*****	0.179
Interest rate			**0.00*****				
Change in net output			**0.00*****				
NETHERLANI	0.29	1980-2010					
Current account			0.201	0.340	**1.286*****	**0.00*****	**0.009*****
Interest rate			**0.00*****				
Change in net output			**0.00*****				
PORTUGAL	0.37	1980-2010					
Current account			0.369	0.330	**0.475****	**0.00*****	**0.01*****
Interest rate			**0.00*****				
Change in net output			**0.008*****				
SPAIN	0.33	1980-2010					
Current account			**0.096***	**0.089***	**0.479****	**0.00*****	**0.009*****
Interest rate			**0.00*****				
Change in net output			**0.00*****				

Notation *=10%, **=5%, ***=1%

Table 2. Stationarity check.

7.2 Estimating the VAR Systems

In order to estimate the VAR I first demeaned all the variables to be included in it. The reason behind this choice is that the ICA model restricts the dynamic interrelation among the variables but not their mean values. The fact that I subtract the mean implies that the variables become "deviations" (from the means) and, in turn, allows me to drop the constant term present in the VAR. The variables that I incorporate in the VAR (after having demeaned them) are the change in net output, the current account and the consumption-based real interest rate.

The first stage is then to choose an appropriate lag length[30] for the VAR. The approach that I have adopted is to choose the most parsimonious VAR, taking into consideration the Akaike (AIC) and Schwarz (BIC) information criteria; when the two criteria suggested the same number of lag, I just picked the VAR model with that number of lags but when the two criteria advised different number of lags I chose the VAR model with least number of lags (i.e., the most parsimonious). I then verified that the residuals of the chosen VAR models satisfied the WN assumptions[31] using the Portmanteau test for Autocorrelations (whose null hypothesis is that there is no residual autocorrelations up to lag $p+1$, where p is the number of lags in the VAR) and looking at the off-diagonal elements of the covariance matrix of the residuals (in fact, zero co-variances show the absence of concurrent linear relationship among the series).

7.3 Implications from the Intertemporal Current Account model: CA dynamics

Table 3 displays the results of the R-test, the k-test and the Granger causality test (comments on the table results are in the following paragraph). These tests are performed taking into consideration the longest time period available for each country and are repeated for each of the three γ values earlier mentioned. The table shows also the number of lags chosen per each country per each value of γ.

The R-test is executed as explained in paragraph 5.1.2: I work out R_t, using the computed demeaned values of ΔNO, r^* and CA, and test the null hypothesis that the estimated coefficients associated to the independent variables are all zero, i.e. the difference between the forecast and the actual current account is unpredictable. The model predictions would hold if this null hypothesis was not rejected.

[30] In the literature of intertemporal current account approach generally VAR models with few lags are used. Obsfeld and Rogoff (1994) use a VAR(1) for UK; Sheffrin and Woo (1990a) use VAR(2) for Belgium, Canada, Denmark and UK; Bergin and Sheffrin (2000) use both VAR(1) and VAR(2) models in their study of Australia, Canada and UK; Campa and Gavilán (2011) also used both VAR(1) and VAR(2) for their European sample.

[31] This was not the case for Finland and France.

AUSTRIA	1980Q3-2009Q4		
γ	0.10	0.25	0.50
VAR(x)	1	1	2
R-test (Prob Fstat)	0.2878	0.2175	0.1022
k-test (Δ*NO* coef)	-0.2704	-0.2707	-0.3009
k-test (*CA* coef)	1.8147	1.8249	1.7712
k-test (*r** coef)	0.0016	-0.0043	0.0042
CA*NGC(Δno-γr*)	0.0344	0.0510	0.1865
(Δno-γr*) NGC CA*	0.5788	0.5690	0.8517

BELGIUM	1980Q3-2009Q4		
γ	0.10	0.25	0.50
VAR(x)	2	1	2
R-test (Prob Fstat)	0.0000	0.0000	0.0000
k-test (Δ*NO* coef)	-0.4306	-0.6292	-0.4734
k-test (*CA* coef)	1.7921	1.8475	1.8713
k-test (*r** coef)	-0.0086	-0.0608	-0.2168
CA*NGC(Δno-γr*)	0.0444	0.0868	0.2583
(Δno-γr*) NGC CA*	0.7785	0.7989	0.7912

FINLAND	1980Q3-2009Q4		
γ	0.10	0.25	0.50
VAR(x)	2	2	2
R-test (Prob Fstat)	0.0079	0.0000	0.0127
k-test (Δ*NO* coef)	-0.1473	-0.1336	-0.2048
k-test (*CA* coef)	2.1215	2.1632	2.1993
k-test (*r** coef)	0.0987	0.0561	0.1957
CA*NGC(Δno-γr*)	0.1605	0.1931	0.1703
(Δno-γr*) NGC CA*	0.0257	0.0349	0.0777

FRANCE	1980Q3-2009Q4		
γ	0.10	0.25	0.50
VAR(x)	1	1	1
R-test (Prob Fstat)	0.0369	0.1096	0.0008
k-test (Δ*NO* coef)	0.6864	0.5705	0.5834
k-test (*CA* coef)	1.9686	1.9640	1.9718
k-test (*r** coef)	-0.0303	-0.0720	-0.2565
CA*NGC(Δno-γr*)	0.8292	0.9744	0.9672
(Δno-γr*) NGC CA*	0.0398	0.0632	0.0198

GERMANY	1980Q3-2009Q4		
γ	0.10	0.25	0.50
VAR(x)	1	1	2
R-test (Prob Fstat)	0.0059	0.0040	0.4293
k-test (Δ*NO* coef)	0.3060	0.3184	0.1016
k-test (*CA* coef)	1.8701	1.8765	2.2774
k-test (*r** coef)	-0.0220	-0.0611	-0.1351
CA*NGC(Δno-γr*)	0.3002	0.3268	0.0100
(Δno-γr*) NGC CA*	0.9398	0.9443	0.7710

GREECE	1995Q3-2009Q4		
γ	0.10	0.25	0.50
VAR(x)	2	2	2
R-test (Prob Fstat)	0.0261	0.0297	0.0353
k-test (Δ*NO* coef)	0.7749	0.6953	0.3889
k-test (*CA* coef)	1.3087	1.3646	1.5892
k-test (*r** coef)	0.1064	0.3892	1.3839
CA*NGC(Δno-γr*)	0.3622	0.2693	0.1424
(Δno-γr*) NGC CA*	0.0000	0.0000	0.0000

IRELAND	1997q3-2009q4		
γ	0.10	0.25	0.50
VAR(x)	1	1	1
R-test (Prob Fstat)	0.4056	0.5479	0.6202
k-test (Δ*NO* coef)	-0.1537	-0.1654	-0.1629
k-test (*CA* coef)	1.8603	1.8654	1.8732
k-test (*r** coef)	-0.0939	-0.2503	-0.5321
CA*NGC(Δno-γr*)	0.5611	0.6298	0.8175
(Δno-γr*) NGC CA*	0.2413	0.3145	0.5259

ITALY	1990q4-2009q4		
γ	0.10	0.25	0.50
VAR(x)	1	1	1
R-test (Prob Fstat)	0.0028	0.0053	0.0105
k-test (Δ*NO* coef)	-0.0970	-0.0454	0.2403
k-test (*CA* coef)	1.9304	1.8968	1.4216
k-test (*r** coef)	-0.0403	-0.1625	-0.1353
CA*NGC(Δno-γr*)	0.5738	0.5533	0.4925
(Δno-γr*) NGC CA*	0.5383	0.3817	0.1659

LUXEMBURG	1995q2-2009q4		
γ	0.10	0.25	0.50
VAR(x)	1	1	1
R-test (Prob Fstat)	0.0000	0.0000	0.0000
k-test (Δ*NO* coef)	0.4213	0.4183	0.4210
k-test (*CA* coef)	1.9251	1.9295	1.9394
k-test (*r** coef)	0.1303	0.3590	0.6070
CA*NGC(Δno-γr*)	0.7596	0.7943	0.8540
(Δno-γr*) NGC CA*	0.0000	0.0000	0.0000

THE NETHERLANDS	1980q4-2009q4		
γ	0.10	0.25	0.50
VAR(x)	2	1	1
R-test (Prob Fstat)	0.0574	0.0255	0.0716
k-test (Δ*NO* coef)	0.1391	-0.1105	-0.1298
k-test (*CA* coef)	1.4665	1.8143	1.8324
k-test (*r** coef)	-0.0573	-0.1888	-0.4963
CA*NGC(Δno-γr*)	0.0007	0.0010	0.0117
(Δno-γr*) NGC CA*	0.1674	0.8532	0.9550

PORTUGAL	1989q3-2009q4		
γ	0.10	0.25	0.50
VAR(x)	1	1	2
R-test (Prob Fstat)	0.1537	0.1515	0.0682
k-test (Δ*NO* coef)	-0.2929	-0.2888	-0.3759
k-test (*CA* coef)	1.8312	1.8358	1.8754
k-test (*r** coef)	-0.0160	-0.0352	-0.2287
CA*NGC(Δno-γr*)	0.9010	0.8794	0.8083
(Δno-γr*) NGC CA*	0.3836	0.3792	0.6940

SPAIN	1980q4-2009q4		
γ	0.10	0.25	0.50
VAR(x)	2	2	2
R-test (Prob Fstat)	0.0001	0.0000	0.0000
k-test (Δ*NO* coef)	-0.4518	-0.5117	-0.6262
k-test (*CA* coef)	1.7897	1.8232	1.8944
k-test (*r** coef)	-0.0504	-0.1308	-0.2587
CA*NGC(Δno-γr*)	0.0962	0.0817	0.1164
(Δno-γr*) NGC CA*	0.9863	0.9754	0.6315

Table 3. Country-by-country VAR tests.

The K-test of the model, as explained in paragraph 5.2, is a joint test of consumption smoothing *CA* and perfect capital mobility, and is implemented using the delta method to construct a χ^2 for the hypothesis that the vector *k* is equal to [0 1 0] for VAR(1) models and [0 0 0 1 0 0] for VAR(2) models. The model predictions would hold if the null hypothesis was not rejected.

Finally, the Granger Causality test aims at verifying that the net output and the consumption based interest rate do not Granger cause the current account: the hypothesis tested is *(ΔNO-γr*) NGC CA*. On the other hand, I wish to test whether the CA Granger-causes the change in net output and consumption based interest rate, the hypothesis tested is *CA NGC (ΔNO-γr*)*. The model would be successful if the first hypothesis held and the second was rejected.

7.4 Predicted versus actual current account: evaluating the performance of the model

In order to test the effectiveness of the model I used two approaches: one is more informal and consists of a graphical comparisons of the current accounts (predicted and actual) and also looks at the ratios of the actual and predicted current account standard deviations; the second approach is more formal and consists of the above mentioned *R*, *K* and Granger Causality tests. The informal evaluation importantly complements the use of formal statistical tests because formal tests might be so powerful that the merits of the model become obscured by statistical rejections (Huang and Lin, 1993).

The graphs 1-12 in Appendix B show the current account variables computed from the original data (CA) and the prediction (*PCA*) generated by the version of the inter-temporal model that I have applied. The model does pretty well in predicting the general direction of the current account fluctuations but the fitted values do not pick up the turning points, lagging a little[32], and the volatility of the predicted current account appears smaller than the variance of the actual current account. In spite of this small problem, the model definitely passes the graphical test with full marks.

The following table (Table 4) shows the ratio of the predicted current account standard deviation to the actual current account standard deviation in the first row for each country, while on the second row it shows the simple correlation between the predicted and the actual current account. The table has three columns because it displays how the two statistics just mentioned depend on gamma. If the standard deviation and the correlation both equaled to one, it would mean that the series are the same and the model would be well specified.

[32] If I plotted the actual and fitted values and the residual, we would see that the residuals moves in the same way as the actual series. That is, when there are big changes, the model is also doing big errors (underestimating the magnitude of the changes).

The figures in the table display some peculiarities in the magnitude of the volatilities; in fact, the ratio is always smaller than one implying that the volatility of the actual current account is larger[33] than that of the predicted current account for each country. The values for the standard deviations vary from a maximum of 0.965 for Luxemburg with a 0.1 gamma to a minimum of 0.849 for Portugal with a 0.1 gamma. On average across the 12 countries, the ratio of the standard deviations is closest to unity in the 0.5 gamma case.

When looking at the correlation coefficients the results seem very similar to those of the standard deviation case. These correlation coefficients are close to one and are positive, implying that between the two series there is a (almost perfect) positive linear relationship.

I conclude that the model passes also this informal test.

	Gamma		
Country	**0.1**	**0.25**	**0.5**
Austria	0.89626	0.89632	0.90620
	0.89635	0.89630	0.90196
Belgium	0.94151	0.93387	0.94148
	0.93788	0.93355	0.93785
France	0.96345	0.96351	0.96346
	0.96445	0.96451	0.96446
Germany	0.92366	0.92354	0.92635
	0.92414	0.92402	0.92691
Greece	0.90219	0.90419	0.90925
	0.90335	0.90516	0.90967
Ireland	0.92507	0.92497	0.92395
	0.92624	0.92580	0.92403
Italy	0.91411	0.91641	0.91429
	0.91093	0.91613	0.91105
Luxemburg	0.96507	0.96492	0.96411
	0.96908	0.96902	0.96844
Netherlands	0.92895	0.92823	0.92846
	0.93223	0.93053	0.93070
Portugal	0.84970	0.84974	0.85167
	0.85055	0.85061	0.85203
Spain	0.92756	0.92297	0.92781
	0.92366	0.92295	0.92389

Table 4. Informal test: standard deviation ratios (1st rows) and correlations (2nd rows) between PCA and CA.

Looking back at Table 3, the results computed from the statistical tests soundly reject the model. In fact, with regards to the *K-test*, while the inter-temporal theory suggests that with one lag and three variables the k-vector should be [0 1 0], the k-vector coefficient on the current account at date *t* is larger than 1 for each of the countries in the sample: while this is significantly different from zero (often previous literature found values close to nil) it is also

[33] This is a common result thought the entire ICA literature.

significantly larger (almost twice as big) than the value of unity suggested by the theory. In addition to this, the magnitudes of net output is often significantly different from its theoretical values of zero while the magnitudes of the consumption based interest rates are very close to zero.

The results are, to some extent, better with regards to the *R-test* as the model holds for Austria, France (only in the 0.25 gamma specification), Germany (in the 0.5 gamma specification), Ireland and Portugal (in the 0.1 and 0.25 gamma specifications). The model is rejected at 1% level for Belgium, Finland (0.1 and 0.25 gamma values), France (0.1 gamma value), Germany (0.1 and 0.25 gamma values), Italy, Luxemburg and Spain. In the rest of the cases the model is rejected at the 5 and 10% levels. Given those results, I conclude that the model does not pass the formal tests for the majority of the countries and specifications.

Lastly, with regards to the Granger causality tests, the results are mixed. While my hypotheses are confirmed by the results from Austria, Belgium, The Netherlands and Spain, they are totally rejected by the results from Finland, France, Greece and Luxemburg. Ambiguous is the situation for Germany, Ireland, Italy and Portugal where one of the hypotheses holds and the other is firmly rejected. In this context is also informative to look at the estimates of the parameters composing the VAR companion matrix in equation *(10)* with their corresponding standard errors and t-statistics (Table 5). In line with what I expect from the theoretical model, a current account surplus in the present t predicts smaller changes in net output in the following period $t+1$; the estimate of $CA(-1)$ in the Δno equations is negative for all the countries with the exception of Spain[34], Finland, France and Italy. What is more, the theory is generally confirmed by the estimate of $CA(-1)$in the r^* equations: this is always positive with the exception of Spain, Greece and Portugal.

As Campa and Gavilán (2011) wrote, the results of the formal tests are difficult to conciliate and this is the case in most of the empirical applications of intertemporal current account models in the literature.

Reflecting on my results, I can think of four likely explanations for the poor performance of the model. Firstly, the quality of the data might not be optimal; alternatively, the problem could relate to a violation of one of the assumptions of the model, in particular a crucial role is played by the assumption of perfect capital mobility. Another possibility is that a series of events, such as balance of payment crisis and BoP policy experiments took place during the sampled period and have, thus, altered the assumed decision making processes that I had aimed to study.

[34] I find, however, that the coefficient is negative in its first lag when using a VAR(2).

Finally, it is possible that another econometric approach could be better than the VAR in the application of the intertemporal approach to the current account.

With regards to the quality of the data, my main concerns are the unknown exact magnitude of some parameters (like the one of the elasticity of substitution), the difficulties in rejecting the non-stationarity hypothesis for the current accounts and the relative arbitrage in choosing the forecast window for the change in inflation and for the interest rate forecasts. What is more, in some cases, I had to include data from different sources in order to complete the dataset (this is the case for the short term interest rate in Germany, for example) or had to modify the frequency of some time series (for example, the population data).

The model assumes that agents can go to the international financial system to finance any current account deficit; although the time frame that I test fully fit in the aftermath of the Bretton Woods Era and thus is characterized by the general absence of capital control, some *sudden stop* episodes occurred around the European Exchange Rate Mechanism (ERM) crisis (1992-1993) and might have sizably affected the development of the current accounts: in these circumstances, deficits in the current account did anticipate a fall in output and a raise in the interest rates rather than a raise in output and fall in the interest rate (as would be expected from the ICA theory). It is worth remembering that the k test is a joint test of consumption smoothing and perfect capital mobility, so that it is not clear which of the two assumptions is actually rejected.

In the third place, when considering the results, it is necessary to take into consideration the fact that national governments have often tried to control the current account applying lots of different policies (see for example various forms of price rationing of imports by means of surcharges and huge devaluations), especially during the ERM crisis, and this might have biased agents' behaviors.

Finally, one could argue that the expectations about the current accounts development of each individual country are not only affected by national economic information but also by the pieces of information about other countries' economic dynamics and thus, a VAR model as I have applied would overlook this insight. I explore the possibility of testing the robustness of the VAR models in the next paragraph.

7.5 Robustness check: SURE Approach

It is reasonable to assume that while the agents in each country act on their own and independently from what happens abroad, there could be some relationships among the variables (unexplained exogenous shocks to productivity and budget deficit, for example) that affect national agents' decision making processes. In statistical terms, this translates in a system where each equation is a valid linear regression on its own (and can be estimated separately) but the error terms of the equations are related. This hypothesis suggests testing the intertemporal current account approach using seemingly unrelated regression equations (SURE) and estimating all the equations at once.

If the error terms are uncorrelated between the equations, SURE is equivalent to Ordinary Least Squares (OLS) method and, given that I used OLS for the VAR estimation, the results would be the same as those that I obtained from the VAR.

I built a system[35] with 36 equations (three per country, as they were for each VAR model I estimated earlier) and estimated three coefficients per equations (I chose to use only one lag). The system has the following general form:

$$y = CX + \varepsilon$$

Where y is a column vector with 36 entries, *C* is a 36x36 coefficient matrix, *X* and *ε* are column vectors with 36 entries:

$$\begin{pmatrix} \Delta NO\_at \\ CA\_at \\ R\_at \\ \vdots \\ \Delta NO\_pt \\ CA\_pt \\ R\_pt \end{pmatrix} = \begin{pmatrix} C1 & C2 & C3 & \cdots & 0 & 0 & 0 \\ C4 & C5 & C6 & \cdots & 0 & 0 & 0 \\ C7 & C8 & C9 & \cdots & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & C100 & C101 & C102 \\ 0 & 0 & 0 & \cdots & C103 & C104 & C105 \\ 0 & 0 & 0 & \cdots & C106 & C107 & C108 \end{pmatrix} \begin{pmatrix} \Delta NO\_at(-1) \\ CA\_at(-1) \\ R\_at(-1) \\ \vdots \\ \Delta NO\_pt(-1) \\ CA\_pt(-1) \\ R\_pt(-1) \end{pmatrix} + \begin{pmatrix} \epsilon_{at1} \\ \epsilon_{at2} \\ \epsilon_{at3} \\ \vdots \\ \epsilon_{pt1} \\ \epsilon_{pt2} \\ \epsilon_{pt3} \end{pmatrix}$$

In Appendix C the complete system is reported.

A simple comparison (Table 5, *SUR/VAR-1* column) of the magnitude, standard deviation and t-statistics of the coefficients estimated through the SURE and the VAR shows important differences among the estimates of the two methods, suggesting that there is some relation among the error terms across the (formerly) different sets of the VAR equations.

Given this result, I estimated another SURE system, this time with 12 equations[36]:

$$\begin{pmatrix} CA\_at \\ CA\_be \\ CA\_de \\ \vdots \\ CA\_lu \\ CA\_nl \\ CA\_pt \end{pmatrix} = \begin{pmatrix} C1 & C2 & C3 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 0 & \cdots & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 0 & \cdots & 0 & 0 & 0 \\ 0 & 0 & 0 & \cdots & C34 & C35 & C36 \end{pmatrix} \begin{pmatrix} \Delta NO\_at(-1) \\ CA\_at(-1) \\ R\_at(-1) \\ \vdots \\ \Delta NO\_pt(-1) \\ CA\_pt(-1) \\ R\_pt(-1) \end{pmatrix} + \begin{pmatrix} \epsilon_{at1} \\ \epsilon_{at2} \\ \epsilon_{at3} \\ \vdots \\ \epsilon_{pt1} \\ \epsilon_{pt2} \\ \epsilon_{pt3} \end{pmatrix}$$

35 I test this system with the assumption that $\gamma=0.25$

36 This time *y* is a column vector with 12 entries, *C* is a 12x36 coefficient matrix, *X* and ε are column vectors with 36 entries.

Table 5. Comparison between VAR(1) and SUR with 36 equations.

C	VAR value	VAR st dev	VAR t-statistics	SUR value	SUR st dev	SUR t-statistics	Variables Y	Variables f(x)	Country	(SUR/VAR)-1 value	(SUR/VAR)-1 st dev
1	-0.21582	0.09407	-2.29414	-0.312575	0.075675	-4.130476		no(-1)	AUSTRIA	0.448313	-0.19555
2	-0.059375	0.0459	-1.29369	-0.047329	0.036903	-1.282507	NO	ca(-1)		-0.20288	-0.19601
3	-0.027744	0.05589	-0.49642	0.004133	0.044518	0.092838		rstar(-1)		-1.14897	-0.20347
4	-0.036723	0.08651	-0.42447	-0.077563	0.077092	-1.0061		no(-1)		1.11211	-0.10887
5	0.906738	0.04221	21.4829	0.934359	0.038431	24.31261	CA	ca(-1)		0.030462	-0.08953
6	0.022973	0.0514	0.44698	0.010242	0.046011	0.222604		rstar(-1)		-0.55417	-0.10484
7	0.072745	0.15531	0.46839	0.139169	0.123394	1.127841		no(-1)		0.913107	-0.2055
8	0.112837	0.07577	1.48919	0.09728	0.061941	1.570524	R	ca(-1)		-0.13787	-0.18251
9	-0.001814	0.09227	-0.01966	-0.034434	0.074549	-0.461903		rstar(-1)		17.98236	-0.19206
10	-0.640356	0.07342	-8.72233	-0.665347	0.05226	-12.73143		no(-1)	BELGIUM	0.039027	-0.2882
11	-0.016876	0.07341	-0.22988	-0.026973	0.052631	-0.512496	NO	ca(-1)		0.598305	-0.28305
12	-0.017557	0.06408	-0.27397	0.00516	0.04493	0.114854		rstar(-1)		-1.2939	-0.29885
13	-0.008679	0.03397	-0.25547	-0.023149	0.028676	-0.807282		no(-1)		1.667243	-0.15584
14	0.915991	0.03397	26.964	0.911839	0.029393	31.02274	CA	ca(-1)		-0.00453	-0.13474
15	-0.000265	0.02965	-0.00893	0.000339	0.025156	0.013462		rstar(-1)		-2.27925	-0.15157
16	-0.079535	0.10511	-0.75666	-0.084572	0.071765	-1.178462		no(-1)		0.063331	-0.31724
17	0.239138	0.10511	2.27513	0.202127	0.078066	2.589168	R	ca(-1)		-0.15477	-0.25729
18	0.171725	0.09175	**1.87162**	0.224078	0.065893	**3.400608**		rstar(-1)		0.304865	-0.28182
19	0.32605	0.09004	3.62123	0.30564	0.074033	4.128452		no(-1)	GERMANY	-0.0626	-0.17778
20	-0.015677	0.03814	-0.41108	-0.024165	0.031801	-0.759881	NO	ca(-1)		0.54143	-0.1662
21	-0.014187	0.03343	-0.42438	-0.00998	0.027551	-0.362225		rstar(-1)		-0.29654	-0.17586
22	0.062962	0.08617	0.73069	0.024808	0.073945	0.335495		no(-1)		-0.60598	-0.14187
23	0.910496	0.0365	24.9471	0.880896	0.031826	27.67847	CA	ca(-1)		-0.03251	-0.12805
24	0.029235	0.03199	0.91381	0.035344	0.027818	1.270534		rstar(-1)		0.208962	-0.13042
25	0.282627	0.23807	1.18715	0.019054	0.171046	0.111395		no(-1)		-0.93258	-0.28153
26	0.09965	0.10084	0.98823	0.124046	0.075127	1.651148	R	ca(-1)		0.244817	-0.25499
27	0.30454	0.08839	3.44542	0.233012	0.066951	3.480354		rstar(-1)		-0.23487	-0.24255
28	-0.339335	0.08798	-3.8568	-0.261974	0.074873	-3.498916		no(-1)	SPAIN	-0.22798	-0.14898
29	0.012009	0.03029	0.39651	-0.018729	0.02609	-0.717871	NO	ca(-1)		-2.55958	-0.13866
30	-0.015007	0.02816	-0.53289	-0.01754	0.023919	-0.733294		rstar(-1)		0.168788	-0.1506
31	-0.351964	0.10987	-3.20335	-0.268995	0.09362	-2.873249		no(-1)		-0.23573	-0.1479
32	0.940546	0.03782	24.8675	0.93486	0.032787	28.51299	CA	ca(-1)		-0.00605	-0.13308
33	-0.041352	0.03517	-1.17585	-0.050158	0.029953	-1.674562		rstar(-1)		0.212952	-0.14834
34	-0.641644	0.28047	**-2.28777**	-0.390029	0.232322	**-1.678829**		no(-1)		-0.39214	-0.17167
35	-0.05065	0.09655	-0.52462	-0.040404	0.082129	-0.49196	R	ca(-1)		-0.20229	-0.14936
36	0.207567	0.08977	2.31224	0.205667	0.07493	2.744808		rstar(-1)		-0.00915	-0.16531
37	-0.264312	0.09068	-2.91468	-0.270605	0.065744	-4.116061		no(-1)	FINLAND	0.023809	-0.27499
38	0.035142	0.03179	1.10533	0.016776	0.023331	0.719066	NO	ca(-1)		-0.52262	-0.26609
39	0.053381	0.03717	1.4363	0.039355	0.026269	1.498133		rstar(-1)		-0.26275	-0.29327
40	0.020645	0.06727	0.30691	0.029379	0.057395	0.511873		no(-1)		0.423056	-0.1468
41	0.970361	0.02358	41.1446	0.951588	0.020776	45.80158	CA	ca(-1)		-0.01935	-0.11891
42	-0.014864	0.02757	-0.53917	-0.013457	0.023533	-0.571841		rstar(-1)		-0.09466	-0.14643
43	-0.072655	0.21589	-0.33654	-0.291691	0.184284	-1.582836		no(-1)		3.014741	-0.1464
44	0.065336	0.07569	0.86321	0.08665	0.066056	1.311767	R	ca(-1)		0.326221	-0.12728
45	0.304954	0.08848	3.44664	0.30773	0.075623	4.06925		rstar(-1)		0.009103	-0.14531
46	0.290852	0.08658	3.35928	0.15179	0.065428	2.319957		no(-1)	FRANCE	-0.47812	-0.24431
47	0.009684	0.02225	0.43528	-0.009605	0.0174	-0.552019	NO	ca(-1)		-1.99184	-0.21798
48	-0.024137	0.01856	**-1.30017**	-0.039855	0.013918	**-2.863582**		rstar(-1)		0.651199	-0.25011
49	0.336438	0.10001	3.36401	0.278686	0.085242	3.269354		no(-1)		-0.17166	-0.14767
50	0.953219	0.0257	37.0922	0.958173	0.02263	42.34083	CA	ca(-1)		0.005197	-0.11946
51	0.009227	0.02144	0.4303	-0.008736	0.018107	-0.482435		rstar(-1)		-1.94679	-0.15546
52	0.227056	0.42368	0.53591	0.240332	0.380836	0.631064		no(-1)		0.05847	-0.10112
53	0.025074	0.10887	0.23031	0.03865	0.099278	0.389305	R	ca(-1)		0.541437	-0.08811
54	0.228554	0.09084	**2.51593**	0.156497	0.081603	**1.917795**		rstar(-1)		-0.31527	-0.10168

C	VAR			SUR			Variables		Country	SUR/VAR-1	
	value	st dev	t-statistics	value	st dev	t-statistics	Y	f(x)		value	st dev
55	-0.039431	0.09926	-0.39724	-0.060634	0.078119	-0.776166		no(-1)	ITALY	0.537724	-0.21299
56	0.020215	0.04033	0.50123	-0.010972	0.032575	-0.336817	NO	ca(-1)		-1.54277	-0.19229
57	-0.010874	0.02638	-0.41226	-0.002517	0.020547	-0.122475		rstar(-1)		-0.76853	-0.22111
58	-0.128661	0.10062	-1.27871	-0.14236	0.081388	-1.749155		no(-1)		0.106474	-0.19113
59	0.935028	0.04088	22.8718	0.933971	0.034052	27.42811	CA	ca(-1)		-0.00113	-0.16703
60	-0.004602	0.02674	-0.17214	-0.00029	0.021495	-0.013507		rstar(-1)		-0.93698	-0.19615
61	-0.245319	0.33648	-0.72907	-0.183087	0.300846	-0.608573		no(-1)		-0.25368	-0.1059
62	0.13189	0.13671	0.96472	0.049668	0.123912	0.400828	R	ca(-1)		-0.62341	-0.09361
63	0.293947	0.08941	3.28768	0.313283	0.079821	3.924806		rstar(-1)		0.065781	-0.10725
64	-0.051198	0.09139	-0.5602	-0.101555	0.07943	-1.278543		no(-1)	NETHERLANDS	0.983574	-0.13087
65	-0.064074	0.03398	-1.88538	-0.044632	0.029993	-1.488074	NO	ca(-1)		-0.30343	-0.11733
66	-0.051648	0.03556	-1.45245	-0.045944	0.031246	-1.470397		rstar(-1)		-0.11044	-0.12132
67	-0.069745	0.09462	-0.73712	-0.081975	0.078915	-1.038771		no(-1)		0.175353	-0.16598
68	0.914659	0.03518	25.9963	0.910222	0.030172	30.16784	CA	ca(-1)		-0.00485	-0.14235
69	-0.049909	0.03681	-1.3557	-0.056451	0.03114	-1.812833		rstar(-1)		0.131079	-0.15403
70	-0.041954	0.22294	-0.18819	-0.16616	0.140103	-1.185985		no(-1)		2.960528	-0.37157
71	0.173466	0.0829	2.0925	0.219616	0.056449	3.890496	R	ca(-1)		0.266046	-0.31907
72	0.348912	0.08674	4.02248	0.314156	0.059116	5.314249		rstar(-1)		-0.09961	-0.31847
73	-0.019291	0.12641	-0.15261	-0.02402	0.110629	-0.217122		no(-1)	GREECE	0.24514	-0.12484
74	-0.25531	0.07303	-3.49591	-0.290423	0.06437	-4.511758	NO	ca(-1)		0.137531	-0.11858
75	0.274678	0.18147	1.5136	0.198384	0.158758	1.249595		rstar(-1)		-0.27776	-0.12516
76	0.329595	0.14651	2.24962	0.290942	0.132276	2.199507		no(-1)		-0.11727	-0.09715
77	0.689595	0.08464	8.14705	0.647305	0.076714	8.437878	CA	ca(-1)		-0.06133	-0.09364
78	0.342159	0.21033	1.62678	0.251263	0.189791	1.323891		rstar(-1)		-0.26565	-0.09765
79	-0.082572	0.09204	-0.89711	-0.021312	0.079905	-0.266716		no(-1)		-0.7419	-0.13184
80	-0.012681	0.05317	-0.23847	-0.016626	0.047108	-0.352931	R	ca(-1)		0.311095	-0.11401
81	0.212615	0.13213	1.6091	0.175165	0.114931	1.524085		rstar(-1)		-0.17614	-0.13017
82	-0.171089	0.14725	**-1.16187**	-0.267303	0.12676	**-2.108742**		no(-1)	IRELAND	0.562362	-0.13915
83	-0.012257	0.05969	-0.20534	-0.021951	0.051491	-0.426319	NO	ca(-1)		0.790895	-0.13736
84	-0.102661	0.0466	-2.2028	-0.097938	0.040363	-2.426431		rstar(-1)		-0.04601	-0.13384
85	-0.116628	0.13284	-0.87796	-0.047411	0.107447	-0.44125		no(-1)		-0.59349	-0.19115
86	0.890906	0.05385	16.5447	0.919168	0.044467	20.67072	CA	ca(-1)		0.031723	-0.17424
87	-0.098775	0.04204	-2.34937	-0.0843	0.034875	-2.417175		rstar(-1)		-0.14655	-0.17043
88	-0.489266	0.46496	-1.05228	-0.360647	0.387816	-0.929945		no(-1)		-0.26288	-0.16592
89	0.061563	0.18848	0.32664	-0.033507	0.159306	-0.210332	R	ca(-1)		-1.54427	-0.15479
90	0.195445	0.14716	1.32816	0.16354	0.124803	1.310388		rstar(-1)		-0.16324	-0.15192
91	-0.095146	0.1391	-0.68401	-0.018742	0.113195	-0.16557		no(-1)	LUXEMBURG	-0.80302	-0.18623
92	-0.008196	0.05314	-0.15424	-0.006849	0.045435	-0.150734	NO	ca(-1)		-0.16435	-0.14499
93	0.004224	0.31599	0.01337	0.423648	0.256635	1.650783		rstar(-1)		99.29545	-0.18784
94	0.514078	0.08752	5.87362	-0.054502	0.09465	-0.575823		no(-1)		-1.10602	0.081467
95	0.936073	0.03343	27.9981	0.93021	0.037971	24.49788	CA	ca(-1)		-0.00626	0.135836
96	0.423905	0.19883	2.13205	0.582023	0.214297	2.715967		rstar(-1)		0.373003	0.07779
97	-0.060356	0.05783	-1.04378	0.00798	0.046074	0.173195		no(-1)		-1.13222	-0.20329
98	0.018892	0.02209	0.85529	0.01358	0.018432	0.736738	R	ca(-1)		-0.28118	-0.1656
99	0.266251	0.13136	2.02688	0.322124	0.104223	3.090721		rstar(-1)		0.209851	-0.20658
100	-0.244742	0.10784	-2.26959	-0.273989	0.086617	-3.163204		no(-1)	PORTUGAL	0.119501	-0.1968
101	-0.06444	0.11133	-0.57883	-0.034378	0.087638	-0.39227	NO	ca(-1)		-0.46651	-0.21281
102	0.032657	0.09418	0.34674	0.014638	0.073944	0.197964		rstar(-1)		-0.55177	-0.21487
103	-0.050379	0.06129	-0.822	-0.01985	0.054292	-0.365604		no(-1)		-0.60599	-0.11418
104	0.85679	0.06327	13.5412	0.876279	0.056027	15.64025	CA	ca(-1)		0.022747	-0.11448
105	0.02057	0.05353	0.38428	0.022908	0.047284	0.484491		rstar(-1)		0.113661	-0.11668
106	-0.025219	0.12479	-0.2021	-0.033721	0.110732	-0.304528		no(-1)		0.337127	-0.11265
107	-0.163424	0.12883	-1.26856	-0.124434	0.114074	-1.090819	R	ca(-1)		-0.23858	-0.11454
108	0.35355	0.10899	3.24393	0.346644	0.096551	3.590256		rstar(-1)		-0.01953	-0.11413

Highlighted figures display considerable differences in the size of the coefficients.

The goal was to check whether the coefficients for the CA would differ between the SURE with 36 (now “SUR36”) and the one with 12 equations (“SUR12”); the idea is that if, they differ, there is a relation among the error terms within the different equations for the same country. In other words, if the coefficients of the explanatory variables in the *CA* equation are the same in the SUR12 and the SUR36, then the error terms within the *CA-ΔNO-r** equation set would be uncorrelated and there would be no gain in estimating the system jointly.

Table 6 shows the results of SURE systems and compare the sizes of the coefficients. The highlighted figures in the table indicate remarkable differences in coefficient sizes and standard deviations: while standard deviations from the SUR36 are always smaller (12% on average) than those from the VAR- with the exception of Luxemburg-, the size of the coefficients varies a lot (for example, the magnitude of the *r*(-1)* coefficient in the equation for the variation of net output in Luxemburg estimated for the SUR is almost 100 times bigger than the one estimated from the VAR). Then, a look at the t-statistics suggests that in a few cases (they are marked with bold) there is a difference in the significance of the variables between the two approaches. When we look at the table 6, we notice that the standard deviations and the size of the coefficients estimated by the SUR36 are always smaller (on average, respectively 7% and 11%) than those estimated from SUR12. I then conclude that the error terms are related both at the inter-equation-sets and intra-equation-sets levels.

This result can be interpreted as the proof that the shocks to national flows are not purely idiosyncratic but that the dynamic behavior of a country’s domestic product can be closely correlated to the corresponding behavior of those aggregates in the rest of the EA-12; it appears important not only to model shocks to domestic output but also shocks arising in the country’s EA-12 neighbors (or even in larger contexts, like the European Economic Area or the entire world).

This result is fairly interesting as it implies that the findings obtained from the VAR models shall be treated with some caution as they do not take into consideration the fact that the error terms across the different VAR models are related.

Table 6. Comparing VAR and SUR systems

C	VAR(1)			SUR 36eq			SUR 12 eq			Variables			(SUR36/VAR)-1		(SUR36/SUR12)-1		(SUR12/VAR)-1	
	value	st dev	t-statistics	value	st dev	t-statistics	value	st dev	t-statistics	Y	f(x)	Country	value	st dev	value	st dev	value	st dev
1	-0.036723	0.08651	-0.42447	-0.077563	0.07709	-1.0061	-0.067329	0.081938	-0.821699		no(-1)		1.11	-0.11	0.15	-0.06	0.83	-0.05
2	0.906738	0.04221	21.4829	0.934359	0.038431	24.31261	0.901277	0.040336	22.34433	CA	ca(-1)	AT	0.03	-0.09	0.04	-0.05	-0.01	-0.04
3	0.022973	0.0514	0.44698	0.010242	0.046011	0.222604	0.029347	0.048822	0.601108		rstar(-1)		-0.55	-0.10	-0.65	-0.06	0.28	-0.05
4	-0.008679	0.03397	-0.25547	-0.023149	0.028676	-0.807282	-0.023542	0.031261	-0.753067		no(-1)		1.67	-0.16	-0.02	-0.08	1.71	-0.08
5	0.915991	0.03397	26.964	0.911839	0.029393	31.02274	0.905499	0.031844	28.43562	CA	ca(-1)	BE	0.00	-0.13	0.01	-0.08	-0.01	-0.06
6	-0.000265	0.02965	-0.00893	0.000339	0.025156	0.013462	-0.017943	0.027398	-0.654888		rstar(-1)		-2.28	-0.15	-1.02	-0.08	66.71	-0.08
7	0.062962	0.08617	0.73069	0.024808	0.073945	0.335495	0.012649	0.079029	0.16005		no(-1)		-0.61	-0.14	0.96	-0.06	-0.80	-0.08
8	0.910496	0.0365	24.9471	0.880896	0.031826	27.67847	0.891804	0.033862	26.33676	CA	ca(-1)	DE	-0.03	-0.13	-0.01	-0.06	-0.02	-0.07
9	0.029235	0.03199	0.91381	0.035344	0.027818	1.270534	0.038175	0.029582	1.290472		rstar(-1)		0.21	-0.13	-0.07	-0.06	0.31	-0.08
10	-0.351964	0.10987	-3.20335	-0.268995	0.09362	-2.873249	-0.283716	0.104263	-2.721143		no(-1)		-0.24	-0.15	-0.05	-0.10	-0.19	-0.05
11	0.940546	0.03782	24.8675	0.93486	0.032787	28.51299	0.923655	0.036052	25.6198	CA	ca(-1)	ES	-0.01	-0.13	0.01	-0.09	-0.02	-0.05
12	-0.041352	0.03517	-1.17585	-0.050158	0.029953	-1.674562	-0.045105	0.033383	-1.351152		rstar(-1)		0.21	-0.15	0.11	-0.10	0.09	-0.05
13	0.020645	0.06727	0.30691	0.029379	0.057395	0.511873	0.038246	0.061546	0.621425		no(-1)		0.42	-0.15	-0.23	-0.07	0.85	-0.09
14	0.970361	0.02358	41.1446	0.951588	0.020776	45.80158	0.95987	0.021938	43.75371	CA	ca(-1)	FI	-0.02	-0.12	-0.01	-0.05	-0.01	-0.07
15	-0.014864	0.02757	-0.53917	-0.013457	0.023533	-0.571841	-0.01402	0.025209	-0.556171		rstar(-1)		-0.09	-0.15	-0.04	-0.07	-0.06	-0.09
16	0.336438	0.10001	3.36401	0.278686	0.085242	3.269354	0.332142	0.093114	3.567032		no(-1)		-0.17	-0.15	-0.16	-0.08	-0.01	-0.07
17	0.953219	0.0257	37.0922	0.958173	0.02263	42.34083	0.946754	0.024086	39.30675	CA	ca(-1)	FR	0.01	-0.12	0.01	-0.06	-0.01	-0.06
18	0.009227	0.02144	0.4303	-0.008736	0.018107	-0.482435	0.0000949	0.019914	0.004764		rstar(-1)		-1.95	-0.16	-93.05	-0.09	-0.99	-0.07
19	-0.128661	0.10062	-1.27871	-0.14236	0.081388	-1.749155	-0.130133	0.094842	-1.372095		no(-1)		0.11	-0.19	0.09	-0.14	0.01	-0.06
20	0.935028	0.04088	22.8718	0.933971	0.034052	27.42811	0.912293	0.038861	23.47588	CA	ca(-1)	IT	0.00	-0.17	0.02	-0.12	-0.02	-0.05
21	-0.004602	0.02674	-0.17214	-0.00029	0.021495	-0.013507	0.005555	0.025142	0.220949		rstar(-1)		-0.94	-0.20	-1.05	-0.15	-2.21	-0.06
22	-0.069745	0.09462	-0.73712	-0.081975	0.078915	-1.038771	-0.087178	0.087441	-0.996993		no(-1)		0.18	-0.17	-0.06	-0.10	0.25	-0.08
23	0.914659	0.03518	25.9963	0.910222	0.030172	30.16784	0.907474	0.032779	27.68439	CA	ca(-1)	NL	0.00	-0.14	0.00	-0.08	-0.01	-0.07
24	-0.049909	0.03681	-1.3557	-0.056451	0.03114	-1.812833	-0.063493	0.034165	-1.858417		rstar(-1)		0.13	-0.15	-0.11	-0.09	0.27	-0.07
25	0.329595	0.14651	2.24962	0.290942	0.132276	2.199507	0.324559	0.139741	2.322579		no(-1)		-0.12	-0.10	-0.10	-0.05	-0.02	-0.05
26	0.689595	0.08464	8.14705	0.647305	0.076714	8.437878	0.65034	0.080945	8.03433	CA	ca(-1)	EL	-0.06	-0.09	0.00	-0.05	-0.06	-0.04
27	0.342159	0.21033	1.62678	0.251263	0.189791	1.323891	0.306969	0.20059	1.530334		rstar(-1)		-0.27	-0.10	-0.18	-0.05	-0.10	-0.05
28	-0.116628	0.13284	-0.87796	-0.047411	0.107447	-0.44125	-0.077174	0.115579	-0.667722		no(-1)		-0.59	-0.19	-0.39	-0.07	-0.34	-0.13
29	0.890906	0.05385	16.5447	0.919168	0.044467	20.67072	0.890916	0.047647	18.69811	CA	ca(-1)	IE	0.03	-0.17	0.03	-0.07	0.00	-0.12
30	-0.098775	0.04204	-2.34937	-0.0843	0.034875	-2.417175	-0.089332	0.03729	-2.395578		rstar(-1)		-0.15	-0.17	-0.06	-0.06	-0.10	-0.11
31	0.514078	0.08752	5.87362	-0.054502	0.09465	-0.575823	-0.079284	0.099468	-0.797078		no(-1)		-1.11	0.08	-0.31	-0.05	-1.15	0.14
32	0.936073	0.03343	27.9981	0.93021	0.037971	24.49788	0.922706	0.039422	23.40572	CA	ca(-1)	LU	-0.01	0.14	0.01	-0.04	-0.01	0.18
33	0.423905	0.19883	2.13205	0.582023	0.214297	2.715967	0.580883	0.224439	2.588153		rstar(-1)		0.37	0.08	0.00	-0.05	0.37	0.13
34	-0.050379	0.06129	-0.822	-0.01985	0.054292	-0.365604	-0.032785	0.058361	-0.561769		no(-1)		-0.61	-0.11	-0.39	-0.07	-0.35	-0.05
35	0.85679	0.06327	13.5412	0.876279	0.056027	15.64025	0.859143	0.060215	14.26784	CA	ca(-1)	PO	0.02	-0.11	0.02	-0.07	0.00	-0.05
36	0.02057	0.05353	0.38428	0.022908	0.047284	0.484491	0.031705	0.050935	0.622466		rstar(-1)		0.11	-0.12	-0.28	-0.07	0.54	-0.05
												AVG	-14 %	-12 %	-11 %	-7 %	0.1 %	-5 %

Note that the Average for SUR36/SUR12 and SUR12/VAR do not take into consideration the outliers

7.6 VAR approach to the EA-12 at the aggregate level

Building on the SURE findings and their hints to consider the shocks at the EA-12 level, I have also tried applying the VAR model to aggregate variables, i.e. treating the 12 European countries as if they were only one country.

For this purpose I used data from Eurostat. In particular:

- For the one year world interest rate I used the IRS for EU15[37] published by the OECD.
- For the inflation I chose the Harmonised Index of Consumer Prices (HICP) published by Eurostat. The original data was monthly, so it was necessary to aggregate it to quarterly frequency[38]. I chose a 4 years window[39] to elaborate the forecasts.
- For the exchange rate my source was Eurostat. The data for the exchange rate based on CPI starts in 1980 while the one based on labor costs in 1990. I chose a 4yrs window for the Real Effective Exchange Rate (deflator: unit labour costs in the total economy - 12 trading partners).
- Alpha: for the share of traded good I used the symmetric input-output table "SIOT_ea_tot" for 2007 which deals with EU15 (33.92%). My Sample is EU12 though. I tried computing a weighted average of the Alphas for the 12 countries I had, and I got a very similar result 34.42%. The reasons for the difference are to be found first in the fact that the siot_ea_tot includes three extra countries (Slovenia, Cyprus and Malta) and secondly that the data is for 2007 while my alphas were from 2005 (Austria, Belgium, Greece, Ireland, Italy, Portugal and Spain) and 2007 (Finland, France, Germany, Luxemburg and Netherlands).
- Beta: discount factor is simply *1/(1+r)* where r is the average of the world real interest rate in the sample (1996-2007).
- Gamma is assumed to be 0.25.

I first checked the unit root assumption and found that it is rejected for the demeaned current account, and the Ljung Box null hypothesis for the residuals of the ADF equation held (the lags were jointly significant).

---

[37] No interest rate was available for EA12 and the additional three countries are so small that their contribution to the interest rate can be ignored for the purpose of my study, I assume.

[38] I used the average for the periods.

[39] In the country by country case, I had selected a five years window because the data were richer in observations.

I then chose an appropriate number of lags for the VAR model. In particular, VAR (1) model was preferred to VAR(2) model because both BIC and AIC information criteria in VAR(1) were smaller than in VAR(2) and the Portmanteau test displayed that there were no residual autocorrelations for VAR(1).

The most interesting part of this experiment is, probably, the informal test. The graphical informal test and standard deviation ratio poorly perform (Appendix D, Graph 13); on one hand, the graph shows that movements of the CA and PCA are very different, and on the other hand, the ratio of their standard deviations is fairly low (only 35.36%).

This finding clearly hints that the CA forecast based on theory is too smooth compared to the actual CA and makes me conclude that the aggregate data do not fit the VAR(1).

Given the failure of the informal test, I expected the formal test to perform even worse. However the *R-test* did not reject the null that the difference between the forecast and the actual current account was unpredictable given the relevant information set. Thus, this test is surprisingly successful (Table 7). What is more, the Granger Causality Tests rejects the null that *CA* does not Granger Cause *(ΔNO- γr*)* and confirms that *(ΔNO- γr*)* does not Granger Cause the Current Account. Therefore, also this test is successful.

Finally, the K-test miserably fails like in the country-by-country VAR models. The χ^2 test rejects the model with a p-value of zero; the k-vector coefficient on the current account at date *t* is close to 2: while this is significantly different from zero, it is also significantly larger from the value of unity suggested by the theory. However, the magnitudes of net output and of the consumption based interest rates are very close to zero. This test cannot be considered a success but to some extent suggests that the VAR(1) model for the aggregate EU12 reflects the theory better than many of the VAR models that were estimated for the single countries.

Although surprising, this result is similar to those found when applying the ICA model to the United States of America and Canada by Otto (1992). The conclusion that I can draw is that the EA-12 countries may be affected strongly by external shocks, which are not considered in the country-specific VAR but emerge to some extent in the SURE analysis and seem further confirmed by the better results obtained from the EA-12 VAR model.

EU12	1996Q1-2007Q4
γ	0.25
VAR(x)	1
R-test (Prob Fstatistic)	0.1302
k-test (Δno coefficient)	0.04739
k-test (CA coefficient)	1.942
k-test (r* coefficient)	-0.0078
CA*NGC(Δno-γr*)	0.0005
(Δno-γr*) NGC CA*	0.8579

Table 7. EA12 VAR Model statistics.

This additional experiment confirms the recommendation to carefully consider the results of the country specific ICA approach. While under the informal testing procedures the aggregate data seemed to underperform the equivalent country-by country analysis, the formal testing suggested the opposite.

8 CONCLUSIONS

In this study I have presented an intertemporal model of the current account in the attempt to better understand the current account dynamics of the twelve countries (EA-12) that joined the Euro currency in the very beginning of the twenty-fist century. The crucial role of this analysis was played by the estimation of multiple systems of equations (both VAR and SUR models) which were meant to forecast the behavior of the representative agents. After checking the stationarity of the variables to include in the system of equations, I proceeded to choose the number of lags for the VAR system on the basis of BIC and AIC information criteria, keeping into consideration both the characteristics of the error terms and the parsimony of the model. In my view, the best representations of the data generating process were VAR(1) and VAR(2) systems in the case of the country by country study, VAR(1) for the aggregate EA-12 analysis and one lag SUR models for the robustness checks. In all of the models, each equation consisted of three explanatory variables (i.e. the change in net output, the current account and the consumption based interest rate).

An important stage was the decision of the values to assign to the discount factor (β), the relative share of traded goods in consumption (α) and, above all, the elasticity of intertemporal substitution (γ). I based my choice of these parameters on the ICA literature for γ and on my own calculations for α and β. Using these parameters and the coefficients estimated from the VAR system, I worked out the *k* vector and the χ^2 Wald statistics to test for the validity of the model, I then tested equation *(4)* and the Granger causality relationships. Along with those formal tests, I estimated the standard deviation of the predicted current account and its correlation with the actual current account.

The results show that the intertemporal model does not pass the formal statistical tests for the validity of the model in any of its specifications (nor VAR neither SUR). The informal tests on the country-by-country VAR, on the contrary, suggest that the predicted current account has mainly been able to track the direction of movements of the actual current account. However, the SUR and EA-12 VAR robustness checks warn on the validity of the country specific VAR results.

My main suppositions about the poor performance of the model are related to possible violation of the perfect capital mobility during the ERM crisis, the consequences of the correlations in the error terms that the VAR modeling overlooks and the necessary modifications that I had to make to the original data. Also it is worth mentioning that there is a considerable amount of literature on whether consumers can actually perfectly smooth their consumption given capital market imperfections.

The conclusion of this paper is that an intertemporal current account model may not explain the developments of the current account in the EA-12 countries over the studied period and it is not possible to firmly assess whether the current account imbalances have been reasonable in terms of the intertemporal consumption optimization theory. Nevertheless I must admit that the studied methodology provides a reasonable approximation to the economic time series analyzed and the found results informally suggest that the current account of the studied countries behaved as the theoretical model would predict. Correlations in the error terms among the set of equations seem to have relevant effects on the size of the estimated coefficients and this confirms the hypothesis put forward by Bergin and Sheffrin (2000) that the current account of relatively small open economies is affected not only by shocks to domestic output or government expenditure but also by external shocks to the economies of large neighbor countries.

Further empirical researches should consider extensions which allow incorporating new exogenous shocks into the model. In the first place, the model that I have tested is very stylized and focuses on consumption and savings but does not take into consideration the endogenous movements in investments which appears in the net output equation and contribute to make the net output the source of uncertainty in the model; it could be interesting to take into account the endogenous behavior of investors and their risk aversion. Secondly, it could be attempted to relax the assumption of Ricardian equivalence in the intertemporal model, as government expenditure is another variable whose fluctuations could correlate with consumption. Although some researchers have started testing those two extensions (Bussiere et al. 2004, Kraay and Ventura 2010) in some countries, there is still too little evidence to assess whether those less stylized models manage to explain current account dynamics or whether they could help gain a better benchmark for the EA-12. It would, finally, be interesting to see how the performance of model changes when including labor supply decisions or income shocks that are non-insurable.

REFERENCES:

- Aguiar M, Gopinath G. 2005. “Defaultable debt, interest rates and the current account”. *Journal of International Economics* 69, pp. 64-83.
- Arghyrou and Chortareas, “Real exchange rate and current account imbalances in the euro area”, *Review of International Economics* 16, 747-764. 2008.
- Auer R. 2013. “Rapid current-account rebalancing in the southern Eurozone”. *Vox, research-based policy analysis and commentary from leading economists.* 7 May 2013.
- Barro R.J., Sala i Martin 1990. ”World real interest rates”. *NBER Macroeconomics Annual. Cambridge,* MA: MIT Press, pp. 15-61.
- Barrios, Salvador, Per Iversen, Magdalena Lewandowska, Ralph Setzer 2009. “Determinants of intra-Eurozone bond spreads during the financial crisis”. *European Economy, Economic Paper 388.*
- Beaudry and van Wincoop, 1996. “The Intertemporal Elasticity of Substitution: an exploration using a US Panel of Stata Data”. *Economica*, vol 63, no 251, August, pp. 595-512.
- Belke and Dreger, 2011. “Current account in the euro area: Catching up or competitiveness?”.
- Berger and Nitsch, “The euro’s effect on trade imbalances”, *IMF WP* 10/226. 2010.
- Blanchard and Giavazzi, “Current account deficits in the euro area: the end of the Feldstein-Horioka puzzle?”, *Brookings Papers on Economic Activity* 2, 147-186. 2002.
- Bussiere, Fratzscher and Muller, 2004. “Current Account Dynamics in OECD and EU Acceding Countries. An Intertemporal Approach”. *ECB Working Paper* No. 311,February.
- Campa and Gavilán, “Current accounts in the euro area: An intertemporal approach”, *Journal of International Money and Finance* 30, 205-228.2011.
- Campbell and Shiller, “Cointegration and Tests of Present Value Models”, *The Journal of Political Economy,* Vol. 95, No.5. 1987.
- Decressin J. and Stavrev E. 2009. “Current Accounts in a Currency Union”. *IMF Working Paper* no. 09/127.
- Dornbusch, “Real interest rates, home goods and optimal external borrowing”, *Journal of political Economy*, Vol. 91, No.1. 1983.
- ECB, “Financial Integration in Europe”. April 2013
- Engle and Granger, 1987. “Cointegration and error correction: Representation, estimation and testing”. *Econometrica* 55, 251-276.
- Gourinchas and Rey, “International Financial Adjustment”, *Journal of Political Economy* 115, 665-703. 2007.
- Gros D. 2011. “External versus domestic debt in the euro crisis”. *CEPS Policy brief* No. 243, May 2011.
- Gros D., Alcidi C. 2011. “Adjustment Difficulties and Debt Overhangs in the Eurozone Periphery”. *CEPS Working document* No.347, May 2011.

- Gros D., Alcidi C. 2013. “Country adjustment to a ‘sudden stop’: does the euro make a difference? *European Economy, Economic Papers 492,* April 2013.
- Hall, 1998. “Intertemporal Substitution in Consuption”. *Journal of Political Economy*, vol. 96, no. 2, April, pp. 339-357.
- Holinski N., Kool CJM, Muysken J. 2010. ”Origins of persistent macroeconomic imbalances in the Euro Area”. *Tjalling C. Koopmans Institute Discussion Paper Series,* Volume 10, Issue 12, pp. 1-18.
- Huang and Lin, 1993. “Deficits, Government Expenditure, and Tax Smoothing in the United States:1929 – 1988”. *Journal of Monetary Economics*, June 1993.
- IMF 2010. “Global Financial Stability Repor”. April 2010, *International Monetary Fund*.
- Jaumotte and Sodsriwiboon, “Current account imbalances in Southern Euro Area*”, IMF WP 10/139, 2010*.
- Knight and Scacciavillani, “Current Accounts: What Is Their Relevance for Economic Policymaking?”, *IMF Working Paper* 98/71.
- Kraay and Ventura 2000. “Current Account in Debtor and Creditor Countries”. *Quaterly Journal of Economics,*vol 115, no 4, November, pp 1137-1166.
- Mankiw and Shapiro, 1985. “Trend, random walks and tests of the permanent income hypothesis”. *Journal of Monetary Economics* 16, 165-174.
- Mayer, 2011. “Euroland’s hidden balance of payments crisis”, *Deutsche Bank Research*.EU Monitor 88.
- Milne R., “Euro fiscal union undermines EU”. *Financial Times*, 19 February 2013.
- Obstfeld and Rogoff, “The intertemporal Approach to the Current Account”, *NBER Working papers Series* No. 4893. 1994.
- Schmitz and von Hangen, “Current account imbalances and financial integration in the euro area”, *CEPR Discussion Paper* 7262. 2009.
- Sinn H.W and Wollmershäuser T. 2011. “Target Loans, Current Acount Balances and Capital Flows: the ECB’s Rescue Facility”. *CESifo Working Paper no.3500.* June 2011.
- West, 1988. Asymptotic normality, when regressors have a unit root. *Econometrica* 56, 1397-1418.

APPENDICES

Appendix A. K-Test for VAR(2).

From the estimates of the VAR2 model one can calculate

$$k = -(g_1 - \gamma g_2)\beta A(I - \beta A)^{-1} \tag{a}$$

where A is the matrix of parameters from the VAR model, I is an identity matrix, and β and γ are known constants.

$$g_1 = [1, 0, 0, 0, 0, 0] \text{ and } g_2 = [0, 0, 0, 0, 1, 0]$$

$$\text{so } g_1 - \gamma g_2 = [1, 0, 0, 0, -\gamma, 0] = x$$

$$k = -x\beta A(I - \beta A)^{-1} \tag{b}$$

Let us then post-multiply both sides of *(b)* by the matrix $(I - \beta A)$:

$$k(I - \beta A) = -x\beta A(I - \beta A)^{-1}(I - \beta A) = -x\beta A$$

$$kI - \beta kA = -x\beta A$$

$$kI = -\beta kA - x\beta A = -\beta(k + x)A$$

$$(-1/\beta)kI = (k + x)A \tag{c}$$

We want to test the hypothesis that the estimated k is equal to the theoretical:

$$k = [0, 0, 1, 0, 0, 0]$$

Let us then insert this theoretical value in the LHS of equation *(c)*:

$$\left(-\frac{1}{\beta}\right)kI = \left(-\frac{1}{\beta}\right)k = \left[0, 0, -\frac{1}{\beta}, 0, 0, 0\right]$$

Similarly, inserting in the RHS of the equation *(c)* the values for *x* and *k*, we would obtain:

$$(x + k) = [1, 0, 0, 0, -\gamma, 0] + [0, 0, 1, 0, 0, 0] = [1, 0, 1, 0, -\gamma, 0]$$

Multiplying the result just obtained times the *A* matrix we get:

$$(x + k)A = [1, 0, 1, 0, -\gamma, 0] \begin{bmatrix} a_{11} & \cdots & a_{16} \\ \vdots & \ddots & \vdots \\ a_{61} & \cdots & a_{66} \end{bmatrix}$$

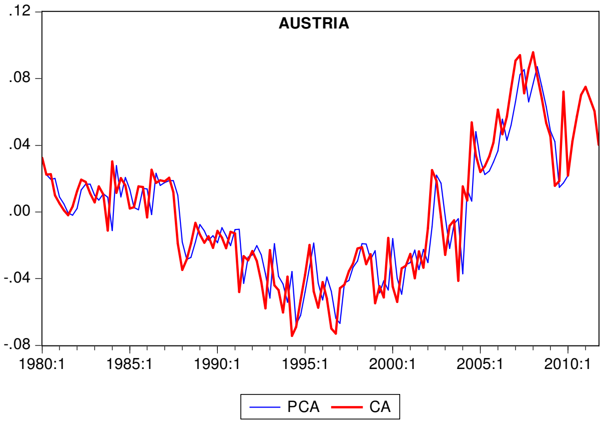
$$= [a_{11} + a_{31} - \gamma a_{51}, a_{12} + a_{32} - \gamma a_{52}, a_{13} + a_{33} - \gamma a_{53}, a_{14} + a_{34} - \gamma a_{54}, a_{15} + a_{35} - \gamma a_{55}, a_{16} + a_{36} - \gamma a_{56}]$$

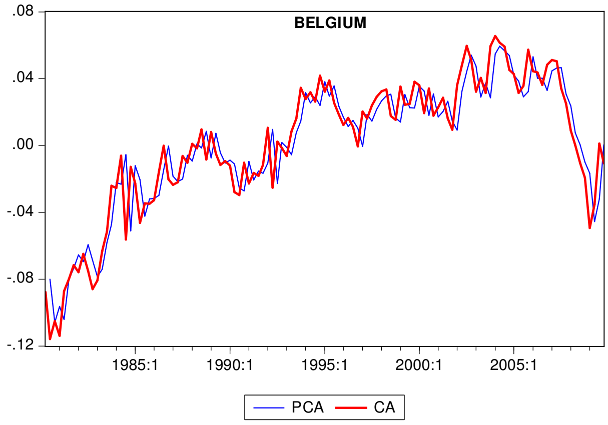
So the hypothesis to be tested from equation *(c)* is

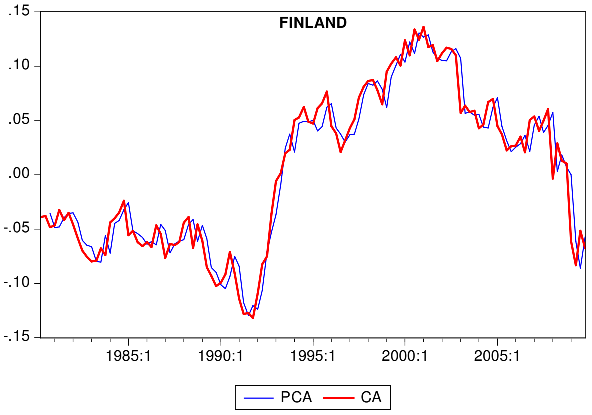
$$\left[0, 0, -\frac{1}{\beta}, 0, 0, 0\right] = [a_{11} + a_{31} - \gamma a_{51}, a_{12} + a_{32} - \gamma a_{52}, a_{13} + a_{33} - \gamma a_{53}, a_{14} + a_{34} - \gamma a_{54}, a_{15} + a_{35} - \gamma a_{55}, a_{16} + a_{36} - \gamma a_{56}]$$

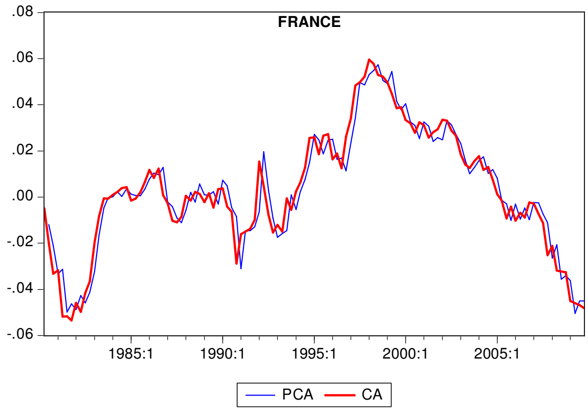
This means six restrictions to the parameters of the VAR model.

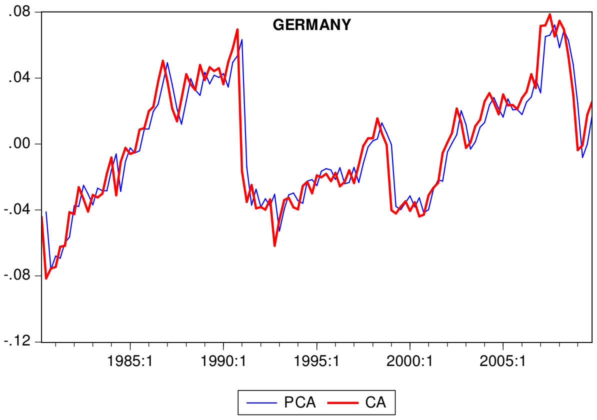
Appendix B. Graphs 1-12 of Actual and Predicted Current Accounts

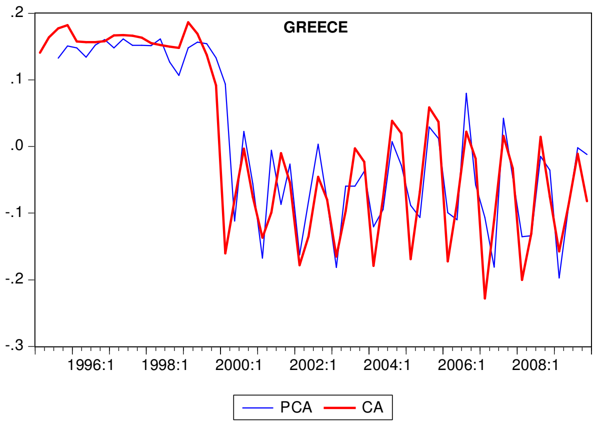


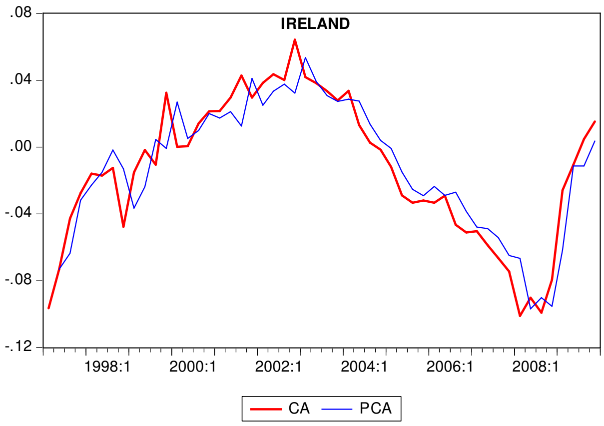


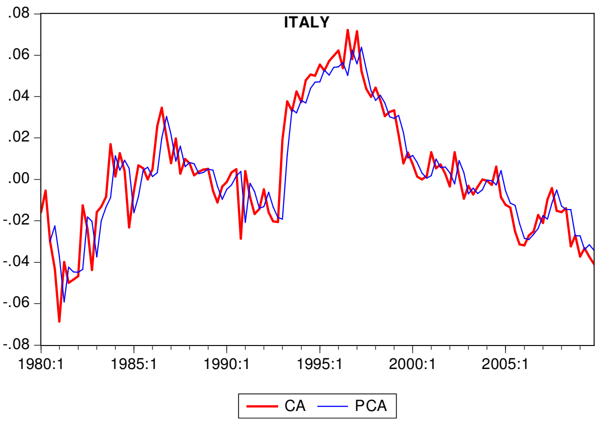


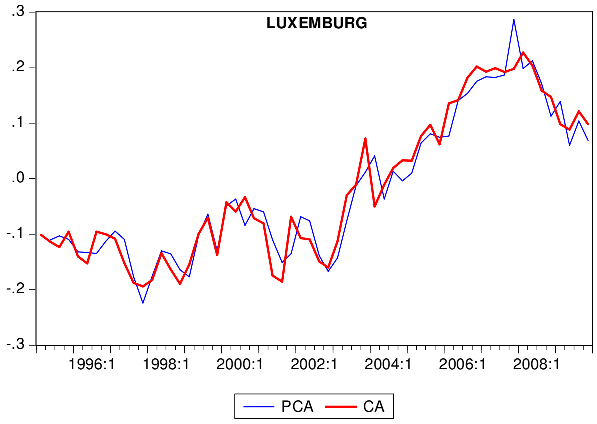


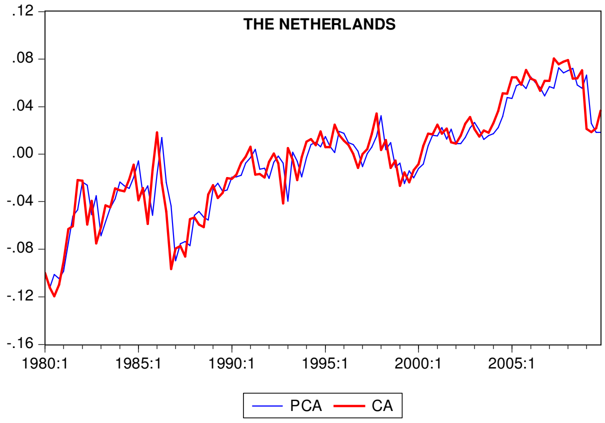


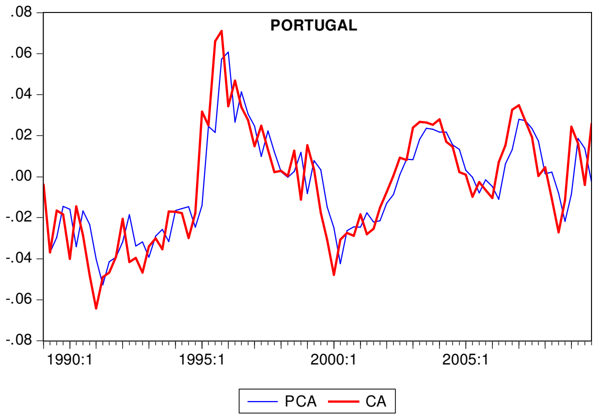


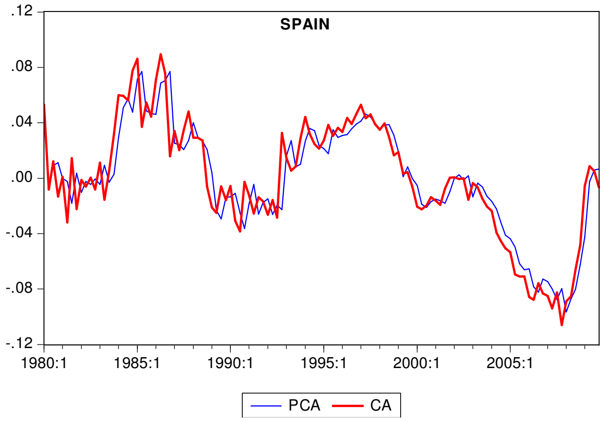





LUXEMBURG
.3
.2
.1
.0
-.1
-.2
-.3
1996:1
1998:1
2000:1
2002:1
2004:1
2006:1
2008:1
PCA
CA


THE NETHERLANDS
.12
.08
.04
.00
-.04
-.08
-.12
-.16
1980:1
1985:1
1990:1
1995:1
2000:1
2005:1
PCA
CA


PORTUGAL
.08
.06
.04
.02
.00
-.02
-.04
-.06
-.08
1990:1
1995:1
2000:1
2005:1
PCA
CA


SPAIN
.12
.08
.04
.00
-.04
-.08
-.12
1980:1
1985:1
1990:1
1995:1
2000:1
2005:1
PCA
CA

Appendix C. Full SUR system with 36 equations.

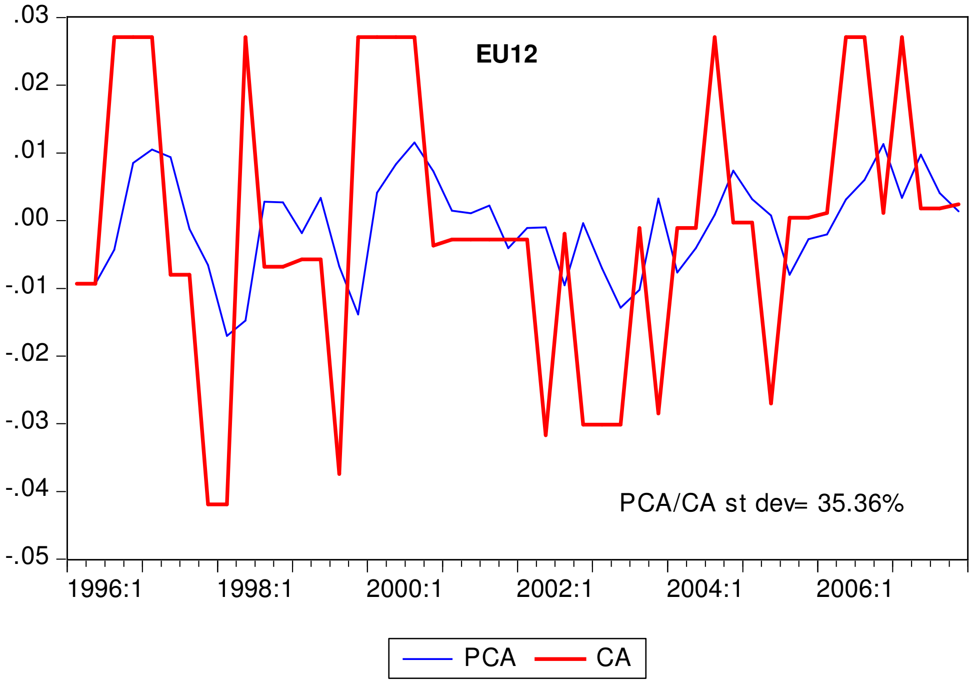
SUR system with 36 equations and 3x36 variables is:

$$dno\_at=C(1)*dno\_at(-1) + C(2)*ca\_at(-1) + C(3)*r\_at(-1)$$
$$ca\_at=C(4)*dno\_at(-1) + C(5)*ca\_at(-1) + C(6)*r\_at(-1)$$
$$r\_at=C(7)*dno\_at(-1) + C(8)*ca\_at(-1) + C(9)*r\_at(-1)$$
$$dno\_be=C(10)*dno\_be(-1) + C(11)*ca\_be(-1) + C(12)*r\_be(-1)$$
$$ca\_be=C(13)*dno\_be(-1) + C(14)*ca\_be(-1) + C(15)*r\_be(-1)$$
$$r\_be=C(16)*dno\_be(-1) + C(17)*ca\_be(-1) + C(18)*r\_be(-1)$$
$$dno\_de=C(19)*dno\_de(-1) + C(20)*ca\_de(-1) + C(21)*r\_de(-1)$$
$$ca\_de=C(22)*dno\_de(-1) + C(23)*ca\_de(-1) + C(24)*r\_de(-1)$$
$$r\_de=C(25)*dno\_de(-1) + C(26)*ca\_de(-1) + C(27)*r\_de(-1)$$
$$dno\_es=C(28)*dno\_es(-1) + C(29)*ca\_es(-1) + C(30)*r\_es(-1)$$
$$ca\_es=C(31)*dno\_es(-1) + C(32)*ca\_es(-1) + C(33)*r\_es(-1)$$
$$r\_es=C(34)*dno\_es(-1) + C(35)*ca\_es(-1) + C(36)*r\_es(-1)$$
$$dno\_fi=C(37)*dno\_fi(-1) + C(38)*ca\_fi(-1) + C(39)*r\_fi(-1)$$
$$ca\_fi=C(40)*dno\_fi(-1) + C(41)*ca\_fi(-1) + C(42)*r\_fi(-1)$$
$$r\_fi=C(43)*dno\_fi(-1) + C(44)*ca\_fi(-1) + C(45)*r\_fi(-1)$$
$$dno\_fr=C(46)*dno\_fr(-1) + C(47)*ca\_fr(-1) + C(48)*r\_fr(-1)$$
$$ca\_fr=C(49)*dno\_fr(-1) + C(50)*ca\_fr(-1) + C(51)*r\_fr(-1)$$
$$r\_fr=C(52)*dno\_fr(-1) + C(53)*ca\_fr(-1) + C(54)*r\_fr(-1)$$
$$dno\_it=C(55)*dno\_it(-1) + C(56)*ca\_it(-1) + C(57)*r\_it(-1)$$
$$ca\_it=C(58)*dno\_it(-1) + C(59)*ca\_it(-1) + C(60)*r\_it(-1)$$
$$r\_it=C(61)*dno\_it(-1) + C(62)*ca\_it(-1) + C(63)*r\_it(-1)$$
$$dno\_nl=C(64)*dno\_nl(-1) + C(65)*ca\_nl(-1) + C(66)*r\_nl(-1)$$
$$ca\_nl=C(67)*dno\_nl(-1) + C(68)*ca\_nl(-1) + C(69)*r\_nl(-1)$$
$$r\_nl=C(70)*dno\_nl(-1) + C(71)*ca\_nl(-1) + C(72)*r\_nl(-1)$$
$$dno\_gr=C(73)*dno\_gr(-1) + C(74)*ca\_gr(-1) + C(75)*r\_gr(-1)$$
$$ca\_gr=C(76)*dno\_gr(-1) + C(77)*ca\_gr(-1) + C(78)*r\_gr(-1)$$
$$r\_gr=C(79)*dno\_gr(-1) + C(80)*ca\_gr(-1) + C(81)*r\_gr(-1)$$
$$dno\_ie=C(82)*dno\_ie(-1) + C(83)*ca\_ie(-1) + C(84)*r\_ie(-1)$$
$$ca\_ie=C(85)*dno\_ie(-1) + C(86)*ca\_ie(-1) + C(87)*r\_ie(-1)$$
$$r\_ie=C(88)*dno\_ie(-1) + C(89)*ca\_ie(-1) + C(90)*r\_ie(-1)$$
$$dno\_lu=C(91)*dno\_lu(-1) + C(92)*ca\_lu(-1) + C(93)*r\_lu(-1)$$
$$ca\_lu=C(94)*dno\_lu(-1) + C(95)*ca\_lu(-1) + C(96)*r\_lu(-1)$$
$$r\_lu=C(97)*dno\_lu(-1) + C(98)*ca\_lu(-1) + C(99)*r\_lu(-1)$$
$$dno\_pt=C(100)*dno\_pt(-1) + C(101)*ca\_pt(-1) + C(102)*r\_pt(-1)$$
$$ca\_pt=C(103)*dno\_pt(-1) + C(104)*ca\_pt(-1) + C(105)*r\_pt(-1)$$
$$r\_pt=C(106)*dno\_pt(-1) + C(107)*ca\_pt(-1) + C(108)*r\_pt(-1)$$

Where *ca* stands for Current Account, *dno* is the change in net output and *r* is the consumption based real interest rate.

Appendix D.

Graph 13



End Notes

[A] Krugman P., 2012. "European Crisis Realities". Viewed 20 March 2012. http://krugman.blogs.nytimes.com/2012/02/25/european-crisis-realities/
[B] Krugman P., 2011, "US State Balance of Payments". Viewed 25 March 2012. http://krugman.blogs.nytimes.com/2011/11/07/us-state-balances-of-payments/
[C] The Economist, 2012. "Building euro-zone competitiveness". http://www.economist.com/node/21553481
[D] Tramo-Seats. Eurostat. http://epp.eurostat.ec.europa.eu/portal/page/portal/euroindicators_conferences/documents_seasons/PALATE.pdf. Accessed on the 15th of August 2012.
[E] Tramo-Seats. Statistics Finland. http://www.stat.fi/til/tramo_seats_en.html Accessed 15th of August 2012.