CURRENT ACCOUNT DYNAMICS IN THE EURO AREA

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Abstract: *This paper investigates the current account (CA) dynamics in the Euro Area by addressing three questions. First, are the vast CA deficits of some Euro Area members still sustainable? Second, what has financed them? Third, what is the reaction of an external shock? The aim of this paper is to address these issues by applying an econometric analysis to the most recent data. The main finding is that the CA does not have to be necessarily stationary. This result does not go in line with what most papers assume and conclude. Last, applying a vector error-correction model (VECM), I conclude that the dynamics of the CA deficits in the Euro Area and bank related net inflows seem to be highly associated. It is also found that CA adjustments do not occur contemporaneously to shocks. However, the adjustment of banking capital flows occurs almost immediately.*

Keywords: Current Account; Euro Area; Banking Capital Flows.
JEL Classification: F30; F32.

INTRODUCTION

The determination of the CA and its different liquidity sources has been a perennial topic in the Euro Area. The economic differences between countries in the Euro Area are of great relevance to the long-term prospects of the single currency union. Since the outbreak of the financial crisis, there has been an increasing interest in balance of payment imbalances.

The CA and the financial account have to compensate each other to satisfy the balance of payment identity. Thus, CA deficits are creating a net financing need in net debtor countries. These can be covered via a variety of sources; but if countries with high CA deficits face their boundary of debt sustainability financing might dry up. Especially if the CA is financed via short-term rather than long-term liabilities, a sudden stop or even a reversal is more likely, when an external shock occurs. Since the CA is reflected as the difference between the savings rate and the investment rate, net debtor countries facing a sudden stop of capital flows, either have to raise the former or cut investment (Lane and Pels, 2012).

In the following, I attempt to defend the view that CA deficits in the Eurozone can be associated to an increase of foreign bank loans. This econometric analysis is conducted via several technical tools. First, I examine the CA in the Euro Area and determine its order of integration. Second, I try to derive inferences about the relationship between the aforementioned variables, in particular bank-related flows.

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The remainder of the paper is structured as follows. Section 2 provides a brief overview of the existing literature. Section 3 reviews the economic theory, considering the intertemporal budget constraint. Section 4 discusses the data I assembled. Section 5 presents the empirical results. Section 6 concludes.

1. LITERATURE REVIEW

There is a sizable literature that the pre-crisis period in the Euro Area was characterised by high capital inflows (see Lane, 2012), which financed the CA deficits in the Euro Area. Since the beginning of the financial crisis, there occurred a sudden stop of cross-border capital flows. This financing can suddenly dry up when concerns about the public debt sustainability arise (Eichengreen, 2005). As pointed out by Milesi-Feretti and Tille (2011), this stop has been predominantly driven by bank-related debt flows.

However, there is a lack of literature on the interdependencies of the CA and these bank-related flows, especially their causal relationship. It might be the case that both variables share a common trend and are highly correlated, but are not directly linked. In an empirical framework it is required to analyse the properties of the CA first, before determining its sources.

Taylor (2002) established that savings and investment are highly correlated, and therefore the CA reaches an equilibrium, since the long-run CA has to satisfy the intertemporal national long-run budget constraint (LRBC). In this fashion, the CA is assumed to be stationary. Holmes et al. (2009) test if the CA deficits are stationary in the European Union. They only find inconclusive evidence by examining individual countries. For the whole panel of EU countries they infer that the CA is non-stationary, which let them draw conclusions about their debt-sustainability.

Obstfeld and Rogoff (1996) as well as Trehan and Walsh (1991) provide the economic theory for the analysis of the long-term budget constraint. In addition, Greene (2012), Lütkepohl and Krätzig (2004) and Enders (2010) provide an overview of the theory of the econometric tools for the dynamic analysis of the CA. In particular, Levin et al. (2002), Hadri (2000), and Im et al. (2003) introduce procedures for unit root tests in panel samples.

2. THEORY AND EMPIRICAL APPROACH

My intuition is that the expansion in CA imbalances during the mid-2000s may have been driven by the volatility of capital inflows, especially loans from foreign banks. On the one hand, higher inflows may drive higher investment and lower savings rates and therefore higher CA deficits. On the other hand, a sudden stop of capital flows requires an improvement in the CA.

Assuming a small open economy, the CA identity yields

$$B_{t-1} - B_t = CA_t = r_t B_t + Y_t - (C_t + G_t + I_t)(1)$$
$$CA_t = S_t - I_t(2)$$

where B, r, G, I, and Y refer to borrowing, the real interest rate, government consumption, investment, and income, respectively. Ignoring valuation effects, a CA deficit moves together with a decrease of the net foreign asset positions between time period (t) and (t+1), i.e. net capital inflows. Defining S as savings with Y+rB-C-G, we can rewrite the CA as savings minus investment (2). However, this two period model is not sufficient for stationarity analysis, if it could be possible that debt can be rolled over perpetually. Iterative substitution yields

$$B_t = \left(\frac{1}{1+r}\right) \sum_{s=t}^{s=\infty} \left(\frac{1}{1+r}\right)^{s-t} (G_s + I_s + C_s - Y_s)(3)$$

assuming

$$\lim_{T\to\infty} \left(\frac{1}{1+r}\right)^T B_{t+T+1} = 0(4)$$

Equation (4) is called the transversality condition. If (4) is not satisfied and is instead an inequality smaller than zero, it implies that an economy consumes and invests more than it produces. Hence, an economy is continually raising its debt, whereas, on the other hand, counterparties have to accept this. This so called Ponzi scheme is ruled out by most authors (Obstfeld and Rogoff, 1996).

However, as long as both of these equations (3) and (4) are satisfied, the CA might satisfy stationarity. Bearing in mind that the transversality condition for the Euro Area might not hold empirically for at least some periods of time, implying that discussing the stationarity is not as obvious as it appears to be. In the very long-run, as T goes to infinity, there might be a certain threshold, when creditor countries do not accept debtor countries to perpetually roll over debt anymore. This threshold may vary across countries and country groups, whereas in the currency unions it might be higher than in 'independent' countries.

First, I approach the stationarity of the CA by making use of different versions of the unit root tests. Second, I attempt to establish a relationship between the CA and bank-related loans applying various techniques commonly used for multiequation time-series models.

3. DATA

For this paper a dataset covering the quarterly evolution of CA balances and banking statistics, since 1995 is assembled. The panel dataset spans from the fourth quarter in 1995 to the fourth quarter in 2013 for all Euro Area countries plus the Euro Area itself except for Cyprus and Malta.

I collect the CA data from the Organisation for Co-operation and Development (OECD) for all Euro Area countries against the rest of the world from 1995 to 2013[*]. Only for Finland, France, Germany, Greece, Portugal and Slovenia, the data is available for quarter four in 2013. For the Euro Area I draw the data from 1997 to 2012.

Information on the banking statistics is collected from the Bank for International Settlement (BIS) Locational Banking Statistics. From this dataset, I use external loans and deposits of reporting banks vis-à-vis individual countries (Table 7). Table 7A represents the loans and deposits vis-à-vis all sectors and 7B vis-à-vis non-banks. These statistics reflect claims and liabilities of banking offices resident in BIS reporting countries. In general, loans and deposits reflect financial claims on both banks and non-banks, which are not negotiable (see also BIS, 2013). The change between two periods is referred to as a capital flow from the banks in BIS reporting countries to individual countries. Hence, increases (decreases) in claims (liabilities) reflect capital inflows to the individual countries and vice versa. The change in the difference between the claims and the liabilities is termed net capital (in)flows[†] or bank related (in)flows. These flows reflect a subset of all capital flows and therefore of the financial account[‡]. Since the locational banking statistics is based on the residence and not on the nationality principle, they are consistent with the balance of payment methodology. Henceforth, I refer to all BIS reporting banks as banks[§].

4. RESULTS

In the following, I present the outcomes from the data analysis. I begin with visualizing the summary statistics, continue discussing the properties of the CA and last but not least, I investigate the relationship between the CA and bank related capital inflows.

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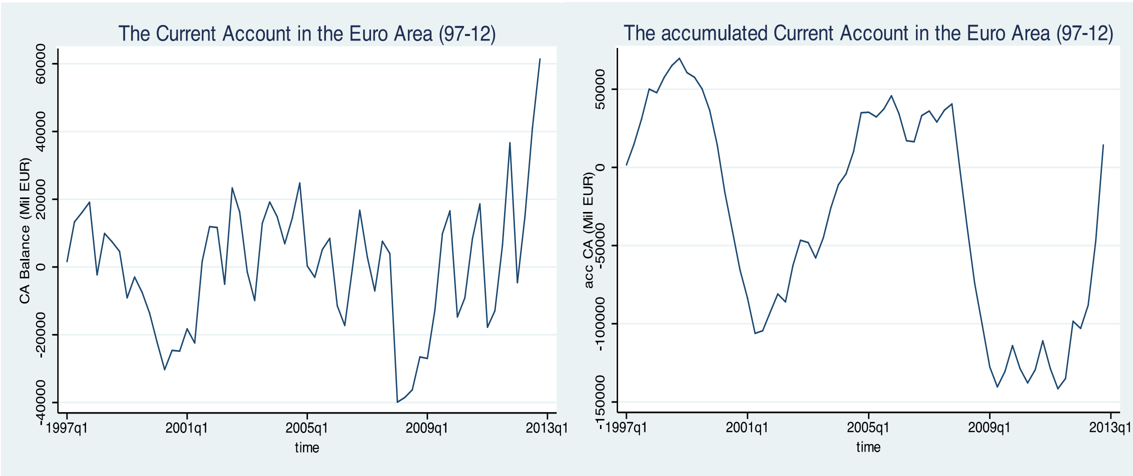
[*] For Portugal the last quarter of 1995 is not available.
[†] Some authors refer net capital outflows as net capital flows.
[‡] The financial account is again determined as CA=-financial account, assuming capital account and errors and omission are zero.
[§] The latest list of BIS reporting countries is available on the BIS website (www.bis.org/statistics/rep_countries.htm).

4.1 The Stationarity of the CA

The left panel of Figure 1 plots the CA, whereas the right panel visualizes the accumulated CA of the Euro Area between 1997 and 2012. This figure gives a first impression of outstanding build-up or deterioration phases.

Figure 1 - The CA



Both until the burst of the dot-com bubble and the beginning of the Lehman-Crisis, we observe sharp deteriorations of the CA. Whilst in the second quarter of 2000 the change of the CA is still negative it increases until it becomes again positive in the third quarter of 2001. This shock of the "Internet bubble" on the 10th March 2000 (Kraay and Ventura, 2007) can be seen as a shock to the system, moving together with a deterioration of the international financial markets. Technically, a large CA reversal is an inevitable reaction; however, from the graphs and the figures as well as intuitively it might be obvious that CA adjustments do not occur instantaneously.

Similarly, a high-accumulated CA deficit in the crisis-period of about 100 billion Euros (from 1997) can be observed from Figure 1. Since some Euro Area countries are partly cut off from the financial markets, the intuition is that they have to reduce their CA deficits by large amounts. However, the recovery from this shock still takes place.

To make the evolvement even more striking it is helpful to separate the Euro Area in two categories, CA deficit and CA surplus countries. At least with respect to the CA there is a remarkable heterogeneity within the single currency union. I make use of Greece, Italy, Ireland, Portugal, and Spain (GIIPS) and Germany as inherent debtor and creditor countries, respectively.

Figure 2 - The accumulated CA for Germany and the GIIPS countries

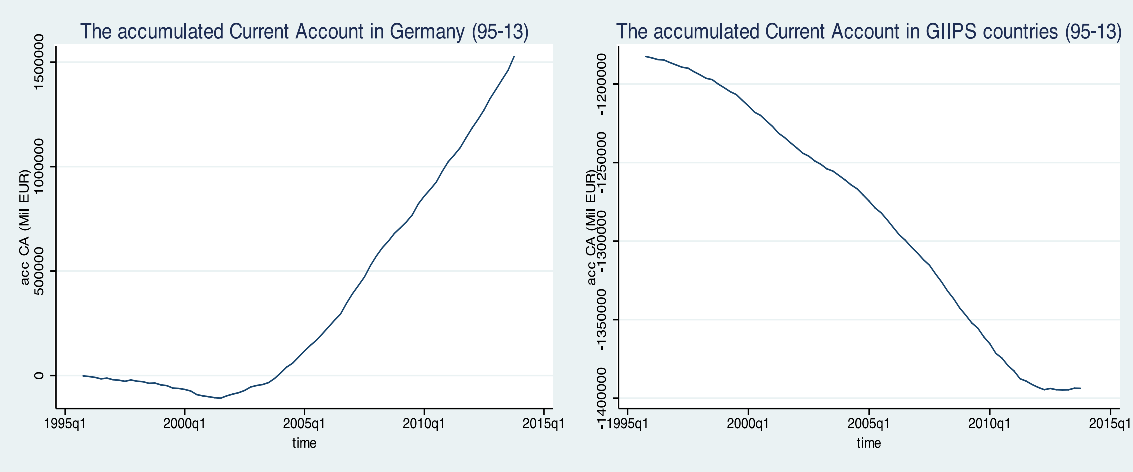


Figure 2 sheds light on the heterogeneity of the CA evolvements in the Euro Area. The left panel shows that Germany accumulated very high CA surpluses until the end of 2013. Whereas Germany ran CA deficits in the beginning of the period, the accumulated CA is even strictly increasing since the third quarter of 2001. Conversely, the CA is strictly decreasing for the GIIPS countries until recently with a slight upwards trend for some countries (right panel).

Bearing in mind that the CA only reflects the difference between savings and investment and hence equals net capital outflows, CA deficits in Euro Area countries, have to be financed through net capital inflows. Additionally, if some countries run CA deficits, others have to run surpluses, such that

$$S_t - I_t = -(S_t^* - I_t^*)(5)$$

where * reflects all foreign countries.

As apparent from the graphs, the CA of the current period seems to follow the value of the last period quite often. To infer statistical persistence or other properties of a time series, the autocorrelation functions can be helpful.

Table 1 - Correlogram of the CA

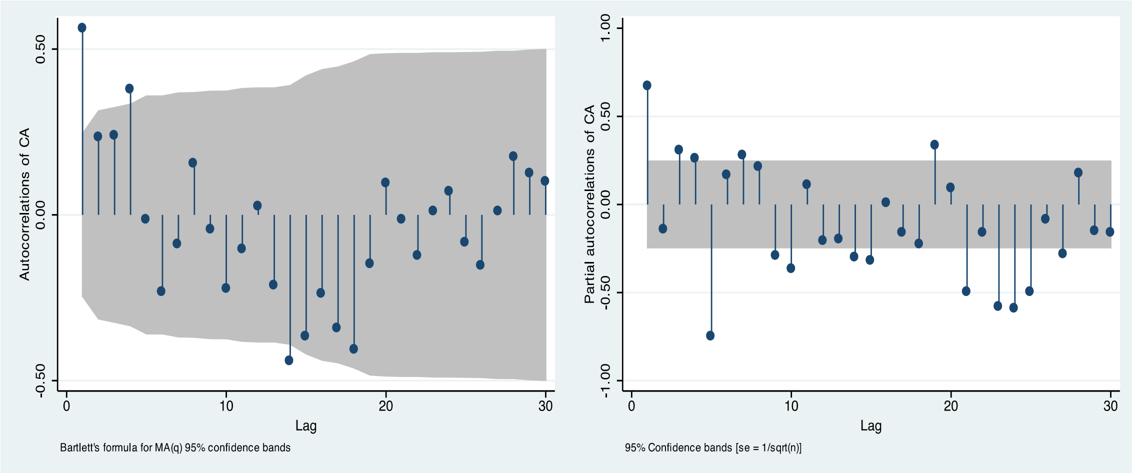
LAG	AC	PAC	Q	Prob>Q
1	0.563	0.6733	21.252	0.0000
2	0.2315	-0.1405	24.903	0.0000
3	0.2393	0.3086	28.869	0.0000
4	0.3761	0.2572	38.827	0.0000
5	-0.0154	-0.7503	38.844	0.0000

6	-0.2312	0.1642	42.737	0.0000
7	-0.0885	0.2761	43.318	0.0000
8	0.1554	0.209	45.139	0.0000
9	-0.0434	-0.2953	45.284	0.0000
10	-0.2252	-0.3655	49.252	0.0000
11	-0.1037	0.1057	50.11	0.0000
12	0.0233	-0.2131	50.154	0.0000
13	-0.2144	-0.204	53.961	0.0000
14	-0.4411	-0.301	70.399	0.0000
15	-0.3694	-0.3246	82.16	0.0000
16	-0.2394	0.0086	87.202	0.0000
17	-0.3442	-0.1603	97.85	0.0000
18	-0.4096	-0.232	113.26	0.0000
19	-0.1506	0.3334	115.39	0.0000
20	0.0936	0.0935	116.23	0.0000

The correlogram (Table 1) shows that the correlation between the current value of the CA and its value two quarters ago (lag 2) is 0.2315 (AC). This coefficient can be helpful determining the order of a moving average process, when the series is stationary (we see that later). The partial autocorrelation (PAC) shows that the correlation between the current value of the CA and its value on the second lag is -0.14, not including the effect of the previous lag (lag 1). To determine the order of an autoregressive process the PAC can give helpful indications.

The Box-Pierce' Q statistic tests the null hypothesis that whether the autocorrelations are equal to zero. Table 1 shows significant autocorrelation between the lags, shown in the Prob>Q values; I can reject the null hypothesis of no autocorrelation for all 20 lags.

Figure 3 - Autocorrelation functions for the CA



The graphical view of the AC shows again that the series does not seem to decay to zero geometrically, which should be the case for a stationary series (Figure 3, left panel). The coefficients of the PAC (right panel) are not only mirror images of the first lags because they are adjusted by eliminating the intervening values between the lags. The graphic view of the PAC does still show spikes, for example at lag 5 or at lag 23 and 24, which might be generated from noise of outliers in the series. I cannot reject the null hypothesis for at least these strong outliers and also some additional lags that they are not partially autocorrelated with the current value. The lag at which the PAC cuts to zero often determines which order of integration the autoregressive (AR) function is.

For examining the Euro Area, I start with modelling the CA as an AR process of the first order, AR (1). The PAC cuts to a relatively small value after the first lag, and all values, except for two outliers, lying inside the 95% confidence interval. In an AR process, a high coefficient of the lag indicates a persistent CA and a small coefficient infers a flexible CA. The error term can be seen as real shocks to the economy, for example world interest rates or technology shocks (Taylor, 2002).

Table 2 - AR(1) of the CA

	(1)
	CA
ARMA	
L.ar	0.658^{***}
	(6.87)
sigma	
cons	15023.7^{***}
	(11.86)

N	64
ll(model)	-706.607
Df	2
AIC	1417.215
BIC	1421.533

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For the AR (1) process I can reject the null hypothesis that the first lag of the CA and the intercept does not affect the CA of the current period on a 1% significance level. The model predicts that the CA of the next period is 66% of the last period plus an intercept of 15023 million Euros (Table 2).

The CA could also be explained by a MA (1) process, which indicates that an innovation, the error term, of the current period and its first lag affect the dependent variable (Table 3). Hence, the AC function should have one spike on the first lag, and then cut to zero; the PAC should be characterised by a slow decay to zero.

Table 3 - MA(1) of the CA

	(1)
	CA
ARMA	
L.ma	0.535^{***}
	(4.97)
sigma	
_cons	15706.4^{***}
	(12.26)
N	64
ll(model)	-709.3373
Df	2
AIC	1422.675
BIC	1426.992

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first lag of the MA is also highly significant as well as the constant. As it can hardly be claimed that the AC function drops to zero after the first lag, the AR (1) model should fit the data better. However, since an AR of an infinite order can be written as a MA (1) process, this representation can make sense[*]. If both the PAC function and the AC function decay to zero the model might be identified by an ARMA (1,1) process (Table 4).

[*] See Cochrane (1997) for the proof.

Table 4 - ARMA (1,1) for the CA

	(1)
	CA
CA	
_cons	1361.6
	(0.28)
ARMA	
L.ar	0.492**
	(2.93)
L.ma	0.274
	(1.56)
sigma	
_cons	14785.7***
	(11.81)
N	64
ll(model)	-705.6037
df	4
AIC	1419.207
BIC	1427.843

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

To compare the qualities of the models I use the Akaike's information criteria (AIC) and the Schwarz's Bayesian information criteria (BIC), presented below the regressions respectively. These model selection criteria are taking both the goodness of fit and the principle of parsimony into consideration. Parsimony is a concept of the Box-Jenkins approach and desires explaining a relationship with as few parameters as possible (Enders, 2010)[*]. The AIC and BIC can make inferences about which model should be selected. The lower the criteria the higher the quality of the model.

For the AR (1) model both, the AIC and BIC, are smaller than for the MA (1) and the ARMA (1,1). These are only three possible variations to model the CA without any exogenous variables. Adding more lags does neither enhance the model selection criteria nor does its economic intuition make sense.

To find out if the data is independently distributed I first predict the residuals of the AR (1) process. The fact that various lags of the correlogram for the residuals are significant already indicates that the residuals are not uncorrelated and therefore not white noise (Table 5). The

[*] Adding more parameter increases the Goodness of fit, but reduces the degrees of freedom.

Portmanteau test for white noise can confirm that this is actually the case, since the null hypothesis can be rejected on all common significant levels (Table 6).

Table 5 - Correlogram for the predicted residuals of the AR (1) process

LAG	AC	PAC	Q	Prob>Q
1	0.0899	0.0977	0.5424	0.4614
2	-0.2274	-0.2699	4.0664	0.1309
3	-0.0388	-0.0282	4.1707	0.2436
4	0.5517	0.6799	25.597	0
5	-0.0962	-0.4523	26.26	0.0001
6	-0.3779	-0.3119	36.662	0
7	-0.124	-0.0654	37.801	0
8	0.4164	0.3552	50.881	0
9	0.0126	0.1619	50.893	0
10	-0.3211	-0.3262	58.956	0
11	-0.0213	0.0268	58.992	0
12	0.3201	-0.0559	67.316	0
13	-0.0231	-0.0961	67.36	0
14	-0.3477	-0.1679	77.576	0
15	-0.1161	-0.4171	78.739	0
16	0.1773	-0.1465	81.505	0
17	-0.1144	-0.1588	82.682	0
18	-0.4522	-0.4633	101.46	0
19	-0.0478	0.0405	101.68	0
20	0.27	0.4216	108.67	0
21	-0.0055	-0.1889	108.68	0
22	-0.2515	0.226	115.04	0
23	0.0533	-0.2159	115.33	0
24	0.2152	-0.5304	120.22	0

Table 6 - Portmanteau test for white noise

Portmanteau (Q) statistic =	50.8806
Prob > chi2(8) =	0.0000

Nevertheless, the CA might not be any ARMA (p,q) process. If a shock to a system is permanent and does not vanish over time, the process might be a random walk - also called unit root process. If the process tends to walk without mean-reversion and thus is non-stationary, this can be tested via a unit root test.

The (augmented) Dickey-Fuller test is one of the most commonly used tests for stationarity. The null hypothesis is the existence of a unit root. The test statistic shows that the CA series is non-stationary, since the test statistic is smaller for all common critical values and therefore I cannot reject the existence of a unit root. This test is conducted for five lags (Table 7).

Table 7 - Augmented Dickey-Fuller test for the CA

	Interpolated Dickey Fuller					
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	N	MacKinnon approximate p-value for Z(t)
Z (t)	-2.556	-3.569	-2.924	-2.597	58	0.1024

The first difference of stochastic trends is one way to deal with non-stationary series. Conversely, deterministic components can be removed by detrending. Running the augmented Dickey Fuller test again for the change in the CA instead of the CA, again for five lags, I can reject the null hypothesis of a unit root (Table 8).

Table 8 - Augmented Dickey-Fuller test for the change of the CA

	Interpolated Dickey Fuller					
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	N	MacKinnon approximate p-value for Z(t)
Z (t)	-4.266	-3.569	-2.924	-2.597	58	0.0005

The often more precise Dickey Fuller generalized least squares (GLS) test is the same as the augmented Dickey Fuller except that the time series is transformed via a GLS regression (Table 9). The null hypothesis of a unit root of the CA series is only rejected for lag 4, on a 1% level*.

Table 9 - Dickey-Fuller GLS test for the CA

Maxlag = 10 chosen by Schwert criterion				
Number of obs = 53				
Lags	DF-GLS mu Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
10	-1.708	-2.614	-2.021	-1.723
9	-2.063	-2.614	-2.041	-1.744
8	-1.528	-2.614	-2.063	-1.767
7	-1.177	-2.614	-2.087	-1.792
6	-1.547	-2.614	-2.112	-1.817
5	-2.244	-2.614	-2.138	-1.842
4	-3.044	-2.614	-2.163	-1.866
3	-1.123	-2.614	-2.188	-1.889
2	-1.591	-2.614	-2.21	-1.91
1	-2.821	-2.614	-2.231	-1.929

* Since I assume the series not to have a linear time trend, I conduct the test with the 'notrend' option.

Opt Lag (Ng-Perron seq t) = 9 with RMSE 9681.336				
Min SC = 19.03828 at lag 4 with RMSE 11292.16				
Min MAIC = 18.94692 at lag 7 with RMSE 10480.17				

Conducting the Phillips-Perron test for a unit root shows that I cannot reject the null hypothesis of a unit root on the 1% significance level (Table 10). The test is again conducted without the trend option, because the series does not seem to exhibit a trend over time.

Table 10 - Phillips-Perron test for the CA

Number of obs = 63				
Newey-West lags = 3				
MacKinnon approximate p-value for Z(t) = 0.0799				
Interpolated Dickey Fuller				
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(rho)	-17.205	-19.134	-13.404	-10.778
Z(t)	-2.667	-3.562	-2.92	-2.595

Since CA deficits have to equal net capital inflows, they are of course economically bounded above by the willingness of foreign countries to give loans unless we do not rule out the Ponzi scheme. In this case, the CA itself should be - in the sense of economic intuition - stationary. If not, one would obtain a violation in the budget constraint, which will lead to government or central bank interventions (Holmes et al 2005). Because of several government transfers and compensation mechanisms, such as TARGET2 (see also Auer 2013), which play a big role since the outbreak of the Euro Crisis, one might take into consideration that the CA in the Euro Area or at least for individual countries might not be stationary. Although the budget constraint might have been violated in some cases this is only a necessary, but not a sufficient condition for a non-stationary CA. Even if the government or central banks intervene, there might be a certain threshold of a CA deficit, which will not be accepted by creditor countries and therefore would lead to a collapse of the Euro Area.

The empirical results of non-stationary CA stem from a default Dickey Fuller test (Table 11), with a constant and no further option. Implementing a non-constant option for the CA and the net inflows from banks I can reject the null hypothesis for the CA.

Table 11 - Augmented Dickey-Fuller with no constant option for the CA

Interpolated Dickey Fuller					
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	N
Z (t)	-3.000	-2.615	-1.950	-1.950	63

Until now, I have conducted all stationary tests with the aggregate series for the Euro Area CA. In this case the determination of a unit root is quite inconclusive. However, because of the vast heterogeneity in the Euro Area in terms of the CA imbalances, it might be interesting conducting a unit root test for the whole sample. A unit root test in a panel framework can be obtained by the Hadri Lagrange multiplier (LM) test, the Im, Pesaran, and Shin (IPS) test or the Levin-Lin-Chu test. They all use the augmented Dickey-Fuller statistics across the cross-sectional units of the panel (Greene 2012). Whereas the Levin, Lin and Chu test makes the simplifying assumption that all panels share the same autoregressive parameters (2002), the IPS test uses some variation within the panel (Im et al. 2003). The advantage of the Hadri (LM) test is that it tests for at least one single unit root in the panel and not only a certain fraction like the IPS or the Levin-Lin test so that the null hypothesis is mostly accepted unless there is very strong evidence for a unit root (Hadri 2000).

As expected, the Hadri LM (Table 12) test rejects the null hypothesis that all panels are stationary. I also control for serial correlation and the demean option to remove cross-sectional means[*].

Table 12 - Hadri LM test for the CA

Ho: All panels are stationary Number of panels = 14		
Ha: Some panels contain unit roots Number of periods = 64		
Time trend: Not included Asymptotics: T, N -> Infinity		
Heteroskedasticity: Robust sequentially		
LR variance: Bartlett kernel, 5 lags Cross-sectional means removed		
	Statistic	p-value
z	22.6535	0.0000

Table 13 - Levin-Lin-Chu test for the CA

Ho: Panels contain unit roots	Number of panels = 14
Ha: Panels are stationary	Number of periods = 64
AR parameter: Common	Asymptotics: N/T -> 0
Panel means: Included	

[*] Malta and Cyprus are not included in the analysis.

Time trend: Not included		
ADF regressions: 6.00 lags average (chosen by AIC)		
LR variance: Bartlett kernel, 13.00 lags average (chosen by LLC)		
	Statistic	p-value
Unadjusted t	-3.9826	
Adjusted t*	3.1035	0.9990

Second, I run a Levin-Lin-Chu unit root rest for the CA taking into account a weaker criterion[*] (Table 13). I cannot reject the null hypothesis of a unit root. This test is one of the weakest criteria, so considering a test with removing cross-sectional means by using the demean option I cannot reject the null hypothesis either (Table 14).

Table 14 - Levin-Lin-Chu test for the CA with subtracting the cross-sectional means

Ho: Panels contain unit roots	Number of panels = 14	
Ha: Panels are stationary	Number of periods = 64	
AR parameter: Common	Asymptotics: N/T -> 0	
Panel means: Included		
Time trend: Not included		
ADF regressions: 5.29 lags average (chosen by AIC)		
LR variance: Bartlett kernel, 13.00 lags average (chosen by LLC)		
	Statistic	p-value
Unadjusted t	-3.8894	
Adjusted t*	2.8175	0.9976

Both random walks with drift and random walks as well as trend stationary processes are characterized by a unit root (Greene 2012). As mentioned above, to overcome the problem of both, non-stationary variables and therefore spurious regression, it has been proven useful to detrend the variables or take the difference of the variables until they are both stationary. Taking the first difference of a random walk with drift leads to a white noise series, but the same procedure for a trend stationary process will not necessarily overcome the problem of non-stationarity. On the other hand, detrending random walks and random walks with drifts does not seem to be the right approach.

[*] I do not include the trend option and let the AIC criteria choose how many lags should be used, restricted by a maximum of 10.

4.2 Is the CA driven by bank-related capital flows?

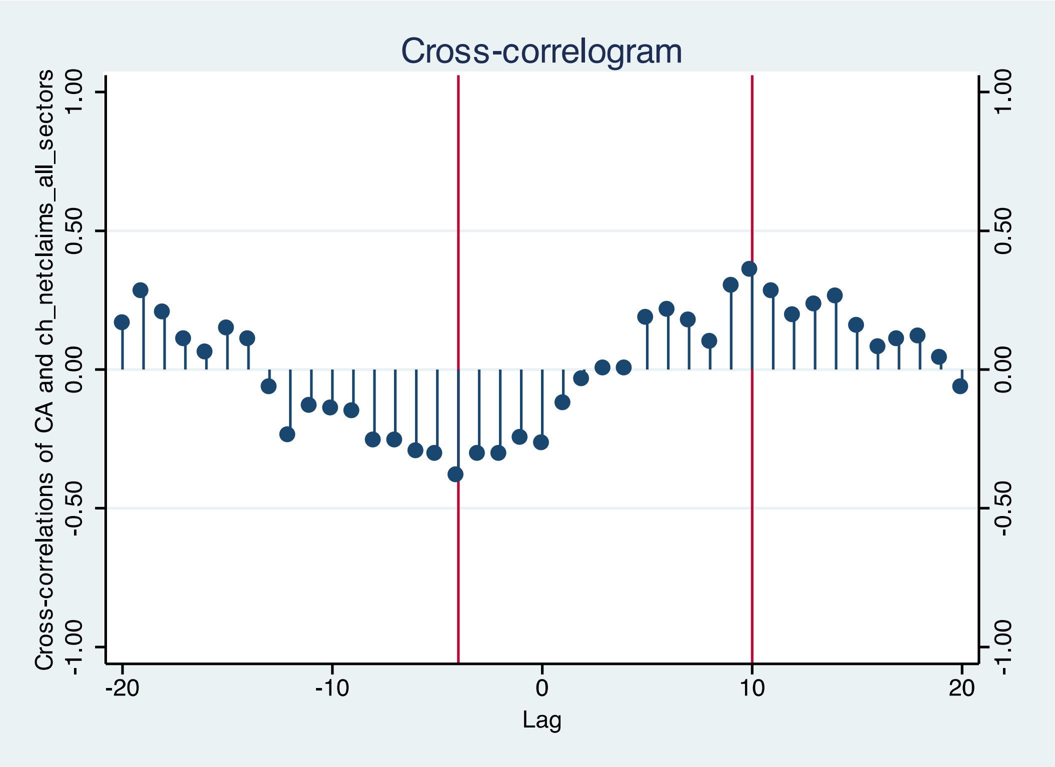
Until the outbreak of the financial crisis the large CA deficits of some Euro Area members, especially the GIIPS countries were financed by private capital inflows and especially banking inflows (Auer, 2013). Hence, the accumulated CA should equal the net international investment position minus net valuation effects, again assuming both the capital account and the errors and omissions are zero[*]. The net international investment positions combine foreign direct investment (FDIs), portfolio equity, portfolio debt, bank debt and others (Bluedorn et al., 2013).

Which of these components drives the CA is an interesting question to explore. FDI's for example are more stable than short-term loans like loans and deposit on the interbank market (Bluedorn et al. 2013). Hence, withdrawing liquidity from loans is easier than withdrawing the FDI's, as they reflect long-term investment. If inter-banking loans and other loans from banks to Euro Area countries mainly drive the CA, it might jeopardize these countries if they are confronted with liquidity withdraws.

Figure 4 shows a cross-correlogram for the bivariate time series of the CA and the change of the net claims of all banks against Euro Area banks. The fact that the correlations are first positive at negative lags and are oscillating after indicates that for example at lag 0, there is a negative immediate correlation between the variables. This means that a drop in the CA is associated with an immediate increase in the change in the net claims of other banks against the Euro Area.

[*] They are both empirically very small, so they can be neglected.

Figure 4 - Cross-correlogram CA and bank related net capital inflows



There is a negative peak at lag minus four and a positive at lag 10. This means that the change in net claims lags the CA positively by 10 periods and the CA negatively lags the change in the net claims by 5 periods (peaks are marked with a line). The negative values between the current period and the 13th negative lag show that a positive change in the net loans in the current period is associated with a higher CA deficit in this period.

Regressing two non-stationary series, which share a common stochastic drift and are integrated of the same order, is not economically meaningful and is called a spurious regression.

For example, assume that the CA deficits and the net increase of banks related loans against the Euro Area are integrated of the same order. It is possible that both share a common trend and are thus cointegrated. To test if this relationship exists, I run an Engle-Granger test. As shown above, the CA has a unit root conducting with a constant option and referring to the Dickey-Fuller FGLS, but the change in the CA does not have one. The Dickey-Fuller indicates that the net inflows from all banks to the Euro Area are non-stationary (Table 15).

Table 15 - Dickey-Fuller test for bank related net capital flows

		Interpolated Dickey Fuller				
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	N	MacKinnon approximate p-value for Z(t)
Z (t)	-1.351	-3.559	-2.918	-2.594	65	0.6057

Table 16 - Dickey-Fuller test for the change of bank related net capital flows

		Interpolated Dickey Fuller				
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	N	MacKinnon approximate p-value for Z(t)
Z (t)	-4.683	-3.560	-2.919	-2.594	64	0.0000

The second difference of the net claims of all banks against the Euro Area, the change of capital flows, does not have a unit root as shown by the Dickey-Fuller test* (Table 16). Since some of the technical unit root tests indicate that both variables the bank-related net capital inflows and the CA are integrated of order one, I test if the variables are cointegrated. The second step of the Engle-Granger methodology is running an Ordinary Least Squares (OLS) regression (Table 17).

Table 17 - Regression CA on bank related net flows

	(1)
	CA
ch_netclaims_all_sectors	-0.0638*
	(-2.24)
N	64
Adjusted R-Squared	0.0589

t statistics in parentheses
$^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

It is not surprising that the regression is significant, because the variables follow a common trend. I cannot establish any causality here; as mentioned above, this is referred to as a spurious regression, which produces seemingly a high explanatory power of the regression, the R square, but a very high autocorrelation as can be seen from the Breusch-Godfrey test (Table 18). This might be the case if both of the variables behave individually as non-stationary random walks. Typically, we can reject the null hypothesis of no serial correlation, like in this example.

* Different variations of this test give the same conclusion.

Table 18 - Breusch-Godfrey test for serial correlation

Lags(p)	Chi2	Df	Prob>chi2
1	20.037	1	0.0000
HO: no serial correlation			

The estimated error terms of this regression show the deviation of the long-run relationship of the two variables. If these estimated error terms are stationary, I obtain a cointegrated relationship of order (1,1). The Dickey-Fuller shows that the series of the estimated error is stationary.

Table 19 - Dickey-Fuller test for stationary of the residuals

	Interpolated Dickey Fuller				
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	N
Z (t)	-3.549	-2.615	-1.950	-1.610	63

Due to the fact that the estimated error is a residual, I do not have to consider a constant in the Dickey-Fuller test (Table 19). However, I can reject the null hypothesis, that the variables are not cointegrated, because the null hypothesis of a unit root can be rejected at all common significance levels.

Similarly, I can test for cointegration by the Johansen test, to estimate the cointegration rank of a VECM. Before, I implement the VECM I have to specify the lag length. Since Table 20 reports that the likelihood-ratio test selected a model with three lags I henceforth include three lags.

Table 20 - Selection-order criteria

Sample: 1998q1 - 2012q4				Number of obs = 60				
lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
1	-1421.97	.	4	.	1.5e+18*	47.5324*	47.587*	47.672*
2	-1419.5	4.9526	4	0.292	1.60E+18	47.5832	47.6924	47.8624
3	-1414.7	9.5891*	4	0.048	1.50E+18	47.5567	47.7205	47.9756
4	-1410.06	9.2841	4	0.054	1.50E+18	47.5353	47.7537	48.0938
Endogenous: CA, ch_netclaims_all_sectors								

The trace statistics, which is calculated by the eigenvalues, shows that I can reject the null hypothesis that the variables are not cointegrated of the first order when I use a model with three lags (Table 21). Economically it makes sense that the two variables are cointegrated, because CA deficits are at least partly financed by banks located in foreign countries. In this context an error-correction model is the logical consequence (Taylor 2002).

Table 21 - Johansen test for cointegration

Trend: constant			Number of obs = 61		
Sample: 1997q4 - 2012q4				Lags = 3	
maximum rank	parms	LL	eigenvalue	trace statistic	1% critical value
0	10	-1448.0303	.	20.4068	20.04
1	13	-1439.4097	0.24621	3.1656*	6.65
2	14	-1437.8269	0.05057		

I can reject the null hypothesis of no cointegration on the one percent level and fail to reject the null hypothesis of at most one cointegrating equation. Thus, there might be one cointegrating equation.

Table 22 regresses the difference (D) of both variables on the lagged (L) differences of both variables, the error correction term (ce), and a constant. The short-term relationship is reflected by the lagged error correction terms (the adjustment parameters), which reflect the speed of adjustment to their long-run equilibrium. Since they are both negative and significant, it represents the negative feedback necessary in the bank related net inflows to bring the CA back to equilibrium and vice versa. The residual from the OLS estimate of the cointegration equation is close to unity for the banking capital flows, indicating an almost immediate adjustment of banking capital flows when there are misalignments in the relationship between banking capital flows and the CA. The error correction term of the CA is also significant but much smaller, implying a half-life of the misalignment of 5 to 6 quarters.

On the opposite, the bank-related net inflows and the second lag of the CA are individually significant on a 5% level to explain the CA (column 1), which is not the case for the banking capital flows. Although I cannot interpret the coefficients causally, this might indicate that the CA reacts rather to the capital flows in the long-run and banking capital flows adjust in the short-run to misalignments. In addition, the F-tests reflect that I can neither reject the null hypothesis that the lags of bank related inflows are jointly zero to explain the CA nor the other way around. For example, if the residual is negative, the CA is lower than its long-term equilibrium; the additional net financing need is first compensated by banking inflows to bring the relationship to its long-run value.

Table 22 - Estimates of the VECM and F-test

(1)		(2)	
D_CA		D_ch_netclaims_all_sectors	
L._ce1	-0.178**	L._ce1	-0.971**
	(-2.59)		(-2.59)
LD.CA	-0.0755	LD.CA	0.345
	(-0.63)		(0.53)
L2D.CA	-0.386**	L2D.CA	0.242
	(-3.20)		(0.37)
LD.ch_netclaims_all_sectors	0.0651*	LD.ch_netclaims_all_sectors	-0.0941
	(2.06)		(-0.54)
L2D.ch_netclaims_all_sectors	0.0252	L2D.ch_netclaims_all_sectors	-0.229
	(0.97)		(-1.61)
_cons	1669.2	_cons	-305.1
	(0.87)		(-0.03)
(1)[D_CA]LD.ch_netclaims_all_sectors= 0 *(2) [D_CA]L2D.ch_netclaims_all_sectors=0*		chi2(2) = 4.34 Prob > chi2 = 0.1143	
(1) [D_ch_netclaims_all_sectors]LD.CA =0 *(2) [D_ch_netclaims_all_sectors]L2D.CA=0*		chi2(2) = 0.37 Prob > chi2 = 0.8304	
Number of obs = 61			

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 23 shows the cointegrating equation and the estimated cointegrating vector with a unity restriction imposed on the CA*. There seems to be an equilibrium relationship between the bank related inflows and the CA. Both the significance of the lagged error correction term (Table 22) and the significant coefficient on the bank related net inflows (Table 23) indicates that a vector autoregression in first differences of these variables would yield inconsistent estimates because of misspecification.

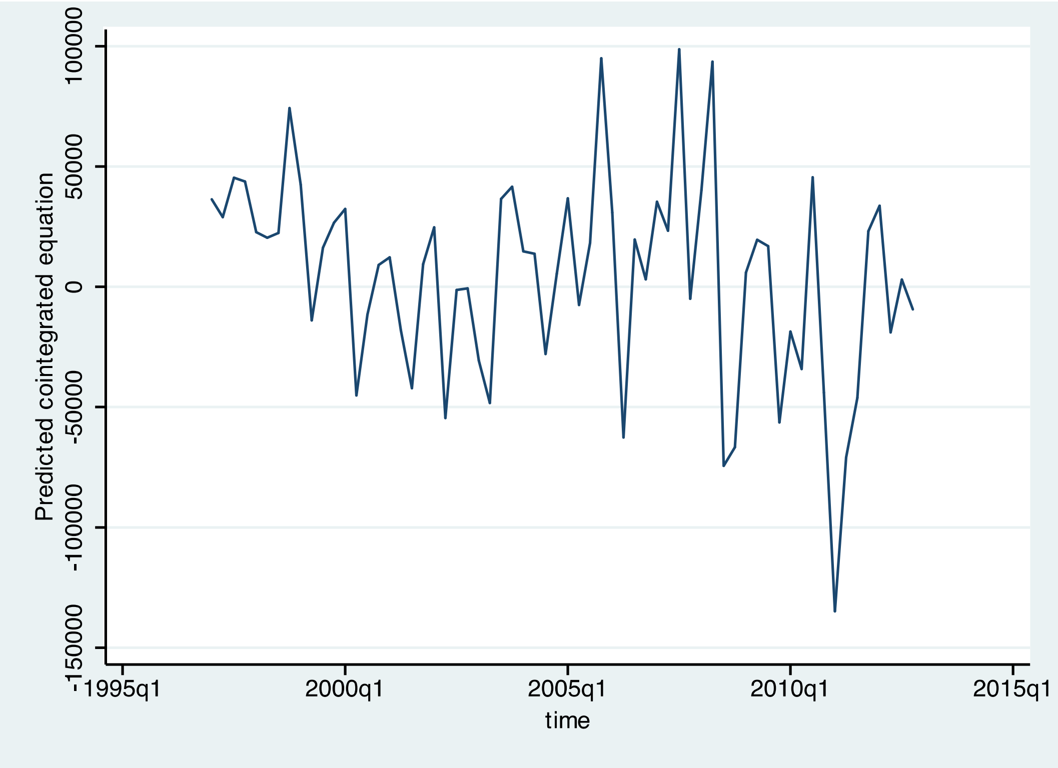
* The estimation of a cointegrating vector from a error-correction model is equivalent to that from an autoregressive distributed lag model.

Table 23 - Estimated parameters of the cointegrating vector

Cointegrating equations						
Equation	Parms	chi2		P>chi2		
_ce1	1	19.489		0		
Identification: beta is exactly identified						
Johansen normalization restriction imposed						
beta	Coef.	Std. Err	z	P>|z|	95% Conf. Interval	
_ce1						
CA	1	.	.	.	.	.
ch_netclai~s	0.5427054	0.1229333	4.41	0.000	0.3017606	0.7836501
_cons	295.7297	.	.	.	.	.

Figure 5 shows the graphical view of the cointegration equation. The relationship appears to be stationary, although there is large shock in 2011. This might be due to the case that bank related inflows stopped abruptly and could not finance the CA deficit more*. Next, I check whether the VECM model is stable (Table 24). I can establish that one of the moduli is equal to unity.

Figure 5 - Cointegration equation



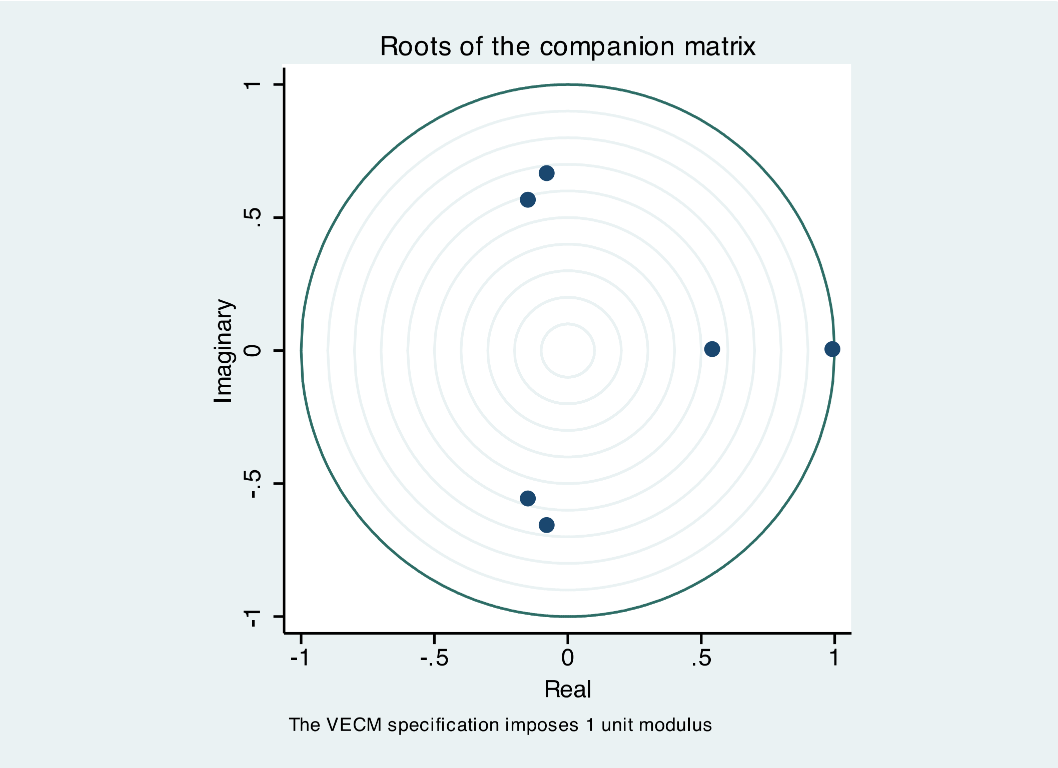
* This period is also characterised by a massive increase in TARGET2 balances, which substituted net private capital inflows.

Table 24 - Eigenvalues of the companion matrix

Eigenvalue	Modulus
1	
-0.0695383 + .6600406i	0.663694
-0.0695383- .6600406i	0.663694
-0.1437328 + .5636676i	0.581705
-0.1437328- .5636676i	0.581705
0.5523206	0.552321
The VECM specification imposes a unit modulus.	

The graph shows the real Eigenvalues on the horizontal axis and the complex components on the vertical axis. This graph (Figure 6) also shows that all eigenvalues of the companion matrix, except for only one, lie inside the unit circle. This indicates that I have specified the model correctly and the eigenvalues meet the stability condition.

Figure 6 - Eigenvalues of the companion matrix



Now, it ought be tested for for serial correlation of the residuals. Table 25 shows that I cannot reject the null hypothesis of no autocorrelation on a 1%, so that I continue with this assumption.

Table 25 - Lagrange- multiplier test

lag	chi2	df	Prob > chi2
1	9.611	4	0.04752
2	7.901	4	0.09527
H0: no autocorrelation at lag order			

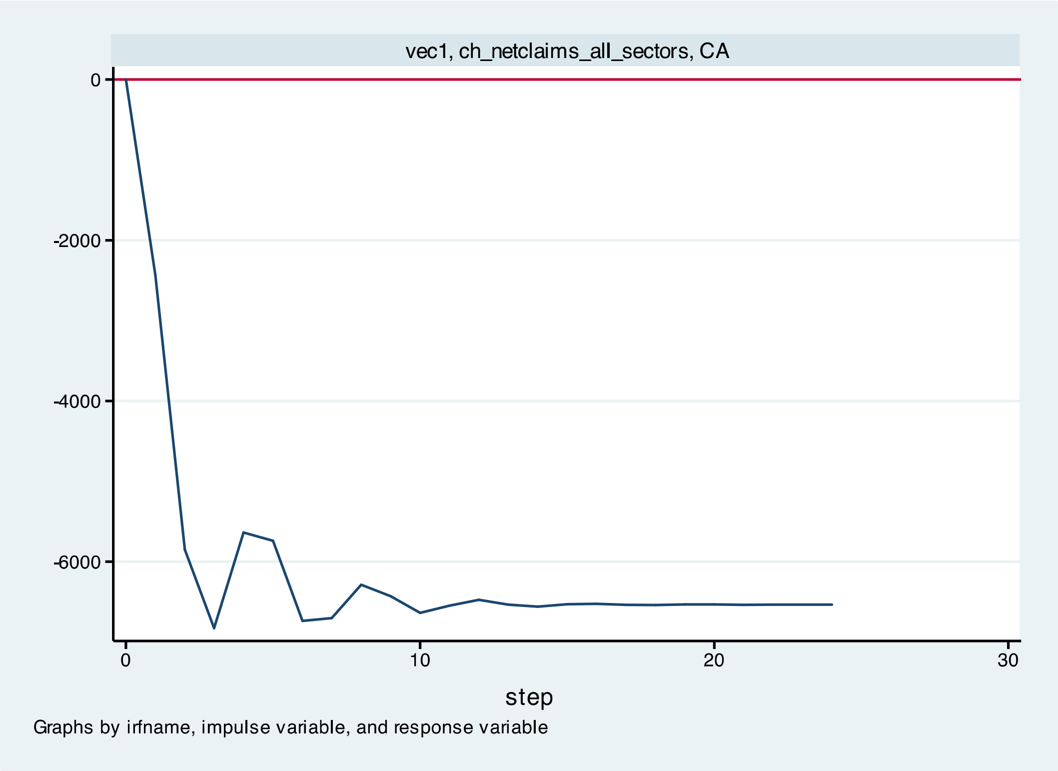
Table 26 - Normality, Skewness, and Kurtosis test

Jarque-Bera test				
Equation		chi2	df	Prob > chi2
D_CA		0.217	2	0.89727
D_ch_netclaims_all_sectors		0.356	2	0.8369
ALL		0.573	4	0.96603
Skewness test				
Equation	Skewness	chi2	df	Prob > chi2
D_CA	-.13983	0.199	1	0.65571
D_ch_netclaims_all_sectors	-.18671	0.354	1	0.55162
ALL		0.553	2	0.75835
Kurtosis test				
Equation	Kurtosis	chi2	df	Prob > chi2
D_CA	2.9158	0.018	1	0.89320
D_ch_netclaims_all_sectors	2.9743	0.002	1	0.96729
ALL		0.020	2	0.99020

The Jarque-Bera test (Table 26) indicates whether the residuals are normally distributed as well as if the skewness and kurtosis matches a normal distribution. I can neither reject the null hypothesis that they are normal nor that their skewness and kurtosis match a normal distribution.

Since I am dealing with non-stationary variables in this case, the impulse response functions (IRF) of a VECM do not have to die out geometrically, because the variables are not mean reverting. In general, the IRF (Figure 7) shows the effect of a standard deviation increase in net inflows of banks on the CA.

Figure 7 - IRF of the VECM



According to the model, the shock remains in the system and does not phase out. First, the CA drops sharply on the first lag and then is oscillating around the long-run mean. Second, after about three years (12 quarters) the effect on the CA converges to its long-run equilibrium. Thus, positive shocks to the bank related capital inflows to the Euro Area, are even in the long-run associated with high CA deficits.

As I mentioned in the beginning, the introduction of the Euro and therefore the financial globalisation of many member countries might have led to massive bank-related capital inflows (see among others Lane 2012; Milesi-Ferretti, Tille 2011). According to the model and assuming it as an exogenous shock, this shock is associated with a permanent deficit in the CA[*]. Conversely, a negative orthogonal shock of the bank related inflows, for example, the retrenchment of the interbank market since the beginning of the financial crisis implies a long-term improvement in the CA.

[*] A possible caveat of this conclusion is of course the assumption that these shocks are assumed to be exogenous.

CONCLUSION

This paper aims to provide an applied econometric analysis of the CA in the Euro Area. The stylized facts following from the technical analysis of the dynamics of the CA illustrate an inconclusiveness of the stationarity of the CA during the time of a single currency union. However, I have illustrated most of the classic and all panel unit root tests that I considered are in favour of not rejecting the null hypothesis of a unit root.

Continuing with a non-stationary CA for the Euro Area for the observed time span, I investigate the relationship between the CA and the bank related net capital inflows. First, I find out that that the CA and the bank related inflows are negatively correlated. Making use of their common integration level of the first order, I apply a VECM. This leads to the conclusion that a shock of vast bank related capital inflows are associated with permanent CA deficits. Misalignments in the long-term relationship are almost immediately adjusted by banking capital flows and much slower by the CA.

I leave it to the reader to apply this result to different scenarios that have occurred in some Euro Area countries since the introduction of the Euro and that might have partly led to the debt crisis in the Euro Area.

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