Capital flows and non-performing loans: An empirical study of the European debt crisis

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August 2016

Lund, Sweden

Abstract

This study investigates the relationship between capital imports and non-performing loans (NPLs) in the context of the European debt crisis. The empirical analysis is based on a panel data set covering 22 countries in the European Union (EU) between year 2001 and 2014. All individual estimations in the empirical analysis indicate a significant and negative relationship between capital imports and NPLs. The results are robust in the sense that two different estimation techniques were used: the First-difference Arellano-Bond generalized method of moments (GMM) estimators and Ordinary least squares (OLS). The results support other studies, which emphasize the large inflow of debt-type capital in the pre-crisis period from core EU-countries, such as Germany, the Netherlands and the UK, to periphery countries, such as Greece, Ireland and Spain. This dependency on foreign interbank lending turned into severe national liquidity crises – and increased ratios of NPLs – when European banks in in the beginning of the crisis started to squeeze capital inflows to financial institutions in the periphery economies.

Keywords: Capital imports, debt flows, non-performing loans, the EU, the First-difference Arellano-Bond GMM estimators, OLS, Random effects.

Table of Contents

List of abbreviations

ECB   The European Central Bank
EU   The European Union
GDP   Gross domestic product
GMM   Generalized method of moments
IMF   The International Monetary Fund
NEER   Nominal effective exchange rate
NPLs   Non-performing loans
OLS   Ordinary least squares
SRM   The Single Resolution Mechanism
SSM   The Single Supervisory Mechanism
VIX   The implied volatility of the
             Standard & Poor's 500 stock market index

List of tables

1 Introduction

1.1 Background

Despite the fact that the European sovereign debt crisis outburst for more than six years ago, countries such as Italy, Greece, Ireland and Portugal still suffer from high ratios of private non-performing loans (NPLs).[1] Greece for instance reported a ratio of above 33 percent in June 2015, which far exceeded the average ratio of 4,23 percent in the EU (Mesnard et al. 2016).[2] The ratio in the EU has been decreasing during 2015 and 2016, although the pace is slow. The high ratios of NPLs are puzzling since excessive levels are a crucial obstacle to a sound economic recovery. A large stock of NPLs reduces the profitability of banks and financial intermediaries, increases funding costs and ties up bank capital – which altogether have an impact on the credit supply and ultimately economic growth.

Even though it is of great importance to discuss policy frameworks that focus on the current situation, this thesis studies the origins of the high levels of NPLs. When the European debt crisis started in the end of 2009, as a chain reaction on the U.S. Subprime mortgage crisis, it became clear that the EU hade developed its own internal imbalances. A low interest rate environment had contributed to excessive investments and a construction boom in the real estate market, not at least in countries such as Ireland and Spain. Periphery countries, which before the introduction of the euro in 1999 were considered less creditworthy, could in the pre-crisis period – due to lower political risk, among other things – issue sovereign debt at yields similar to German bonds (Hale & Obstfeld, 2014).

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[1] The ratio of bank's NPLs is defined as the value of non-performing loans divided by the gross value of the total domestic loan stock. According to the most commonly used definition of a NPL, default occurs when the bank considers that an obligor is unlikely to repay its credit obligations in full, or if the obligor is past due for more than 90 days on any credit repayment. Source: The World Bank.

[2] See the Appendix, figure A.1, for a complete overview of ratios of NPLs in the EU between 2008 and 2014.

In addition, the euro implied an abolishment of the currency risk for investments and lending within the EU. Also, the EU had prior to the crisis intensified the process of financial integration by harmonizing regulations and by working for an equal access to financial services among the member states (ECB, 2015). These factors together contributed to large financial flows, especially in the form of debt-type flows, from core countries, with current account surpluses, to periphery countries with current account deficits (Lane, 2008).[3] Between 1999 and 2009, the total lending from core Eurozone banks to the so-called GIPS-countries – Greece, Ireland, Portugal and Spain – increased by 495 percent (Baldwin et al, 2010).

However, when European financial institutions began to lose confidence in each other's creditworthiness in August 2007, many banks became more restrictive regarding foreign lending (BIS, 2013). Later, due to the large losses that European banks experienced in the aftermath of the collapse of the bank Lehman Brothers in September 2008, the European financial system started to enter a liquidity crunch. The EU banks reacted to the pressure by slowing down total lending, and in particular, foreign lending. Even though the domestic lending of euro area banks was generally quite stable in the beginning of the crisis, the foreign lending dropped rather sharply between 2008 and 2010. Therefore, according to Daniel Gros, the Director of the center for European policy studies, as cited in Baldwin and Giavazzi (2015), the European sovereign debt crisis "started as a classic 'sudden stop' to cross border capital inflows." The nations that were affected the most in the crisis were not the ones with the highest ratios of sovereign debt to GDP. Belgium and Italy,

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[3] The current account is one of two balances in the balance of payments, where its counterpart is the capital account. The current account consists first of all of the balance of trade. Countries with a current account surplus will consequently have a negative capital account, since the balance of payments is assumed to approximately equal to zero (Sörensen & Whitta-Jacobsen, 2010: 712).

According to the neoclassical growth theory, capital will flow from high-income countries – most commonly countries with a current account surplus – to lower-income or current account deficit economies, where the marginal rate of return on capital is greater (Lane & Pels, 2012).

for instance, which entered the crisis with public debts of about 100 percent to GDP, did not end up with loan programmes from institutions such as the European Central Bank (ECB) and the International Monetary Fund (IMF). In contrast, countries such as Ireland and Spain, with ratios of 40 percent to GDP in the beginning of the crisis, needed indeed financial aid. Instead, what the crisis economies to a large extent had in common were large current account deficits and substantial debt-type capital inflows prior to the crisis (Baldwin and Giavazzi 2015).

1.2 Aim and research question

The more or less sudden stop of capital inflows to countries with large current account deficits raises the question of how the ratio of NPLs develops during times of a foreign liquidity squeeze. The aim of this thesis is therefore to evaluate the relationship between capital imports and NPLs in the EU during the period 2001 to 2014. The relationship between NPLs and the yearly percentage change in total capital imports is first of all investigated by the use of the First-difference Arellano-Bond GMM estimator, developed by Manuel Arellano and Stephen Bond (1991), among others.

The study is based on the hypothesis that capital imports should have a negative impact on the ratio of non-performing loans. A sudden downturn in capital imports is assumed to, among other things, lead to an overall liquidity shortage, which will make it harder for borrowers to service debt (Gavin and Hausmann, 1996).

The aim of the thesis cumulates into one specific research question:

- *What was the relationship between the yearly growth rate of capital imports and NPLs in the EU between 2001 and 2014?*

1.3 The relevance of the subject

The research question is relevant from several perspectives. Firstly, it lies in the interest of banks and creditors to minimize their losses on non-

performing loans. Macroeconomic factors that might indicate how a particular credit market will perform could encourage financial institutions to decrease their risk exposure to those markets. Secondly, a minimized ratio of NPLs is important from a governmental perspective. The European sovereign debt crisis has shown how private debt can quickly be transformed into public debt through bail out programmes of domestic banks (Tirole, 2012). Thirdly, manageable ratios of NPLs are important for a well-functioning monetary policy. Banks that are concerned about capital adequacy and losses on their banking books, are less likely to respond to changes in the policy rate (Mesnard et al, 2016).

1.4 Possible research contributions

Studies on non-performing loans are not unique; instead several papers have investigated different factors behind ratios of NPLs. These studies have covered a wide range of countries, both advanced economies and emerging markets. Even a few studies have considered countries in Europe. Furthermore, several researchers have pointed at the fact that periphery countries in the EU had large current account deficits and large capital inflows prior to the crisis. However, few studies have focused on the direct relationship between the bank specific variable non-performing loans and the change in total capital imports. In particular, the direct relationship has not been, as far as we can tell from earlier research, examined in the context of the European debt crisis. Instead, other factors such as the real GDP growth, the exchange rate or bank specific factors, such as return on equity, have been in focus in global studies on NPLs. Therefore, the possible contribution to the research field lies in the somewhat alternative focus variable in relation to NPLs, and the fact that the study focuses on the European situation, covering a unique dataset with both euro and non-euro countries.

2 Literature review

The literature review is divided into two subsections. The first one covers the main theoretical work on the relationship between the credit market and financial crises – and between capital flows and non-performing loans. The second subsection exemplifies empirical studies on NPLs. Also, it describes empirical findings on capital flows within the EU.

2.1 Theoretical review

2.1.1 The role of the credit market in financial crises

One reason why the credit market might be crucial for an understanding of the European debt crisis lies in the theoretical concept of *the financial accelerator*. This is a term that not at least Bernanke, Gertler and Gilchirst (1996) have put emphasize on. The fundamental idea is that the credit market has an amplifying effect during economic downturns. The theory highlights asymmetric information, where creditors cannot fully foresee a borrowers ability to meet its obligations. Financial institutions will therefore try to protect themselves against future credit losses by letting a borrower set forth its ability to repay its loans, most commonly in the form of collateralized assets. However, during times of economic contraction, when both share and house prices tend to fall, the net worth of current and potential borrowers will shrink. This will consequently affect the level of investments in the economy, since fewer firms will have enough net wealth to prove its ability to repay loans. A downturn in investments will have an additional negative effect on asset prices, which results in a negative feedback loop with an accelerating downturn in aggregated supply.

2.1.2 Reduced capital inflows and liquidity crunches

One fundamental aspect behind default probabilities is the implicit importance of time. A shorter debt maturity means that the borrower might have to refinance its obligations more often, which increases the rollover risk in times of liquidity squeezes and rising interest rates. Rodrik and Velasco (1999) developed a theoretical model that shows how countries with large short-term debt stocks are more likely to develop a severe crisis at sudden "stops" of capital inflows. According to Rodrik and Velasco, the economic downturn is likely to be generated either through a credit squeeze; through the effects on bank's balance sheets due to drops in asset values; through a currency depreciation, which increases foreign debt burdens; or through the traditional Keynesian multiplier channels.

Eichengreen and Hausmann (1999) do also highlight the increased vulnerability that abrupt freezes in foreign funds might have on domestic lending. In addition, they connect the vulnerability of foreign fund dependency to the so-called moral hazard problem and the quality of bank supervision. In a nutshell, the moral hazard hypothesis states that financial institutions will take on excessive risk if depositors or taxpayers are likely to cover the losses, most commonly through bail out programmes. However, if banks are appropriate regulated, the expansion of their balance sheet will be limited by certain capital requirements. Lax regulations on the other hand, may allow domestic banks to expand their balance sheets excessively through foreign interbank borrowing – funds that are allocated to local firms and households. Banks use foreign funding to compete for domestic market shares, which potentially leads to a lending boom problem (Gavin and Hausmann, 1996). Ultimately, inflow of foreign funds and sizeable domestic credit growth, increase the risk for a financial crisis whenever capital streams stop to flow into the country.

Although, the financial risk is not symmetric across current account surplus economies and deficit economies, a sudden stop of capital flows does in fact have implications for creditors in the lending country. The direct impact is assumed to emerge through the financial channel, where

the sharply worsened financial position of debt holders in the borrowing country is assumed to generate credit losses. In a longer perspective, the creditor country is affected through the trade channel. An overall economic decline in the importing deficit country implies a loss in export revenues. This interconnection of countries, via the credit market, is an essential factor behind international financial contagion.

2.2 Empirical review

2.2.1 Earlier studies on non-performing loans

Studies on macroeconomic determinants behind non-performing loans tend to first of all highlight the importance of the economic cycle. A well-cited paper performed by Beck et al. (2013) – which apply both a static and a dynamic panel data model covering 75 countries over the period 2000 to 2010 – concludes that real GDP growth is the most important factor for non-performing loans. However, Beck et al. do also find a significant influence from other variables; for instance, an exchange rate depreciation tend to lead to an increased ratio of NPLs in countries with flexible exchange rates, especially in countries with a large loan stock issued in foreign currencies. As the third most important variable, Beck et al. find that stock market downturns tend to affect bank asset quality negatively, not at least in countries with a high stock market capitalization in relation to GDP.

Another study that confirms the results found in the paper by Beck et al. is Klein (2013), who investigates ratios of NPLs in Eastern and South-eastern Europe, in countries such as Romania, Russia and Hungary. The period of interest is between 1998 and 2011, and Klein does not only evaluate macroeconomic determinants, instead he also examines bank-level factors, such as the equity-to-asset ratio and return on equity. However, by using panel data for individual bank's balance sheets, Klein draws the conclusion that bank specific factors have relatively low

explanatory power in relation to macroeconomic determinants. Klein uses a dynamic fixed effects panel regression and finds that the variable of NPLs is associated with high autocorrelation. In fact, the coefficient of the lagged variable of NPLs ranges between 0.6 to 0.93, thus suggesting that a shock to NPLs is likely to have a prolong effect on the banking system. In addition, Klein finds a positive relationship between NPLs and the contemporaneous unemployment rate, and between NPLs and the so-called VIX-index – a risk aversion-index based on the implied volatility of Standard & Poor's 500 stock market index.

Jakubik and Reininger (2013) present a paper that studies a similar set of countries as Klein. They use both a static OLS-model with fixed effects and a GMM-approach applied on quarterly panel data for the period 2004 to 2014. The main result from both estimation methods shows an elasticity for the one period lagged GDP growth variable of around -1,5. Another emphasized variable in the study is the ratio of private credit to GDP. Jakubik and Reininger hypothesize that the variable has a negative sign in the short run, since a higher credit growth to GDP may indicate "a sound and sustainable process of financial deepening". However, the authors expect a positive sign in long run due to the hypothesis which states that episodes of high credit growth might be coupled with low lending standards. This potential two-folded relationship between credit to GDP and NPLs is indeed supported by the results in their empirical analysis. They find a negative sign for the contemporaneous and the one-period lagged variable, while the effect goes in the opposite direction for the sixth time lag.

Earlier research has, as mentioned in the introduction section, put little emphasize on the direct connection between the change in capital imports and NPLs. However, De Bock and Demyanets (2012) have a rather similar focus, as this thesis, in their study of 25 emerging economies over the period 1996 to 2010. One main result is that NPLs are negatively related to a squeezed inflow of debt-creating capital. Specifically, they estimate that a percentage point decrease in foreign

inflows of portfolio and bank liabilities in relation to GDP increases the aggregated ratio of NPLs by between 0,49 and 0,67, where the former coefficient is generated by an OLS-estimation, while the latter is given by a GMM-approach. It seems thereby, according to the authors, that an abrupt cease of debt-related inflows is associated with a contraction of domestic credit supply and thereby an increased ratio of non-performing loans. Furthermore, the results by De Bock and Demyanets support the theory of the financial accelerator in the sense that the credit market is found to cause feedback effects on the wider economy.

2.2.2 Empirical findings on capital flows within the EU

The collapse of gross capital flows, calculated as total outflows and inflows of capital as percentage of GDP, within the Eurozone in 2008, began after a period with a clear boom pattern (Lane, 2013). From year 2003 rose the ratio of capital flows within the Eurozone from about 15 percent, to its peak at over 40 percent in the end of 2007. The ratio was far in excess of other advanced economies, and when the flows later on stopped, the drop was unprecedented to historical references, falling to about 5 percent of GDP. Lane shows how the large inflows of gross capital to current account deficit countries in the Eurozone highly correlated with domestic credit growth during the pre-crisis period. The opportunity for banks to raise external debt allowed domestic lending growth to outstrip domestic deposit growth, which contributed to the strong increase in property prices in some countries.

Lane also points out the fact that the growth in debt flows was in general much higher than equity streams. From 2002 to 2008 did the ratio of debt-equity flows rise from about 1 to 3,7, while it dropped to around zero during the crisis.[4] One explanation behind the imbalanced debt-equity-flows is that the exchange rate risk is a minor factor in valuation of equity-type assets, and the euro effect was thereby smaller for this type of

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[4] Debt flows in the debt-equity flow ratio is defined as the sum of portfolio debt flows plus other debt flows plus reserves flows. The equity part in the ratio on the other hand, is the sum of FDI flows plus portfolio equity flows. Source: Lane (2008).

capital flows. Forbes and Warnock (2012) have, among others, emphasized why the composition of gross capital imports matters in a bank asset perspective. Their results suggest that countries in the euro area with large stocks of foreign portfolio assets, rather than foreign loans, in the pre-crisis period did in fact mitigate cross-border credit contagion during the crisis. Furthermore, the vulnerabilities within the Eurozone were also built up by the fact that much of the cross-border funding was, according to Lane, in the form of short-term debt. In addition, the large expansion of European bank's balance sheets, contributed to moral hazard and to a 'too big to fail'-phenomenon.

In summary, Lane concludes that "the qualitative nature of the boom-bust cycle was similar for the broader European region and the global set of advanced economies, but the quantitative scale was larger inside the euro area". Also, according to Lane, the squeeze in gross capital flows, especially in the form of debt flows, did indeed amplify the crisis in the banking system.

3 Methodology

Firstly, the methodology-section motivates the choice of the model and the reason why Ordinary least squares might be inappropriate in a dynamic model setup. Secondly, the panel data set is described, followed by a subsection explaining the variables and their expected relation to NPLs. Finally, a more detailed description of the main estimation model is specified.

3.1 The underlying empirical method

3.1.1 The First-difference Arellano-Bond GMM estimators

One advantage of panel data is the opportunity to model individual dynamics (Verbeek, 2012: 396). This is not at least relevant in the context of non-performing loans, since the variable of NPLs is assumed to be characterized by persistency. If one looks at the European debt crisis, countries with high ratios of NPLs in a particular year have clearly been burdened by high ratios in the following years as well. Therefore, it is preferable to use an estimation method that allows for at least one lagged dependent variable as an explanatory variable. However, one might think that the conventional OLS with one lagged dependent variable, would be applicable, possibly expressed in the following way:

$$y_{it} = \beta y_{it-1} + \sum_k \beta_k x_{ikt} + \alpha_i + \varepsilon_{it} \qquad (1)$$

In this setup, the dependent variable y_{it} is the outcome of interest for individual i at time t, y_{it-1} is the lagged value of the dependent variable, $\sum_k \beta_k x_{ikt}$ is a set of control variables with their respective coefficients, α_i is a time-invariant unobservable individual effect, while ε_{it} is a time-varying error term. To be able to eliminate the unobservable

fixed effect, and thereby avoid the possible endogeneity problem, it may seem to be enough to just apply first difference in the following way:

$$y_{it} - y_{i\,t-1} = \beta(y_{i\,t-1} - y_{it-2}) + \sum_k \beta_k (x_{ikt} - x_{ikt-1}) + (\varepsilon_{it} - \varepsilon_{i,t-1}) \qquad (2)$$

or expressed as:

$$\Delta y_{it} = \beta \Delta y_{it-1} + \sum_k \beta_k \Delta x_{ikt} + \Delta \varepsilon_{it} \qquad (2)$$

However, even though the time-invariant effect is eliminated, another endogeneity problem would appear if first-difference is applied. In fact, in a linear OLS-model, with at least one lag of the dependent variable as an explanatory variable, the first-differenced error term becomes correlated with the first-differenced lagged dependent variable:

$$E(\Delta y_{it-1} \Delta \varepsilon_{it}) \neq 0 \qquad (3)$$

Therefore, to be able to both use the lagged dependent variable as an explanatory variable, and to be able to eliminate the potential unobservable time-invariant individual effect, it is not appropriate to use first-difference and estimate the transformed model with OLS. Similarly, using Random or Fixed effects would also lead to inconsistent estimates (Verbeek, 2012: 397).

Instead, one possible solution is to instead use the dynamic First-difference Arellano-Bond GMM estimators. In contrast to OLS, the method is indeed designed for dynamic relationships (Roodman, 2006). In addition, the method is useful for panel data sets with relatively short time-periods in relation to the number of cross sections, which is, more or less, what the data of this study is associated with. Also, the Arellano-Bond estimators can handle (i) independent variables that are not strictly exogenous; (ii) fixed individual effects; and (iii) autocorrelation and heteroskedasticity within individuals.

In more specific terms, the Arellano-Bond estimators use instrument variables to avoid the correlation in equation (3), between the first-differenced time-varying error term and the first-differenced version of the lagged dependent variable. In fact, the Arellano-Bond estimator suggests the second lag – or if necessary: a lag of a higher order – of the lagged dependent variable as an instrument for the contemporaneous value of the lagged dependent variable. As long as the error term does not suffer from autocorrelation, the second lag of the dependent variable is a sufficient instrument to avoid the endogeneity problem, and thereby generate consistent estimates. The necessary condition can be summarized as:

$$E\left(\Delta y_{it-j} \Delta \varepsilon_{it}\right) = 0 \ \ j \geq 2 \hspace{3cm} (4)$$

The so-called *Arellano-Bond test for zero auto-correlation in first differenced errors* can be used for controlling whether the model suffer from autocorrelation. As long as the first-differenced error term is not associated with autocorrelation higher than of order one, I will be able to conclude that a lag structure with two lags is enough to avoid the potential enodgeneity problem. The Arellano-Bond post-estimation test will be used to test the validity of the chosen number of lags for the instruments.

3.2 Data collection and description

3.2.1 A panel data set

The empirical study is based on panel data for 22 EU-countries spanning over the years 2001 to 2014.[5] The data for all the included variables is collected from six different sources: the World Bank, the IMF, the Eurostat, the Bank for International Settlements, the Chicago Board

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[5] A complete list of the included countries can been found in table A.1 in the Appendix.

Options Exchange and Oxford Economics.[6] Data on the dependent variable is only provided with yearly frequency, and therefore are all panel series collected on an annual basis. The total number of observations is 308. However, the number of observations included in each regression differs depending on the estimation technique.

The panel data set contains nine out of ten of the original Eurozone-countries, excluding Luxemburg due to "extreme" values in several variables. In fact, if Luxemburg would have been included, it might have skewed the estimates. The number of included EU-countries, which did not join the euro, is in total seven. These are countries such as Sweden, the UK and Bulgaria. In addition, Estonia, which joined the euro in 2011, Latvia (2014), Lithuania (2015) and Slovakia (2009) are all included. However, EU-countries such as Cyprus, Malta, Croatia and Slovenia are excluded due to lack of complete and reliable data for several variables. Also, Romania was omitted due to incomplete data series and its many outlier observations; for instance, the inflation rate in 2002 exceeded 22 percent.

The reason why the data set starts at year 2001 is that statistics regarding non-performing loans is very modest before the new millennium. However, a period of 14 years in this kind of panel data setting should be sufficient to achieve precision in the estimates. Furthermore, the data set should be large enough to allow for a separation of the pre-crisis period, year 2001 to 2008. By evaluating this period separately, one might be able to examine how the ratio of NPLs is affected by macroeconomic factors during "normal" financial times.

A potential drawback of the data set is the issue of missing observations. Even though the data series for almost all variables are indeed complete, the data for the variables Credit to GDP, the 10-year government bond yield and the variable NEER, do have some missing values.[7] One simple solution could be to discard the entire country from

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[6] See Appendix, table A.2, for a complete list of the variables and their data sources.
[7] See page 22, Table.1 for descriptive statistics for all variables.

the panel that has incomplete information – which was also done for countries with many missing observations – and only use balanced subpanels. However, if countries with just a few missing observations at most would be thrown away, this might lead to loss in efficiency (Verbeek, 2012: 47). A better solution could be to use all observations, including those on individuals that are not observed in all time periods; or what is called: an unbalanced panel. Conveniently, the software program that is used for the regression analysis, Stata, can handle unbalanced data sets in an appropriate manner. The issue of the relatively few missing values is therefore assumed to have, at most, a trivial impact on the estimates.

3.3 Description of variables and their expected impact

3.3.1 Non-performing loans

The variable non-performing loans are quite often used in research on bank asset quality (Serwa, 2013). One advantage of the variable is the relatively generous supply of comparable national data, most commonly provided by the World Bank.[8] The advantage of this source is that it builds on a similar definition of NPLs, regardless of what country the data concerns. In contrast, De Bock and Demyanets (2012), and Klein (2013), for instance, use bank level data, which potentially can skew the results due to the fact that banks use different qualitative and quantitative elements in their loan quality assessments. It is not uncommon that some banks define a loan that is just over 30 days past due as a non-performing loan. This is an ambiguity in the definition that can been foreseen by using the national data from the World Bank, which does apply the rule of at least 90 days overdue for all non-performing loans.

One drawback of NPLs is the fact that the variable is backward-looking. Its practical application in the financial industry might therefore be somewhat limited; instead, it might be more practical relevant to use

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[8] The exact definition of NPLs is the one described in the footnote 1 in section: 1.1 Background, on page 5.

forward-looking credit models built on concepts like the probability of default in evaluations of the potential performance of borrowers. On the other hand, one might argue that historical regressions built on NPLs do have a practical value, since it contributes to an understanding of how macroeconomic factors found the basis of the credit market.

3.3.2 Capital import

Countries with positive trade balances will possess funds to invest in other countries in the form of either (i) foreign direct investments; (ii) portfolio investments in financial assets, such as shares and bonds; (iii) via currency actions by the Central bank; or through (iiii) bank loans or direct flows into foreign bank accounts. Researchers such as Lane (2013) have shown how the pre-crisis period was first of all associated with the last category, while the home bias regarding foreign shares, for instance, was more extensive. Therefore, the variable of the yearly percentage change in total capital import from other EU-member states (EU28) is first of all assumed to reflect the shift in inflows of debt-type capital.

The sign of the coefficient of the Capital Import-variable is expected to be negative; a downturn in the total import of capital should be associated with shrinking liquidity supply, and thereby a higher ratio of NPLs.

3.3.3 Control variables

The motivation behind the chosen control variables is first of all based on earlier empirical work.[9] These variables are commonly used in other studies, and they are proven to have a significant relationship with non-performing loans. As mentioned in the theory section, real GDP growth is a key variable, and the expected effect on NPLs is negative. The assumed effect of the unemployment rate on the other hand, is positive. A larger share of unemployed would imply reduced income for individual borrowers, such as house owners, which is assumed to make it harder to

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[9] Again; see Appendix, table A.2, for a complete list of the variables and their data sources.

service debt. The 10-year government bond yield-variable is assumed to control for the interest rate level. With the same rational as with the unemployment rate, interest rate hikes affect the ability to service debt negatively, particularly in cases of private and corporate loans based on floating rates (Klein, 2013). The impact of inflation, however, may be more ambiguous. On one hand, higher inflation can make debt servicing less costly by eroding the real value of outstanding loans. On the other hand, it can also reduce a borrower's real income when wages are sticky.

The house index variable is used to control for the price development on domestic real estate markets. An increase in asset prices is assumed to push up the net worth of firms and households, and thereby improve the capacity for borrowing, leading to a decrease in NPLs. The expected sign of the coefficient of the VIX-index variable is positive. An increased risk aversion in the U.S. – based on the country's 500 largest companies – should indicate a higher international risk aversion due to the global reach of large U.S. firms. The VIX-index might indeed be appropriate for catching financial spill-overs from the U.S. stock market. The effect of the variable Private credits to GDP is less straightforward. As mentioned in the literature review, Jakubik and Reininger found a negative relationship in the short run, where higher credit growth was assumed to "indicate a sound financial deepening". However, the effect was the opposite for the sixth quarterly time lag. Therefore, I do expect the effect to be negative, even though it is not unlikely that the coefficient would take a positive value.

Also, the empirical analysis includes the percentage change in nominal effective exchange rate (NEER) to capture the effect that a currency change may have on the value of the external loan stock. An appreciation will allow countries with a large amount of external loans to reduce its debt burden, and vice versa. However, an appreciation may not only be beneficial. A relatively higher exchange rate will reduce export incomes and thereby shrink domestic output and potentially increase NPLs. The effect is therefore, in some sense, ambiguous.

Lastly, summary statistics for all ten variables can be examined in Table.1 beneath. Most of the variables are defined in terms of yearly growth rates, or in other words, as yearly percentages changes. The growth rates vary substantial for some of the variables, reflecting the economic volatility during the crisis period. Not at least the variable Capital Import shows a high volatility in the annual growth rate.

Table 1. Descriptive statistics

Variable	Obs	Mean	Std.D	Min	Max	Units
NPLs	308	5.21	5.69	0.08	33.70	% of total loan stock
Capital Import	308	5.30	17.48	-57.07	71.18	yearly % change
Inflation	308	2.61	2.19	-4.48	15.43	yearly % change
Real GDP Growth	308	-0.63	3.82	-19.25	11.69	yearly % change
Unemployment	308	9.29	4.48	2.10	27.30	% of total workforce
VIX	308	4.59	43.55	-52.05	100.72	yearly % change
Credit to GDP	306	84.74	46.85	1.13	202.20	% to GDP
Yield Bond	299	4.66	2.21	1.16	22.50	yearly average in %
NEER	287	0.71	3.55	-18.05	12.44	yearly % change
House Index	308	4.48	10.50	-38.63	52.55	yearly % change

3.4 Model specification

In general, GMM estimates the model parameters directly from the moment conditions that are imposed by the model (Verbeek, 2012: 166). In the Arellano-Bond framework, the parameters are estimated from the moment conditions that are generated by the instruments, or in the case of this study: the second lag of the first-differenced lagged dependent variable of NPLs and all feasible lags thereafter. The set of instruments are called GMM-type instruments. It is only the lagged dependent variable of NPLs that is treated as GMM-type instruments; the control variables are instead treated as standard instruments.

The First-difference Arellano-Bond GMM estimators can either be estimated as the first-step or the two-step GMM estimator. The difference between the two regards how they treat the optimal weighting matrix, which is essential for generating the most efficient estimates. In technical words, the optimal weighting matrix is proportional to the inverse of the covariance matrix of the sample moments, and it is the one that gives the smallest asymptotic covariance matrix of the GMM-estimator (Verbeek, 2012: 400). The two-step estimator is the most appropriate one when the variance structure of the errors is assumed to be complex, and when the errors are not necessarily independent and identical distributed. In fact, Windmeijer, as cited in Roodman (2006), finds that the two-step GMM performs slightly better than the one-step in estimating the coefficients, with lower bias and lower standard errors. Historically, researchers have often reported both the one-step and the two-step results, and I will do the same as well.

The baseline model of this study can be expressed, in more technical terms, as follows:

$$\Delta y_{it} = \beta_1 \Delta y_{it-1} + \beta_2 \Delta x_{it} + \beta_3 \Delta x_{it-1} + \beta_4 \Delta x_{it} + \beta_5 \Delta x_{it} + \beta_6 \Delta x_{it}$$
$$+ \beta_7 \Delta x_{it} + \beta_8 \Delta x_{it} + \beta_9 \Delta x_{it} + \beta_{10} \Delta x_{it} + \beta_{11} \Delta x_{it} + \Delta \varepsilon_{it} \qquad (5)$$

Where Δy_{it} is the first-differenced dependent variable of NPLs, $\beta_1 \Delta y_{it-1}$ represents the one-period lagged dependent variable of NPLs and its respective coefficient, $\beta_2 \Delta x_{ikt}$ symbolizes the variable Capital Import, $\beta_3 \Delta x_{it-1}$ represents the one period lagged Capital Import variable, $\beta_4 \Delta x_{it}$ expresses the control variable Inflation, $\beta_5 \Delta x_{it}$ stands for Real GDP Growth, $\beta_6 \Delta x_{it}$ is the Unemployment variable, $\beta_7 \Delta x_{it}$ represents VIX, $\beta_8 \Delta x_{it}$ symbolizes the Credit to GDP, $\beta_9 \Delta x_{it}$ expresses the 10-year government bond yield-variable, $\beta_{10} \Delta x_{it}$ is the NEER variable, while $\beta_{11} \Delta x_{it}$ symbolizes the House Index. Finally, $\Delta \varepsilon_{it}$ stands for the first-differenced version of the error term.

4 Empirical results

This section begins with a presentation of the results from the First-difference Arellano-Bond GMM estimations. Secondly, the results from the post-estimation test are presented, which are performed to check the validity of the estimation method. Thirdly, the results from an alternative estimation technique, a conventional OLS-regression, are presented as a robustness check. Finally, the section ends with a discussion of the main results.

4.1 Baseline regression results

4.1.1 The First-difference Arellano-Bond GMM estimators

The first two columns in Table 2 beneath, column (A) and (B), should be considered as the baseline estimates. The two regressions are both based on equation (5) from the section: 3.4 Model specification. The results in column (A) build on the one-step First-difference Arellano-Bond GMM estimator, while the results in column (B) are based on the two-step estimator. The standard errors for the one-step estimator are corrected according to the Arellano-Bond robust VCE estimator. The standard errors in column (B) are bias-corrected according to the Windmeijer WC-robust estimator (Windmeijer (2005).

Table 2: The First-difference Arellano-Bond GMM estimators

	(A) One-step Arellano-Bond GMM	(B) Two-step Arellano-Bond GMM	(C) Two-step Arellano-Bond GMM, 2001-2008
NPLs(-1)	0.891***	0.886***	1.013***
	(0.052)	(0.125)	(0.093)
Capital Import	-0.024***	-0.022**	-0.020**
	(0.008)	(0.010)	(0.010)
Capital Import(-1)	-0.016***	-0.014**	-0.006
	(0.006)	(0.010)	(0.006)
Inflation	-0.104*	-0.077	-0.124
	(0.061)	(0.077)	(0.150)
Real GDP Growth	-0.066**	-0.065	-0.060
	(0.032)	(0.044)	(0.045)
Unemployment	0.138*	0.090	-0.160
	(0.071)	(0.104)	(0.102)
VIX	0.002	0.001	0.006*
	(0.192)	(0.002)	(0.003)
Credit to GDP	0.031***	0.027***	-0.005
	(0.009)	(0.012)	(0.015)
Yield Bond	0.166***	0.191	-0.147
	(0.042)	(0.143)	(0.231)
NEER	-0.040*	-0.024	-0.042
	(0.022)	(0.026)	(0.030)
House Index	-0.014	-0.020	-0.026
	(0.010)	(0.020)	(0.024)

Note: Robust (VCE) standard errors in parentheses. P-values: *** = 1 %, ** = 5 %, * = 10 %. Number of observations and instruments for (A): 252 and 88; for (B): 252 and 88; and for (C): 131 and 31.

As presented in (A), the coefficient of NPLs(-1) is highly significant and shows a positive sign of 0.891. The result suggests indeed that a shock to NPLs is likely to have a persistent effect on the banking industry. The coefficients of both the contemporaneous and the one-period lagged Capital Import-variables are negative and significant. The results are in line with the initial hypothesis, which states that a downturn in capital imports tends to lead to a liquidity shortage in the banking sector and

increased NPLs. The results do also support earlier studies, such as De Bock and Demyantes (2012).

In addition, all the following control variables in (A) are both significant and have their expected coefficient signs: Real GDP Growth, Unemployment, NEER and the variable of the 10-year government bond yield. The results coincide with earlier studies, which highlight the importance of the economic conjuncture for NPLs, utterly reflected in Real GDP Growth and, to some extent, in the Unemployment rate. The expected sign of the Inflation-coefficient was ambiguous beforehand; however, the result indicates that increased Inflation potentially leads to an erosion of the net value of private loans, and thereby to a lower ratio of NPLs. The result of the Credit to GDP variable is rather counter-intuitively; increased credits should imply increased liquidity, which, according to theory, should decrease the ratio of NPLs.

The main results in column (B) corresponds to the ones in column (A). The variable NPLs(-1) and the two Capital Import-variables are all significant and have similar, although slightly lower, coefficient-values. However, it is only Credit to GDP of the control variables that is significant; again indicating a positive relationship between the overall credit supply in the economy and NPLs. Furthermore, the Capital Import-variables in both (A) and (B) could be interpreted as the mean change in the variable NPLs for one unit change in Capital Imports, while holding the other predictors in the models constant. The estimate of the contemporaneous Capital Import-variable in column (B) indicates that if the growth rate of capital imports increases with one unit, expressed in the yearly percentage change, decreases the ratio of NPLs to total loans by an average of -0.022 percent. Or in other words, if the yearly growth rate of capital imports would increase, for instance, from ten to 20 percent, this would imply that the ratio of NPLs to total loans would decrease by an average of -0.22 percent. The interpretation of Capital Import(-1) is identical; although the magnitude of coefficient is slightly lower.

In column (C), where the time-period has been reduced to the pre-crisis-period, the coefficient of the lagged dependent variable of NPLs is again positive and significant. However, the coefficient of 1.013 is higher, suggesting that the prolong effect on the banking system might be slightly longer during non-crisis periods. In contrast, the Capital Import-coefficient of -0.020 is marginally lower compared to its counterparts in (A) and (B), while Capital Import(-1) is not significant. Again, it is only one control variable that is significant: the VIX-variable indicates a positive relationship with NPLs, which could have its explanation in the fact that a higher VIX-index might indicate higher interest rates on the international financial markets.

4.1.2 Post-estimation tests

To be able to test whether two lags is enough for the construction of the GMM-instruments, we perform the Arellano-Bond test for zero autocorrelation for both the one-step and the two-step estimators.[10] The test-statistics concludes that the dynamic first-differenced models are, as expected, associated with autocorrelation of order one; however, neither model suffer from autocorrelation of order two. Therefore, the first-difference transformations of the models do not imply misspecification (Stata Press, 2013).

Furthermore, to test whether the Arellano-Bond GMM estimators produce consistent estimates, one might use the so-called Sargan-Hansen test, which investigates whether the moment conditions of the estimators are valid (Stata Press, 2013). Although there is no method to test if the moment conditions from an exactly identified model are valid, one can test whether the so-called overidentifying moment conditions are valid. The test-statistics for the one-step Arellano-Bond estimator shows that the null-hypothesis, which states that the overidentifying restrictions are

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[10] See Appendix, table A.3, for test-statistics.

valid, is rejected.[11] In contrast, the null-hypotheses for the two-step estimators, presented in column (B) and (C), are not rejected.

However, the Sargan-Hansen test is only based on an asymptotic chi-squared distribution when the error terms are assumed to be homoskedastic. In fact, Arellano and Bond have shown that the one-step Sargan-Hansen test tends to overreject in the presence of heteroskedasticity. Therefore, since the data is indeed associated with at least groupwise heteroskedasticity (see the 5.2 Robustness check section beneath for a test regarding this issue) it is hard to conclude whether the estimates from the one-step estimator are inconsistent or not. Nevertheless, the estimates in column (A) should be interpreted with caution.

Furthermore, since the Sargan-Hansen test for the two-step Arellano-Bond estimator presented in column (B) shows a test-statistic of exactly 1.000, these estimates should be interpreted with caution as well. In fact, Roodman (2006) explains that a relatively small sample may lack adequate information to estimate the variance matrix of the moment conditions in a proper way. Or in other words, too many instruments in relation to the sample size might weaken the Sargan-Hansen test to the point where it generates implausibly good p-values of 1.000. Therefore, the results in column (B) should also be considered with caution. However, the p-value for the Sargan-Hansen test for the estimates in (C) does not suffer from this issue. These results might therefore be interpreted as the most reliable ones.

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[11] Again; see Appendix, table A.3, for test-statistics.

4.2 Robustness check

4.2.1 A Random effects OLS-regression

As a robustness check of the results generated by the Arellano-Bond GMM estimators, we apply a simpler regression method, namely OLS with Random effects. However, as mentioned in the section 3.1.1, using OLS in a dynamic model setting might lead to the problem of endogeneity and inconsistent estimates. Despite this obvious issue, the estimates could still have some value as a robustness check. If the estimates are rather similar to the ones generated by the Arellano-Bond estimators, this would propose at least some legitimacy to the results in column (A) and (B), and in particular to the results in (C).

The estimates from the OLS-regression is presented beneath in Table 3, column (D). The choice of Random effects, rather than Fixed effects, was built on the statistics from a Hausman-test.[12] In addition, a Wooldrige-test was implemented to be able to identify possible serial correlation of order one in the errors terms. The test showed indeed that autocorrelation had to be considered in the estimation. Also, since it is reasonable to assume that it may exist heteroskedasticity across EU-countries – for instance, European economies differ vastly as to the GDP level – the presences of this issue had to be evaluated as well. The test did, as expected, indicate the existence of groupwise heteroskedasticity. Therefore, the Random effects OLS-regression is both corrected for autocorrelation and heteroskedasticity across countries.

Furthermore, in an OLS-setting one usually has to consider the issue of unit root, or in other words, non-stationary time series. However, since the OLS-estimation is based on the same equation as in the case of Arellano-Bond estimators, namely equation (5) – where all variable are in first-difference – the presence of unit root should not be an issue.

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[12] See Appendix, table A.4, for test-statistics for the Hausman-test, the test-statistics for the Wooldrige autocorrelation-test, and statistics for the LR-test for heteroskedasticity.

Table 3: OLS with Random effects

	(D) OLS, Random effects
NPLs(-1)	0.566***
	(0.397)
Capital Import	-0.010**
	(0.004)
Capital Import(-1)	-0.008*
	(0.004)
Inflation	-0.120
	(0.079)
Real GDP Growth	-0.074**
	(0.033)
Unemployment	0.330***
	(0.115)
VIX	0.002
	(0.002)
Credit to GDP	0.127
	(0.009)
Yield Bond	0.003
	(0.049)
NEER	-0.028
	(0.022)
House Index	-0.020*
	(0.011)
Constant	0.004
	(0.069)

Note: Robust (cluster) standard errors in parentheses. P-values: *** = 1 %, ** = 5 %, * = 10 %. The number of observations for (D) is 252.

The main results in column (D) do support the estimates from the Arellano-Bond GMM estimators. The lagged explanatory variable of NPLs is significant and has a positive coefficient of 0.566. Even though the value is lower compared to its counterparts in (A), (B) and (C), it still strengthens the finding that problems with NPLs tend to be persistent. The coefficient of Capital Import is -0.010, while Capital Import(-1) shows a coefficient of -0.008. Both are significant, although the values of the estimates are lower compared to the Arellano-Bond estimates. Regarding the control variables, all of them, except Credit to GDP, have their

expected coefficient sign, though it is only Real GDP Growth, Unemployment and House Index that are significant. The negative coefficient sign of the variable House Index suggests that a drop in the value of collateral for housing loans could negatively affect the quality of the total consumer loan stock, or in other words, increasing non-performing loans.

4.3 Discussion

All four regressions suggest a negative relationship between capital imports and non-performing loans in the EU during the period 2001 to 2014. Since all estimations point at the same relationship, the main results have to be considered to be fairly robust. The relationship is also in line with the initial hypothesis, theoretical arguments and earlier empirical works. It seems therefore that a reduction in capital imports, most importantly in the form of debt inflows, does have an effect on the domestic liquidity supply, and thereby on the proportion of NPLs.

On the one hand, one might argue that the size of the coefficients are rather small; for instance, the contemporaneous Capital Import-variable in the most robust of the three Arellano-Bond estimations, namely column (C), shows a coefficient of -0.020. On the other hand, one has to bare in mind that the variable Capital Import is very volatile, and as one can see in Table 1 with descriptive statistics, the minimum value of variable Capital Import is -57.07, while the maximum value of the growth rate is as high as 71.18. Therefore, the total effect of large downturns in capital imports can be rather costly for the domestic banking system.

Even though the control variables unemployment and Real GDP Growth are not significant in all four regressions, they do show their expected coefficient sign in most of the columns. The positive coefficient of Unemployment and the negative coefficient of Real GDP Growth are not surprising given that many EU-countries with high ratios of NPLs have been puzzled with relatively high and steady unemployment rates and low

GDP growth rates during the last couple of years. Italy for instance, whose banking system in the summer of 2016 is estimated to be saddled with €360 billion of loans which are unlikely to be repaid in full, have been concerned with high Unemployment and GDP growth rates around or just above zero ever since the outbreak of the crisis (Hale & Sanderson, 2016).

The fact that the variable Credit to GDP is positive in most cases, while the variable of NPLs is negative, may seem contradictory. After all, the main theoretical argument to why a downturn in capital imports should be associated with a higher ratio of NPLs is that it is assumed to lead to a contraction in the credit supply. The positive coefficient of the Credit to GDP is also in contrast to some earlier studies. It is not obvious why the coefficient is positive, but one possible explanation could be that "episodes of high credit growth may be coupled with low lending standards" (Jakubik and Reininger, 2013). Jakubik and Reninger did after all find a positive coefficient for the sixth lag, using quarterly data, and since my regressions results are based on yearly data, it is not unreasonable that the coefficients would turn out to be non-negative.

The main regression results could to some extent be seen as a support for some of the policy actions that have been introduced at EU-level in the aftermath of the crisis. The Banking Union that was initiated in 2012 may in fact mitigate some of the risks that a large dependency on foreign lending might imply for individual member states. In particular, the Single Supervisory Mechanism (SSM), which places the ECB as the central prudential supervisor of financial institutions in the euro area and in those non-euro EU-countries that have chosen to join the SSM, may be necessary to fully monitor how debt allocates within the union (Finance newsletter, 2015). One lesson from the crisis is that the national macro-prudential measures that were implemented to cool down the expansion in domestic credits were not sufficiently aggressive, or executed to late in the boom phase (Lane, 2015). Therefore, the SSM may be necessary to make sure that sufficient measures are applied at the same time in all EU-countries, and not only in a few, in case of a future potential crisis.

Furthermore, in the light of excessive lending in the pre-crisis period, the new capital requirements, the ambition to ensure protection for depositors, and the legislatives regarding prevention and management of bank failures, can potentially contribute to a sounder European credit market. Also, since the high ratios of NPLs in many countries turned into public debt, the Single Resolution Mechanism (SRM), which will allow bank resolution to be managed through a single resolution board and a single resolution fund, all financed by the banking sector itself, might be a necessary initiative to protect taxpayers and the real economy.

The main limitation of the empirical study is that the number of observations would preferably be larger. Also, it is disadvantageous that some, although few, observations are missing for control variables such as NEER. However, we have included as many observations as possible, and proper data on NPLs before the millennium is simply not available. It is possible that the Sargan-Hansen test of overidentifying restrictions would not reject the validity of the instruments in the one-step Arellano-Bond GMM estimator if the data set would be larger. However, as mentioned in the section 4.1.2 Post-estimation tests, the Sargan-Hansen test tends to overreject the validity in the presence of heteroskedasticity. Therefore, even though the robustness of single regression results might be questioned, they all together point at the same conclusion, namely: The relationship between capital imports and non-performing loans is negative for EU countries in the time period 2001 to 2014. This was the main research question of the study, and the chosen empirical methods seem to have been accurate enough to offer at least some valuable indications.

The Capital Import-variable is comprehensive in the sense that it covers all categories of capital, for instance, both debt flows and FDI-flows. One suggestion for future research could therefore be to analyse the impact of different capital categories on NPLs in relation to the European debt crisis, or in relation to other crises in other economies. However, this might imply that the sample of EU-countries would be smaller, since the supply of capital flows data is first of accessible as the one used in this

study, where capital imports is defined as a wide concept. It would also be interesting if further research would examine how the new European Banking Union will perform in monitoring and mitigating credit risks within the EU. This study and earlier research have indeed underlined that non-performing loans are preferably studied as a cross-border phenomena, and having that observation as a starting point could contribute to further research and future policy actions.

5 Conclusion

The main research question of this study was to investigate the relationship between capital imports and non-performing loans in the EU between year 2001 and 2014. The empirical analysis, first of all performed by the use of the First-difference Arellano-Bond GMM estimators, and secondly by the use of OLS suggested a negative relationship between capital imports and NPLs. The relationship was both significant and negative in all four regressions, despite the fact that two different estimation techniques were used. The results were in line with the initial hypothesis and main theoretical arguments, which state that a sharp reduction in capital inflows might lead to an overall liquidity shortage and higher interest rates, and thereby a reduced possibility for borrowers to service debt. Also, the study suggest that the European debt crisis cannot be fully comprehended without an understanding of how several periphery countries, prior to the crisis, developed large dependency on foreign credits. This dependency turned into national credit crises as soon as banks in core countries, such as Germany, the Netherlands and the UK, started to squeeze its capital inflows to countries such as Spain, Greece, Ireland and Italy.

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7 Appendix

Figure A.1: Bank non-performing loans to total gross loans (%) in the EU
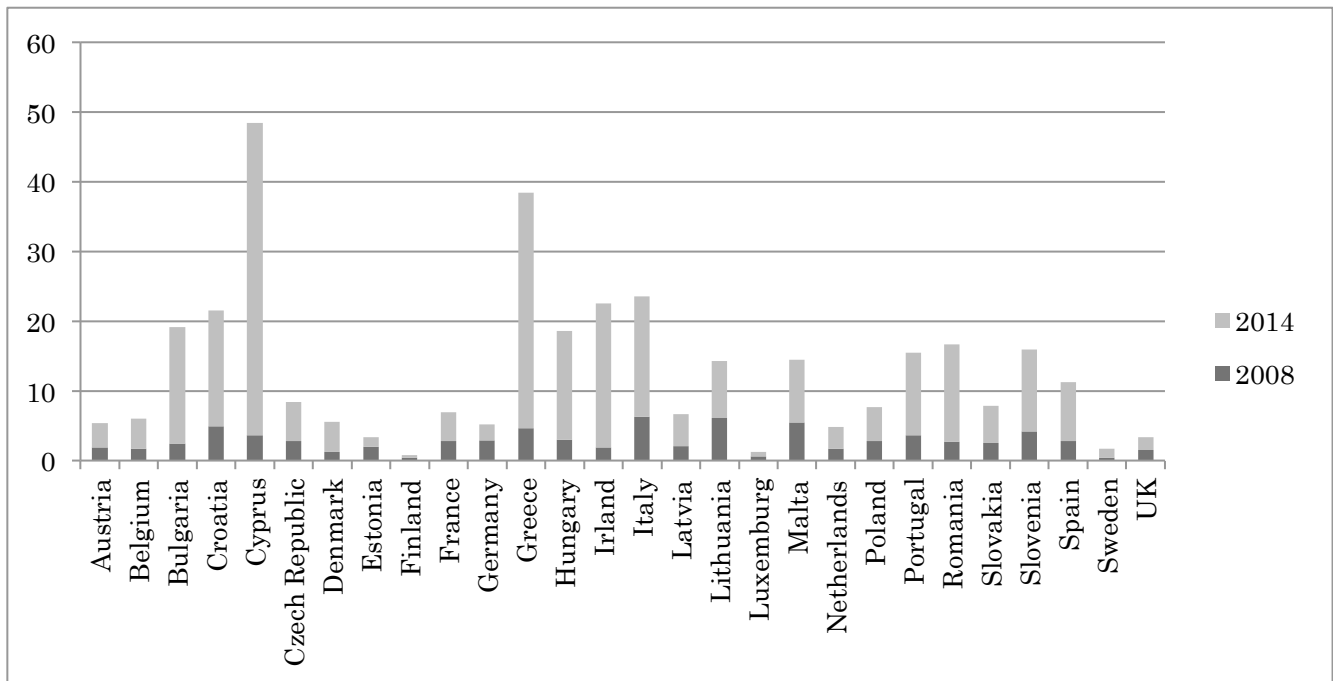
Source: The World Development Indicators, the World Bank (2016).

Table A.1: List of included EU-countries

Country	Joined the euro year:	Current account balance in the pre-crisis period, year 2001-2008
Austria	1999	Surplus
Belgium	1999	Surplus
Bulgaria		Deficit
Czech Republic		Deficit
Denmark		Deficit
Estonia	2011	Deficit
Finland	1999	Surplus
France	1999	Surplus
Germany	1999	Surplus
Greece	2001	Deficit
Hungary		Deficit
Ireland	1999	Deficit
Italy	1999	Deficit
Latvia	2014	Deficit
Lithuania	2015	Deficit
Netherlands	1999	Surplus
Poland		Deficit
Portugal	1999	Deficit
Slovakia		Deficit
Spain	1999	Deficit
Sweden		Surplus
UK		Deficit

Source for the current account balance: International Monetary Fund, World Economic Outlook Database (2016).

Table A.2: Description of variables

Variable	Description	Source
NPLs	Bank non-performing loans to total gross loans (%)	World Development Indicators, The World Bank
Capital Import	Imports of all capital goods from other EU member states (EU28), change (annual % change). Imports in total millions Euro. Own calculations into year over year change in percentages.	Eurostat
Real GDP Growth	Gross domestic product growth (annual % change) minus inflation (annual % change)	Both from World Development Indicators, The World Bank
Inflation	Inflation, consumer prices change (annual % change)	World Development Indicators, The World Bank
NEER	Nominal broad effective exchange rate index (annual % change). NEERs are calculated as geometric weighted averages of bilateral exchange rates. The baseline year is 2010; year 2010 = value 100. An increase in the index indicates an appreciation. The yearly change is based on own calculations.	Bank for International Settlements
House Price Index	House price index change from baseline year 1997 (annual % change).	Oxford Economics
VIX-index	CBOE SPX Volatility VIX, change (annual % change). Own calculations, year over year change in the index.	Chicago Board Options Exchange
Yield Government Bond	10 year long-term bond yields (monthly average in percentages, converted into yearly average).	Eurostat & Banco de Espana (complementing for Spain)
Unemployment	Unemployed of total labor force (%)	World Development Indicators, The World Bank
Private credit to GDP	Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable that establish a claim for repayment. The ratio is calculated as percentages to GDP.	World Development Indicators, The World Bank

Table A.3: Specification test for the First-difference Arellano-Bond GMM estimators

The Arellano-Bond test for zero autocorrelation in first-differenced errors

For the one-step estimator (A):

Order	z	Prob > z
1	-2.431	0.015
2	-0.678	0.498

H0: no autocorrelation

For the two-step estimator (B):

Order	z	Prob > z
1	-1.868	0.062
2	-0.682	0.495

For the two-step estimator, year 2001-2008 (C):

Order	z	Prob > z
1	-1.030	0.305
2	0.015	0.988

The Sargan-Hansen test of overidentifying restrictions

For the one-step estimator (A):

Chi2(77) = 194.350   Prob > chi2 = 0.000

H0: overidentifying restrictions are valid

For the two-step estimator (B):

Chi2(77) = 13.741   Prob > chi2 = 1.000

For the two-step estimator, year 2001-2008 (C):

Chi2(20) = 17.053   Prov > chi2 = 0.650

Table A.4: Specification test for the OLS-model

1. The Hausman-test for random or fixed effects:

chi2(9) = 12.690   Prob>chi2 = 0.177

H0: use Random effects

2. The Wooldridge rest for autocorrelation:

F(1, 21) = 160.887   Prob > F = 0.000

H0: no first-order autocorrelation

3. Likelihood-ratio test for heteroskedasticity

LR chi2 (104) = 288.240   Prob>chi2 = 0.000

H0: homoskedasticity