THE EURO CRISIS:
THREE ESSAYS

to my fiancée, Frederike

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OVERVIEW

1. Abstract

This dissertation is a collection of three essays dealing with selected problems of the Euro Area during its most recent crisis. It applies empirical, theoretical, and institutional analyses to gain new insights into many of its financial aspects.

The first essay offers an alternative explanation for the surge in government bond spreads. Many researchers attribute this phenomenon to market sentiment and multiple equilibria alone. We show that an often neglected fundamental variable may drive spreads: a decrease in the expected recovery value of private market participants. With an ever-increasing share of crisis countries' debt held by official creditors, private investors may feel pushed into the position of subordinated creditors.

The other two essays both explain the sharp increase in central bank credit from different perspectives. First, from the national perspective, central banks may be confronted with a classical tragedy-of-the-commons problem, which gives rise to an expansionary bias. Second, from the perspective of the ECB, we argue that the empirical patterns surrounding the liquidity provision in December 2011 are reminiscent of a speculative attack on a fixed exchange rate system.

***Keywords**: Balance of payments crisis, Capital flight, Credit channel, Creditor Seniority, Decentralized monetary policy, Euro area, Government bond spreads, Inflation bias, Multiple equilibria, Preferred creditor, Private sector involvement, Sovereign debt crisis, Speculative attack, TARGET2, Tragedy of the commons.* ***JEL Classifications:** E52, E58, H41, F3, G11, G12, H81.*

2. Introduction

Motivation

The Euro crisis – now in its 5th year – still has a tight grip on many European countries. Some of the major problems the European Monetary Union (EMU) faces today were already foreseen when the euro was introduced in January 1999. At this time, scientific heavyweights of the economic profession in America and Europe were divided on the prospects of such an ambitious project. Rüdiger Dornbusch, briefly but concisely, categorized the views of many American economists into three more or less pessimistic camps: "it can't happen, it's a bad idea, it won't last" (Dornbusch (2001)).[1] European economists, on the other hand, showed more optimism regarding the idea of a single European currency (see Wyplosz (1997)). Sure enough, apart from some tensions in its early years, the member countries and their common currency fared relatively well in the subsequent years. The debate calmed and the euro was celebrated as "a spectacular success" (Wyplosz (2006)).

Fast forward to the end of 2011 – an exit from the Euro Area for some countries or even a complete break-up cannot categorically be ruled out anymore. Participants of the leading prediction market, Intrade, consider the likelihood of at least one country leaving the union as being greater than 65%. Only a few months later, the famous investor George Soros predicted the end of the euro within less than three months. Even the President of the European Central Bank Mario

[1] Most of the arguments of American economists rested on the Theory of Optimum Currency Areas, a strand of enquiry pioneered by Robert Mundell (1961).

Draghi's rhetoric changed temporarily as he breached a central bankers' taboo and discussed the consequences of a break-up, instead of simply dismissing such a scenario as unthinkable.[2]

Central bankers and other policy makers reacted to the crisis with some unprecedented – or at least unconventional – policy measures. Among them were large rescue funds like the EFSF or the ESM, providing emergency lending in the spirit of IMF credit lines. Also, central bank credit to the countries in crisis was at times expanded by more than 1000%. Lastly, the European Central Bank officially assumed the role of a lender of last resort when it announced a potentially unlimited bond buying program, the Outright Monetary Transactions (OMT), in September 2012. Policy makers faced severe trade-offs in many of these decisions.

This thesis discusses some of the problems that policy makers had and – to a large extent – still have to deal with in their designing of policy measures. This may help find effective and long-lasting solutions to current concerns in the EMU.

Summary

This dissertation comprises three essays, each of them discussing one peculiar problem that ails the monetary union.

In the **first essay**, we analyze whether the preferred creditor status, which came along with the official rescue packages, may increase interest rates on government bonds of the countries in crisis. The **second essay** documents a sharp increase in central bank credit for some of the Euro Area member countries and offers a simple theoretical explanation:

[2] See Shambaugh et al. (2012).

a classical tragedy-of-the-commons problem caused by decentralized implementation of monetary policy. The **third essay** characterizes empirical patterns in the Euro Area as akin to a speculative attack on a fixed exchange rate system, and presents a rationalization for them.

One common theme among the essays is the analysis of different policy options of the European Central Bank. Today's financial crises typically involve large amounts of short-term money. Multilateral decision making, on the other hand, is often a slow process – involving extensive negotiations and compromise. At many times, this left the ECB at the forefront of the international policy response. Throughout the Euro crisis, the leading role of the ECB sparked many intense debates. Among its crisis measures were the expansion of central bank credit, the broadening of collateral rules, the purchase of government bonds on the secondary markets, and Mario Draghi's already famous commitment to do "whatever it takes" to preserve the euro. The latter statement was substantiated when the ECB announced the possibility of Outright Monetary Transactions. This new program of bond purchases is not only potentially unlimited in size, but the ECB also indicated itself to be on equal footing with private investors in the case of sovereign defaults. We analyze some of the trade-offs involved in these decisions. For example, we point out the critical aspect of the ECB's willingness to participate in debt write-downs. While insisting on a full repayment may affect the interest rate premium demanded by other debt holders, participation in debt restructurings may constitute forbidden monetary financing.

Another commonality between all three essays is that Target2[3]-balances between the Euro Area member countries play an important role in each of them. The organization of the Target statistics varies widely across the 17 central banks and sometimes over time for

[3] **T**rans-European **A**utomated **R**eal-time **G**ross Settlement **E**xpress **T**ransfer System.

individual central banks. The collection and publication of these data is a major part of the thesis's contribution to the economic profession—and a pre-condition for any transparent discourse about the welfare effects of many different policy proposals throughout the Euro crisis.

Methodologically, this thesis aims to contribute empirically as well as theoretically to the literature. Furthermore, all essays carefully take into consideration the Euro Area's unique institutional setting. More precisely, the first essay presents an extensive empirical analysis based on a broad spectrum of econometric methods. These include regression analyses of macro- and micro-data, as well as case studies. The two shorter essays, on the other hand, each make use of simple theoretical models to explain—or at least rationalize—the development of key macroeconomic variables during the crisis.

In the following, I shortly summarize the essays. More detailed summaries are given in the introductory chapters of each particular essay.

The **first essay**, which makes up nearly half of the thesis, discusses the question of creditor seniority during the Euro crisis. The share of public debt that is held by lenders with preferred creditor status (i.e. the IMF, ECB, ESM, etc.) has increased substantially during Europe's sovereign debt crisis. Empirically, we document in both macro and survey data that there is a close relationship between the increase in senior tranche lending and the interest rates of countries in crisis. With regard to policy implications, we point out a predicament that policy makers are facing: while aiming to stabilize interest rates at a reasonable level, providing further senior loans might achieve just the opposite, as private markets are gradually pushed into a junior position.

In the **second essay**, we document that countries with a negative output shock—Greece, Italy, Ireland, Portugal and Spain—increased their central bank credit by more than 1000% from 2007 to 2012. This essay makes two contributions to understand this stylized fact. First, we discuss a simple model of monetary policy that includes (i) a credit channel and (ii) a common pool problem in a monetary union. We illustrate that the interaction of the two elements leads to an inflation bias that is independent of the standard time-inconsistency bias. Second, we present an institutional analysis that is consistent with the view of fragmented monetary policy, and empirical evidence that illustrates the heterogeneity of central bank credit expansion.

The **third essay** offers an explanation for the events and policy decisions surrounding December 2011. Over the past years, the Euro Area has been characterized by heterogeneity in fundamentals as well as macroeconomic policies. Prior to the enormous liquidity injection via long-term refinancing operations (LTRO) in 2011, the ECB followed an exit-strategy in the aggregate, by raising interest rates and tightening collateral requirements. At the same time, the continued full allotment policy led to sizable monetary expansions in some member countries. In this essay we analyze the conflicts arising from this dichotomy. First, we document key stylized facts, taking account of fundamental and policy variables. Secondly, we rationalize these developments in the theoretical framework of a portfolio balance model in a currency union. We conclude that the events surrounding the first LTRO in December 2011 are akin to a speculative attack on a fixed exchange rate system. Persistent capital flight from the crisis countries into the safe havens of other Euro Area countries forced the ECB to either to give up on its monetary target or to abandon the common exchange rate. We point out similarities and differences between the Euro Area and previous attacks on fixed exchange rate systems.

Bibliographic information

All essays are strongly based on joint research with different co-authors. Also, some results of the first two essays have already been published or are forthcoming in academic journals.

- Essay I ***"The Role of Creditor Seniority in Europe's Sovereign Debt Crisis"*** is an extended synthesis of earlier works:
  - Steinkamp & Westermann (2012), "On Creditor Seniority and Sovereign Bond Prices in Europe", Osnabrueck University, Institute of Empirical Economic Research Working Paper #92, August 2012.
  - Steinkamp & Westermann (2012), "What explains high interest rates in Europe? On creditor seniority and sovereign bond markets", Vox.EU, August 22nd 2012.
  - Steinkamp & Westermann (2012), "On Creditor Seniority and Sovereign Bond Prices in Europe", CESifo Working Paper #3944, September 2012.
  - Steinkamp & Westermann (2013), "The Role of Creditor Seniority in Europe's Sovereign Debt Crisis", Paper presented at the 58th Panel Meeting of Economic Policy in October 2013. A revised version of this paper is forthcoming in *Economic Policy*.

- Essay II *"**The Tragedy of the Commons and Inflation Bias in the Euro Area**"* is based on
  - Dinger, Steinkamp & Westermann (2012), "The Tragedy of the Commons and Inflation Bias in the Euro Area", Institute of Empirical Economic Research Working Paper #94, November 2012.

  - Dinger, Steinkamp & Westermann (2012), "The Tragedy of the Commons and Inflation Bias in the Euro Area", CESifo Working Paper #3944, December 2012.
  - Dinger, Steinkamp & Westermann (2014), "The Tragedy of the Commons and Inflation Bias in the Euro Area", *Open Economies Review*, Vol. 25(1), 71-91.

- Essay III **"Speculative Attack in the Euro Area: Facts and Explanation"** is based on an ongoing research project together with Andreas Steiner and Frank Westermann. Both co-authors contributed significantly.

3. Acknowledgments

No, no scientist likes to be criticized. Every scientist feels an affection for his or her ideas and scientific results. You feel protective of them. But you don't reply to critics: "Wait a minute, wait a minute; this is a really good idea. I'm very fond of it. It's done you no harm. Please don't attack it." That's not the way it goes. The hard but just rule is that if the ideas don't work, you must throw them away. Don't waste any neurons on what doesn't work. Devote those neurons to new ideas that better explain the data. Valid criticism is doing you a favor.

Carl Sagan, „Wonder and Skepticism", 1995

First and foremost, I am thankful to my academic supervisor Frank Westermann for always doing me the favor of criticizing my thoughts and ideas honestly, while remaining tremendously encouraging at all times. I am grateful for his constant support, considerable patience, and invaluable guidance throughout my studies. His enthusiasm for research is contagious and inspiring – I learned a great deal from him.

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Scientific work is almost always a team effort: one is dependent on a number of people and their feedback to improve ideas and writings. Therefore, I am especially thankful to all those who challenged my thoughts and results, and contributed to better research and a deeper understanding. General thanks go to the countless people from who I (and my co-authors) received feedback and criticism on numerous occasions, whether in seminars or e-mail exchanges or from volunteer referees of academic journals. Each essay in particular benefitted from a number of certain people to whom I and my co-authors are grateful and who deserve special mention:

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The third essay is part of ongoing joint research being conducted together with Andreas Steiner and Frank Westermann. I am especially grateful for many fruitful discussions during our collaboration.

Sven Steinkamp

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ESSAY I

THE ROLE OF CREDITOR SENIORITY IN EUROPE'S SOVEREIGN DEBT CRISIS

1. Introduction

Interest rate spreads in Europe have evolved in a way that most researchers find hard to reconcile with the underlying economic fundamentals. While some authors take it as evidence of multiple equilibria in government bond markets, or default risk driven by market sentiment, others just point out the large forecast errors that standard empirical specifications of interest rates would generate.[4] Even after the OMT announcement, interest rate spreads of the countries in crisis are, at the time of writing, on average still as high as in the end of 2010.

In this essay, we argue that an important element is missing in this debate, by pointing out the increasing share of total debt that is held by multilateral creditors (i.e. the ECB, the EFSF/ESM and IMF) due to the ongoing rescue operations. As most of these multilateral creditors are likely to have senior status in case of insolvency, the remaining public debt in the market has become a junior tranche that requires a higher marginal interest rate.

"Preferred Creditor Status" or "Senior Status" means that the preferred lender gets his money back first, in case of insolvency. The subordinated creditor, or junior creditor, on the other hand, receives no or only incomplete repayment of claims. Financial analysts and rating agencies take this question very seriously, and consider the ranking of claims when assessing the risk of a country. In the euro crisis, they have repeatedly referred to this issue when downgrading member countries of the euro area.

[4] See De Grauwe and Ji (2013a), Favero and Missale (2012), Aizenman et al. (2013b) and Beirne and Fratzscher (2013).

In the present article, we analyze the role of creditor seniority in the euro crisis from two different angles. On the one hand, we ask the empirical question whether the seniority of rescue packages had an impact on the level on interest rates and sovereign bond spreads in Europe. We show in the empirical analysis that this effect is statistically significant and quantitatively important. On the other hand, we would like to contribute to the policy debate. Institutions like the ECB, the ESM and the IMF face the following predicament: While aiming to reach reasonably low levels of interest rates, by providing additional senior credit, the ongoing rescue operations might have unintended side effects. Ceteris paribus, an increase in the senior tranche will increase the market interest rate charged by junior lenders[5].

In a preliminary analysis, we also look at debt ratios in the euro area. A debt restructuring or default must be perceived at least a plausible scenario in the markets for the seniority stance to matter. The current levels of debt are not particularly large on average – in the end of 2012, it reached a value of about 90%. The highest debt ratios are in Greece and Italy, with values of 157% and 127%. However, the time paths and future projections are worrisome. We compute steady state values of debt ratios that would arise if the past five years were representative for future developments. In a counterfactual analysis we show that these values would be alarmingly high in some countries, even if interest rate payments were zero in the future. This is not meant

[5] The theoretical motivation of the senior tranche explanation has its roots in several academic and policy papers. The closest recent theoretical models that would explain high marginal interest rates in the presence of senior official lending are by Corsetti et al. (2006), as well as Chamley and Pinto (2013). See also Bolton and Jeanne (2009), and Saravia (2010). More generally, the link between bond prices and the seniority of lenders is modeled for government bonds in Bartolini and Dixit (1991) and for corporate bonds in Black and Cox (1976). Chamley and Pinto (2011) as well as Gros (2010) also pointed out the relevance of this literature for the euro crisis.

to be an unconditional forecast, as hopefully economic policy will be designed to avoid these scenarios. However, it shows that it is plausible for markets to assume that some countries hit their intertemporal budget constraints, and thus entered a region where issues like creditor seniority start to matter.

We then start our main analysis with an assessment of the seniority status of different components of the rescue package. De jure, the preferred creditor status of multilateral lenders is often not unambiguous. The International Monetary Fund (IMF), which has proven its seniority in the financial crises of the past decades, for instance, is *de jure* not senior - it awards its credit lines without corresponding clauses in its contracts or institutional by-laws. Also in the current euro crisis, with various multilateral rescue-components, the rules of seniority are sometimes unclear and have evolved over time. Seniority of multilateral lenders is thus rather a convention that is widely accepted by the markets. In a survey analysis, we show that almost 90% of the respondents expect at least one of the rescue components to be senior to private markets.

In the empirical analysis, we have five main elements to document the effect of senior tranche lending on interest rates and sovereign bond spreads. (i) We point to the fact that the rescue operations have been large in magnitude both in historical comparison and when compared to the total public debt of the countries in crisis. The share of public debt that is held by multilateral lenders, in countries that were most strongly affected by the financial crisis, reaches approximately 60% towards the end of our sample period. (ii) We document the reactions of rating agencies, which motivated their downgrades explicitly pointing to the seniority issue. (iii) We highlight a striking correlation between interest rate spreads and the share of senior lenders in the total public debt of each country. In the main part of the essay, we analyze this link more

formally, in a panel regression analysis. Using a range of different control variables, and interaction terms, we quantify the impact of senior lending on sovereign bond spreads. We also address concerns of endogeneity in a set of instrumental two-stage regressions. (iv) We analyze a survey data set on interest rate expectations. We show that in the countries in crisis, respondents who expect seniority of rescue packages are also characterized by higher interest rate expectations. (v) Finally, we look at two case studies. First, we compare the Securities Markets Program (SMP) of the ECB with the new Outright Monetary Transactions (OMT) program. Both programs are similar, but differ with respect to the seniority status of the ECB. Secondly, we illustrate the effect of senior lending by considering the price patterns of UK- and domestic-law bonds for the case of Cyprus.

Our panel regression analysis starts with a benchmark regression that is related to earlier specifications of the literature. We explain the interest rate spread by standard variables including public debt ratios, the current account, real effective exchange rate and GDP growth rates, and show that the senior tranche of public debt, i.e. the sum of all multilateral loans relative to general government debt, is statistically significant in a multiple regression setup.[6]

We assess the magnitude of the coefficient in a second regression where we add dummy variables for certain thresholds of debt-to-GDP ratios. We find that higher debt ratios are associated with a higher partial correlation between the senior tranche variable and sovereign bond

[6] This finding complements some earlier evidence on the role of creditor seniority. For example, Dooley and Stone (1993) document that creditor seniority was an important determinant of secondary market prices of debt in emerging markets during the Latin American debt crisis in the 1980s. For the case of the Russian crisis of 1998 see Kharas et al. (2001). See Ritschl (1996) for the case of German reparations. See also Bulow et al. (1992), Sturzenegger & Zettelmeyer (2008).

spreads. Evaluated at the debt ratios that existed at the time of the first rescue packages in Greece, Ireland, Portugal, and more recently Spain, as well as the actual size of the senior tranche increase, we find that the senior tranche effect explains between 9% (Ireland) and 53% (Greece) of the total increase in interest rate spreads in the same period.

The magnitude of the coefficient further varies also with the specific time window of the analysis. To illustrate this time-varying nature of the effect, we include interaction dummy variables for specific time periods. For instance, we show that in the period after Lehman brothers, the coefficient is significantly larger than in the pre-crisis period. The magnitude of the coefficient further increases, when considering the period following the Deauville meeting in October 2010, when the probability of private sector involvement (PSI) had increased substantially. More recently, the size of the coefficient moved in the other direction. For instance, it fell slightly after the first maturity extensions in July 2011, and more substantially after the decision to transfer EFSF loans to the ESM without gaining seniority. Finally, the coefficient is smallest, and loses significance, when considering the post-OMT period only.

We perform various robustness tests to evaluate the sensitivity of our findings to plausible alternative specifications. A first step is to decompose the senior tranche into different components and make use of the survey data set, the World Economic Survey (WES), from the ifo Institute. The ifo survey shows that not all components are viewed as equally senior by market participants. In a nested-regression setup, we illustrate that the IMF, which is viewed most clearly senior by survey participants, also has the largest coefficient, when used as a proxy for the senior tranche. When adding other elements one by one, in the order of expected seniority, the coefficient declines. Our benchmark proxy that includes all components has the lowest coefficient.

A second set of robustness test evaluates whether our benchmark regression is leaving out the unobserved probability of private sector involvement (PSI) that may have changed during our sample period, at least since the Deauville meeting in the autumn of 2010[7]. Our benchmark regression already includes time fixed effects to address this issue. Furthermore, we use economic sentiment indicators, the number of Google searches for "private sector involvement", as well as CDS spreads as additional control variables. We also take into account contagion and fragmentation as further potentially omitted variables. In all specifications the senior tranche remains statistically significant and roughly similar in size.

A key question to ask is whether the partial correlation between senior tranche and interest rate spreads reflects a *causal* impact of the senior tranche on interest rate spreads. From a political economy perspective one could argue the other way – that rescue packages have been targeting interest rates – and we are capturing a policy response, rather than a causal effect.

We address the endogeneity question in a set of instrumental two-stage regressions. As a first step we take the assessment of rating agencies as an external instrument for the senior tranche. Conceptually, it is a good instrument, as it fulfills two key requirements: First, a high correlation with the instrumented variable. As we document in Section 3, rating agencies have repeatedly referred to the preferred creditor status of official lenders when downgrading countries in the euro crisis. Secondly, from a political economy perspective there is no motivation for reverse causality. Unlike the official creditors, rating agencies have no motivation to stabilize interest rates of countries in crisis. We find that the senior tranche variable remains statistically significant when

[7] See Lane (2012).

instrumented by the rating decisions, as well as other internal instruments, and instruments that are derived from specific characteristics of our dataset.[8]

As a second approach to address possible concerns about endogeneity, we evaluate the survey data set in more detail. As part of the World Economic Survey, participants have been asked about seniority expectations, as well as their interest rate expectation. We find remarkable differences in subsets of respondents to this question – suggesting that a causal link at least partly explains the co-movements documented in the panel regressions.

First, respondents from countries in crisis on average have falling interest rate expectations, while respondents from other countries in the euro area have rising interest rate expectations. Among the first group, however, respondents are less likely to expect falling interest rates when at the same time expecting the rescue packages to be senior. In their (aggregate) view, interest rates will stay nearly constant.

This difference also prevails, when considering the group of IMF loan recipients worldwide. Respondents from countries who make substantial use of IMF credit lines have on average falling interest rate expectations. However, respondents, who expect that the IMF will be able to enforce its preferred creditor status, do not share this expectation. They only expect a very minor decline on average.

[8] More specifically, as alternatives to the external rating decision instrument, we use lagged values of the senior tranche and the other exogenous variables as internal instruments. Furthermore, we use the identification approach suggested by Lewbel (2012) that exploits the heteroscedasticity in the first stage of the regression. This IV technique yields consistent estimates by imposing higher moment restrictions even when valid external instruments are unavailable or weak.

We show that these differences are statistically significant in an ordered probit regression setup, when controlling for participants' assessment about the development of public debt levels, GDP growth rates, trade balances and the exchange rate – similar to the panel regressions reported above.

We conclude our empirical investigation by looking at two case studies. First, we compare the Securities Markets Programme (SMP) of the European Central Bank to the Outright Monetary Transactions (OMT). In the former, the ECB announced, and later enforced, its preferred creditor status with respect to private markets during the Greek debt restructuring in early 2012. In the more recent OMT program, however, the ECB announced to be treated "pari-passu" with private markets in case of default. Focusing on the two countries with the largest drop in interest rates following the announcement – Italy and Spain – we analyze the timing of the interest rate decline and the news content of a sequence of announcements that took place in summer of 2012. These include the "whatever it takes" statement, the first announcement of outright open market operations and finally the details of OMT – including the pari-passu status – that have been announced on September 6th, 2012. As the trend-change in interest rate spreads, as well as the single largest drop occurred on September 6th, we argue that the pari-passu clause constituted an important element of the success of OMT in bringing down interest rates.

A final alternative to illustrate the importance of creditor seniority is to investigate the bonds issued under different jurisdictions – an aspect of seniority also highlighted by Choi et al. (2011). We compare bonds with similar maturity for the case of Cyprus that were issued under UK-law and Cypriot-Law, respectively. We show that in the financial crisis the prices of these two bonds have changed differently over time,

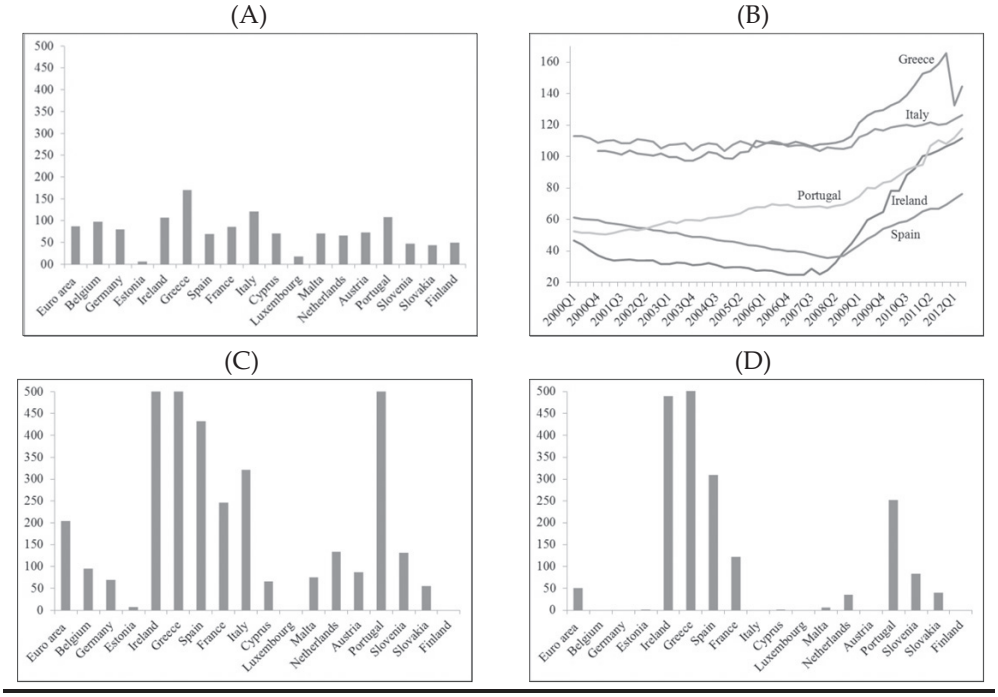
indicating that markets have a preference for UK-Law bonds that can be considered safer from subordination.

With regard to policy implications we would like to highlight a predicament that the current process of rescue policies is facing. On the one hand, further loans with explicit senior status are likely to be inefficient in bringing down interest rates of the countries in crisis. On the other hand, the acceptance of pari-passu status entails more risks for multilateral lenders if the reduction in interest rates does not eventually lead to a turn-around of the economy. In the concluding section of the essay, we also discuss what a gradual separation into a junior and a senior tranche – as an unintended by-product of rescue policies – implies for the OMT program as well as the debt-purchase program of the ESM, the Secondary Market Support Facility (SMSF). Highlighting these trade-offs and taking stylized facts into account for future policies is in our view very important to sharpen minds for finding a long-lasting solution of the crisis.

2. Sustainability of Public Debt

Before we address a possible impact of senior tranche lending, we will analyze the level and time paths of public debt levels in the euro area. This preliminary assessment of the macroeconomic circumstances will help understand the significance of the seniority issue in Europe. The ranking of creditors can only matter for the interest rate, if the eventual repayment of the debt is doubtful, i.e. there are plausible and quantifiable indicators that suggest that the debt levels might ultimately not be sustainable.

Figure 1: Comparison of Actual Versus Steady-State Debt Ratios in the Euro Area



Notes: (A) Debt-to-GDP ratio 2011; (B) Dynamics of debt-to-GDP ratios of countries in crisis; (C) Domar steady-State debt-to-GDP ratio based on 5 year average headline deficit (2007-2011); Domar steady-State debt-to-GDP ratio based on 5 year average primary deficit (2007-2011). Data Source: Eurostat.

In Figure 1 we display various ways to approach this question. First, in Figure 1A we show the 2011 debt levels when government bond spreads where nearly at their peaks. The average debt-to-GDP ratio in the Euro Area is 87.3%. Countries with the highest debt ratios are Greece, Italy and Portugal, with debt ratios of 170.6%, 120.7% and 108.1%. Although quite high, the numbers do not appear unusual when compared to other countries since the beginning of the financial crisis in 2007. Market expectations about a possible default thus appear to have their source in the dynamics of the past years, rather than the current present level of debt in most cases.

Figure 1B illustrates the time paths of public debt of the five largest debtor countries, Greece, Ireland, Italy, Portugal and Spain. A first interesting aspect, visible in this graph, is the pre-crisis development of public debt. While in Portugal and, to a lesser extent, also Greece and Italy, there has been an increase of the debt-to-GDP ratios already before the financial crisis – despite a cyclical upswing –, Ireland and Spain were characterized by declining debt ratios before the crisis. Somewhere between 2007 and 2008, however, there occurred a remarkable trend change. In the past five years, all countries that are struggling with high interest rates have a clear positive time trend in their debt-levels. The downward jump in Greece, in the first quarter of 2012 is the result of the private sector involvement (PSI) that reduced Greece's debt level substantially. In the present essay, we will not discuss the reasons of the high level of public debt in more detail.[9] But clearly, the crisis itself, with bank-bailout operations and the post-2007 recession, with associated social costs, is a large part of the explanation.

[9] See Lane (2012) for an overview.

The potential unsustainability of the time paths these countries have taken in the last years is illustrated in Figure 1C. Using the classic Domar (1944) formula to compute the long run steady-state values of public debt, we show the debt levels to which – ceteris paribus – the countries would converge to, if the past five years were representative for the coming years in the future. We see that the euro area as a whole would converge to about 200% debt-to-GDP, which could still be considered sustainable, when comparing for instance to the post-crisis debt levels in Japan, after its financial crisis in 1997/8. In some individual countries, however, the debt-levels appear to be beyond plausible concepts of sustainability. In Ireland, Greece, Spain and Portugal, the debt level would exceed 400%. In Italy, it would be above 300% and also in France, it would be close to 250%.

With regard to the policy implications of this observation, it is important to separate the future path of debt-ratios that occur as a result of public spending and the growth path of the real economy, from the impact that the interest rates themselves will have on public debt levels. De Grauwe and Ji (2013a) have argued that the euro area is best characterized by a multiple-equilibria situation. Interest rates are high because markets are panicking and the high interest rate itself triggers the insolvency of the countries. In order to address this question, Figure 1D shows the results of a counterfactual simulation, where we assume that all future interest payments would be zero. In this graph, the long run steady state debt ratios are purely driven by the primary deficit (without interest rates) and the nominal growth rates of GDP. We see that under this scenario the debt levels of all countries are somewhat lower. However, Ireland and Greece are still converging to debt ratios above 400%, Spain to about 300% and Portugal to about 250%. An exception is Italy, whose primary surpluses would bring the debt ratio eventually to zero, in the absence of interest rate payments.

There clearly seems to be a sustainability problem that goes beyond the interest rate burden in some euro area countries. In these cases, it seems plausible to argue that markets expect a less than full repayment of their debt-holdings, a precondition for seniority rankings to matter for the level of interest rates.

3. Seniority of Rescue Operations

3.1 De jure seniority – an institutional overview

There is surprisingly little "de jure" evidence that multilateral lenders are indeed senior to other creditors. It is primarily a convention and follows from the logic that in future crisis, this lender of last resort may be needed again to borrow further resources[10]. The concrete bylaws of the lending institutions are often rather vague and ambiguous.

Table 1 summarizes the de jure seniority status of various rescue packages where the seniority status has been explicitly addressed. A simplified reading of these texts would suggest that the ESM and the SMP program can be classified as *senior* to private creditors, while the first Greek loan facility, the EFSM, bilateral lenders and the OMT are *pari passu* – thus "on equal footing" with the private sector. In each case, it gets more complicated, however, when considering the details of the arrangements.

3.1.1 The International Monetary Fund

The best example of the lack of clear de-jure seniority is the IMF. Although we document below that the IMF is *de facto* the most clearly senior lender among all multinational lenders, its institutional setting does not provide a basis for this (see Martha (1990) and Roubini & Setser

[10] It has been shown by Kletzer & Wright (2000), that this is actually sufficient. In a formal analysis, they derive an equilibrium, where no external enforcement is needed. A result already anticipated by Keynes (1924) when he wrote: "There is, on the part of most foreign countries, a strong tendency to default […] whenever the expectation of further loans no longer exceeds in amount the interest payable on old ones."

(2004)). The seniority is widely accepted, but it is not written in the contracts of IMF emergency lending. Nevertheless, in the course of the financial crisis, this senior role of the IMF has never been challenged by any of the commentators. It was re-affirmed for instance by Jean-Claude Trichet on May 6th of 2010, during a press conference when he said that "the IMF has a general privilege of seniority which is part of the overall global institutional framework"[11]. Also later in the year, when the seniority debate of the official rescue packages, has become more intense, the Eurogroup stated that the "ESM loans will enjoy preferred creditor status, junior only to the IMF loan"[12]

3.1.2 The first Greek loan facility and the EFSM

In the first Greek loan facility lenders are considered to be treated "at least" pari-passu. Later, however, the text adds that "the Borrower undertakes not to grant to any other creditor or holder of its sovereign debt any priority to the Lenders". This leaves room for interpretation, as at a time the IMF had already committed €30 billion under a stand-by arrangement. A similar wording was also used in the agreement on bilateral loans to Ireland from the UK.

When the EFSM was activated for the first time in the case of Ireland, it contained an even stronger clause "The support from the EFSM needs to be supplied on terms and conditions similar to those of the IMF". Again, a vague statement, but the IMF reference clearly signals that the loans might be considered senior at the time of repayments.

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[11] European Central Bank Press Conference, May 6th 2010.

[12] Statement by the Eurogroup, November 28th 2010.

Table 1: De Jure Seniority

Greek Loan Facility	"[…] each Loan shall constitute an unsecured, direct, unconditional, unsubordinated and general obligation of the Borrower and will rank at least pari passu with all other present and future unsecured and unsubordinated loans and obligations of the Borrower arising from its present or future Relevant Indebtedness […]"	Greek Loan Facility Agreement (4), 1, (a), May 8th 2010.
	"The Borrower undertakes not to grant to any other creditor or holder of its sovereign debt any priority over the Lenders."	Greek Loan Facility Agreement (4), 2, (a) ii), May 8th 2010.
EFSM	"The support from the EFSM needs to be supplied on terms and conditions similar to those of the IMF"	EU Council Decision, 17211/1/10 REV 1, December 2010.
Bilateral loans to Ireland from UK	"The Borrower must ensure that its payment obligations under this Agreement at all times rank at least pari passu with all its other present and future unsecured indebtedness."	Credit Facility Agreement 13.3, December 2010.
EFSF	"Financial support shall be provided by EFSF in conjunction with the IMF and shall be on comparable terms to the stability support loans advanced by euro-area Member States to the Hellenic Republic on 8 May 2010"	Recital 1 of the Preamble of the EFSF Framework Agreement, June 07th 2010.
	"all Financial Assistance made available to the Beneficiary Member State shall constitute an unsecured (save to the extent of any security provided in accordance with Clause 5(2)(a)(i)), direct, unconditional, unsubordinated and general obligation of the Beneficiary Member State and will rank at least pari passu with all other present and future unsecured and unsubordinated loans and obligations of the Beneficiary Member State arising from its present or future indebtedness"	EFSF Master Financial Assistance Agreements with Greece, Ireland and Portugal, 5. (1), (a), December 12th 2012.
ESM	"In all cases, in order to protect taxpayers' money, and to send a clear signal to private creditors that their claims are subordinated to those of the official sector, an ESM loan will enjoy preferred creditor status, junior only to the IMF loan."	Statement by the Eurogroup, November 28th 2010.
	"Like the IMF, the ESM will provide financial assistance to a Member State when its regular access to market financing is impaired. Reflecting this […] the ESM will enjoy preferred creditor status in a similar fashion to the IMF, while accepting preferred creditor status of IMF over ESM"	European Council Conclusion (EUCO 10/1/11), April 4th 2011.

	"In the event of ESM financial assistance in the form of ESM loans following a European financial assistance program existing at the time of the signature of this Treaty, the ESM will enjoy the same seniority as all other loans and obligations of the beneficiary ESM Member, with the exception of the IMF loans."	Recital 13 of the Preamble in the Treaty establishing the ESM, March 25th 2012.
	"The euro area Member States will support equivalent creditor status of the ESM and that of other States lending bilaterally in coordination with the ESM."	Recital 14 of the Preamble in the Treaty establishing the ESM, March 25th 2012.
OMT & SMP	"it [referring to the OMT] accepts the same (pari passu) treatment as private or other creditors with respect to bonds […], in accordance with the terms of such bonds."	ECB press statement, September 6th 2012.
	"With regard to seniority, the statement on outright monetary purchases does not apply to the SMP holdings."	ECB press conference, September 6th 2012.

3.1.3 The temporary rescue fund, EFSF

A similar wording was used when the EFSF was introduced as a société anonyme incorporated in Luxembourg. Referring to the definition of "pari-passu" above, it states that "Financial support shall be provided by the EFSF in conjunction with the IMF and shall be on comparable terms to the stability support loans advanced by euro-area Member States to the Hellenic Republic on 8 May 2010". The ambiguity in the bilateral loans thus translated into an ambiguity in the EFSF lending that was strengthened by the uncertainty about the concrete terms of the transition of this loan facility to the ESM three years later.

In public statements, however, the EFSF and other policy makers made clear that it did not claim a senior role for its lending. On July 13th, 2010, Klaus Regling, the chief executive officer of the EFSF stated in an interview with a Wall Street Journal that "Unlike the IMF, the EFSF will not be a preferred creditor."[13]

[13] Wall Street Journal, July 13th 2010.

3.1.4 The permanent rescue fund, ESM

When on November 28th, 2010, the Eurogroup agreed on the ESM, as an intergovernmental organization under public international law, they expressed the ESM's status very clearly: "an ESM loan will enjoy preferred creditor status, junior only to the IMF loan." Later on, this was renewed and justified by the ESM's debtor-in-possession financing. A first version of the treaty containing the above statement was signed on July 11th, 2011.

In a later version of the treaty, March 25th 2012, an important clarification was added. While both versions claimed seniority for the ESM itself and envisaged the transfer of EFSF credits into the ESM, only the second version made clear how the transferred EFSF credits stand in terms of creditor seniority. They were intended to gain the same seniority status as the ESM.

As the financial crisis developed, there were also some downgrades of its strong initial seniority stance. For instance, in the final version of the ESM treaty the seniority statement was weakened. While the first draft read "the ESM will enjoy preferred creditor status", the final version said "The ESM *loans* will enjoy preferred creditor status" (emphasis added). Other instruments, such as the Secondary Market Support Facility *(SMSF)* are thus excluded from the seniority clause. It is furthermore interesting to note that the seniority status of the ESM is only governed in its preamble - as a mutual understanding.[14]

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[14] According to ESM chief, Klaus Regling, this is however, legally binding as any "repeal or amendment of their earlier statement would therefore also require a decision by the Heads of State or Government. In several Member States it would require support by the national parliament." (Transcript of a conference call from August 09th 2012, via the EFSF webpage. Later, this statement was also published in the official EFSF FAQ).

Also the extension of maturities of EFSF and ESM loans can be interpreted as a withdrawal from its strong seniority position. On July 21st, 2011, the heads of state for the first time extended the maximum maturity for Greece, Ireland and Portugal from 7.5 years to a minimum of 15 years and up to 30 years with a grace period of 10 years. The maximum EFSF maturity for Spain has been increased 15 year in July 2012, with an average maturity of 12.5 year. All these maturities are substantially longer than typical senior IMF-loans.[15]

3.1.5 SMP and OMT

The Eurosystem of Central Banks also became an important creditor of countries in crisis via its Securities Markets Programme (SMP), collateralized lending to financial institutions and, later, the Outright Monetary Transactions (OMT), a component not yet used at the time of writing. Despite a controversial public debate on the seniority status of the Eurosystem, there is de jure little justification for claiming such a preferred status. All government bonds in the open (secondary) market contain the same legal clauses[16] – whether bought by the ECB or by private investors. In the case of OMT, the ECB explicitly acknowledged this fact in stating: "that it accepts the same (pari passu) treatment as private or other creditors with respect to bonds […], in accordance with the terms of such bonds." However, accepting pari-passu treatment does not mean that the Eurosystem is allowed to participate in voluntary debt restructurings, such as the Greek PSI in February/March 2012. Both, SMP

[15] Furthermore, in December 2012, the Eurogroup decided to reduce the interest rate of the Greek Loan Facility and the EFSF loans, at the same time deferring interest payments on the later by 10 years.

[16] Generally, government bonds come with a pari-passu clause. In the context of sovereign lending it is, however, unclear what pari-passu really means (See Weidemaier et al. (2013)).

and OMT are monetary policy instruments. *Voluntarily* writing down claims on these bonds would constitute forbidden monetary financing (Article 123 EU Treaty, Article 21 ECB statute), a fact highlighted repeatedly by members of the ECB.[17]

3.1.6 Target2-balances

Also Target2-balances are de jure not senior, although they constitute multilateral claims of an institution – the Eurosystem of Central Banks – that is widely accepted as a preferred creditor, and that has already enforced its senior status in the case of the Greek private sector involvement 2012.

In principle, the entire lending operations of national central banks (NCBs) – which are part of the Eurosystem - could be seen as senior to private markets. In practice, however, it is unclear whether NCBs can enforce this position with respect to their own banks and – indirectly – governments. The Target2-balance, however, measures only the share of NCBs credit that is used for international transactions. Thus it turns a domestic credit of an NCB given to a private bank into a multilateral liability of the country (as owner of the NCB) with respect to the

[17] For example Bundesbank president Weidmann stated in an interview published on the Bundesbank webpage: „Auf jeden Fall gilt: Die Notenbanken dürfen Griechenland die Schulden nicht erlassen, das wäre ein direkter Transfer und käme damit einer verbotenen monetären Staatsfinanzierung gleich." (November 10th 2012). Also, ECB board member Jörg Asmussen: "The ECB would not be able to take part in any such restructuring because this would constitute state financing, which is forbidden" (Die Welt, August 25th 2012).

Eurosystem (see Garber (1999)). If these loans are not repaid, or at least serviced, the remaining Eurosystem countries will realize losses.[18]

Sinn and Wollmershäuser (2012) and Whelan (2014), despite other differences, also both state that Target2-balances are best characterized as "loans" with respect to the Eurosystem. Even in the case of an exit from the euro, Whelan (2014) argues that Target2-liabilities (and interest rates) are likely to continue to be serviced, in order to maintain access to the international payments system. Whelan also points out that Target2-balances are de jure not collateralized. However, as the survey results show, there are nevertheless expectations in the market, that the Target2-claims will have senior status in case of default.

3.2 De facto seniority

3.2.1 A survey among experts

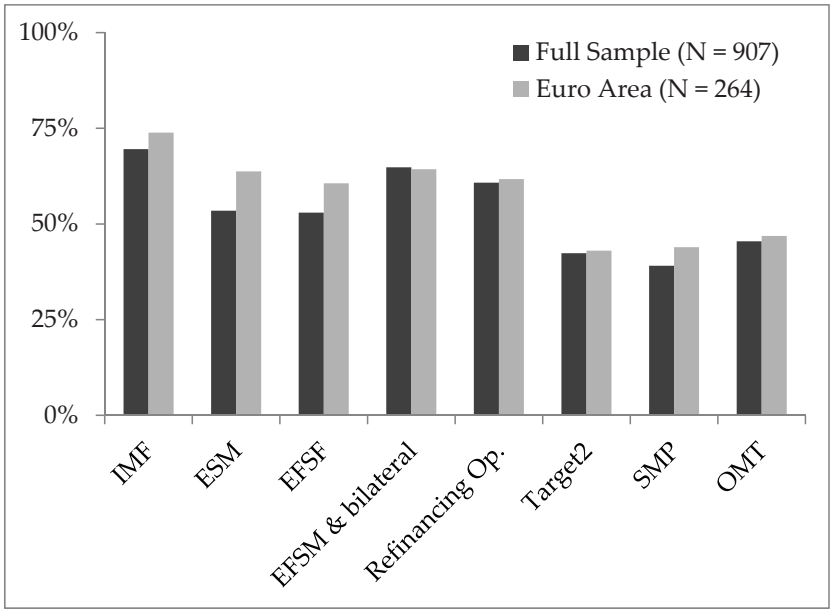
Whether this ambiguity in legal contracts, as well as the public debate on the seniority question has actually had an impact on market expectations can be evaluated when looking at survey data. In the *World Economic Survey*, of April 2013, the ifo Institute asked experts worldwide about their expectations regarding the seniority status of different

[18] An additional argument is that government bonds are often used as collateral in refinancing operations. This strengthens the case that large Target2-liabilities can drive up interest rates. Note however that this is not the case in all countries (See also Drechsler et al. (2013) on the composition of collateral in the Eurosystem). In Italy the share of government bonds is on average about 50%. At the margin, however, the share is likely to be higher as government securities make up 88% of all freely available assets of Italy's banking system (See Banca D'Italia's Financial Stability Report, April 2012). On the other hand, sovereign debt is not the main source of collateral in Ireland. Irish banks used substantially haircut "own" bonds, backed by real estate. Also they used NAMA-bonds, which are not sovereign debt, but are viewed as carrying a government guarantee.

components of the rescue umbrella. The experts were asked to answer the following question, with either *Yes* or *No*:

> *"In a case of default (or debt restructuring) of a member country of the European monetary union, do you expect the following public creditors to get preferred treatment (i.e. have senior status), compared to private sector creditors?"*

Figure 2: Market Expectations about De Facto Senior Status



Notes: Figure shows the percentage of respondents expecting the respective component of rescue packages to be senior to private market participants. Data source: World Economic Survey, April 2013, ifo Institute.

Overall, expectations regarding the seniority of multilateral loans can be said to be very high: 88% of the respondents see at least one component of the rescue umbrella as senior to private creditors. There are, however, some differences in the details. As illustrated in Figure 2, 70% of respondents see the IMF as a preferred creditor. This is the highest share among all components of the rescue package. 65% of the

respondents expect that bilateral loans (as part of the EFSM agreement), will have a preferred creditor status. Expectations regarding the EFSF and the ESM are substantially lower, scoring only 53% each. It is interesting that the latter, despite their differences in "de Jure" seniority, are judged almost identically by survey participants. [19]

Part of the WES-question also covered the ECB and the national central banks of the Eurosystem. Overall, the expectation about seniority was somewhat lower in this case. The highest expectations were expressed with respect to the refinancing credit of the national central banks, which are partly collateralized with the government debt of their respective countries. 61% of respondents expect that the central banks will be able to enforce their status as a senior lender in case of insolvency. The share is somewhat smaller in case of Target2-claims, which are not explicitly collateralized. Here, 42% of the respondents expect that the claims will have a preferred creditor status.

As far as bond purchases by the ECB are concerned, 39% of the respondents state that the bonds purchased in the SMP program will have preferred creditor status, while 45% expect such a status for the new OMT program. This comparison again reflects the discrepancy between *de jure* and *de facto* seniority.

[19] The complete question can be found in Appendix A1. The ifo Institute's WES survey is conducted on a quarterly basis since 1981 and includes a wide range of more than 1000 experts who are very well informed about the economic development in their countries. All respondents work in leading positions or are conducting economic research within their institution. About 65% of the panelists work for international corporations, 10% work each in economic research institutes and chambers of commerce, 5% in consulates and embassies and the last 5% in multilateral organizations (such as OECD and IMF), foundations, media or small scale enterprises. For more information on the ifo survey datasets in general, and the WES in particular, see Seiler (2012) and references therein.

Differences also exist between the regions covered in the WES survey. Among the participants from euro area countries considered on their own, 91% of all respondents see at least one component of the rescue package as senior. The largest difference among the subcomponents exists regarding the seniority of the ESM, where 65% (rather than 53%) of respondents see a preferred creditor status.

3.2.2 Rating Agencies

The rating agencies reacted quite sensitively to the ups and downs in the debate on creditor seniority of rescue funds. In several cases, the downgrading of individual countries was explicitly motivated by the concerns about subordination of private markets. In the context of our subsequent empirical analysis, this is an important aspect, as it shows in a non-technical way that a causal impact that runs from the seniority status to the level of interest rate spreads is plausible.

Prior to the crisis, there have been occasional statements that S&P would generally take multilateral lenders as preferred creditors with a triple-A rating (see statements from 1998, 2005, 2011). [20] In January 2011, S&P for the first time publicly linked the European public rescue funds to future borrowing costs of the countries in crisis. In the S&P economic

[20] Standard & Poor's, September 18th 1998: "Multilateral lenders, such as the triple-'A'-rated World Bank, enjoy preferred creditor status that, while fundamentally a political expression, reflects the incentives of a borrowing/guaranteeing government to place priority on loan repayment to the multilateral lending institutions." Standard & Poor's, 2005: "Buttressed by the long record of favorable treatment of loans from multilateral institutions by sovereigns under severe financial distress, these incentives have led Standard & Poor's to expect that in most cases obligations to these institutions will receive similarly preferential treatment in the future." Standard & Poor's, November 26th 2011: "Preferred creditor treatment on the exposures to sovereigns is a cornerstone of the Multilateral lending institution sector that historically has enabled it to operate with low losses."

outlook, it argued that "Unlike the current vehicle, the new vehicle will be senior to commercial debt, in other words, to bond debt […] the ranking of this official European lending vehicle is a change in the rules of the game and that's having an impact on government's refinancing costs."[21] About one month later, the Financial Times referred to the case of Portugal when it said: "S&P warned it would downgrade Portugal's sovereign debt rating by one or two notches if European leaders decided later this month to require borrowers from the European Stability Mechanism – due to replace the EFSF in 2013 – to restructure their government bonds and make the ESM a preferred creditor."[22] Again, only three weeks later, S&P actually did downgrade Greece and Portugal for exactly this reason, arguing that "[Subordination by ESM is] detrimental to commercial creditors", on the 29th of March 2011. A full list of rating decisions by the two biggest rating agencies that were explicitly motivated by the seniority issue is given in Table 2, below.

In later statements, the ESM was also clearly seen as a senior lender by the rating agencies. S&P for instance, in January 2012, expressed the expectation that "the ESM, [is] a privileged creditor that is expected to be senior to bondholders in any future restructuring".[23]

The rating agencies also reacted to the ECB's decision to not participate in haircuts during the Greek debt-restructuring in early 2012. Moody's for instance argued as follows: "The agreement and a bond swap that took place over the previous weekend confirm the European Central Bank's (ECB) and national central banks' (NCBs) status as 'senior creditors'. […] the subordination of private sector creditors may make it more difficult to re-access the markets once their existing support

[21] Standard & Poor's, John Chamber, January 3rd 2011.

[22] Financial Times, March 2nd 2011.

[23] Standard & Poor's, January 13th 2012.

programmes run out in 2013. This is a credit negative factor that we have already reflected in recent sovereign rating actions, including those announced on 13 February"[24].

The list of rating decisions based on creditor seniority considerations, reported in Table 2, illustrates the awareness of markets and the careful monitoring of the decision making process that took place in this regard in Frankfurt and Brussels.

Table 2: Rating Decisions influenced by Problems of Creditor Seniority.

S&P	Downgrade of Greece to BB- and Portugal to BBB-	29.03.11	"[Subordination by ESM is] detrimental to commercial creditors" and "Nevertheless, any ESM borrowings would be senior to Portugal's government bonds. The seniority of ESM borrowings (and the consequent subordination of government bonds) in our view reduces the prospect of timely repayment to government bondholders, and likely also results in lower recovery values."
S&P	Lowered sovereign credit ratings on the Republic of Ireland to 'BBB+/A-2'.	01.04.11	"The downgrade reflects our view of the concluding statement of the European Council (EC) meeting of March 24-25, 2011, that confirms our previously published expectations that (i) sovereign debt restructuring is a possible pre-condition to borrowing from the European Stability Mechanism (ESM), and (ii) senior unsecured government debt will be subordinated to ESM loans. Both features are, in our view, detrimental to the commercial creditors of EU sovereign ESM borrowers."
S&P	Downgrades for nine eurozone sovereigns and affirmations of the ratings on seven others.	13.01.12	"Decision based results of on EU summit Dec. 9, 2011: As we noted previously, we expect eurozone policymakers will accord ESM de-facto preferred creditor status in the event of a eurozone sovereign default. We believe that the prospect of subordination to a large creditor, which would have a key role in any future debt rescheduling, would make a lasting contribution to the rise in long-term government bond yields of lower-rated eurozone sovereigns and may reduce their future market access"

[24] Moody's, February 27th 2012.

Moody's	Key Drivers of Decision to Downgrade Spain's Rating to Baa3 and Review for Further Possible Downgrade	26.06.12	"[…] there are several factors that differentiate Spain's anticipated programme from the support packages extended to Ireland, Portugal and Greece. In addition to being sector specific, its size is significantly smaller than it is in those cases. We therefore consider the issue of subordination of bondholders to the senior creditor EFSF/ESM to be less of a negative factor."
S&P	Long-Term Rating of Cyprus Lowered To 'BB'; Placed On Watch Negative As Bailout Talks Continue"	01.08.12	"The CreditWatch placement reflects our view of the increasing short-term financing pressures on the Cypriot government. We see at least a one-in-two chance that we could lower the rating in the third quarter of 2012 if official assistance is not forthcoming and/or it carries an explicit preferred creditor status."
S&P	Ireland Ratings Affirmed At 'BBB+/A-2'; Outlook Remains Negative	02.08.12	"Regarding the status of a possible ESM loan to Ireland and its impact on commercial creditors, we note that the ESM has indicated that they would not seek preferred creditor status should the prospective European Financial Stability Facility loan to recapitalize Spanish banks be transferred to the ESM at a later date. Preferred creditor treatment may therefore only be applied on a case-by-case basis. We will assess the implications of ESM financial assistance for Ireland in the event that it is required"
Moody's	Assigns Aaa/ Prime-1 rating to European Stability Mechanism (ESM); negative outlook"	08.10.12	"The fourth key rating factor is the ESM's preferred creditor status that is junior only to that of the IMF. This status differentiates the ESM from its predecessor entity, the EFSF, which ranks pari-passu with senior unsecured bondholders."
S&P	Cuts long-term rating for Cyprus to 'B'	17.10.12	"Cyprus' commercial banks – or the government itself – could be forced to reschedule their debt in order to meet the terms of an official lending program. Potential loans from the ESM could be senior to holders of Cypriot debt, and we understand it is somewhat uncertain whether this could trigger the acceleration of debt repayment issued under the government's medium term notes (EMTN) program according to the provisions of the EMTN transaction documents. This could significantly weaken confidence in Cyprus' financial system"

Moody's	Downgrades ESM to Aa1 from Aaa and EFSF to (P) Aa1 from (P) Aaa, maintains negative outlook on ratings	30.11.12	"[…] the ESM benefits from credit features that differentiate it from the EFSF, including the preferred creditor status and the paid-in capital of EUR80 billion. However, […] these credit features do not enhance the ESM's credit profile to the extent that it would warrant a rating differentiation between the two entities.
S&P	Ratings On European Investment Bank Affirmed At 'AAA/A-1+' Following Criteria Revision: Outlook Negative	05.12.12	"The EIB benefited from preferred creditor treatment (PCT) during the Greek debt private-sector involvement earlier in 2012: it did not incur any losses. While there is no guarantee that PCT will always apply to the EIB, we believe that the bank's past experience is relevant for future debt restructurings if and when they occur."
Moody's	Assigns (P)Aa1/(P)P-1 ratings to ESM debt issuance programme, negative outlook	06.12.12	"The fourth key rating factor is the ESM's preferred creditor status that is junior only to that of the IMF. This status differentiates the ESM from its predecessor entity, the EFSF, which ranks pari-passu with senior unsecured bondholders."

4. Co-movement with Interest Rate Spreads

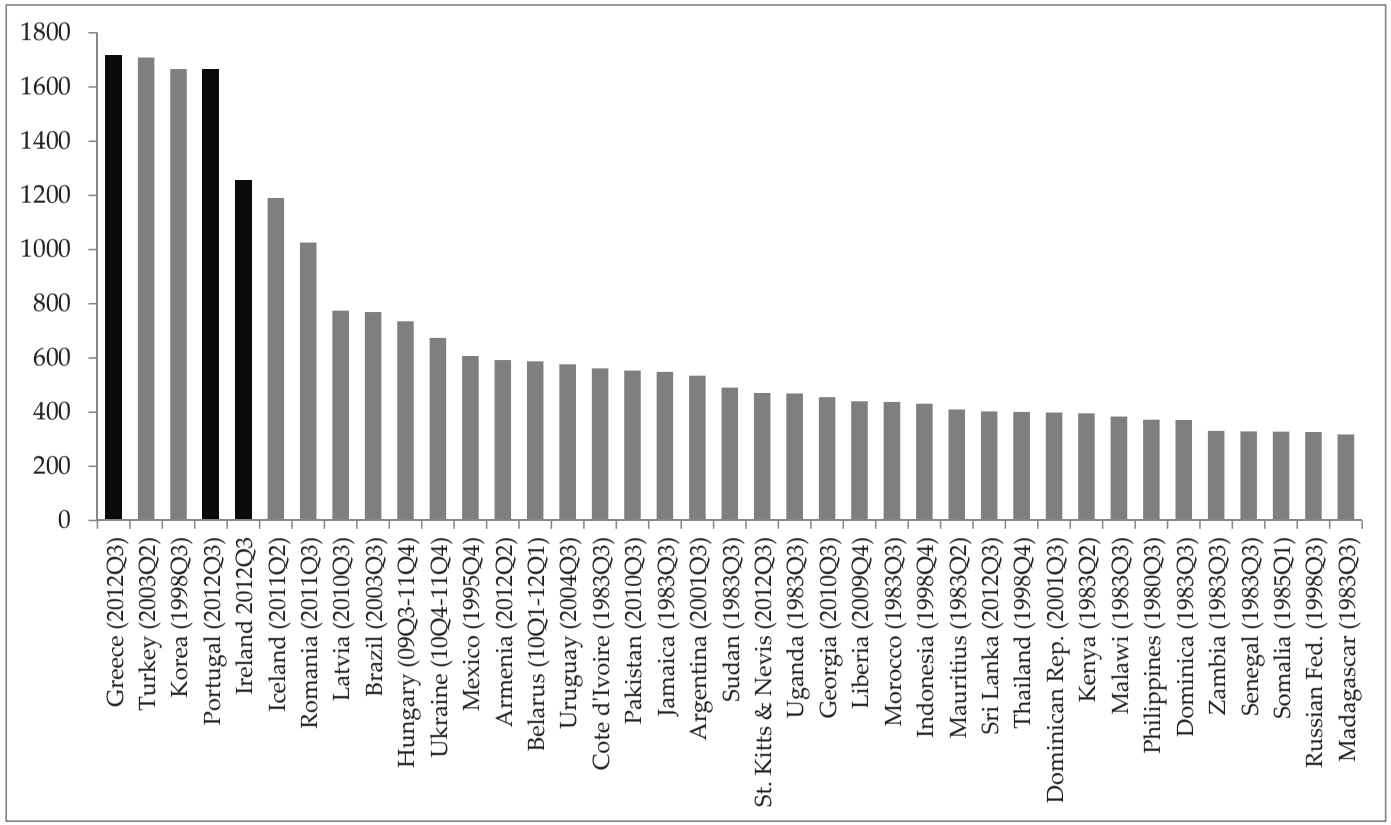
In this section we start our empirical analysis by illustrating that the senior tranche relative to total public debt is large in magnitude and also large by historical standards. Furthermore, there is a striking correlation between the share of senior tranche debt and the interest rate spread in the countries currently experiencing a financial crisis.

4.1 The magnitude of the senior tranche

Rescue operations since the beginning of the financial crisis have been large in comparison to other countries. Even when focusing on the IMF alone, the most clearly senior lender, the European countries are among the largest recipients of IMF emergency lending. Figure 3 shows that Greece, Portugal and Ireland, are among the top-five largest IMF programs, when compared to its quota share in the IMF. The first 400% of the quota are available to participating countries without a special decision on emergency assistance. Greece, Portugal and Ireland have exceeded this quota by a factor of four, and three, respectively. Figure 4 further shows that the average size of IMF programs has substantially increased during the European sovereign debt crisis. It is clearly larger in magnitude than the Latin-American debt crises in the 1980ies and mid-1990ies or the Asian financial crisis in 1997/98.[25]

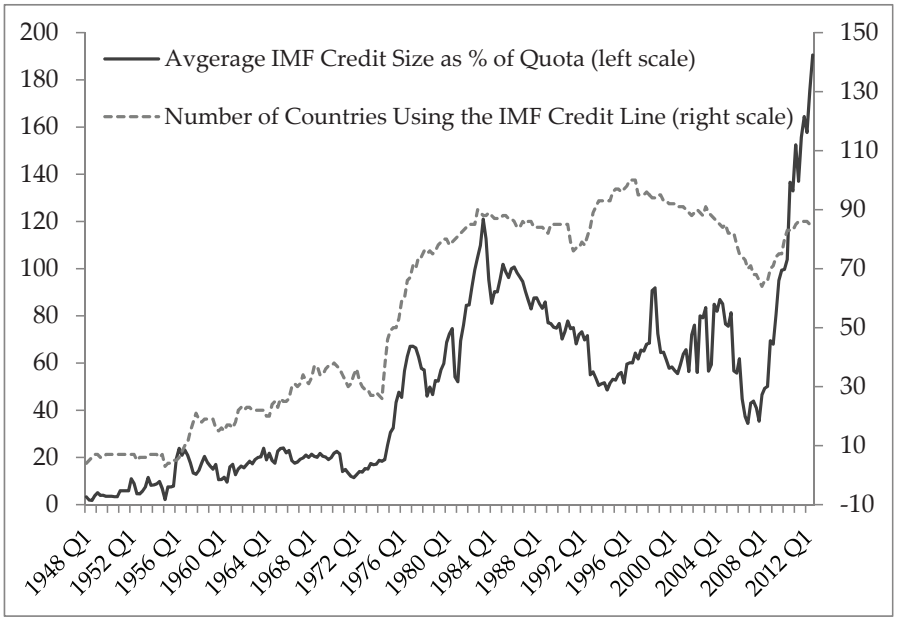
[25] See also Barkbu et al. (2012) for an analysis of the size of multilateral responses to different episodes of financial crisis.

Figure 3: Countries' Maximum Use of IMF Credit between 1948 and 2012 (as % of quota)



Notes: Figure shows the biggest IMF credits (as % of quota) in the respective country's history. Data source: International Financial Statistics (IMF).

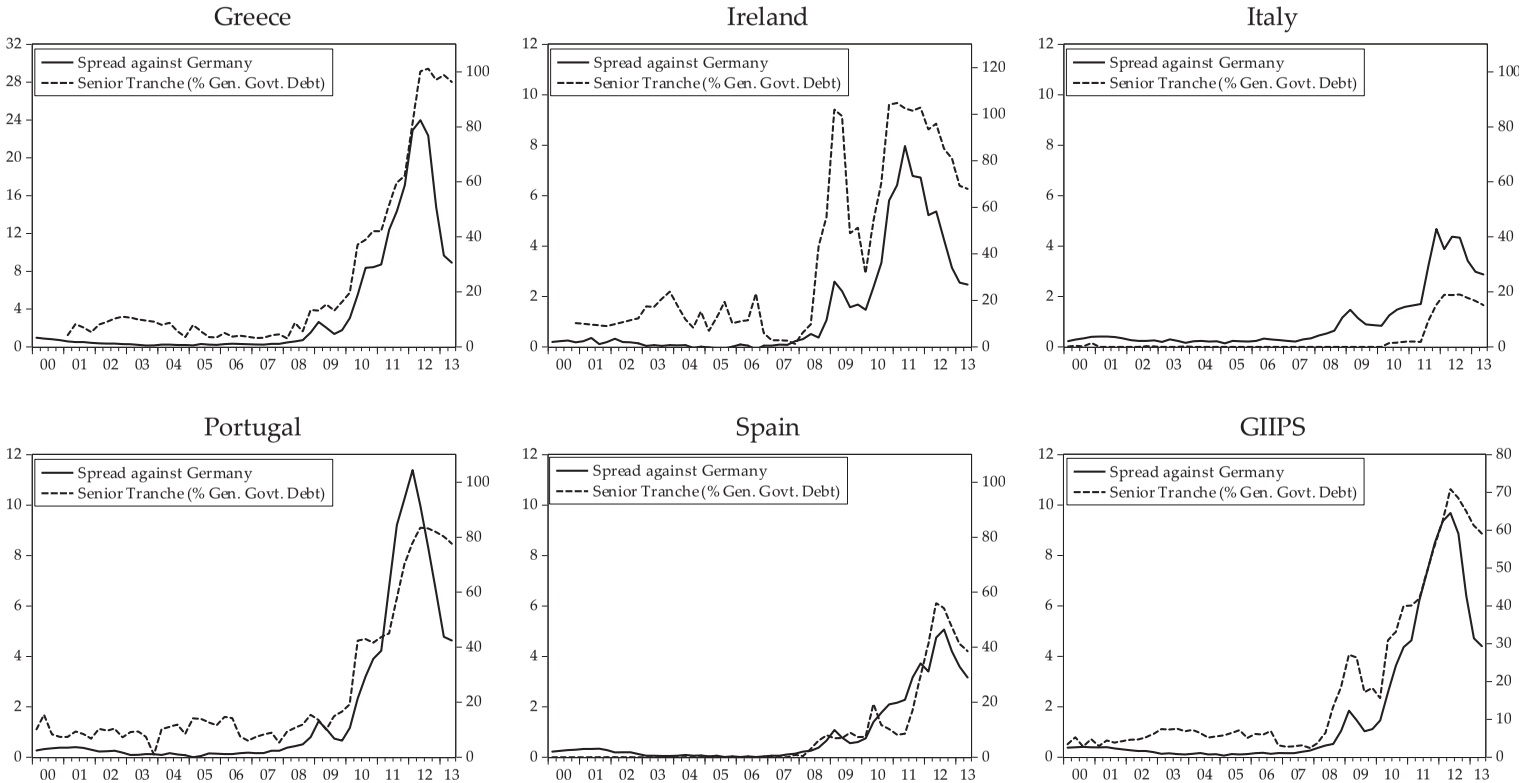
Figure 4: Development of Size and Number of IMF Credits



Notes: Figure shows the development of the average size of IMF credits (dark line) and the number of IMF members being a net creditor to the IMF (light-grey line). Data source: International Financial Statistics (IMF).

Despite this quite large IMF involvement, the contribution of the IMF to the total rescue packages in the euro area has been relatively small. Bilateral loans of the EU member countries as well as the multilateral agreements within Europe, as discussed above, constitute a much larger share of total rescue efforts. Furthermore, either type of institution is relatively small, when considering the Eurosystem of central banks as senior lender, as for instance the rating agencies did, as shown in the previous section.

Figure 5: Development of the Senior Tranche and the Crisis Countries Government Bond Spreads



Notes: Figure shows the spread between the interest rate of countries' government bonds and the German Bund, both with a maturity of 10 years (left scale). The senior tranche proxy is calculated as described in this Section (right scale). The last graph in the figure compares GIIPS countries' means of both variables. Data source: See data appendix A1.5.

Our benchmark-proxy for senior tranche lending in the subsequent empirical analysis consists of all multilateral claims. There are two different parts: The first component, official loans, comprise all loans provided by the IMF, the EU and euro area (through ESM, EFSF and EFSM) and individual countries. The second component includes all government bonds purchased under the SMP and Target2-liabilities of national central banks (NCB's). In sum, the total senior tranche lending in the end of our sample period ranges in between 15% (Italy) and more than 96% (Ireland) of total public debt. The average senior tranche share of the five countries in crisis is 59%.

Figure 5 provides an initial visual impression of the data and displays the dynamics over time. It compares the senior tranche share with spreads on the sovereign bonds of the crisis countries. One can clearly see a high contemporaneous correlation for the individual countries as well as in their aggregate. This impression is confirmed in a first correlation analysis in Table 12 of the appendix. The correlation between senior tranche lending and government bond spreads is 0.76.

4.2 Preliminary analysis and benchmark regression

In this section, we establish our first empirical finding: a robust partial correlation of the senior tranche share in total public debt and the interest rate spreads of 10-year government bonds. We start our analysis by providing an overview of the descriptive statistics and the stationarity and cointegration properties of the variables that enter the regression analysis, reported in Appendix A1.4. In the subsequent regression analysis, we analyze whether the bivariate correlation, visible in the graphs of the previous section, is statistically significant and robust in a multivariate framework.

Table 3 contains a first set of results that we use as our benchmark regression for the latter analysis and robustness tests. In this benchmark regression, we use standard sets of control variables that were also chosen in other articles (see for instance De Grauwe & Ji (2013a) and Beirne & Fratzscher (2013)). These include the debt to GDP ratio, the current account, the real effective exchange rate and the real GDP growth rates.

Our analysis focuses on the member countries of the euro area which joined the common currency before the onset of the global financial crisis. The panel dataset consists of quarterly observations from the beginning of 2000 until mid-2013. The main data sources are Eurostat of the European Commission, International Financial Statistics of the IMF, Thomson Reuters' Datastream and the Target2-database "Euro Crisis Monitor", collected at the Institute of Empirical Economic Research at Osnabrück University. The sources and construction of the variables are described in the Appendices A1.5 and A1.6.

All regressions in Table 3 are estimated using Ordinary Least Squares with robust standard errors.[26] Columns (1) and (2) replicate earlier specifications in the literature. In these regressions, we explain the interest rate spread by fundamentals.[27] Following De Grauwe and Ji (2013a), we also add country fixed effects (Column 1) and time fixed effects (Column 2). The first is included to control for unobserved time-

[26] The higher standard deviations in the post-crisis sample reported in the descriptive statistics in Appendix A1.3 raised the issue of heteroscedasticity in our data set. A modified Wald-test rejected the null hypothesis of homoscedasticity at the 1% level. We therefore report robust standard errors in all regressions.

[27] In Table 18 of the appendix we also report regression results for other dependent variables, such as sovereign bond prices, or real versus nominal government bond yields as a robustness test. For a more extensive analysis of the link between sovereign bond prices, rather than interest rate spreads, and senior tranche lending see also Steinkamp and Westermann (2012).

invariant heterogeneity between countries.[28] The later is included to control for unobserved default risk that is not explicitly captured by our fundamental variables.[29] Columns (3) and (4) show that the bivariate correlation between senior tranche and interest rate spreads is indeed statistically significant and columns (5) and (6) document that it remains significant in a multiple regression setup that includes the standard explanatory variables. A one percentage point increase in the senior tranche share is associated with a higher interest rate spread of about 0.047 percentage points.

Applying this coefficient to the data – over the full sample period – , would imply that a country with a senior tranche share of 60%, approximately the average senior tranche share of the crisis countries is in the end the sample period, would ceteris paribus be charged an additional interest rate of about 2.82% above the German interest rate.[30]

[28] Alternatively, we could have chosen a random effects model. We follow an artificial regression approach to test the overidentifying restriction of the additional orthogonality condition imposed in random effects models that the country-specific error is not correlated with the regressors. The Sargan-Hansen statistic of $\chi_5^2 = 69.9$ rejects the assumption of random effects in favor of the used fixed effects model at the 1% level of significance.

[29] Furthermore, as discussed in Section 4.5.2, it helps capture influences of herding behavior/unobserved contagion (see also De Grauwe & Ji (2013a) who follow the same approach).

[30] The magnitude of the senior tranche varies considerably across countries. In Table 19 of the appendix, we eliminate each country from the benchmark regression to show that the results do not depend on any individual country, or are driven by outliers.

Table 3: Benchmark Regression

Dependent Variable: Government Bond (10y) Secondary Market Spreads Against Germany						
	(1)	(2)	(3)	(4)	(5)	(6)
Senior Tranche			0.111***	0.098**	0.057***	0.047***
			(3.26)	(2.70)	(3.26)	(3.55)
Debt/GDP	0.080***	0.070***			0.041***	0.034**
	(5.05)	(4.28)			(3.65)	(2.99)
Current Account/GDP	-0.004	0.034			-0.043***	0.000
	(0.16)	(1.28)			(3.30)	(0.01)
REER	0.030**	0.120**			0.025	0.112***
	(2.47)	(2.42)			(1.63)	(3.24)
Real GDP Growth	-0.061	-0.147*			-0.042	-0.143*
	(1.66)	(1.80)			(1.17)	(1.84)
Country FE	yes	yes	yes	yes	yes	yes
Time FE	no	yes	no	yes	no	yes
R^2 (within)	0.59	0.72	0.63	0.68	0.69	0.78
Obs.	634	634	611	611	597	597

*Notes: Robust t-statistics in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. Results are from a panel fixed effects model estimated using OLS. Reported R^2 is calculated "within", i.e. from the mean-deviated regression. Data sources: See data appendix A1.5.*

4.3 Interaction effects

The magnitude of this coefficient, however, might vary, depending on the current level of public debt. Suppose a country did not have any public debt to start with, than it would not matter whether the bonds are sold to junior or senior lenders – in any case, both could be expected to be repaid. On the other hand, when countries have exceeded a certain threshold, say the critical 90% value of Reinhart and Rogoff (2010), the seniority status of public debt clearly begins to matter. In Table 4, we address this issue, by adding various interaction terms to our benchmark regression.

In the first two columns, we interact the senior tranche variable with the level of public debt. The dummy variable takes a value of one, if the general government debt of the country has passed the 80%, 100% and 120% debt-to-GDP threshold, respectively, and is equal to zero otherwise. In this table, the interpretation of the senior tranche variable becomes that of senior lending in "good-times", when the level of public debt is below the thresholds defined above.

The effect of the senior tranche share in times with high debt levels can be seen in the second row of Table 4, labeled "Senior Tranche X Dummy". This variable is our senior tranche variable interacted with the dummy variable defined above. In all cases, the high-debt coefficient is larger and statistically significant at the 1% level. Also, the larger the public debt, the larger is the magnitude of this coefficient.

Table 4: Interaction Effect

Dependent Variable: Government Bond (10y) Secondary Market Spreads Against Germany								
	Debt to GDP Thresholds			Time				
Variables	>80%	>100%	>120%	After Lehmann	After Deauville Meeting	After Maturity extension	After EFSF/ESM pari passu	After OMT (pari passu)
Senior Tranche	0.023**	0.040***	0.046***	0.032*	0.021***	0.039***	0.050**	0.049**
	(3.00)	(8.33)	(5.21)	(2.12)	(3.80)	(5.88)	(2.79)	(2.72)
Senior Tranche X	0.060***	0.070***	0.076**	0.048***	0.062***	0.059***	0.033*	0.025
Dummy	(5.45)	(4.44)	(2.92)	(3.34)	(5.97)	(4.59)	(2.16)	(1.64)
Debt/GDP	0.015	0.015	0.025**	0.031**	0.017	0.026*	0.039**	0.041***
	(0.89)	(1.58)	(2.23)	(2.61)	(1.07)	(1.92)	(3.10)	(3.45)
Current	0.007	-0.005	-0.009	0.002	-0.003	-0.007	0.009	0.010
Account/GDP	(0.45)	(0.40)	(0.79)	(0.15)	(0.25)	(0.55)	(0.44)	(0.49)
REER	0.122***	0.111***	0.098***	0.110***	0.110**	0.105**	0.116***	0.117***
	(3.60)	(3.56)	(3.52)	(3.20)	(2.94)	(2.98)	(3.25)	(3.34)
Real GDP Growth	-0.165**	-0.145*	-0.118**	-0.144*	-0.159*	-0.161*	-0.136*	-0.135*
	(2.26)	(2.18)	(2.34)	(1.84)	(2.14)	(2.05)	(1.92)	(1.89)
Country FE	yes	yes	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes	yes	yes
R^2 (within)	0.78	0.78	0.77	0.78	0.81	0.79	0.79	0.79
Obs.	597	597	597	597	597	597	597	597

*Notes: Robust t-statistics in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. Reported R2 is calculated "within", i.e. from the mean-deviated regression. The coefficient of the interaction term "Senior Tranche X Dummy" is the sum of the senior tranche coefficient plus the additional senior tranche effect, when the dummy variable is equal to one. In the first three columns the dummy variable is one if the country exceeds certain debt-to-gdp ratios. In the other five columns the dummy is coded 1 after the collapse of Lehman brothers (2008Q4), the Deauville Meeting (2010Q4), the maturity extension of rescue loans (2011Q3), the decision that EFSF loans do not gain seniority when transferred to the ESM (2012Q2), and the announcement of the OMT with pari-passu status (2012Q3). Data source: See data appendix A1.5.*

Furthermore, we also find that the magnitude of the coefficient also varies over time. For instance, there is a larger coefficient in the post-Lehmann period, when debt levels increased substantially. It also increases, after the Deauville meeting in autumn 2010, when private sector involvement (PSI) was first considered an option. On the other hand, the interaction variables show that there was also a decline of the coefficient after maturities where extended in July 2011. The effects of maturity extension is rather small, however, as the Greek private sector involvement was announced at the same time. Furthermore, the coefficient declines after it had been clarified that loans given by the EFSF would be transferred to the ESM without gaining in seniority. Another decline occurs after the announcement of the OMT program, at which the ECB explicitly accepted pari passu treatment. In the latter two cases, the magnitude of the point estimates declines as well as the level of significance. Note, however, that the last window is also based on a rather small sample.

In Table 5, we use these coefficients of the total effect, conditional on the current debt level, to evaluate the quantitative effect of senior lending on interest rate spreads, at the time when each country received its first official rescue package. In Greece, it explains the largest share, with a value of 53.7% of the actual increase in interest rate spreads. In Ireland it explains 9.0%, in Portugal 45.3%, and in Spain 25.4%.

Table 5: Predicted Senior Tranche Effect at Time of First Official Rescue Payments

Country		Greece	Ireland	Portugal	Spain
Time		2010/Q2	2011/Q1	2011/Q1	2012/Q2
ΔSenior Tranche		17.51	0.77	2.07	14.84
Debt to GDP		>120%	>100%	>100%	<80%
Predicted Effect on Spreads	95% Confidence Interval	0.33	0.03	0.07	0.09
		2.32	0.08	0.22	0.60
	Point Estimate	1.32	0.05	0.15	0.34
Actual ΔSpread		2.46	0.60	0.32	1.35
Explained		53.74%	9.01%	45.32%	25.42%

Notes: Table 5 compares the predicted effect of changes in senior tranche lending on government bond spreads, for a given level of public debt, with the actual change. All changes in percentage points. Data source: See data appendix A1.5.

4.4 Components of the senior tranche

As a first step to address the identification question, we take advantage of the ifo survey data set discussed above, which showed that not all components of the rescue packages are viewed as equally senior by the markets. While nearly 70% of the respondents view the IMF to be senior in case of default, only 42% share this expectation in the case of Target2-claims in the Eurosystem.

In Table 6, we decompose the senior tranche into its subcomponents, and add them one by one in a nested regression setup. Column (1) of Table 6 reports the impact of IMF lending only. The coefficient is statistically significant at the 5% level, but substantially larger in magnitude than the senior tranche definition in our benchmark regression. This result confirms previous findings of Dooley and Stone (1993), who report related evidence on the IMF's role in the Latin American sovereign debt crisis in the 1980ies. As shown in Figure 3 and 4, the IMF's involvement in Europe is even larger than in previous crisis.

When adding the second most senior item, the bilateral loans and loans under the EFSM agreements (Column 2), the magnitude of the coefficient declines, but is still considerably larger than in our benchmark. Adding one by one the different elements of the senior tranche, the coefficient continues to decline, but remains statistically significant in all cases.

A substantially lower coefficient is found when adding the Target2-component. This seems plausible, as the Target2-loans are the least clearly senior component of the rescue package, but also constitute the largest share in the total senior tranche in most countries.[31] Finally, the coefficient remains nearly identical, when also the SMP is added.[32]

As all components of the rescue packages share the same goal of preventing a deeper financial crisis, it is remarkable that they have different strength of impact on the interest rate spread variable that is in line with the seniority expectations of market participants. We take this as another indication that the direction of causality may be at least two-sided, i.e. going in both directions. In later sections we address this issue more formally, performing two-stage least squares regressions and analyzing the survey data set in more detail.

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[31] In Table 9, which addresses the issue of fragmentation, we show that Target2-liabilities are also significant when being included separately in the same regression with the remaining senior tranche (excluding Target2-liabilities). Interestingly, it is only significant when looking at Target2-*liabilites* as a percentage of the *total public debt*, not the Target2-*balance* as a percentage of *GDP*. The later variable could be taken as a proxy for fragmentation, rather than for creditor seniority.

[32] The effectiveness of the SMP in reducing interest rates has been discussed recently. Trebesch and Zettelmeyer (2014) have considered the impact of specific bonds purchases and find a positive (but short-lived) impact. Eser and Schwaab (2012), as well as Doran et al. (2013), find a positive impact in daily data, but little impact beyond the same trading day. Its successor, the OMT, has not been activated at the time of writing.

Table 6: Nested Senior Tranche Definitions

Dependent Variable: Government Bond (10y) Secondary Market Spreads Against Germany					
	(1)	(2)	(3)	(4)	(5)
Debt/GDP	0.040***	0.032***	0.036***	0.040***	0.034**
	(4.90)	(3.56)	(4.65)	(3.66)	(2.99)
Current Account/GDP	0.019	0.017	0.013	0.006	0.000
	(1.23)	(1.03)	(0.87)	(0.36)	(0.01)
REER	0.112**	0.108**	0.107**	0.120***	0.112***
	(2.42)	(2.49)	(2.46)	(3.43)	(3.24)
Real GDP growth	-0.147*	-0.136**	-0.142*	-0.145*	-0.143*
	(2.06)	(2.24)	(2.10)	(1.84)	(1.84)
Nested Definitions					
IMF	0.189**				
	(2.24)				
+ EFSM & Bilateral		0.144**			
		(2.33)			
+ EFSF & ESM			0.110**		
			(3.01)		
+ TARGET2				0.043**	
				(3.10)	
+ SMP					0.047***
					(3.55)
Country FE	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes
R^2 (within)	0.74	0.76	0.75	0.77	0.78
Obs.	634	634	634	597	597

*Notes: Robust t-statistics in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. Results are from a panel fixed effects model estimated using OLS. Reported R^2 is calculated "within", i.e. from the mean-deviated regression. In this table, we start with a narrow definition of the senior tranche and, step-by-step, add several additional components to our proxy. Data source: See data appendix A1.5.*

4.5 Omitted variables

4.5.1 Unobserved probability of private sector involvement

In our benchmark regression we have included time fixed effects to capture the possibility of unobserved default risk as a potential omitted variable. Here we pursue this idea further by adding various control variables that might address this issue more directly.

Table 7 starts by adding two indices of economic sentiment as further control variables to our benchmark regression, the Economic Sentiment Index (ESI) of the European Commission (Column 1) and the World Economic Climate index of the ifo Institute (Column 2). The Economic Sentiment Indicator (ESI) is a large composite indicator made up of five sectoral confidence indicators each covering several questions on present economic situation and economic outlook. The ifo World Economic Climate Index is the arithmetic mean of the assessments of the general economic situation and the expectations for the economic situation in the next six months. In both cases, the senior tranche variable stays significant and the coefficient remains of similar size.

Next we add the number of Google searches for "private sector involvement" (PSI), dummy variables for the post-Deauville meeting period and the announcement of the OMT. While the Deauville Meeting fostered nervousness in the sovereign debt market (see Lane (2012)), the OMT marked another important change in crisis policies. In these regressions (in columns 3 & 4) the coefficient of the senior tranche again remains significant and of similar size.

We furthermore try to decompose the interest rate spread into a default and non-default component, following the approach of Favero and Missale (2012). They subtract the CDS spreads from the interest rate spreads and interpret the remainder as the non-default component in

interest rate spreads. Column (6) illustrates that our senior tranche variable also remains significant when explaining this non-default component, rather than the total interest rate spread. Alternatively, we include the CDS spread explicitly as a proxy for the default probability in our benchmark regression, reported in column (7). Although the size of the coefficient declines slightly, the senior tranche still remains statistically significant at the 1% level.

We choose not to use the specification of these regressions as our benchmark, however, as the CDS spread not only captures the unobserved default risk but also changes in the recovery rate. The latter is exactly what we aim to capture by our senior tranche variable.

4.5.2 Contagion and Fragmentation

As a last step in the panel-regression analysis, we ask whether our coefficient has been influenced by contagion during the euro crisis, as well as the process of fragmentation that took place in Europe over the last 5 years. Tables 8 and 9 address this point by adding further control variables to our benchmark specification.

Contagion

In Table 8, we start with the issue of contagion, as several authors suggested that contagion has been a main driver of interest rate spreads during the euro crisis.[33] In regressions (1-3), we add three regional

[33] De Grauwe & Ji (2013a) as well as Beirne & Fratzscher (2013) both find evidence for unobserved herding contagion based on an analysis of cross-sectional correlation in a panel analysis similar to ours. Beirne & Fratzscher (2013) additionally look at the possibility of regional contagion but find only little evidence in favor of this. Favero & Misalle (2012) use a global VAR framework, where the dynamics of each spread is determined by its distance between their fiscal fundamentals and the exposure of each country's spread to the other countries' spreads. They find evidence for contagion, which is again correlated across the euro area countries.

contagion proxies, the average interest rates spread of the countries in crisis, a trade weighted index of the interest rate spread of all euro area countries and the VStoxx index that measures market expectations of near-term volatility of the biggest European stocks. We also add the VIX index, which is the US equivalent of the VStoxx, as a measure of global contagion. Our senior tranche variable remains of similar size and stays statistically significant in all of these regressions. None of the contagion variables, however, is statistically significant. This absence of regional and global contagion effects is in line with the earlier literature. For instance Beirne and Fratzscher (2013), who analyze this question more extensively, find little evidence on the role of regional contagion in determining interest rate spreads.

However, we did find evidence for time fixed effects, which is sometimes interpreted as unobserved herding contagion. Without time fixed effects we reject the null of cross-sectional independent residuals at the 1% level, whereas we did not find evidence for herding contagion when including them. Consequently, we added time fixed effects also to our benchmark regression. Similar results regarding herding contagion have been obtained in other recent papers (e.g. De Grauwe & Ji (2013a)) and again Beirne and Fratzscher (2013)).[34]

[34] To control for the possibility that both variables – senior tranche lending as well as government bond prices – are jointly driven by market sentiment and herding behaviour, we furthermore estimate partial correlations. In contrast to the reported regression coefficients above, Table 20 of the appendix presents partial correlations between the senior tranche and the government bond prices with the effect of other influences partialled out *from both variables*. The correlation seems to be neither jointly driven by our standard control variables (A), nor the increase in risk reflected by the variance of government bond spreads (B), nor different measures of sentiment, regardless whether based on public attention (C-D), survey data (E-F), or stock market data (G-H). The estimated correlation coefficients continue to be statistically significant in all cases and do not change remarkably in size.

Table 7: Unobserved Default Probability

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Interest Rate Spread	Interest Rate Spread	Interest Rate Spread	Interest Rate Spread	Non Default Component	Interest Rate Spread
Senior Tranche	0.047***	0.047***	0.047***	0.047***	0.028*	0.041***
	(3.55)	(3.55)	(4.10)	(3.55)	(2.20)	(4.52)
Debt/GDP	0.034**	0.034**	0.039**	0.034**	-0.054	0.031**
	(2.99)	(2.99)	(2.33)	(2.99)	(1.24)	(2.65)
Current Account/GDP	0.000	0.000	0.006	0.000	0.081	0.001
	(0.01)	(0.01)	(0.18)	(0.01)	(1.58)	(0.04)
REER	0.112***	0.112***	0.205**	0.112***	-0.099	0.218***
	(3.24)	(3.24)	(2.94)	(3.24)	(0.89)	(3.76)
Real GDP Growth	-0.143*	-0.143*	-0.127	-0.143*	0.071*	-0.052
	(1.84)	(1.84)	(1.76)	(1.84)	(1.88)	(1.04)
EC Economic Sentiment	0.049*					
	(2.05)					
ifo Economic Sentiment		0.022**				
		(2.27)				
Google Searches PSI			0.019			
			(1.52)			
Deauville Meeting (10/2010)				-0.202		
				(0.31)		
OMT (09/2012)				-1.582**		
				(2.23)		
CDS Spreads						0.319***
						(3.62)
Country FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes
R^2 (within)	0.78	0.78	0.79	0.78	0.14	0.92
Obs.	597	597	441	597	306	306

*Notes: Robust t-statistics in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. Results are from a panel fixed effects model estimated using OLS. Reported R2 is calculated "within", i.e. from the mean-deviated regression. The first two columns control for market sentiment based on survey sentiment indices (by the European Commission and the ifo Institute). Columns (3)-(4) add variables reflecting changes in the expected probability of private sector involvement or major policy shifts. More specifically, we control for the relative number of Google searches on the keyword "private sector involvement". Furthermore, we add dummy variables taking the value 1 after the Deauville meeting and after the OMT announcement. Column (5) replicates our benchmark specification, albeit with the difference between sovereign bond spreads and the respective CDS spreads as dependent variable. Column (6) uses the CDS spread as a control variable. Data source: See data appendix A1.5.*

Table 8: Contagion

Dependent Variable: Government Bond (10y) Secondary Market Spreads Against Germany						
	Regional Contagion			Global Contagion	Unobserved Contagion / Herding Behavior	
	(1)	(2)	(3)	(4)	(5)	(6)
Senior Tranche	0.047***	0.044***	0.047***	0.047***	0.057***	0.047***
	(3.55)	(3.17)	(3.55)	(4.10)	(3.26)	(3.55)
Debt/GDP	0.034**	0.034**	0.034**	0.039**	0.041***	0.034**
	(2.99)	(2.62)	(2.99)	(2.33)	(3.65)	(2.99)
Current Account/GDP	0.000	0.004	0.000	0.006	-0.043***	0.000
	(0.01)	(0.21)	(0.01)	(0.18)	(3.30)	(0.01)
REER	0.112***	0.111***	0.112***	0.205**	0.025	0.112***
	(3.24)	(3.67)	(3.24)	(2.94)	(1.63)	(3.24)
Real GDP Growth	-0.143*	-0.153*	-0.143*	-0.127	-0.042	-0.143*
	(1.84)	(1.91)	(1.84)	(1.76)	(1.17)	(1.84)
GIIPS Spread	-0.042					
	(0.44)					
Trade weighted		-0.57				
EA Spread		(0.67)				
VStoxx			-0.022			
			(1.45)			
VIX				-0.017		
				(1.22)		
Country FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	no	yes
H_0: No cross-sectional dependence						
Pesaran test	0.734	0.464	0.734	0.427	12.55***	0.734
R^2 (within)	0.78	0.79	0.78	0.79	0.69	0.78
Obs.	597	551	597	441	597	597

*Notes: Robust t-statistics in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. Results are from a panel fixed effects model estimated using OLS. Reported R2 is calculated "within", i.e. from the mean-deviated regression. Column 1 includes the average spread of the (other) euro area crisis countries (Greece, Ireland, Italy, Portugal and Spain) as a control variable. Column (2) analyzes the trade channel of contagion by adding the trade-weighted spread of all other euro area countries as explanatory variable. Columns (3) and (4) control for stock market volatility expectations, based on European stocks (VStoxx) and US stocks (VIX). The last two columns compare our benchmark regression (Column (5)) with the same regression, albeit without time fixed effects (Column (6)). In the second part of the table we report the results of a Pesaran (2004) test with the H_0 of no cross-sectional dependence. Data source: See data appendix A1.5.*

Fragmentation

In Table 9, we also include several proxies for fragmentation. First, with a common monetary policy one would expect lending rates and real sector loans to commove across countries. In Column (1) we include the lending rate of each country relative to the rest of the EMU and in Column (2) the real sector loans relative to GDP as a first control variable for fragmentation. Furthermore, we also add the total foreign claims (Column 3), the euro area cross-border claims (Column 4) and the exposure to the GIIPS countries only (Column 5) as alternative proxies. In all regressions, the senior tranche variable stays roughly unchanged. Of the control variables for fragmentation only the divergence of lending rates across the euro area countries is statistically significant at the 5% level.

Some authors also argued that Target2-balances reflect euro area fragmentation (e.g. Cour-Thimann (2013)). In the last two columns of Table 9, we therefore dropped Target2 from our senior tranche definition and instead included the Target2 variable separately to the regression. It is interesting that the Target2-balances, as percentage of GDP (Column 6), are negatively correlated with government bond spreads, albeit only significant at the 10% level. When including Target2-*liabilities* as percentage of public debt, on the other hand, the coefficient is positive and statistically significant at the 1% level. The latter can be interpreted as senior-tranche proxy, while the former might instead be taken as a proxy of fragmentation. In any case, the senior tranche variable – without Target2 – remains significant at the 1% level in both regressions.

Table 9: Fragmentation

Dependent Variable: Government Bond (10y) Secondary Market Spreads Against Germany							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Senior Tranche	0.049***	0.047***	0.046***	0.047***	0.038***		
	(6.79)	(4.23)	(3.64)	(3.98)	(5.31)		
Debt/GDP	0.029**	0.035**	0.035**	0.050**	0.064**	0.010	0.024**
	(2.29)	(2.29)	(3.09)	(2.39)	(3.22)	(0.72)	(2.49)
Current Account/GDP	-0.021	0.008	-0.002	0.013	-0.052	-0.015	-0.007
	(0.81)	(0.34)	(0.12)	(0.36)	(1.01)	(1.20)	(0.49)
REER	0.043	0.174**	0.120***	0.266**	0.273**	0.105**	0.131***
	(0.65)	(2.87)	(3.35)	(2.96)	(2.93)	(3.09)	(4.24)
Real GDP Growth	-0.150**	-0.144*	-0.152*	-0.094	-0.150*	-0.140*	-0.145**
	(2.38)	(1.98)	(1.97)	(1.48)	(2.03)	(2.14)	(2.36)
MFI Lending Rate	1.322**						
	(2.42)						
MFI Real Sector Loans/GDP		-0.001					
		(0.32)					
MFI Foreign Claims/GDP			-0.050				
			(0.65)				
MFI EA cross-border claims				-0.002			
				(0.53)			
MFI GIIPS Exposure					0.005		
					(1.28)		
TARGET2 Balance/GDP							-0.002*
							(2.10)
TARGET2 Liabilities/Debt						0.034***	
						(6.75)	
Senior Tranche (w/o TARGET2)						0.121***	0.106***
						(7.41)	(4.51)
Country FE	yes	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes	yes
R^2 (within)	0.82	0.79	0.78	0.79	0.82	0.81	0.8
Obs.	486	486	589	385	277	597	597

*Notes: Robust t-statistics in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. Results are from a panel fixed effects model estimated using OLS. Reported R^2 is calculated "within", i.e. from the mean-deviated regression. In order of appearance, we control for: The average lending rate of monetary financial institutions (MFI) to the real sector (as deviation from the euro area mean), MFI loans to the domestic real sector (as % of GDP), MFI's foreign claims (2007=100), the total size of MFI cross-border claims within the euro area (2007=100) and MFI's cross-border claims against the (other) countries in crisis (2007=100). In the last two columns, we compare the Target2-balance (as % GDP) with the Target2-liabilities (as % of public debt). Data source: See data appendix A1.5.*

4.6 Instrumental variable regressions

The analysis above raises the question whether we are picking up a causal impact of the senior tranche on interest rates. The decisions of rating agencies, reported in Table 2 of Section 3, suggest in a non-econometrically way that a causal channel exists that runs from the senior tranche to the interest rate spread. Rating agencies have repeatedly pointed to the senior tranche when downgrading countries in crisis.[35] The ordering of creditor claims and the expected recovery values are a recurring theme in their rating actions. Also the congruence between de facto seniority expectations of survey respondents and our nested regressions results can be viewed as an additional indication of a causal link.

From a political economy perspective, however, one could argue the other way around. Public rescue efforts have been motivated by increases in the spread and the partial correlation above may be capturing the response of the rescue packages to the crisis, rather than the response of interested rates to the senior tranche. In this section we further explore this hypothesis in our panel regressions.

In Table 10 we report the results of several two-step Instrumental Variable (IV) regressions to account for possible endogeneity of our senior tranche variable. We use three different sources of instrumental variables: Based on (i) an external instrument, (ii) lagged values and (iii) generated instruments justified by the specific properties of our variables. In all cases, the senior tranche variable remains statistically significant and is of roughly equal size, compared to our benchmark regression.

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[35] Empirically ratings are found to have an impact on sovereign bond spreads (see Aizenman et al. (2013a)). Our identifying restrictions show, however, that there is no remaining explanatory power after fitting a regression that includes the senior tranche.

Table 10: Instrumental Variable Regressions

Dependent Variable: Government Bond (10y) secondary market spreads							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	External Instrument		Lagged Values			Lewbel Approach	Combined
Variables	Set A	Set B	Set C	Set D	Set E (C+D)	Set F	Set G (F+E)
Senior Tranche	0.092***	0.146***	0.047***	0.036*	0.045***	0.033***	0.042***
	(5.45)	(6.91)	(7.12)	(1.92)	(7.08)	(5.20)	(7.39)
Debt/GDP	-0.007	-0.045***	0.042***	0.049***	0.044***	0.047***	0.044***
	(0.51)	(2.73)	(7.19)	(2.90)	(7.98)	(6.25)	(8.41)
Current Account/GDP	-0.016	-0.037*	0.012	0.019	0.011	0.012	0.006
	(1.11)	(1.90)	(0.87)	(1.23)	(0.87)	(1.19)	(0.62)
REER	0.072***	0.024	0.139***	0.124***	0.140***	0.124***	0.146***
	(2.79)	(0.56)	(5.74)	(4.90)	(6.04)	(6.42)	(6.80)
Real GDP Growth	0.004	-0.031	-0.049	-0.065	-0.045	-0.082**	-0.053
	(0.07)	(0.27)	(1.15)	(1.55)	(1.10)	(2.46)	(1.51)
Country Fixed Effects	yes	yes	yes	yes	yes	yes	yes
Time Fixed Effects	yes	yes	yes	yes	yes	yes	yes
R^2	0.67	0.34	0.79	0.78	0.79	0.77	0.79
Obs.	455	480	492	513	491	542	491
First Stage F-Statistic	10.55	51.52	85.69	6.51	52.71	72.20	83.02
H_0: Underidentified	0.000	0.000	0.000	0.000	0.000	0.000	0.000
H_0: Not Overidentified	0.101	Ex. ident.	0.199	0.285	0.985	0.238	0.450
H_0: Senior Tranche Exogenous	0.003	0.000	0.361	0.120	0.476	0.007	0.241

*Notes: Robust t-statistics in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. Table shows two-step GMM regressions using different sets of instrumental variables for senior tranche lending, for the period 2000Q1 to 2012Q2. Column (1) uses lagged changes in S&P sovereign credit rating scores as external instruments, whereas Column (2) uses the most recent credit rating. Columns (3)-(5) use lagged values as instrumental variables: Set C includes only lagged values of the senior tranche variable up to the fourth order. Set D consists of a subset of lagged exogenous variables (i.e. first lagged values of the debt ratio and the current account ratio and the debt ratio of the previous year). Set D makes use of the combined set of instrumental variables from sets C and D. Column (6) makes use of the Lewbel (2012) identification approach, while Column (7) follows a combined approach using lagged values of Set E as well as the Lewbel instruments. In the Lewbel approach, $(Z - \bar{Z})\hat{\varepsilon}_1$ is used as an identifying instrument, where Z is the vector of our exogenous variables, $\bar{Z}$ the vector of means of the Z variables, and $\hat{\varepsilon}_1$ the residual of the first stage regression. In the lower part of the table, we report p-values of several specification tests as well as the F-Statistic of excluded instruments from the first stage regression. As an underidentification test, we apply the Kleibergen-Paap rk LM statistic. As a test of overidentification, we use Hansen's J-Statistic. Based on the difference of two Sargan-Hansen statistics, we also test whether the senior tranche can be treated as exogenous. Since our senior tranche variable is the only variable instrumented, this test essentially becomes equivalent to a simple Hausman test comparing the consistent simple estimate with the potentially more precise two-step estimate. Data source: See data appendix A1.5.*

In the first two columns, we choose S&P sovereigns credit rating and its lagged changes (Set A and Set B) as external instruments. While the rescue packages might increase as a political reaction to the increase in the interest rate spread, the rating agencies have no such political motivation to stabilize interest rates in the respective countries. There is, however (as Table 2 of the essay shows), a clear influence of the senior tranche share on the decisions of rating agencies. It thus fulfills the two criteria for a good instruments of being correlated with the independent variable, but under null not being impacted by the dependent variable. Columns (1) and (2) show that the senior tranche proxy stays significant, and that the instrument passes standard tests regarding the validity of the instrument (reported in the lower part of Table 10). The Hansen-J statistic indicates that for Column (1) the null hypothesis of no overidentification has not to be rejected at a reasonable level of significance.[36] Furthermore, the null that the equation is underidentified can be rejected at the 1% level for both IV regressions. Thus, our instruments seem to be valid, i.e. uncorrelated with the error term and correlated with the (potentially) endogenous regressor. The common rule-of-thumb of an F-Statistic > 10 also holds in both cases. Thus, weak identification does not seem to be a problem either.

In columns (3) - (5), we proceed by following the common IV approach of using lagged values as instruments. The instruments are chosen from the lagged values of our senior tranche variable (Set C), the benchmark control variables (Set D), or both (Set E). Again, standard tests

[36] In Column (2) it is not possible to test for overidentification. The number of instruments equals the number of (potentially) endogenous explanatory variables, so there are no overidentifying restrictions to test.

generally confirm the validity of these instruments.[37] The coefficient of our senior tranche variable remains of roughly the same size and is still significant at the 1% level in Columns (3) and (5), but only at the 10% level in Column (4).

In the final two regressions, we use the identification approach suggested by Lewbel (2012) that exploits the heteroscedasticity in the first stage of the regression. This IV technique yields consistent estimates by imposing higher moment restrictions even when valid external instruments are unavailable or weak – as in Set D. As identifying instrument $(Z - \bar{Z})\hat{\varepsilon}_1$ is used, where Z is the vector of our exogenous variables excluding the senior tranche, $\bar{Z}$ the vector of means of the Z variables, and $\hat{\varepsilon}_1$ the residual of the first stage regression explaining the senior tranche variable with the Z variables. A Breusch-Pagan test rejects homoscedasticity of the first stage regression at the 1% level, indicating that this approach is indeed valid for our data set. In Column (6) we solely use the Lewbel instruments, whereas in column (7) we complement our lagged value IV regressions with the Lewbel instruments to increase estimation efficiency. As above, size and statistically significance of the senior tranche coefficient does not change considerably in these regressions, and our instruments pass all tests of weak-, under-, and overidentification.

The partial correlation of the senior tranche share and the government bond spreads remains remarkably robust in all of our IV regressions. The coefficient is statistically significant at the 1% level in all IV regressions except for column (4), where the instruments seem to be rather weak. The effect size does not change considerably, too. Only

[37] With one exception in Set D, where the first stage F-Statistic is lower than 10. The results of this regression should be interpreted with caution as we cannot rule out the problem of weak identification.

when using the external instrument, our coefficient increases.

Based on the difference of two Sargan-Hansen statistics, we formally test whether the senior tranche can actually be treated as exogenous. The test provides mixed evidence on this question. The majority of the tests suggest that this is the case, but in three regressions we reject the null of the senior tranche being exogenous.

4.7 De Grauwe – puzzle

As a final exercise before turning to the survey data analysis, we compare how our regression results relate to the De-Grauwe puzzle. De Grauwe and Ji (2013a) argue that the development of government bond spreads cannot sufficiently be explained by the underlying economic fundamentals. In their regressions, large residuals remain for the countries in crisis in the period 2007 to 2012. They take this as evidence for multiple equilibria (and mispricing driven by herding behavior) in the sovereign debt market.

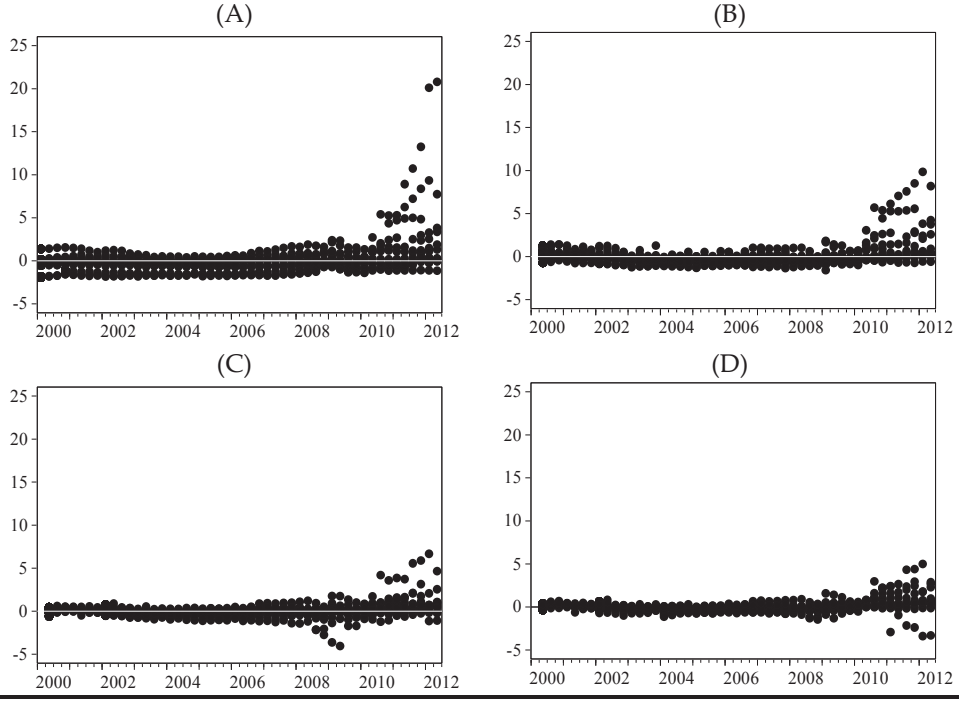
Our regression analysis, on the other hand, suggests that standard specification in the literature miss out on a statistically and economically significant explanatory variable: The share of public debt that is held by creditors with a preferred status in case of default.

Theoretical models of debt pricing assume the spread to be a function of the recovery value and the default probability with both being jointly stochastic variables. Ignoring a positive covariance between default probabilities and recovery values thus may lead to a systematic underestimation of spreads, notably in turbulent times of high sovereign default risk[38] – such as after the Deauville Meeting.

[38] See Pan & Singleton (2008), also Bilal & Singh (2012).

Graph (A) of Figure 6 shows the residuals of a univariate regression explaining the spreads by the Debt-to-GDP ratio. The deviations between the fitted and the actual values are especially high for the crisis countries since the onset of the European debt crisis. The residual has a maximum of about 21 percentage points. This confirms the puzzle established by De Grauwe and Ji (2013a).

Figure 6: Residual Analysis of the Benchmark Regression



Notes: All four scatter plots show the residual of a regression with different sets of explanatory variables on government bond spreads. The residuals in graph (A) result from a simple univariate regression explaining the spreads by the Debt to GDP ratio. Graph (B) includes the other controls of our benchmark regression, except for the senior tranche variable. The residuals in plot (C) and (D) stem from regressions additionally incorporating our senior tranche proxy. For Graph (D) we also added the interaction between the senior tranche and the level of public debt (Table 4 of the essay). Data sources: own calculations.

The graph (B) of Figure 6 extends the simple univariate regression to the full set of explanatory variables of our benchmark regression, except for the senior tranche share that we focus on in our essay. The senior tranche variable is then included in regressions (C) and (D). A considerably higher part of the development in spreads can now be explained. The residuals only marginally exceed 6 percentage points now. When in graph (D) we additionally allow for the interaction between senior tranche lending and the debt level – similar to Table 4 of the regression analysis – the residuals become even smaller.

Incorporating our senior tranche proxy to control for possible changes in recovery values not only diminishes the unexplained component. Interestingly, this specification also seems to cure the systematic underestimation of spreads, as the residuals are well centered around zero. These results raise doubts on the hypothesis of multiple equilibria in the sovereign debt market as spreads can alternatively be explained by empirical specifications founded on standard theoretical models of the debt pricing literature.

5. Evidence from Survey Data

In this section, we evaluate the survey data set from the ifo Institute on de facto seniority of different items of the rescue packages. As part of the World Economic Survey, participants have also been asked about their expectations regarding the path of interest rates in the following 6 month. An advantage compared to a macro data analysis is that it is plausible to assume that there exists no causal channel running from the expectation about interest rates development to the expectation about the preferred creditor status of different rescue components.

Figure 7 gives a first visual impression of the differences between respondents that consider the rescue packages senior and those who view them as pari-passu with private markets.

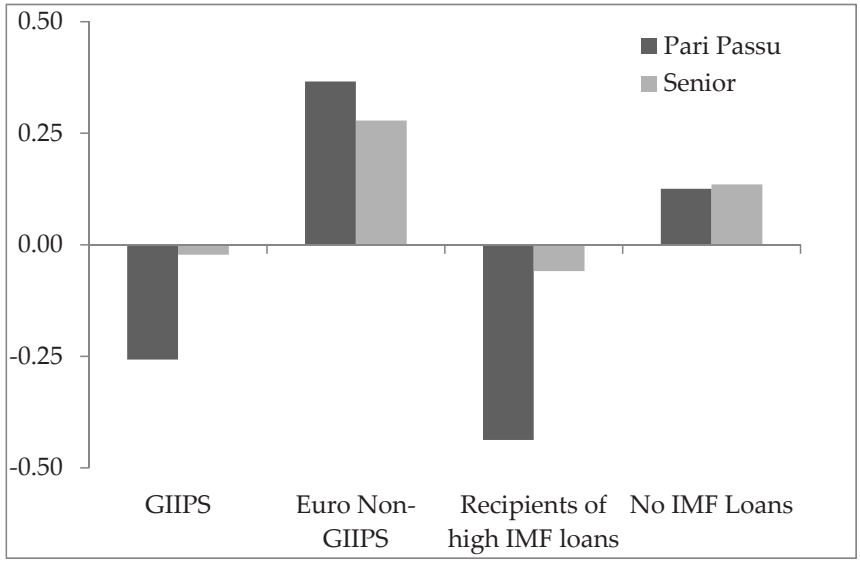
5.1 Differences in subgroups

Among the set of countries in crisis, which currently have high interest rates, both groups of respondents have on average the expectation of falling interest rates[39]. It is remarkable however, that the expectation of falling interest rates is much stronger in the subset of respondents that view the rescue packages to rank pari-passu with private markets. On the other hand, the set of respondents who view the rescue packages as senior to private markets have a nearly constant interest rate expectation, and expect only a very minor decline.

[39] This may be viewed as supportive of the idea that rescue policies have been overall successful. Note however, that it may also be a result of a general pattern of cyclicality in interest rates.

The opposite relationship - although less pronounced - is present in the set of countries in the euro area that are currently not in crisis. On average, they expect rising interest rates. However in the set of respondents that have pari-passu expectations, the expectation of a future increase in interest rates is stronger. This seems plausible, as these are mainly creditor countries. In both groups of countries in this graph, the set "senior" refers to respondents who view at least half of the components of rescue packages as senior to private markets.

Figure 7: Average Interest Rate Expectation in Different Samples



Notes: Light-grey bars show the average response of survey participants that expect the rescue packages to have senior status. Dark bars show the average response of participants with pari-passu expectations. Answers are scaled [-1, 0, 1], indicating expectations of falling, constant or rising interest rates, respectively. Data source: World Economic Survey, April 2013, ifo Institute.

As a control group we also consider the world-wide response of survey participants to the question whether the IMF is senior to private markets. The ifo survey is conducted in 120 countries, many of which have used IMF loans substantially during the crisis. The third pair of

bars in Figure 7 displays the average interest rate expectations of respondents in countries that have used more than 500% of their IMF quota in special drawing rights at least once in the last five years. Again, we see that both groups have falling interest rate expectations. Among respondents who expect the IMF to be senior to private markets, however, these expectations are much less pronounced than in the other group. The fourth pair of bars in Figure 7 shows that respondents from countries without strong use of IMF loans expect rising interest rates on average. There is not a large difference between those respondents that have the expectation that the IMF is senior and those who do not.

5.2 Ordered Probit Regressions

In Table 11 below, we analyze the impact of the seniority status on interest rate expectations more formally in an ordered probit regression. In the survey, interest rate expectations are scaled [-1, 0, 1], indicating expectations of falling, constant and rising interest rates. We explain this variation by the seniority expectations on rescue packages of the respective respondents, as well as different sets of control variables. The first set of control variables is quite similar to those that were used in the panel regressions above. We control for the expectations about public debt, the expected trade balance, the expected GDP growth rates and the expected change in the exchange rate relative to US Dollar. We find that most of these control variables are statistically significant and have the expected signs. For robustness, we also consider an extended set of control variables, making use of the full ifo-survey data set.

The main variable of interest in the regression is a dummy variable that is equal to one, if the survey participants expect the rescue packages to be senior to private markets. Making no further distinction, this variable, however is insignificant in all specifications. When adding another dummy variable that indicates whether the respondent comes

from country that received large loans from senior creditors (according to various definitions) and interact this variable with the seniority expectation, we find a significant and sizable effect of seniority expectations on interest rate expectations among those countries who are large debtors.

In the first four columns of the table, the debtor indicator is equal to one, if the respondents come from one of the crisis countries of the euro area, i.e. Greece, Ireland, Italy, Portugal and Spain. We find that respondents from these countries have on average significantly lower interest rate expectations, as indicated by the negative sign on the debtor variable. For respondents, who expect rescue packages to be senior, this expectation of falling interest rates is significantly less pronounced, however, as indicated by the interaction term between the seniority-dummy and the debtor-dummy, which is positive. They have a statistically significant higher probability of being in a category of rising or stalling interest rate expectations compared to being in the falling interest rate expectations category.

The magnitude of these effects is also substantial. When using the coefficients from the ordered probit regression to compute the difference in predicted probabilities for a discrete change in seniority expectations from zero to one, we find that respondents from the European countries in crisis, are 21.2% more likely to have rising interest rate expectations when they view the rescue packages as senior, and 9.3% less likely to have falling interest rate expectation.[40]

In columns (B3) and (B4), we repeat the exercise focusing on countries that used IMF loans intensively. The dummy variable "debtor" is here equal to one if the respondents come from a country that used

[40] Using regression results (A4) from Table 11 as a basis for the computation.

500% or more of its IMF quota at least once during the last five years.[41] The seniority variable is equal to one, if the respondents expect the IMF to be senior to private markets. Interestingly, we find a similar effect, compared to the findings for Europe. Survey participants from highly indebted countries expect on average falling interest rates. But significantly less participants share this expectation, when they also expect the IMF to be senior. The same finding also prevails in our columns (C3) and (C4), where we exclude the euro area countries in crisis from the regression analysis. Again, differences in predicted probabilities are of substantial size. Respondents from countries that are large IMF debtors, are 31.7% more likely to have rising interest rate expectations if they believe that IMF will be senior, and 10.6% less likely to have falling interest rate expectations.[42]

Overall, our survey data analysis is reminiscent of as a triple difference strategy to illustrate the impact of senior-status in rescue loans on interest rate expectations. There is a difference between debtor countries and other countries, and there is a difference between those respondents that have seniority expectations and those how do not. There is however no such difference between countries from the Euro Area, and other countries that intensively make use of IMF loans outside the Euro Area.

[41] Note that this dummy variable capturing whether a respondent comes from a country with high IMF credit is negative and statistically significant at the 1% level in most regressions. This result can be interpreted as evidence for the expectation of IMF's catalytic finance and complements earlier findings of the literature (see e.g. Corsetti et al. (2006), Morris & Shin (2006), and Mody & Saravia (2006).

[42] Using regression results (C4) from Table 11 as a basis for the computation.

Table 11: WES Survey Ordered Probit Regressions

Dependent Variable: Expectation about the development of 10 year government bond interest rates

	Set A: GIIPS				Set B: Countries with high IMF credit				Set C: Countries with high IMF credit - excluding GIIPS countries			
Variables	(A1)	(A2)	(A3)	(A4)	(B1)	(B2)	(B3)	(B4)	(C1)	(C2)	(C3)	(C4)
Seniority	0.08	0.06	0.02	-0.02	0.09	0.11	0.04	0.05	0.03	0.04	0.00	0.01
	(1.03)	(0.66)	(0.24)	(-0.21)	(1.10)	(1.27)	(0.43)	(0.59)	(0.33)	(0.48)	(0.00)	(0.15)
Debtor	-0.39**	-0.32*	-0.73***	-0.68***	-0.43***	-0.33***	-1.04***	-1.01***	-0.52**	-0.38*	-1.19***	-1.05***
(Set A, B, C)	(2.16)	(1.71)	(3.04)	(2.64)	(3.07)	(2.28)	(4.72)	(3.31)	(2.52)	(1.70)	(7.35)	(5.68)
Seniority			0.60**	0.64**			0.80***	0.88**			0.85***	0.84***
X Debtor			(2.37)	(2.29)			(3.18)	(2.53)			(4.41)	(4.17)
Debt Problem	0.15*	0.26**	0.16**	0.28***	0.16**	0.23*	0.16**	0.23***	0.15**	0.23**	0.14*	0.23**
	(1.86)	(2.54)	(1.98)	(2.65)	(2.45)	(2.75)	(2.46)	(2.76)	(1.91)	(2.52)	(1.87)	(2.48)
Trade Deficit	0.17***	0.18***	0.17***	0.18***	0.14**	0.14**	0.14**	0.14**	0.11**	0.11*	0.11*	0.11*
	(2.99)	(2.77)	(2.94)	(2.72)	(2.56)	(2.39)	(2.49)	(2.38)	(1.82)	(1.82)	(1.78)	(1.81)
Real GDP [%]	-0.05**	-0.05**	-0.05***	-0.05**	-0.04**	-0.04**	-0.04**	-0.04**	-0.06**	-0.05**	-0.06**	-0.05***
	(2.28)	(2.20)	(2.28)	(2.17)	(2.25)	(2.17)	(2.26)	(2.19)	(2.55)	(2.31)	(2.58)	(2.35)
Exchange Rate	0.07	0.06	0.06	0.06	0.05	0.04	0.04	0.04	0.07	0.06	0.06	0.06
	(0.83)	(0.78)	(0.86)	(0.82)	(0.74)	(0.63)	(0.69)	(0.58)	(0.93)	(0.80)	(0.86)	(0.73)
Further controls	no	yes	no	yes	no	yes	no	yes	no	yes	no	yes
(Pseudo) R^2	0.02	0.03	0.03	0.04	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.03
Obs.	632	604	632	604	741	702	741	702	668	631	668	631

*Notes: *, **, *** indicate variables significant at a 10%, 5%, and 1% level respectively. z-values in parentheses. Standard errors clustered at the country level, resulting in 120 clusters. The dependent variable is coded [1, 2, 3] if respondents expect falling, stalling or rising interest rates, respectively. The seniority dummy is 1 if respondents expect at least half of the official creditors to be senior, zero otherwise. We also control for the participants assessment of how much of a problem they see in the countries debt level (coded [0, 1, 2] for "not important", "very important" and "most important", respectively), their expectation about the development of the trade balance [%], the real GDP growth [%] and the direction of change in the exchange rate compared to the US dollar. Survey participants have also been asked about their assessment on how much of a problem they see in the issues like government policy, inflation, competitiveness, trade openness, public deficits, capital shortage or unemployment. These variables make up our "further controls" set. Data source: World Economic Survey, April 2013, ifo Institute.*

6. Case Studies

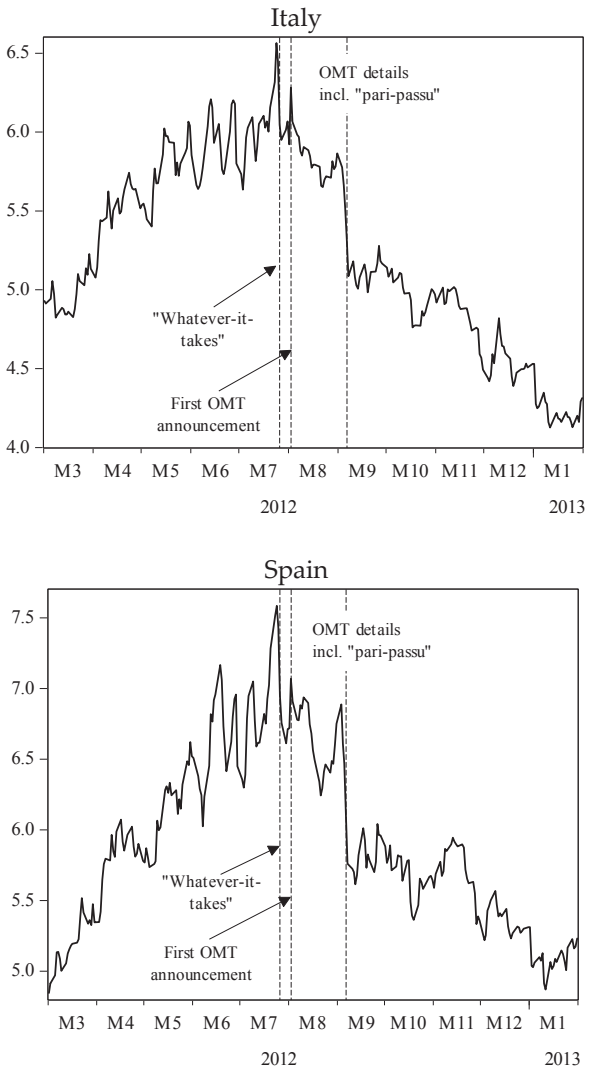
6.1 Securities Markets Programme vs. Outright Monetary Transactions

Another perspective on the role of creditor seniority can be taken by comparing two different programs of the ECB that are very similar to each other, but differ with regard to the seniority stance. In the first bond-purchase program of the ECB, the Securities Markets Program (SMP), the ECB had communicated to the markets, that it would be senior to private lenders when these government bonds mature. Markets calculated their recovery values accordingly, and the interest rates spread did not decline. Instead, it increased the months following the announcement, as well as the implementation of the bond purchases. The program was eventually phased out, as it was considered ineffective. In the Greek bond-restructuring, the ECB actually enforced its senior position and did not participate in the haircut.[43] Also in August 2012 when the first Greek bond matured, the ECB got paid in full.

In the Outright Monetary Transactions (OMT) program, on the other hand, the ECB was announced to be treated "pari-passu" with private markets in case of insolvency. Interestingly the interest rates fell, and the program is widely considered a very successful component of the rescue efforts in Europe's sovereign bond crisis. Clearly it was more successful in bringing down interest rates than its predecessor, the SMP.

[43] Instead, it extended the list of eligible collateral to so-called T-bills, which enabled Greece to repay its debt.

Figure 8: Development of 10-year Government Bond Yields



Notes: Figure shows the 10-year government bond yields of Spain and Italy around the ECBs announcement of the OMT. Dashed vertical lines mark (1) Mario Draghi's speech at the Global Investment Conference, July 26th, 2012, (2) the first announcement of Open Market Operations at the ECB press conference on August 2nd, 2012 and (3) the ECB press release outlining the technical details of the OMT on September 6th, 2012. Data source: Thomson Reuters Datastream (Mnemonic: TRES10T, TRIT10T).

A more detailed look at the timing of the OMT announcement is helpful to illustrate the role of the pari-passu announcement in the OMT-package that contains other elements, such as conditionality comparable to the ESM and the fact that unlike the SMP, it contains no ex ante limits. Figure 8 documents the time paths of interest rate spreads in Italy and Spain, where the impact on interest rates was the most pronounced.

Several different steps were taken in the summer of 2012, where interest rate spread reached record levels in Europe, before the OMT programme was fully announced. First, on July 26th, the ECB President Mario Draghi announced that the ECB will do "whatever it takes" to preserve the euro. This statement was most widely discussed in the international press, however it had comparably little effect on the interest rate spreads of either country, Italy or Spain. Only one week later, both countries again had interest rate spreads with respect to Germany that exceeded 5.5%. When on August 2nd, 2012, the ECB clarified how it intended to implement its "whatever it takes" statement, it announced that it would conduct "outright open market operations" to an extent necessary to achieve its objective. However, again, there was no sustained decline of interest rates. At this point, he also raised the issue of creditor seniority for the first time, but he remained rather vague, stating that "concerns of private investors about seniority will be addressed". By the end of the month, Spain was again characterized by spreads above 5.5% and Italy above 5% with respect to Germany.

A major trend change, as well as the largest single drop during this period occurred on September 6th, when the ECB announced the details of the plan to conduct outright open markets operations, announced on August 2nd. Among these details the two most important items were (i)

there would be no ex ante limits and (ii) the ECB would be treated pari-passu with respect to private markets.[44]

When analyzing the exact wording of the announcements, one can argue that (ii) was the most important incremental news component on this day. On August 2nd, president Draghi had already stated that the ECB will conduct "outright open market operations of a size adequate to reach its objective" and later added: "we will do everything that is required to reach the objectives". When concretely being asked about what the previous "whatever it takes"-statement meant, he said: "'Whatever-it-takes' means two things: it means the list of measures, all the measures that are required, and it means that their size ought to be adequate to reach their objectives." This wording appears to be not substantially different from the September 6th announcement: "there are no ex-ante limits on the amount of Outright Monetary Transactions. And the size – as I think it said in the first press release or the introductory statement – is going to be adequate to meet our objectives". It is therefore unclear whether there had really been a new decision on the possible size of intervention.

It was certainly news, however, that the ECB made a clear statement that it would not again enforce its position as a senior lender. The pari-passu announcement marked a major turning point in the ECB policy.

[44] An additional news element was that countries needed to be under an ESM program to be eligible for OMT purchases. This third news element, however, would not lead to a decline in interest rates, and this thus not considered in the discussion on why interest rates fell after the September 6th press conference of the ECB.

6.2 Evidence from Legal Terms of Debt Contracts

A final perspective to take on the role of creditor seniority is to look at the legal terms of debt contracts. In a detailed analysis of the Greek debt restructuring, Zettelmeyer et al. (2013) have shown that local-law bonds have been more easily to restructure than foreign-law bonds. During the private sector involvement (PSI) Greece retroactively applied collective action clause to its domestic-law bonds – unilaterally through an act of parliament. Contract terms of UK-law bonds, however, remained the same. Thus, UK-Law bondholders effectively became senior creditors, with a greater ability to hold out. Greece addressed this issue, by offering an exchange of local-law to UK-law bonds in its debt restructuring. Zettelmeyer et al. (2013) argue that this seniority-upgrade may have acted as a PSI-sweetener to reach the targeted participation threshold.

If holding bonds falling in a foreign jurisdiction indeed effectively increases the seniority status of investors, this should translate to a lower risk premium of these bonds. Such an effect on sovereign bond prices can be illustrated by making use of a natural experiment offered by recent developments in Cyprus. Figure 9A plots the prices of two comparable sovereign bonds of Cyprus. The dark line shows the development of a bond issued under UK-jurisdiction and the light-grey line of a domestic-law bond, both with a maturity date in spring 2020 (February 2020 vs. April 2020). The bonds, however, differ within their coupon. The light-grey bond pays an semi-annual interest of 6.1%, while the dark grey one only offers an 4.65% annually.

Accordingly, at the beginning of 2010, the domestic-law bond is traded about 15% above the UK-law bond, reflecting its higher coupon. However, the price differential between the two bonds is non-constant. When in mid-2011 bond prices plummeted by 40%, their difference decreased considerably. We further investigate this relationship in the

scatter plot of Figure 9B. There is indeed a strong correlation between default probability (as measured by the price level of the domestic bond) and the risk premium differential. The lower the price level, the less favorable investors perceive the domestic-law compared to the UK-law bond.

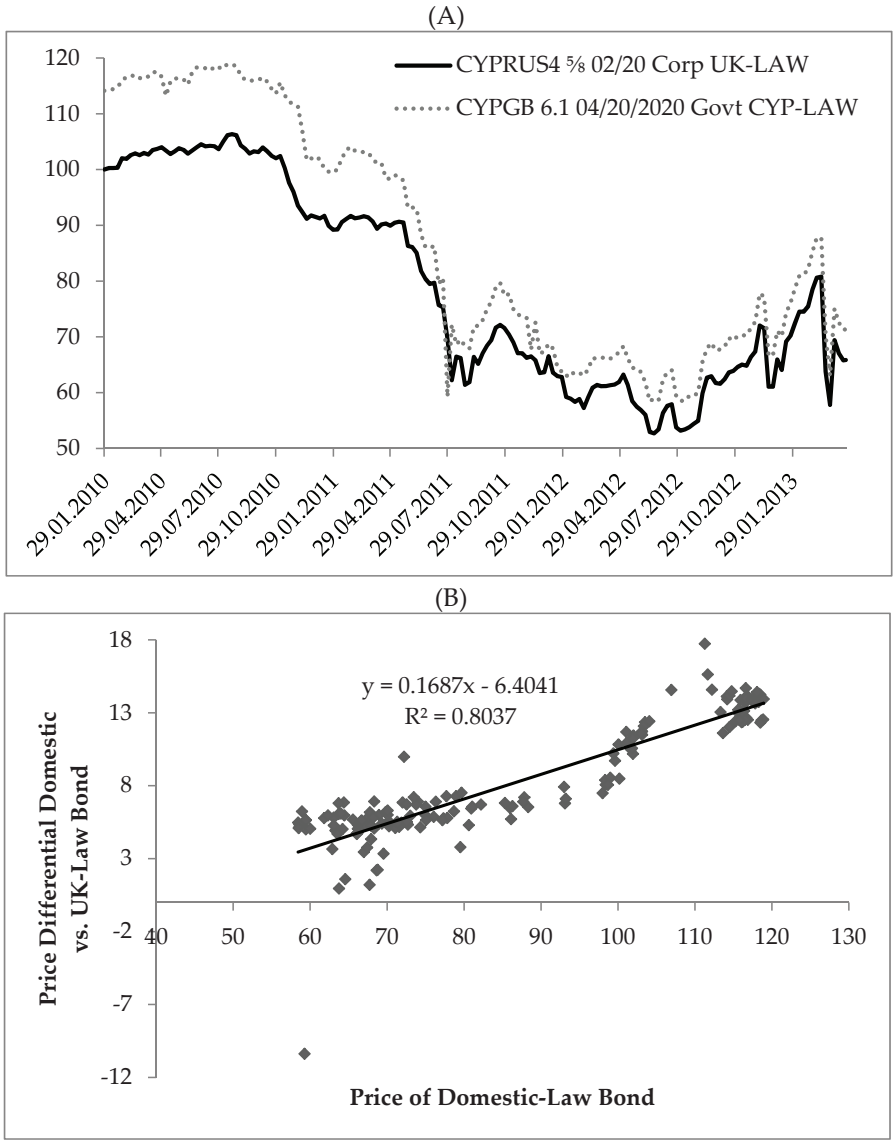
Furthermore, in the last week of June 2011 the higher-coupon domestic-law bond even traded a lower price than its UK-law cousin. During the European stress tests it became clear that Cypriots banking system was heavily exposed to Greek Government Debt. Furthermore, the Cyprus cabinet resigned. This led to a sharp downgrade of the S&P creditor ratings for Cyprus and several of its private banks including the biggest one, the Bank of Cyprus. Apparently, investors valued UK-law bonds status considerably higher (around 14% price differential) during this time, than the promise of an extra 1.45% in coupon payments.[45] This revealing outlier can also be seen in the lower-left corner of Figure 9B.

The results of these simple graphical analyses indicate that investors indeed fear a sovereign selective default on their debt obligations and the importance of the seniority status in case of debt restructuring.[46]

[45] This is consistent with some anecdotal evidence in the market for unsecured bank bonds. For example, ECB president, Mario Draghi remarked at a press conference on 2nd may, 2013: "[…] the same bank issued a bond in Munich and issued a bond in Milan […], and there was a spread of, I think, roughly 150, 200 basis points difference between the two, so it's the same bank issuing in two different sovereign jurisdictions."

[46] Choi et al. (2011) perform a similar exercise, albeit with Greek government bonds in the period from mid-2009 to mid-2010. Their results are consistent with ours: UK-law bonds are traded more favourably compared to domestic-law bonds when default probability is high. However, as the authors note, the Greek government bonds at times seem to be traded at very low volumes.

Figure 9: Cyprus' Risk-premium of Domestic-law Bonds



Notes: Panel (A) plots the price of two government bonds of Cyprus. The dark line shows a bond issued under UK-governing law, paying a coupon of 4.65%. The light-grey line shows a bond issued under domestic (Cypriot) law, paying a coupon of 6.1%. Both bonds mature in spring 2020, with the UK-law being due about two month earlier. The scatter plot in Panel (B) shows differential between the two bonds on the y-axis and the level of the domestic law government bond on the x-axis. Data Source: Bloomberg. ISIN: CY0049570811 and XS0483954144.

7. Conclusions and Policy Implications

The main objective of this essay was to empirically document that rescue policies can have unintended side effects. We illustrate a striking correlation between interest rate spreads and the senior tranche of public debt. This correlation is strongest, when the share of the senior tranche gets large. In case studies and survey data, we show that seniority expectations exist and help to explain the co-movement.

In the European sovereign debt crisis, the size of the senior tranche has grown substantially over the last five years. In the set of countries we have focused on, there is quite a wide range. On average, however, it has reached a share of about 60% towards the end of our sample period. Note that this corresponds to the threshold of senior government debt relative to GDP that has been suggested in the Eurobond proposal of the European Parliament (2010/2242(INI)).[47]

The idea in these proposals is to explicitly partition the debt into a senior and a junior tranche. As a result, the average interest burden would decline due to the seniority of the first 60% of the debt. On the other hand, incentives for fiscal discipline would remain intact because of the high marginal interest rate of the resulting junior tranche, the debt above the 60% level.

[47] Several researchers have argued that the introduction of Eurobonds would help to resolve the euro crisis, providing the theoretical background of the European Parliament's proposal. See for instance the red/blue bond proposal of Delpla and Von Weizsäcker (2010), which is the closest analogy. Similar proposals, but without joint liability for the senior tranche, include the European Safe Bonds (ESB) proposal of Brunnermeier et al. (2011), or the Euro-standard bill proposal of the EEAG (2012)).

Based on the results of our essay, some countries in the euro area might already be quite close to the scenario sketched out in these proposals. Even without explicit Euro-bonds, countries in crisis are largely borrowing from official sources at low interest rates, while simultaneously facing a higher interest rate in the markets.

In the essay we highlight trade-offs that policy makers are facing from different perspectives. From the perspective of multilateral lenders, we argue costs and benefits of a downgrade of seniority should be made visible and explicit. While on the one hand downgrading the seniority status is effective in reducing interest rates, taxpayers of other countries are assuming a share of the default risk. If the reduction of interest rates does not ultimately lead to higher growth, the multilateral institutions will share losses with the private sector.

From the financial markets perspective, it is important to reduce uncertainty about seniority and to establish clear rules. An abundance of different legal clauses by a range of senior lenders, and a lack of enforceability, makes it more difficult to correctly price sovereign risk. It also may make it very difficult to restructure sovereign debt if needed.[48]

Considering the welfare implications, there is an important distinction between the SMP/OMT component in the senior tranche and other components. Also the Secondary Market Support Facility (SMSF) – the bond purchase program of the ESM -, must be evaluated differently from other ESM loans: From an investors perspective they may be the same, as both are public debt in the hands of senior creditors. But from a perspective of the recipient governments, this clearly matters.

[48] See also Bolton and Jeanne (2009) for a theoretical discussion.

When a country receives senior loans from the ESM, for instance, this will reduce their average interest burden, and it will have consequences for marginal interest rates, similar to the Eurobond idea. Importantly, their average interest bourdon will decline. When multilateral lenders purchase debt on secondary markets, however, their average interest burden remains unchanged. There is the risk that recipient countries find it even more difficult to obtain financing, while financial markets reap the benefit of the bond-purchases.

A way the central bank could avoid this puzzle is to be willing to buy all government bonds in the markets, and accept pari-passu treatment. Note however, that if it should do so, it could be missing another important component of the Eurobond idea – the incentive effect of high marginal interest rates. This consideration may help to explain the ECB's decision to announce the OMT program in the summer of 2012. The main elements of OMT are the ex-ante unlimited announcement, the conditionality and the pari passu treatment. While the first two have received most attention in the discussion so far, our analysis suggests that the latter also plays an important role.

8. Appendix

Appendix A1.1: World Economic Survey Question

"In a case of default (or debt restructuring) of a member country of the European monetary union, do you expect the following public creditors to get preferred treatment (i.e. have senior status), compared to private sector creditors?

	YES	NO
International Monetary Fund, IMF	□	□
Permanent rescue facility, ESM	□	□
Temporary rescue facility, EFSF	□	□
European Union (EFSM and bilateral)	□	□
European System of Central Banks (incl. ECB)		
A) Collateralized Refinancing Operations	□	□
B) Target2 claims	□	□
C) Old bond purchase program, SMP	□	□
D) New bond purchases program, OMT	□	□

"

Appendix A1.2: Correlations Matrix

Table 12 (Appendix): Contemporaneous Correlations Matrix

	Gov. Bond Spreads	Debt / GDP	Senior Tranche	Current Account to GDP	REER	Real GDP Growth
Gov. Bond Spreads	1					
Debt/GDP	0.48***	1				
Senior Tranche	0.76***	0.34***	1			
Current Account/GDP	-0.19***	-0.40***	-0.16***	1		
REER	0.22***	0.01	0.22***	-0.11**	1	
Real GDP Growth	-0.44***	-0.32***	-0.36***	0.13***	-0.43***	1

*Notes: Table 12 shows pairwise correlations of government bond spreads, our senior tranche variable and the main control variables. *, **, *** indicate variables significant at a 10%, 5%, and 1% level respectively. Data source: See data appendix A1.5.*

Appendix A1.3: Summary Statistics

Table 13 (Appendix): Summary Statistics

		Gov. Bond Spreads			Debt to GDP			Real GDP Growth		
	Sample	00 - 08	08 - 13	full	00 - 08	08 - 13	full	00 - 08	08 - 13	full
Countries	Greece	0.4 (0.2)	9.5 (7.6)	3.8 (6.4)	104.1 (4.2)	138.4 (18.9)	114.1 (18.9)	4.0 (1.9)	-4.8 (2.7)	0.73 (4.8)
	Ireland	0.1 (0.1)	3.7 (2.2)	1.4 (2.2)	31.6 (5.1)	87.9 (27.2)	52.5 (32.2)	5.3 (3.0)	-1.5 (3.4)	2.8 (4.6)
	Italy	0.3 (0.1)	2.2 (1.4)	1.0 (1.2)	108.0 (2.4)	119.9 (7.1)	112.4 (7.4)	1.5 (1.3)	-1.7 (2.8)	0.32 (2.5)
	Portugal	0.2 (0.1)	4.6 (3.7)	1.8 (3.1)	60.5 (6.7)	98.7 (19.7)	74.2 (22.7)	1.4 (1.5)	-1.5 (2.4)	0.4 (2.3)
	Spain	0.1 (0.1)	2.3 (1.5)	0.9 (1.4)	48.2 (7.8)	63.9 (16.2)	54.0 (13.8)	3.5 (0.9)	-1.3 (1.6)	1.7 (2.7)
Aggregates	Euro Area	0.1 (0.3)	2.1 (3.7)	0.87 (2.4)	62.2 (29.5)	79.0 (32.2)	68.3 (31.6)	2.9 (2.1)	-0.97 (3.2)	1.44 (3.18)
	Non-GIIPS	0.04 (0.3)	0.5 (0.4)	0.2 (0.4)	56.2 (26.9)	65.4 (25.0)	59.6 (26.5)	2.7 (1.9)	-0.13 (3.2)	1.6 (2.8)
	GIIPS	0.2 (0.2)	4.5 (4.8)	1.8 (3.5)	70.5 (31.1)	99.4 (31.0)	80.8 (34.0)	3.2 (2.4)	-2.2 (2.91)	1.2 (3.6)

		Senior Tranche			Current Account / GDP			REER		
	Sample	00 - 08	08 - 13	full	00 - 08	08 - 13	full	00 - 08	08 - 13	full
Countries	Greece	6.4 (2.7)	50.3 (34.6)	24.0 (30.7)	-8.8 (3.5)	-8.3 (4.9)	-8.6 (4.0)	96.8 (5.8)	105.9 (1.6)	100.2 (6.4)
	Ireland	11.6 (6.4)	78.2 (24.1)	41.2 (37.4)	-2.1 (2.3)	1.0 (3.8)	-1.0 (3.3)	96.2 (9.9)	101.6 (5.4)	98.2 (8.9)
	Italy	0.1 (0.2)	7.0 (8.1)	2.6 (5.9)	-0.7 (0.8)	-2.1 (1.6)	-1.2 (1.3)	97.3 (4.4)	99.9 (2.1)	98.3 (3.9)
	Portugal	9.5 (3.0)	46.5 (28.1)	23.2 (24.8)	-9.5 (1.8)	-7.3 (4.9)	-8.7 (3.4)	97.7 (4.2)	100.6 (1.2)	98.8 (3.7)
	Spain	0.1 (0.5)	21.7 (17.9)	8.1 (15.0)	-6.1 (2.7)	-3.7 (2.7)	-5.2 (2.9)	97.1 (5.5)	104.2 (1.7)	99.7 (5.6)
Aggregates	Euro Area	3.9 (5.3)	19.6 (28.9)	10.1 (20.1)	0.2 (6.4)	-0.0 (5.8)	0.1 (6.2)	97.7 (4.9)	100.8 (3.5)	98.8 (4.7)
	Non-GIIPS	3.0 (4.8)	4.5 (7.1)	3.6 (5.8)	4.4 (4.2)	2.9 (4.3)	3.8 (4.3)	98.1 (3.5)	99.6 (2.9)	98.7 (3.4)
	GIIPS	5.2 (5.6)	40.7 (34.3)	19.0 (27.9)	-5.5 (4.2)	-4.1 (5.1)	-5.0 (4.6)	97.0 (6.3)	102.5 (3.6)	99.0 (6.0)

Notes: Table shows arithmetic means and standard deviations (in parentheses) of government bond spreads, our senior tranche proxy and the main control variables used in the regression analysis. Data sources: See Appendix A1.5.

Appendix A1.4: Unit Root and Cointegration Properties

In order to correctly specify the regressions in the subsequent analysis, we conduct tests for stationarity and cointegration. Table 14 reports the panel unit root tests according to several definitions. We find that the variables are integrated of order one, i.e. they have a unit root in levels and are stationary in first differences. In Table 15 we proceed by reporting the results of the Engle-Granger based cointegration tests. In all cases, we can reject the null of non-stationary residuals.

Table 14 (Appendix): Panel Unit Root Properties

Test	H_0	Test Statistics			
		Spread	ΔSpread	Senior Tranche	ΔSenior Tranche
Fisher type ADF (z-stat.)	All panels contain (individual) unit roots	1.15 (0.875)	-10.90 (0.000)	1.35 (0.912)	-13.53 (0.000)
Fisher type Phillips-Perron (z-stat.)	All panels contain (individual) unit roots	0.71 (0.760)	-12.56 (0.000)	-1.92 (0.028)	-13.44 (0.000)
Hadri LM (z-stat.)	All panels are stationary	9.05 (0.000)	-1.24 (0.892)	8.75 (0.000)	1.00 (0.168)

Notes: Probability values in parentheses. Lags up to sixth order have been selected using Akaike Information Criterion (AIC). In a panel context the rejection of the unit root hypothesis should be interpreted as evidence that a statistically significant proportion of the units are stationary. For Hadri LM test we report the heteroscedastic consistent version of the z-statistic.

Table 15 (Appendix): Panel Cointegration Properties

Included Variables / Trend Assumption	Pedroni Residual Based Test with H_0: No Cointegration	
	Panel statistics / Common AR Coefficient	Group statistics / Individual AR Coefficient
Benchmark Variables		
Intercept	-3.97 (0.000)	-2.16 (0.015)
Intercept & Trend	-3.81 (0.000)	-2.89 (0.002)

Notes: ADF statistics reported with probability values in parentheses. Lags up to sixth order have been selected using AIC. Additionally to the reported tests above, we also performed a simple Kao-type cointegration test. An ADF test z-statistic of -2.28 and a respective p-value of 0.011 reject the null of a unit root at the 5% level, thus confirming that the residuals of our benchmark are indeed stationary.

Appendix A1.5: Data Descriptions and Sources

Table 16 (Appendix): Data Descriptions and Sources

VARIABLE	DESCRIPTION	PERIOD	SOURCES	UNITS	NOTES
Government Bonds					
Spreads/ Yields	Spread between Government Bond secondary market yield and the German Bund (both with a 10 year maturity)	2000Q1–2013Q2	OECD - Monthly Monetary and Financial Statistics (Series: "Long-term interest rates, Per cent per annum"). For gaps in series of Luxembourg: International Financial Statistics (Series: "Interest Rates, Government Securities, Government Bonds", Code: 61...ZF).	Per cent per annum	
Prices	Government Bond secondary market price (10 year maturity)	2000Q1–2013Q2	Thomson Reuters Datastream (Series: "Benchmark 10 year DS Govt. Index – Clean Price Index")	Index (2000Q1 = 100)	No data for Luxembourg available
Senior Tranche	Sum of official sector loans (incl. Target2-liabilities) and SMP purchases	2000Q1–2013Q2	See components below	% of General Government Debt	For further details see Section 4
Intra-Eurosystem Liabilities ("Target2")	Liabilities of the individual countries' central banks against the Eurosystem	2000Q1–2013Q2	See separate data Appendix A1.6		

Table 16 (Appendix): Data Descriptions and Sources CONTINUED

VARIABLE	DESCRIPTION	PERIOD	SOURCES	UNITS	NOTES
SMP	ECB Government Bond purchases in its "Securities Markets Programme". See decision ECB/2010/5.	2000Q2–2013Q2	Thomson Reuters Datastream (Series: "Sec. Markets Prog. Amount"; Code: S244FC)		The ECB does not report the composition of bond purchases. We therefore assume the ECB bought the bonds in the same relative amounts as it reported to hold in the end of 2012 (ECB press release February 21st, 2013)
Official Loans					
EFSM/ bilateral	EU loan packages for Ireland and Portugal	2000Q1-2013Q2	Websites of the European Commission (http://ec.europa.eu/economy_finance/eu_borrower/efsm/), Ministerial statements of HM Treasury.		Excludes loans of about 1 bn. € from Sweden and Denmark to Ireland since the exact disbursement dates are unknown.
EFSF/ ESM	ESFS/ESM loans to Ireland, Portugal, Greece, Spain	2000Q1-2013Q2	Websites of the European Financial Stability Facility (http://www.efsf.europa.eu) and of the European Stability Mechanism (http://www.esm.europa.eu)		
IMF	Credit granted by the IMF	2000Q1–2013Q2	International Financial Statistics (Series: "Use of Fund Credit (UFC)"; Code: .2TL.ZF)		
Main Macroeconomic Controls					
Debt Ratio	General Government Debt to GDP ratio	2000Q1–2013Q2	Eurostat (Series: "Gross Government Debt"; Code: gov_q_ggdebt)	% of GDP	For Greece until 2011Q4.

Table 16 (Appendix): Data Descriptions and Sources CONTINUED

VARIABLE	DESCRIPTION	PERIOD	SOURCES	UNITS	NOTES
Current Account Ratio	Net Current Account to GDP ratio	2000Q1–2013Q2	Eurostat (Series: "Current Account"; Code: bop_q_c)	% of GDP	For Belgium, time series are only from 2002Q1 onwards.
REER	Real effective exchange rate (based on CPI)	2000Q1–2013Q2	International Financial Statistics (Series: "Real Effective Exchange Rate, Consumer Price Index"; Code: ..RECZF)	Index (2005=100)	
Real GDP Growth	Percentage change of real GDP compared to corresponding period of the previous year	2000Q1–2013Q2	Eurostat (Series: GDP and main components – volumes; Code: namq_gdp_k)	% chg.	
Other Controls					
CDS Spreads	Credit Default Swap spread against Germany	2006Q1-2013Q2	Thomson Reuters Datastream (Series: "SEN 10Y CDS - CDS PREM. MID")	Basis points	For Spain, Ireland and Netherlands from 2007Q1 onwards, for Finland starting 2008Q2. For Greece ending at time of debt swap in 2012Q2.
EC Economic Sentiment	Economic Sentiment Indicator (ESI) for the euro area of the European Commission	2000Q1–2013Q2	Eurostat (Series: "Economic sentiment indicator"; Code: teibs010)	Index (arith. mean = 100)	
Ifo Economic Sentiment	World Economic Climate index for the Euro Area of the ifo Institute	2000Q1–2013Q2	Ifo Institute's webpage (www.ifo.de/de/w/3TAL6okDN)	Index (2005=100)	

Table 16 (Appendix): Data Descriptions and Sources CONTINUED

VARIABLE	DESCRIPTION	PERIOD	SOURCES	UNITS	NOTES
Google Searches PSI	Relative volume of search queries on "private sector involvement" conducted through Google.	2004Q1–2013Q2	Online Application Google Trends	Index (max. in 2012M02 = 100)	
VStoxx	Implied Volatility Indices based on Eurostoxx 50.	2000Q1–2013Q2	Datastream (WKN A0C3QF)	Percent per annum	
CBOE VIX	Implied Volatility Indices based on S&P 500.	2004Q1–2013Q2	Federal Reserve Bank of St. Louis	Percent per annum	
MFI Lending Rate	Average MFI interest rate to non-financial corporations (as spread to euro area average)	2003Q1-2013Q2	ECB Statistical Data Warehouse (MIR.M….B.A20.K.R.A.2240.EUR.O)	Percent per annum	No data for Luxembourg available.
MFI Real sector Loans	MFI outstanding loans to non-financial corporations	2003Q1-2013Q2	ECB Statistical Data Warehouse (BSI.M….N.A.A20.A.1.U2.2240.Z01.E)	% of GDP	
MFI Foreign Claims	MFIs total foreign claims on a contractual basis	2000Q2–2013Q2	Bank for International Settlements, Consolidated Banking Statistics, Table 9A:S	% of GDP	
MFI EA cross-border claims	Sum of cross-borders claims within the euro area	2005Q1-2013Q1	Bank for International Settlements, Consolidated Banking Statistics, Table 9C:T	Index (2005Q1 = 100)	
MFI GIIPS exposure	MFIs foreign claims against counterparties in Greece, Ireland, Italy, Portugal and Spain	2005Q1-2013Q1	Bank for International Settlements, Consolidated Banking Statistics, Table 9C:T	Index (2005Q1 = 100)	
Rating	Standard & Poor's Rating	2000Q1–2011Q4	Favero (2013)	Scaled from 0 to 76.	

Table 16 (Appendix): Data Descriptions and Sources CONTINUED

VARIABLE	DESCRIPTION	PERIOD	SOURCES	UNITS	NOTES
Other variables used for calculations only					
Nom. GDP	Gross domestic product at current prices	2000Q1–2013Q2	Eurostat (Series: „Gross domestic product at market prices" ; Code: namq_gdp_c)	Mio. €	
Exchange rate	National Currency per U.S. Dollar	2000Q1–2013Q2	International Financial Statistics (Series: "National Currency per U.S. Dollar, period average"; Code: ..RF.ZF)	€/$	
Government Debt	General Government Consolidated Gross Debt	2000Q1–2013Q2	Eurostat (Series: „ Government consolidated gross debt (GD)" ; Code: gov_q_ggdebt)	Mio. €	
Trade Weights	Average share of one country in the trade volume (exports plus imports) of another.	2000Q1–2013Q2	Favero (2013)	% Total Trade Volume	No data for Luxembourg available.
Consumer Prices	Harmonized Consumer Prices	2000Q1–2013Q2	International Financial Statistics (Series: "Consumer Prices, Harmonized"; Code: 64H..ZF)	Index (2005 = 100)	

Notes: Our sample consists of quarterly data from 2000 until the 2nd quarter of 2013. We include all EA-12 countries, namely Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. If the original data source did not provide the series seasonally adjusted – and we suspected a seasonal pattern in it – we accounted for this using the U.S. Census method (X12-ARIMA). For a complete description of the variables used in the analysis of the World Economic Survey data of the ifo Institute (Section 5) see http://www.cesifo-group.de (doi: 10.7805/ebdc-wes-2012).

Appendix A1.6: TARGET2 Data Sources

The organization of the Target statistics varies widely across the 17 central banks and sometimes over time for individual central banks. Most of the central banks publish them as a part of their annual, quarterly, or in many cases monthly financial statements. The relevant positions are in most cases called "Intra-Eurosystem Claims/Liabilities", "Other Liabilites/claims of euro area residents" or "Deposits/Liabilities of/to other euro area MFI's". In the data set, we try to construct the narrowest definition of Target2 balances available for the individual countries. The following table describes the adjustments made for each country. An alternative although less precise proxy can be constructed from Central Bank Survey data of the IMF and is discussed in Sinn and Wollmershäuser (2012). For a more detailed comparison of different sources of Target2-data see Westermann (2014).

Table 17 (Appendix): TARGET2 Data Sources

CENTRAL BANK	SOURCE/PUBLICATION	POSITION	NOTES
Sample countries			
Bank of Greece	Website of the Bank of Greece (http://www.bankofgreece.gr) 1. Balance sheet of the Bank of Greece 2. Bank of Greece Monthly Financial Statement	1. "Claims on MFIs, Other euro area countries" / "Liabilities to MFIs, Other euro area countries" 2. "9.4 Net claims related to transactions with the ESCB (TARGET2)" / "9.3 Net liabilities related to transactions with the ESCB (TARGET2)"	

CONTINUED

CENTRAL BANK	SOURCE/PUBLICATION	POSITION	NOTES
Central Bank and Financial Services Authority of Ireland	Website of Central Bank and Financial Services Authority of Ireland (http://www. centralbank.ie), Money and Banking Statistics, Table A.2 Financial Statement of the Central Bank of Ireland.	"Other liabilities"	We adjust this item for "Liabilities related to the allocation of euro banknotes within the Eurosystem", using the latest data available in the IFS database. After correction, this position still contains some smaller other liabilities which amount to roughly 2.3 bn. € in December 2011 (see note 30 of the annual report 2011).
Bank of Italy	Bank of Italy Balance Sheet Aggregates and Official Reserves, Bank of Italy Balance Sheet Aggregates	"Other claims within the Eurosystem (net)" / "Other liabilities within the Eurosystem (net)"	
Bank of Portugal	Statistical Bulletin, Table B.2.4, Assets and liabilities of the Banco de Portugal Vis-à-vis non-residents	Column 8: "Liabilities - Monetary financial institutions - Euro area countries"	
Bank of Spain	– Sistema de búsqueda de información estadística: Table 7.09 – Economic Bulletin: 8.1.b Balance sheet of the Banco de Espana. Net Lending to credit institutions and its counterparts (monthly average of daily data)	– Sistema de búsqueda de información estadística: Column 4: "Deposits of other Euro Area MFI's" – Economic Bulletin: Column 21: "Counterparts, Intra ESCB, Target"	For the period 01/99 to 11/07 only monthly averages of daily data are available.
Austrian National Bank	Website of the Austrian National Bank (http://www.oenb.at), Report 1.1.31	"Net liabilities related to TARGET and correspondent accounts" / "Net claims related to TARGET and correspondent accounts"	

CONTINUED

CENTRAL BANK	SOURCE/PUBLICATION	POSITION	NOTES
National Bank of Belgium	Statistical Bulletin / Belgostat online	"Other liabilities within the Eurosystem (net)" / "Other claims within the Eurosystem (net)"	These items comprise also some other, but minor, positions.
Federal Bank of Germany	Website of the Federal Bank of Germany (http://www.bundesbank.de)	"Time series BBK01.EU8148B: MEMO ITEM: External position of the Bundesbank since the beginning of EMU / Claims within the Eurosystem / TARGET 2 (net)"	Before Target balances were explicitly published, one could find the series EU8148. This one diverges from EU8148B in two aspects: Firstly, the accrual principle is applied. Secondly, Target balances with central banks of countries not member of the Euro area are not included.
Bank of France	Balance sheet of the Banque de France	Liabilities, other euro area countries – Deposits, MFIs	
Bank of Finland	Website of the Bank of Finland (http://www.suomenpankki.fi): 1. Balance sheet of the Bank of Finland Bank of Finland Bulletin: 2. Balance sheet of the Bank of Finland	1. "9.4 Claims related to Target and correspondent accounts (net)", "9.2 Liabilities related to Target and correspondent accounts (net)" 2. "Other claims within the Eurosystem (net)" / "Other liabilities within the Eurosystem (net)"	Monthly data does not match annual data since the first ones are as of the last Friday of the month while the figures in the annual report are as of the last day of the year.
Central Bank of Luxembourg	Website of the Central Bank of Luxembourg, Tab. 1.2 Financial statement of the Banque centrale du Luxembourg	"Cl. 18 Claim on the Eurosystem" / "Cl. 16 Liabilities to the Euroystem"	
Netherlands Bank	Website of the Netherlands Bank, T5.1 Balance sheet of the Nederlandsche Bank (monetary presentation)	"Loans to euro area residents, MFI, of which: target2 balance", "Deposits of euro area residents, MFI, of which: target2 balance"	

CONTINUED

CENTRAL BANK	SOURCE/PUBLICATION	POSITION	NOTES
Other euro area countries not part of the sample			
Central Bank of Cyprus	Website of the Bank of Cyprus (http://www.centralbank.gov.cy), Monthly Balance Sheets	„Intra-Eurosystem liabilities“ / „Intra-Eurosystem claims“	
Bank of Estonia	Website of the Bank of Estonia (http:// http://www.eestipank.info), Statistical Indicators, Quarterly Balance sheet of the Eesti Pank	"9.4 Other claims within the Eurosystem (net)" / "10.3 Other liabilities within the Eurosystem (net)"	
Central Bank of Malta	Website of the Central Bank of Malta (http://www.centralbankmalta.org), Balance Sheet of the Central Bank of Malta based on Statistical Principles	"Intra-Eurosystem claims" / "Intra-Eurosystem liabilities"	In the case of net liabilities to the Eurosystem, we adjust this item for "Liabilities related to the allocation of euro banknotes within the Eurosystem", using the latest IFS data available.
Bank of Slovenia	Website of the Bank of Slovenia (http://www.bsi.si/), Table 1.7., Balance Sheet of the Banke of Slovenia – by Instruments – Liabilities	„Intra-Eurosystem liabilities“ / „Intra-Eurosystem claims«	
National Bank of Slovakia	Annual Report	Note 18 to "Intra-Eurosystem liabilities"	Data published only on a yearly basis

Notes: In the past, sources of Target2-data often changed in some countries. We therefore maintain a regularly updated list of these sources on our website www.eurocrisismonitor.com, as well as the dataset itself (both also available upon request).

Appendix A1.7: Further Robustness tests

Table 18 (Appendix): Varying Dependent Variables

	(1)	(2)	(3)	(4)	(5)
Variables	(Spread)	(1st Diff.)	(Nom. Yield)	(Real Yield)	(Price)
Senior Tranche	0.047***	0.027***	0.047***	0.047***	-0.335***
	(3.55)	(6.88)	(3.55)	(3.58)	(3.39)
Debt/GDP	0.034**	0.011	0.034**	0.034**	-0.275***
	(2.99)	(0.89)	(2.99)	(2.97)	(4.57)
Current Account/GDP	0.000	-0.004	0.000	0.001	0.095
	(0.01)	(0.45)	(0.01)	(0.09)	(0.56)
REER	0.112***	0.132**	0.112***	0.116***	-0.709**
	(3.24)	(2.78)	(3.24)	(3.22)	(2.36)
Real GDP Growth	-0.143*	-0.049	-0.143*	-0.141*	1.096*
	(1.84)	(1.71)	(1.84)	(1.82)	(2.12)
Country Fixed Effects	yes	yes	yes	yes	yes
Time Fixed Effects	yes	yes	yes	yes	yes
R^2	0.78	0.46	0.73	0.72	0.81
Obs.	597	576	597	589	551

*Notes: Robust t-statistics in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. Results are from a panel fixed effects model estimated using OLS. Reported R2 is calculated "within", i.e. from the mean-deviated regression. This table compares different dependent variables: The 10-year government bond spread against Germany (Column 1), the first differences of the spread and (if necessary) the explanatory variables (Column 2), the nominal and real government bond yield (Columns 3 and 4) and the government bond price. Data source: See data appendix A1.5.*

Table 19 (Appendix): Outlier Analysis

Dep. Variable: Government Bond (10y) Secondary Market Spreads Against Germany					
	(1)	(2)	(3)	(4)	(5)
	(GRC)	(IRL)	(ITA)	(PRT)	(ESP)
Senior Tranche	0.050***	0.073***	0.046***	0.038***	0.048**
	(4.19)	(6.34)	(3.49)	(4.59)	(3.14)
Debt/GDP	0.020**	0.048***	0.036***	0.035**	0.031***
	(2.39)	(4.04)	(3.32)	(2.73)	(3.31)
Current Account/GDP	0.001	-0.019	0.001	-0.005	0.007
	(0.06)	(1.38)	(0.01)	(0.33)	(0.37)
REER	0.072**	0.080*	0.112**	0.103**	0.129**
	(2.85)	(2.08)	(3.09)	(2.71)	(2.74)
Real GDP Growth	-0.019	-0.161***	-0.142	-0.164*	-0.147*
	(0.61)	(3.21)	(1.77)	(1.98)	(1.94)
Country FE	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes
R^2 (within)	0.79	0.84	0.78	0.75	0.77
Obs.	553	552	543	543	543

*Notes: In the reported regressions individual countries are dropped from the sample. Robust t-statistics in parentheses; *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. Results are from a panel fixed effects model estimated using OLS. Reported R^2 is calculated "within", i.e. from the mean-deviated regression. Data source: See data appendix A1.5.*

Table 20 (Appendix): Market Sentiment

FUNDAMENTALS		SENTIMENT BASED ON PUBLIC ATTENTION	
(A) Full set of controls from benchmark regression	0.716***	(C) Benchmark control variables + Google searches "euro crisis"	0.684***
(B) Benchmark control variables + 2y rolling variance of government bond spreads	0.503***	(D) Benchmark control variables + Google searches "private sector involvement"	0.699***
SENTIMENT BASED ON SURVEY DATA		**SENTIMENT BASED ON STOCK MARKET DATA**	
(E) Benchmark control variables + European Commission Economic Sentiment Index	0.717***	(G) Benchmark control variables + VStoxx	0.702***
(F) Benchmark control variables + CESifo World Economic Sentiment Index for the Euro Area (Difference between 6 month expectation and assessment of the current economic situation)	0.718***	(H) Benchmark control variables + VIX	0.720***

Notes: The table shows partial correlations between senior tranche lending and government bond spreads with the effect of our benchmark control variables and different measures of market sentiment partialled out *from both variables*. Stated differently, displayed coefficients are identical to the bivariate correlation between the residuals regressing the government bond spreads, and the senior tranche respectively, on the different sets of variables specified within the table. *, **, *** indicate variables significant at a 10%, 5%, and 1% level respectively. Columns (C-D) make use of the application Google Trends, which provides an index of the relative volume of specific search queries conducted through Google. *Data source: See data appendix A1.5.*

ESSAY II

THE TRAGEDY OF THE COMMONS AND INFLATION BIAS IN THE EURO AREA

1. Motivation

Central bank credit has expanded on an order of magnitude that is unprecedented in the post-war history of Europe. In countries with a negative output shock - Greece, Italy, Ireland, Portugal and Spain - it has increased by more than 1000% from 2007 to 2012. In this essay, we review the institutional arrangements in the euro area and present a theoretical model, as well as empirical evidence, that help to understand this stylized fact. We argue that the expansion was facilitated by a fragmentation of the ECB's monetary policy that is implemented by the national central banks. This fragmentation gives rise to classical tragedy of commons problems and generates a positive inflation bias.

The institutional changes that set the stage for a tragedy of the commons-dilemma have started in 2007, when the ECB introduced the TARGET2 clearing system.[49] This clearing system linked the money markets across Europe, creating a common pool of money demand to which all central banks had access.[50] Furthermore, the ECB, which in principle controls monetary policy, announced a "full allotment" policy. Under this policy, private banks had unlimited access to central bank credit, provided that they were able to pledge collateral that was acceptable to the ECB. The national central banks (NCBs) finally gained control over monetary policy in their jurisdiction, when the ECB relaxed their collateral standards. An important institutional aspect is that the NCB's assess the quality of this collateral as well as the solvency of their

[49] The tragedy of the commons interpretation was also given in Tornell & Westermann (2012a, 2012b) and Tornell (2012).

[50] See Sinn & Wollmershäuser (2012), Garber (1999), Cour-Thimann (2013) and Auer (2014), as well as Section 2 of this paper for more institutional details and the economic interpretation of TARGET2 balances.

counterparties. It is thus the *implementation* of monetary policy, not the decision making that is the source of the common pool problem.[51]

To motivate why such an institutional setting leads to an additional inflation bias in monetary policy, we set up a simple partial-equilibrium model that starts with a standard central bank utility function, including the output gap and inflation. We add two non-standard elements to this model: (i) A credit channel of monetary policy. We assume that the national central banks can have a direct impact on the domestic economy by extending central bank credit to relax credit constraints. (ii) We assume that there is a common pool problem in a monetary union of the following type: Central banks can extend credit to private banks in their jurisdiction. However, the associated increase in money supply is not confined to lead to inflation in this particular country. There exists a single money market in the currency union, thus prices will increase in all countries. By extending central bank credit the NCB's reap the full marginal benefit of their policy, but face only the average cost in terms of inflation.[52]

We show in the model section that there is an inflation bias resulting from this common pool problem that is independent of the standard time-inconsistency bias.[53] Our model builds on an earlier literature on inflation bias in currency unions, in particular Aizenman (1992) and Casella (1992). In their papers, the inflation bias arises from externalities among jurisdictions that are competing for seigniorage and the inflation tax. On an abstract level, our model can be viewed as a simple partial-

[51] See von Hagen & Süppel (1994) for an analysis of a common pool problem in the central bank decision making.

[52] More broadly, the cost could also include potential losses of extending credit to illiquid banks. These would be shared by the capital key in the Eurosystem. In our model, we abstract from this possibility.

[53] See e.g. Barro & Gordon (1983) and Walsh (2010).

equilibrium representation of these ideas. Furthermore, it takes special features of the current euro crisis into account. This includes the central banks objective of achieving financial stability - i.e. avoiding the cost of bank closures - and the credit crunch suffered in several European countries after the 2007/8 financial crisis.

In the empirical section of the essay, we illustrate key stylized facts about central bank credit expansion. Among these, three observations stand out: First, countries that recently experienced a negative output shock have increased central bank credit substantially. Furthermore, this central bank credit did not stay within the national borders of the respective country. It has been wired to other countries via the TARGET2 clearing system to buy goods and assets abroad and to repay international loans, thus increasing the money supply throughout the whole monetary union. The absolute values of TARGET2 liabilities are nearly identical to the increase in central bank credit.[54] Secondly, we illustrate that central bank lending already constitutes a substantial share of total lending in the countries in crisis. In the GIIPS countries (Greece, Ireland, Italy, Portugal and Spain), it has increased from 1.6% in 2007 to 16.4% in 2012. Third, consistent with our common pool argument, money M1 and prices have increased only moderately in the countries that experienced the negative shock. This could of course also be due to deflationary pressure in these countries.

The findings of our model reflect the option of individual countries to push their fiscal limit (Davig et al. (2012)) without immediately bearing the political costs of domestic inflation. In section 5, we provide an extended review of related common pool problems in fiscal policy. They also raise important questions about the long-term consequences of non-standard monetary policy measures, such as a reduction of collateral

[54] See also Neumann (2012).

standards and full allotment policies. Lastly, the inflationary bias documented in the model is a potential explanation of why, despite strong deflationary pressures currently at force in some euro area countries, observed inflation rates are still positive.

In section 2 of the essay, we discuss in more detail the institutional arrangements. In section 3, we present the theoretical model. Section 4 illustrates some stylized facts. In section 5, we relate our findings to previous studies in the literature. Section 6 concludes by pointing to concrete policy proposals that help to internalize existing externalities.

2. The Eurosystem's institutional framework

The tragedy of the commons (or common-pool problem) describes a situation when multiple players operate in a framework where it is possible that each individual player extracts some benefits from exploiting a common pool of resources while paying only a portion of the costs. The key institutional questions that we review in this section are: What is the common pool that is overly used, and why do national central banks have access to this common pool?

The common pool is the euro-area wide money demand.[55] It has been created in several steps. First, the introduction of the euro itself eliminated exchange rate risks among member countries and created an integrated capital market. The ECB in Frankfurt centrally sets the interest rate for all countries of the monetary union. However, national central banks continued to exist. The allocation of money creation by the different national central banks, until 2007, was mainly driven by the demand of private banks for central bank credit. This demand, however, was limited by the money demand in the respective country. This was changed when the TARGET2 clearing system was introduced that contained a so-called "real-time settlement system". In this settlement system, national central banks have the task to execute transfer payments, even before the incoming funds have arrived.

In principle this leads to imbalances, which last only for a few seconds. However, in the financial crisis, these balances have become more and more persistent, accumulating to substantial levels of claims

[55] See also Tornell (2012) and Tornell & Westermann (2012a).

and liabilities between the central banks of the Eurosystem (see Sinn & Wolmershäuser (2011) and Garber (1999) for further details). With regard to the common pool problem, this meant the following: the national central banks where no longer limited by the demand for money in their own country, but instead they could service the entire euro-area wide money demand. While the demand for money used for domestic purposes was small, the demand for money for the purpose of international transactions was very large.

2.1 Decision on eligible counterparties

The second institutional question is how the national central banks gained access to this common pool. The classical perception of monetary policy operations within the EMU excludes this possibility. The ECB is supposed to provide uniform monetary policy by setting uniform interest rates and equal conditions for the access of banks from all participating countries to central bank funding. If this is indeed the case - as it was broadly the case until the end of 2007 - exploiting the common pools should be hardly possible for any individual member of the union.

However, since 2007, individual countries gradually gained control over credit extension so that - even though the ECB still determines a single interest rate for central bank credit - substantial heterogeneity across member countries exists as to the quality of financial institutions and to the collateral to which this interest rate applies. To start with, the national regulators de facto decide on the list of banks eligible to receive central bank's funds.[56] This is the case since the ECB declares all solvent banks eligible for central bank refinancing, but the definition by which

[56] For the purpose of the subsequent analysis we can view central banks and national regulators as one entity. In the policy conclusions we highlight the need for both, a common regulation and a uniform catalogue of eligible collateral.

banks are solvent or not is still made by the national financial regulation authorities.[57] The ECB clarified in the debate about the solvency of the Cypriot Laiki bank that the NCBs are solely responsible for solvency *supervision* of their counterparties as well.[58] By not closing down virtually insolvent banks national authorities achieve at least two targets. First, they avoid both the political and economic costs of the liquidation of these banks. Second, they exploit the advantage of the fact that these banks' remaining assets - instead of being liquidated under the currently adverse conditions - can be used as collateral to generate increased central bank credit to the domestic banking sector. This is why the right of national regulators to decide on the solvency of the banks is an important determinant of the amount of central bank's credit to commercial banks and a key component of the tragedy-of-the-commons problem.

2.2 Collateral standards

Another important determinant of this amount is the gradual reduction of collateral standards by the ECB starting in October 2008. In fact, from the end of 2011, the European Central Bank has virtually given up control over the eligible collateral on the central banks refinancing operations. This fact is nicely illustrated by a Governing Council decision announced by the ECB on February 9th, 2012 which allows "specific *national* eligibility criteria and risk control measures for the temporary acceptance of additional credit claims as collateral in Eurosystem credit operations" (italics added).

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[57] See Tornell & Westermann (2012a).

[58] "Die zyprische Notenbank ist dafür verantwortlich, die Solvenz ihrer Banken zu beurteilen", ECB spokeswoman, June 26th, 2013, Süddeutsche Zeitung.

Again, not only the definition of eligible collateral has been delegated to the NCBs. They are also responsible for the collection of necessary information on the quality of potential collateral and the concluding eligibility assessment.[59]

This decision puts the national central banks in charge of the decision about which assets can serve as eligible collateral and which cannot. The fact that the ECB abandons control over collateral quality is also illustrated by a most recent decision of the ECB announced on September 6th, 2012 which suspends the application of the minimum credit rating threshold in the collateral eligibility requirements.

The expansion of eligible collateral categories affects not only the volume of central bank's funding. In combination with the relatively rough grid of asset categories used for the determination of the collateral haircuts it also gives rise to substantial variation of the costs of central bank funding for banks from different countries. Given almost uniform haircuts for each asset category banks with more risky assets enjoy an advantage in the de facto costs of funding relative to banks with safer assets from the same haircut category.

In sum, the volume of refinancing can significantly differ across countries. In the beginning of the crisis, this was due to a built-in flexibility under existing rules. But since the ECB's reduction of collateral standards, this expansion has been increasingly a result of the national central bank's policies. 54% of the total expansion occurred after

[59] See e.g. European Parliament (2013), Question P-004750/2013. See also ECB website: "Prior to the publication [...] in the list of eligible marketable assets, national central banks (NCBs) proactively assess the eligibility of the marketable assets. The NCB of the country where the asset is admitted to trading on a regulated market or traded on a non-regulated market is responsible for the assessment of the eligibility of the marketable asset" (https://www.ecb.int/paym/coll/standards/marketable/html/index.en. html).

December 8th, when the most significant drop in collateral standards was announced. The former ECB Chief Economist, Jürgen Stark, recently summarized these developments in the statement The ECB is about to lose its ability to perform uniform monetary policy.[60]

[60] Frankfurter Allgemeine Zeitung, October 24, 2012.

3. A model of monetary policy with a credit channel and a common pool problem

In this section, we illustrate the effect of a common pool problem in a simple model of monetary policy. We start from a standard loss function for the central bank (see e.g. Walsh (2010) and Barro & Gordon (1983)) and add two new elements. First, we assume that there is a direct effect of central bank credit on output. This assumption can be motivated by the literature on the credit channel of monetary policy (Kashyap, Stein & Wilcox (1993) and Tornell & Westermann (2005)). In the framework of the European problem at hand one can also think of the positive effects in terms of avoiding the costs of liquidating financial institutions. These costs will be represented by increased financial uncertainty and instability, as well as reduced aggregate investment due to limited access to credit.

Secondly, we assume that there is a common pool problem in the currency union as discussed above. Each individual central bank can extend credit to its banks. By doing so the central bank reaps the full benefits from this credit extension, but only bears the average loss in the form of the average inflation in the euro area.[61]

[61] Also in the case of losses, if counterparties become insolvent, it only shares the average of these costs.

3.1 A single country

Let us start with a single country as a point of reference, where only the credit channel is added to the standard model of the central bank's optimization problem. The notation of the model is as follows. The utility function of a national central bank is given by $U(y, \pi)$, where y denotes output and π denotes inflation. The utility function is taken from a standard textbook. The central bank gets positive utility from closing the gap between output y and the exogenously given potential output $\overline{y_n}$. Furthermore, there is a quadratic loss from inflation. λ denotes the weight attached by the central bank to closing the output gap.

$$U(y, \pi) = \lambda(y - \overline{y_n}) - \frac{1}{2}\pi^2 \quad (1)$$

The output function consists of two components. First, the potential output, $\overline{y_n}$, and a cyclical component, y_c, that depends on the change of central bank credit in the economy, which in turn depends on the central banks supply of credit to commercial banks, Δd. This later term is kept very general and could take various functional forms. For the moment we only assume that the effect of central bank's credit on output is positive $\frac{\partial y}{\partial \Delta d} > 0$.[62]

$$y = \overline{y_n} + y_c(\Delta d) \quad (2)$$

In order to link this credit channel to money supply and inflation, we furthermore assume that the change in the monetary base is equal to the change in the amount of central bank's credit provided to the commercial banks: $\Delta d = \Delta m$ where m denotes the monetary base (we

[62] The credit channel effect is assumed to be the same for all countries. The results of Jiménez et al. (2012), however, suggest that the credit channel of monetary policy may be particularly strong in environments with weak bank balance sheets such as in some of the euro area member countries in crisis.

thus abstract from other forms of monetary expansions that would for instance follow from explicit bond purchases of the central bank, as well as minimum reserve holdings).[63]

We further assume that inflation is a function of monetary base changes, $\pi(\Delta m)$, where $\frac{\partial \pi}{\partial \Delta m} > 0$. The value of this partial derivative depends on the money multiplier and in particular on the commercial banks' reserves with the central bank (e.g. the higher the propensity of commercial banks to distribute the funding received from the central bank to the non-financial sector). Since these are not at the core of the analysis presented here, we assume for simplicity that $\frac{\partial \pi}{\partial \Delta m} = 1$.

LEMMA 1: *In a single country there is an inflation bias of* $\lambda \frac{\partial y}{\partial \Delta m}$.

PROOF: $$\underset{\Delta m}{\text{ARG MAX}}\, U = \lambda y_c(\Delta \text{m}) - \frac{1}{2}(\Delta m)^2; \frac{\partial U}{\partial \Delta m} = \lambda \frac{\partial y}{\partial \Delta m} - \Delta m = 0; \Delta m^*$$
$$= \lambda \frac{\partial y}{\partial \Delta m}. \blacksquare$$

The intuition for this result directly follows from the utility function of the central bank. Since inflation enters as a quadratic term, most functional forms for $y_c(\Delta d)$ will generate a positive equilibrium inflation. For instance if $y_c(\Delta d)$ is linear, the additional inflation would simply be a constant added to the term λ.

[63] Refinancing credits in the European System of Central Banks usually make up the largest part of the monetary base, e.g. in the end of 2012 central bank credit accounted for 69.2% of the total monetary base.

3.2 A currency union

In this section we now extend the model to a currency union, with $i = 1, \dots, n$ countries. In this currency union, each country has its own central bank utility function, $U_i(y_i, \pi_i)$. It also has a country specific output function y_i and the currency unions inflation rate, π_i. The monetary base in each country is denoted by m_i. Again, changes in the monetary base are equal to the changes in credit provided by the central banks to the domestic banking system, d_i. In the utility and output functions we furthermore assume that the potential output is the same for all countries:

$$U_i(y_i, \pi_i) = \lambda(y_i - \overline{y_n}) - \frac{1}{2}{\pi_i}^2 \tag{3}$$

$$y_i = \overline{y_n} + y_c(\Delta d_i) \tag{4}$$

$$\text{with } \frac{\partial y_i}{\partial \Delta \mathrm{d_i}} > 0.$$

The common pool problem in this setup follows from the fact that in an integrated capital market of a currency union the inflation rate is a positive function of each country's change in monetary base:[64]

$$\pi = \frac{1}{n}\sum_{i=1}^{n} \Delta m_i \tag{5}$$

[64] This assumption can also be motivated by the law of one price. Money printed in one country can be used to purchase goods in any other member country, thus in an arbitrage-free world the price level will be the same for all countries. It is, however, sufficient to assume that domestic inflation costs do not rise proportionally to domestic credit for the inflation bias to occur.

This is the case because changes in the monetary base do not stay in the country of origin but can spread across the currency union, i.e. inflation arising from expansionary policies is shared across member countries. Each country thus has the full marginal benefit of central bank credit extension that enters its output function, but faces only the average marginal cost that derives from inflation.

PROPOSITION 1: *In a currency union with a common pool problem, the inflation bias is larger than in a single country.*

PROOF: $\underset{\Delta m_i}{\text{ARG MAX}}\, U_i = \lambda y_i(\Delta m_i) - \frac{1}{2}\left(\frac{1}{n}\sum_{i=1}^{n}\Delta m_i\right)^2;$

In symmetric equilibrium: $\frac{\partial U_i}{\partial \Delta m_i} = \lambda \frac{\partial y_i}{\partial \Delta m_i} - \frac{1}{n}\Delta m_i = 0;$

$\Delta m_i{}^* = n\lambda \frac{\partial y_i}{\partial \Delta m_i}; n\lambda \frac{\partial y}{\partial \Delta m} - \lambda \frac{\partial y}{\partial \Delta m} = \frac{\partial y}{\partial \Delta m}\lambda(n-1) > 0.$ ■

The intuition for our proposition follows from the tragedy of the commons. Each country has an incentive to exploit the credit channel effect of its central bank credit extension, but it only bears the average cost of such action. The temptation to extend central bank credit and to contribute to the average inflation rate is, therefore, extraordinarily high. In the presence of deflationary pressures the inflationary bias documented here can play a mitigating role and explain why we actually observe less deflation in countries with substantial negative output shocks than one might have otherwise expected.

4. Stylized Facts

The simple model outlined above helps to explain the pattern of central bank credit expansion in the euro area since the beginning of the 2007/8 financial crisis. In this section, we document the recent developments by pointing out three stylized facts that are consistent with the view that national central banks have indeed gained room to implement country specific monetary policy.[65]

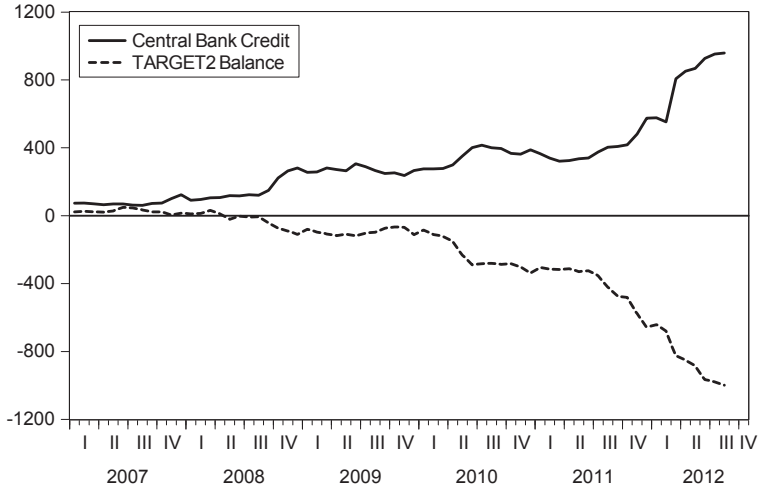
STYLIZED FACT 1: *Countries with a negative output shock have expanded central bank credit substantially.*

Most of the world's major economies are engaged in expansionary monetary policy; the ECB's situation, however, differs considerably from other central banks. While the increase of the Eurosystem's *aggregate* balance sheet from the beginning of 2007 is comparable with other central banks (see Figures 17 and 18 of the appendix), a remarkable feature of the European financial crisis is that national central banks of the Eurosystem expanded credit to domestic banks in an *asymmetric* pattern. While central banks in countries with negative output shocks have expanded credit to domestic commercial banks (in particular Greece, Ireland, Portugal and Spain), countries which did not experience such a negative shock kept their central bank's credit relatively constant or even reduced it. Figure 10 shows that the credit expansion in the crisis countries is unprecedented in post-war history. On average, it amounts to a more than 1000% increase in less than five years, or more than 800bn

[65] See also Tornell & Westermann (2012a) for an overview of some of these patterns.

Euros in absolute terms.[66,67] This phenomenon reflects in part the fact that in these countries the central bank was taking over the liquidity insurance role earlier provided by private interbank markets. In the presence of sharp reversals in private capital flows, they have replaced private capital by central bank credit.

Figure 10: Central Bank Credit and TARGET2 Balance



Notes: The figure shows the sum of central bank credit and the sum of claims/liabilities against the Eurosystem (TARGET2 balance) of the national central banks of Greece, Ireland, Italy, Portugal and Spain (in bn €). Sources: International Financial Statistics, Euro Crisis Monitor.

[66] See Sachs, Tornell & Velasco (1996) for the analysis of a similar pattern in Mexico 1994/5.

[67] Some expansion of central banks credit was also observed in countries without a negative output shock, however, in these countries the change in central banks credit was offset by an increase of commercial banks reserves with the central bank of a similar magnitude (See Figures 15 & 16 of Appendix A2.4).

The dashed series in Figure 10 illustrates that the money extended to the domestic banking system was not used to purchase goods or assets domestically, but rather financed international transactions. The TARGET2 balances measure the international balance of payments within the European Monetary Union (See Sinn & Wollmershäuser (2012)).[68] The fact that central bank's credit is used to facilitate transactions outside the individual country, but within the EMU, illustrates the spread of inflationary pressures generated by individual countries expansionary policy to other members of the Union.

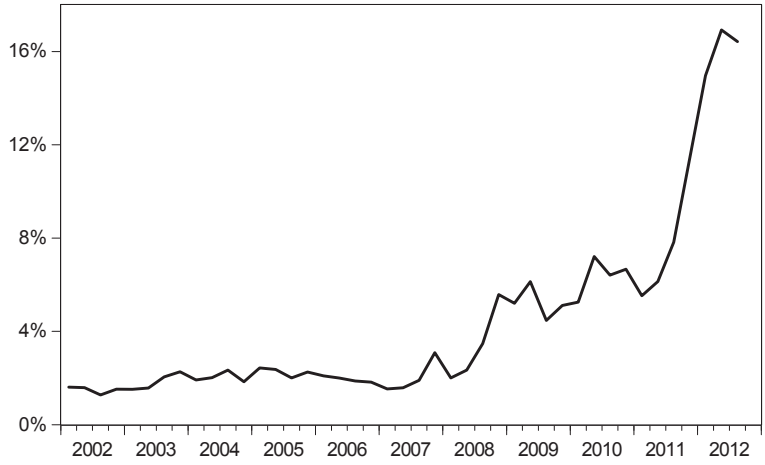
***STYLIZED FACT 2**: Private bank lending has increasingly been funded by central bank credit.*

Figure 11 shows that the commercial banks have funded a substantial share of their lending to the non-financial sector by credit from the central bank. The average share of total lending to the non-financial sector funded by central bank credit went up from around 1.6% in 2007 to 16.4% in the third quarter of 2012. The dynamics of central bank's credit in the individual countries is illustrated in Figures 13 and 14 of the appendix. It shows that the issue is particularly severe in Greece and Ireland. This fact is indicative for the potential benefit of central bank credit for the national economies. Furthermore, it is in line with recent results of Jiménez et al. (2012), who found out that the credit channel of monetary policy is particularly strong in environments of weak bank balance sheets.

[68] See also Alessandrini et al. (2013) who discuss how TARGET2-balances have contributed to macroeconomic imbalances in the Euro Area. The authors argue that limits on TARGET2-balances would be hard to implement, as they would increase the risk of a speculative attack within the Euro Area.

The central banks thus acted to prevent a credit crunch that would have occurred without the intervention of the central banks, with potentially severe negative consequences for the real economy.

Figure 11: Ratio of Central Bank Credit to Private Bank Lending



Notes: The figure shows the sum of central bank credit as percentage of total lending by other monetary financial institutions for the GIIPS countries (Greece, Ireland, Italy, Portugal and Spain). Source: International Financial Statistics.

STYLIZED FACT 3: *Central bank credit correlates positively with unemployment, but not with inflation.*

Figure 12 shows that central bank credit reacts to negative output shock as approximated by the level of unemployment. It does not seem to be related to inflation. This fact is consistent with our argument that the policy has been to exploit the common pool of euro-wide money demand for the stabilization of domestic financial systems and avoiding the short-term costs of the liquidation of financial institutions without internalizing any potential longer-term inflation biases. Figures 13 and

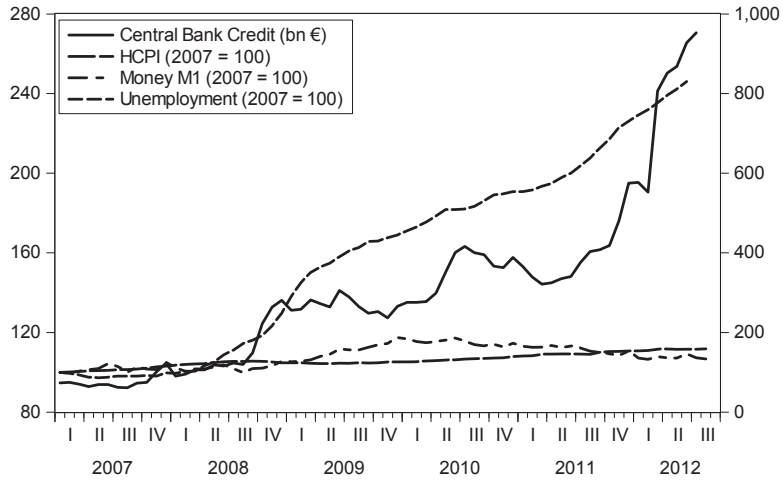
14 of the appendix show that the same pattern also holds at the country-level.[69]

Finally, the monetary expansion in the countries in crisis was feasible without any substantial impact on domestic inflation.[70] As the additional money was used primarily to purchase goods and assets abroad, domestic prices were little affected. In Figure 12, both unemployment and domestic prices are displayed on the same (left) scale, starting at 100. While unemployment increased by a factor of 2.5 on average, domestic prices had a cumulative increase of only about 12 percent during the same period. In fact, as the crisis has not reached the largest countries in the euro area, the central bank expansion has left the total monetary base relatively unchanged until the end of 2011. And, the aggregate increase is still not remarkably large when compared to other major central banks like the US Federal Reserve Bank, the Bank of England, or the Bank of Japan (see again figures 17 and 18 of the appendix). The future inflationary effect of the Euro Area's expansionary behavior will therefore crucially depend on whether the ECB gets the tragedy-of-the-commons problem under control.

[69] Appendix A2.3 analyzes the dynamics of central bank credit, inflation and unemployment in a simple Taylor-type panel regression analysis. The results (i) confirm the visual impression of a positive correlation of central bank credit with unemployment, but not with inflation, and (ii) point to significant policy shift in euro area central banks behavior since the onset of the global financial crisis.

[70] Also in other countries inflation is still moderate at this point. When we discuss the inflation bias and the "costs in terms of inflation", we also mean the risks of future inflation that NCBs are willing to accept. The banks present holdings of excess deposits have prevented a larger inflation for the euro area as a whole so far, but certainly bear the risk that this inflation will come at a later stage, once excess deposits are withdrawn from the central banks.

Figure 12*:* Central Bank Credit, Unemployment and Inflation



Notes: The figure shows the sum of central bank credit (bn €, right scale), the average unemployment rate, the average price level and the sum of monetary aggregate M1 (all 01/2007 = 100, left scale) for the GIIPS countries (Greece, Ireland, Italy, Portugal and Spain). Sources: International Financial Statistics, Eurostat.

5. Related literature

A natural area of application of the common-pool problem approach in macroeconomics has been the use of common-tax-pools in fiscal policy. Weingast, Shepsle and Johnson (1981) apply a version for the common-pool problem to the inefficiency of regional fiscal distributions by arguing that whenever central parliaments decide on the funding of regional projects an overspending bias will arise. This is the case since the members of parliaments are elected from certain regional areas and as such overvalue the interest of these regions. From the regional perspective the benefits of a locally executed project, which is funded by the central budget, will always be overvalued since the full marginal benefit of the project for the region is not weighed against the full marginal costs of the project, but rather against the costs covered by the region, which is only a negligible portion of the full costs.

Alesina and Drazen (1991) take the interpretation of the common pool problem of fiscal policy further. They argue that the common-pool problem is not only a potential source of fiscal instability, but it is also at the core of delayed fiscal stabilization. This conclusion is based on applying the common-pool problem in a political economy framework with heterogeneous groups, where delayed fiscal stabilization is modeled as the result of disagreements upon the distribution of the costs and benefits of stabilization.

The common-pool problem issues of fiscal policy have also been extensively studied with regard to the functioning of fiscal unions (see Knight (2003) and Alesina & Perotti (1999) for detailed discussions of studies documenting the common-tax pool problem and proposed solutions). With this regard the common--pool problem has typically

been employed in the analysis of the funding of infrastructure or other locally used public goods where a large portion of the benefits stays within one member of the union, while the costs are symmetrically distributed across all participants (Basley & Coate (2003)). The objects of the analysis in this strand of the literature have been examples for public overspending from around the world ranging from the US (Feldstein & Vaillant (1998)) and the European Union (e.g. Hallerberg & von Hagen (1999)) to developing countries (e.g. Kletzer & Singh (1997) and Hausmann & Purfield (2004)).

In the years following the decision for the establishment of the European Monetary Union a broad strand of the literature has been focused on the analysis of fiscal common-pools problems in the European Union. One strand of this literature focused on the interaction between the loss of monetary and fiscal stabilizers in the framework of the monetary union (Gali & Perotti (2003)). Another strand of this literature has been concerned with analyzing whether the existence of common currency will generate bail-out expectations for countries in fiscal distress and thus aggravate the standard common-pool problem (von Hagen & Eichengreen (1996), Chari & Kehoe (2008), Krogstrup & Wyplosz (2010)). These studies recognize that if the fiscal issues arising from the common-pool problem are not successfully solved these would generate incentives to jeopardize monetary policy stability, since in this case the ECB is forced to accommodate the lax fiscal policy and engage in bail-outs as we observe now. However, this literature has so far assumed that the ECB will keep its ability and willingness to perform uniform monetary policy, so that even if a bail-out is decided the limits and the conditions of the bail-out will be determined by the ECB. As we discussed above the recent undermining of the ECB's institutional setting has raised substantial concerns about whether this is indeed the case. In particular, individual member countries have been given the opportunity to modify the stance of the Union's monetary policy which

in turn has created incentives to apply monetary policy tools such as central bank's credit to commercial banks in a way that is prone to the emergence of common-pool type externalities.

This common-pool distortion of the incentives to create inflation has so far only been discussed by Aizenman (1992), Casella (1992) and von Hagen and Süppel (1994). Similar to the set-up analyzed in our essay Aizenman shows that the inflationary bias will be high if the optimal inflation rate is set by several decision makers rather than by a centralized decision maker. We generally come to a similar conclusion with regard to inflationary biases as Aizenman (1992). However, our approach differs from his in that we focus on the trade-off between the benefits of credit expansion and costs of inflation, while Aizenman (1992) is concerned with the optimality of inflation tax from a Laffer curve perspective. Cassella (1992) and von Hagen and Süppel (1994) discuss how the inflationary bias depends on the decision structure of the monetary union's central bank. While in our framework we allow for completely decentralized monetary policy within the union, these authors assume common monetary policy and discuss, which is the optimal design of the decision about these common monetary policy rules and what are the incentives of countries with small impact on the monetary decision making process to participate in the union.

The possibility of exploiting the ECB monetary policy tools as a common-pool has only been analyzed by few works, none of which explicitly covers inflation biases. In a policy paper Tornell and Westermann (2012a, 2012b) suggest that the implicit bank bail-outs given by the lax monetary policy and emergency funding in the euro area are an example for the common-pool problem, since each of the regional banking supervisor can (at least in the short-run) achieve the benefit of not having to bear the costs of bank liquidations, while it's paying only a minor share of the costs generated by the explosion of central bank's

credit to the banking sector. Further, Tornell (2012) discusses the emergence of overwhelming TARGET2 balances as an expression of the common-pool problem. He presents a formal general-equilibrium model on the political economy of TARGET2 balances.

Buiter (2012) presents a detailed review of the current ECB institutional framework and draws parallels between the ruble union and the current ECB policy. Indeed, Lipton and Sachs (1992) and Eichengreen et al. (1993) documented a similar free-rider problem faced by the Russian central bank during the disintegration of the Soviet Ruble Zone, 1991 - 1995. While the Central Bank of Russia maintained control over physical money creation, each central bank of the ruble zone had the authority to issue ruble credits. Lipton and Sachs conclude:

> *"[...] each of the fifteen independent states had a central bank with the ability to exercise an important degree of control over monetary policy. [...] In our view, there is no realistic possibility of controlling credit in a system in which several independent central banks each have the independent authority to issue credit. The reason is simple. Pressure is overwhelming in each of the states to "free ride" by issuing ruble credits at the expense of the rest of the system. It is a nearly self-evident proposition that a single currency area should have a single bank of issue."*

Our essay is also related to the recent literature on the potential risks stemming from the expansion of the central bank balance sheet. Williamson (2013) argues that while the Fed's balance sheet has increased by a factor of almost 4 between 2007 and 2013 no direct inflation consequences follow since the expansion simply counteracts misintermediation by the private sector. In his argument the price level in a monetary system close to the zero bound is determined by the demand and supply of all assets that can be intermediated and transformed into assets that are used in exchange. Given substitutability between private and public intermediation and maturity transformation

of these assets, the size of the central bank balance sheet is irrelevant for inflation. Our argument essentially differs from Williamson's in that we describe a segmentation of public and private asset markets along the borders of the Euro Area member countries that makes the size of central bank credit relevant.

Finally, our essay is reminiscent of the competition among bank regulators that has been modeled by Sinn (2003). While Sinn models the race-to-the-bottom with regard to capital-ratios, illustrating that national regulators neglect the external effect on other countries, his model could be extended to the decision of whether or not a bank is classified "solvent", or the quality of collateral acceptable for central bank refinancing.

6. Conclusions

In this essay we show how a tragedy-of-commons, stemming from the institutional shortcomings of the European Monetary Union, gives rise to excess central bank credit and an increased inflation bias.

We present a brief description of the institutional features of the EMU. We then discuss the inflation effects in the framework of a simple model of monetary policy where the central bank minimizes a loss function with two arguments: the output gap and inflation. We add two new elements two this model. First, we directly include a credit channel effect: the central bank can generate positive output changes by expanding credit to domestic banks. Second, we model the common-pool problem by assuming that while the positive credit channel effects are fully appropriated at "home" the inflation biases generated by the credit extensions and the increased money supply are shared across all union members.

We support the tragedy-of-commons argument and the implications of the theoretical model by presenting an empirical examination of the dynamics of central bank's credit, monetary aggregates and unemployment in the EMU. Plotting the dynamics of these variables we graphically show the abrupt expansion of central bank credit in some EMU countries, which correlates with unemployment, has not increased money supply and inflation in these countries.

We do not argue that a period of high inflation - or even hyperinflation - is inevitably around the corner, but rather that a decentralized monetary policy in a currency union gives rise to expansionary pressure and thus may lead to a *higher* inflation compared to a situation with only one central authority being able to create

money[71]. At the moment, a fragmented monetary policy and the resulting export of inflationary pressure may even be beneficial for the euro area as a whole by supporting price convergence and thus reducing internal balance-of-payments imbalances. Whether the currently observed expansionary bias will result in high inflation levels will crucially depend on whether the ECB will be able to implement an exit-strategy when the deflationary pressure loses momentum. In principle the ECB could centralize monetary policy at any time. It is, however, debatable on whether it can successfully implement a contractionary policy in spite of the disparities in member countries banking systems.

If a price stability target should be achieved in the long-run, the monetary policy common-pool problems presented in this essay illustrate the need for an institutional reform of the Union. Applying the implications of the literature focused on fiscal common pools problems to the area of monetary policy common-pool problems discussed in this essay would suggest that creating a stronger institutional framework, which is able to endogenize the externalities of excessive monetary policy expansion, is essential. In particular, a centralized decision making process about the key features of monetary policy and a uniform implementation of this policy can help mitigate the problems arising from the common-pool incentives to access central bank's credit. These should include both a centralized decision making about the solvency of banks, as well as going back to a uniform catalogue of eligible collateral. The joint Euro Area single supervisory mechanism in its currently scheduled form will not be sufficient both because it only covers a small share of banking institutions eligible to central bank credit and because it does not require the uniform treatment of collateral.

[71] A condition called a "key feature of a unified currency" by Friedmann (1992).

7. Appendix

Appendix A2.1: Interaction with a Barro-Gordon time inconsistency problem

In this appendix we analyze the interaction between the two new elements - a credit channel and a common pool problem - with the standard time inconsistency problem that derives from the Phillips curve trade-off in a Barro-Gordon setting. We show that the results presented above are independent from this other classical inflation bias in the literature.

A2.1.1: A single country

We keep the notation as above, and add the expectation about future inflation denoted by π^e. The utility function and output in a single country are as follows:

$$U(y,\pi) = \lambda(y - \overline{y_n}) - \frac{1}{2}\pi^2 \tag{6}$$

$$y = \overline{y_n} + \alpha(\pi - \pi^e) + y_c(\Delta d) \tag{7}$$

$$\text{with } \frac{\partial \pi}{\partial \Delta \mathrm{d}} > 0 \text{ and } \Delta m = \Delta \mathrm{d}.$$

Furthermore, we assume that agents are characterized by rational expectations.

LEMMA 1: *In a single country with Barro-Gordon time inconsistency problem and a credit channel of monetary policy, the inflation bias is:* $\lambda\left(\alpha + \frac{\partial y}{\partial \Delta m}\right)$.

PROOF: $\underset{\Delta m}{\text{ARG MAX}}\, U = \lambda\big(\alpha(\Delta m - \pi^e)\big) + y_c(\Delta m) - \frac{1}{2}(\Delta m)^2;\ \frac{\partial U}{\partial \Delta m}$

$$= \lambda\left(\alpha + \frac{\partial y}{\partial \Delta m}\right) - \Delta m = 0; \Delta m^* = \lambda\left(\alpha + \frac{\partial y}{\partial \Delta m}\right). \blacksquare$$

The optimal inflation $\Delta m^* = \lambda\left(\alpha + \frac{\partial y}{\partial \Delta m}\right)$ is larger than zero, and larger than the standard Barro-Gordon result, which is $\Delta m^* = \lambda\alpha$ in the simple setting. The existence of a credit channel adds a further motive to conduct expansionary monetary policy.

A2.1.2: A currency union

Now consider, again, the same setup for a currency union. Utility and output functions are given as follows:

$$U(y_i, \pi_i) = \lambda(y_i - \overline{y_n}) - \frac{1}{2}\pi_i^2 \tag{8}$$

$$y_i = \overline{y_n} + \alpha(\pi_i - \pi^e) + y_c(\Delta d_i) \tag{9}$$

$$\text{with } \frac{\partial y_i}{\partial \Delta d_i} > 0.$$

We make the same assumptions as above, namely, $\pi_i = \pi$, and $\pi = \frac{1}{n}\sum_{i=1}^{n} \Delta m_i$, as well as $\Delta m_i = \Delta d_i$.

PROPOSITION 1: *In a currency union with a Barro-Gordon time inconsistency problem and a credit channel of monetary policy, the inflation bias is larger than in a single country.*

PROOF: $\underset{\Delta m_i}{\text{ARG MAX}}\, U_i = \lambda\left(\alpha\left(\frac{1}{n}\sum_{i=1}^{n}\Delta m_i - \pi^e\right) + y_c(\Delta m_i)\right) - \frac{1}{2}\left(\frac{1}{n}\sum_{i=1}^{n}\Delta m_i\right)^2;$

$$\frac{\partial U_i}{\partial \Delta m_i} = \frac{1}{n^2}\left(\sum_{\substack{j=1\\ j\neq i}}^{n}\Delta m_j - n^2\frac{\partial y_i}{\partial \Delta m_i}\lambda - n\alpha\lambda + \Delta m_i\right) = 0;$$

$$\Delta m_i{}^* = n\lambda\left(\alpha + n\frac{\partial y_i}{\partial \Delta m_i}\right) - \sum_{\substack{j=1\\ j\neq i}}^{n}\Delta m_j;$$

In symmetric equilibrium: $\Delta m^* = \lambda\left(\alpha + n\frac{\partial y}{\partial \Delta m}\right);$

$$\lambda\left(\alpha + n\frac{\partial y}{\partial \Delta m}\right) - \lambda\left(\alpha + \frac{\partial y}{\partial \Delta m}\right) = \frac{\partial y}{\partial \Delta m}\lambda(n-1) > 0. \blacksquare$$

The inflation in equilibrium will be $\Delta m^* = \lambda\left(\alpha + n\frac{\partial y}{\partial \Delta m}\right)$.

Note that the original Barro-Gordon inflation bias is unaffected by our extensions. When comparing the optimal inflation rate in the currency union of the main part of the essay (without Barro-Gordon) and the appendix, we get exactly the standard inflation bias explaining the difference:

COROLLARY: *The tragedy of the commons does not affect the Barro-Gordon time inconsistency bias.*

PROOF: In a currency union without time inconsistency problem:

$$\Delta m_i{}^* = n\lambda\frac{\partial y_i}{\partial \Delta m_i};$$

In a Currency union with time inconsistency problem:

$$\Delta m^* = \lambda\left(\alpha + n\frac{\partial y}{\partial \Delta m}\right);$$

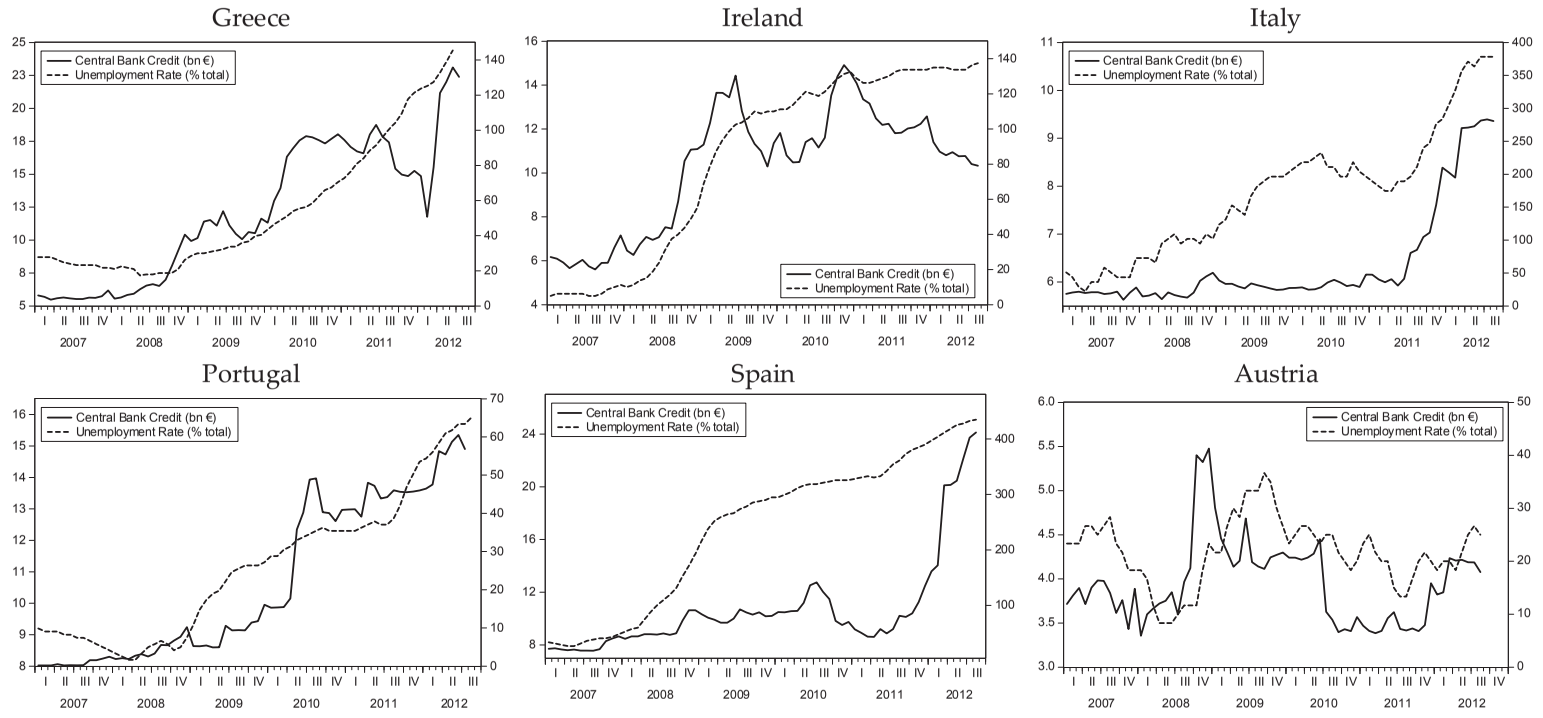
It follows that:

$$n\lambda\frac{\partial y_i}{\partial \Delta m_i} - \lambda\left(\alpha + n\frac{\partial y}{\partial \Delta m}\right) = \lambda\alpha. \blacksquare$$

The intuition for this corollary can be illustrated by analyzing the effect of a currency union on the marginal cost and benefit from inflation. As the benefits from inflation in the Barro-Gordon model derive from the impact of inflation on wages, the currency union will not affect the trade-off between the output and inflation. Printing more money will be associated with the average cost in terms of inflation, as above. But it will also lead only to the average benefit. As both are aligned, there is no additional incentive for printing money to make use of the Phillips-curve trade off.

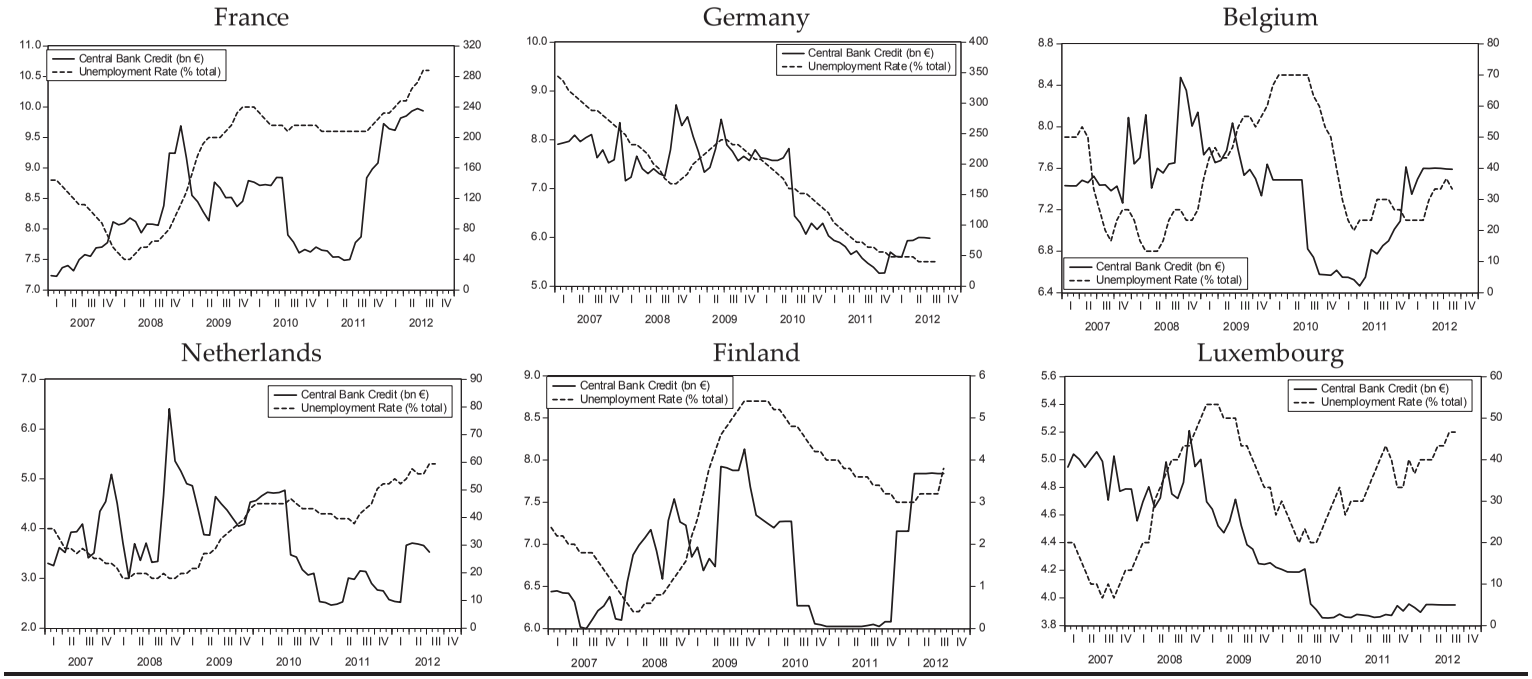
Appendix A2.2: Country-level figures

Figure 13 (Appendix): Central Bank Credit and Unemployment I



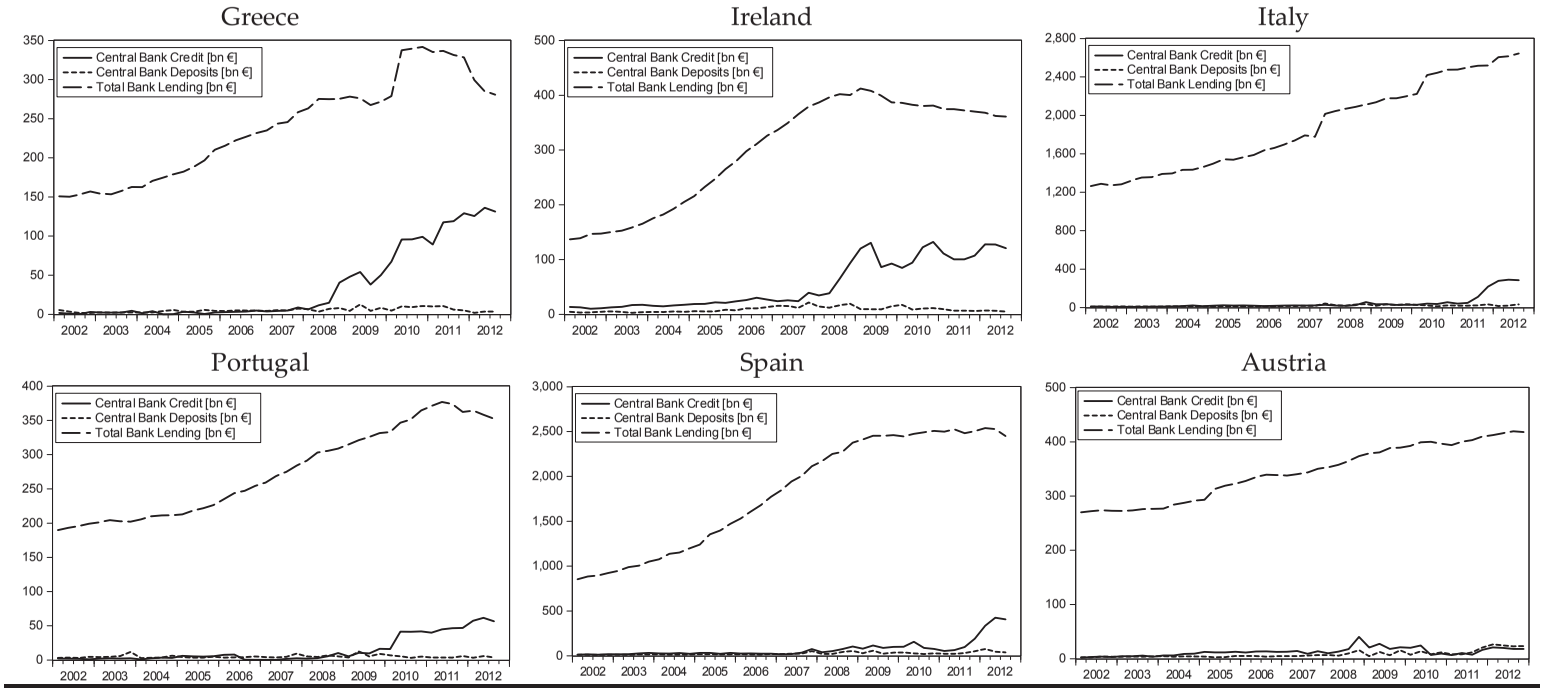
Notes: Figures show the credit of national central banks (bn. €, right scale) versus the total unemployment rate (%, left scale). Sources: International Financial Statistics, Euro Crisis Monitor, Eurostat.

Figure 14 (Appendix): Central Bank Credit and Unemployment II



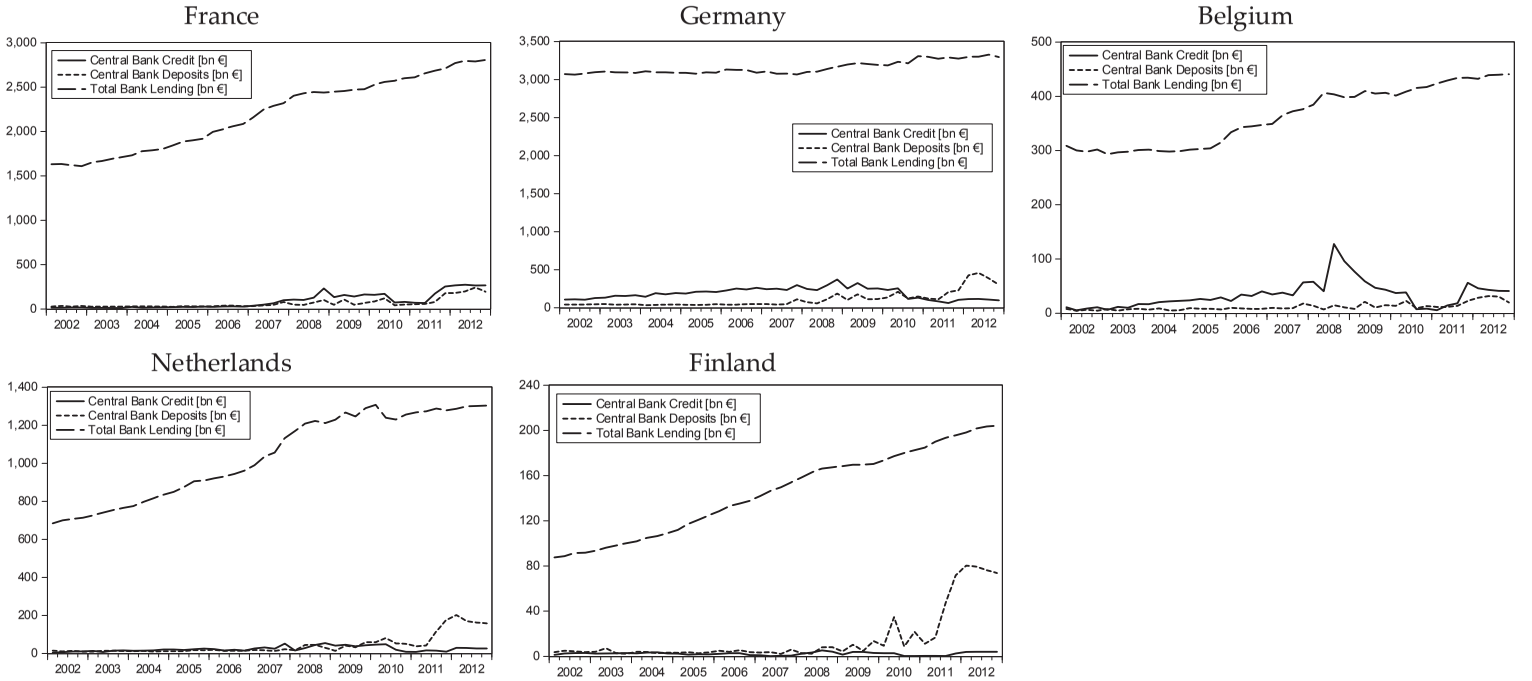
Notes: Figures show the credit of national central banks (bn. €, right scale) versus the total unemployment rate (%, left scale). Sources: International Financial Statistics, Euro Crisis Monitor, Eurostat.

Figure 15 (Appendix): Central Bank Credit and Total Bank Lending I



Notes: Figures show the credit of national central banks, the deposits of national central banks and the bank lending of the national monetary financial institutions (in bn €). Sources: International Financial Statistics.

Figure 16 (Appendix): Central Bank Credit and Total Bank Lending II



Notes: Figures show the credit of national central banks, the deposits of national central banks and the bank lending of the national monetary financial institutions (in bn €). Data on total bank lending not available for Luxembourg. Sources: International Financial Statistics.

Appendix A2.3: Regression analysis

In this section, we econometrically evaluate whether the co-movements of central bank credit, unemployment rates and inflation are statistically significant. We estimate Taylor-type reaction functions of national central banks in the euro area in a panel regression analysis.[72] The evidence presented is consistent with the view that before the crisis, central bank credit was primarily correlated with domestic inflation, while since the beginning of the crisis, it follows the unemployment rate more closely.

The execution of the empirical analysis faces several challenges. First, the time series are rather short. Secondly, there are some series that start from values close to zero, and increase in a short period to quite large numbers. In first differences, the later aspect leads to time series with initially very large growth rates, which decline over time. To avoid these data issues, we chose to estimate the subsequent regressions in log levels. Tables 21 and 22 show that estimating the linkages in levels is indeed appropriate; the variables are all non-stationary in levels and stationary in 1st differences. Furthermore, we cannot reject the null of no-cointegration. The later regression results can thus be interpreted as a cointegrating relationship among the variables. In order to address the small sample issue, we estimate all regressions as panel regressions and use monthly, seasonally adjusted data. We estimate our model using fixed effects to control for country specific effects and report robust clustered standard errors.[73]

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[72] See Table 26 of the appendix for a detailed description of the data sources.

[73] An F-Test confirms that the country specific constants are indeed not jointly equal to zero at the 1% level of significance. Furthermore, from a graphical analysis of the data we suspected cross-country heteroscedasticity. Indeed, a modified Wald-test rejects the null of homoscedasticity with $\chi^2_{12} = 7523.71$ at the 1% level of significance.

Table 21 (Appendix): Unit Root Properties

	Fisher type ADF with H_0: All panels contain (individual) unit roots	Breitung LM with H_0: Panels contain (common) unit root
VARIABLES		
NCB Credit	14.50 (0.935)	-0.42 (0.337)
ΔNCB Credit	370.77 (0.000)	-24.39 (0.000)
HCPI	18.45 (0.780)	20.37 (1.000)
ΔHCPI	192.40 (0.000)	-15.27 (0.000)
Unemployment	26.81 (0.313)	7.09 (1.000)
ΔUnemployment	103.30 (0.000)	-15.97 (0.000)

Notes: Probability values in parentheses. Variables in logs and differenced logs, respectively. Tests have been conducted for time series from 2001 onwards to ensure balanced panels.

Table 22 (Appendix): Cointegration Properties

	Error correction model based test by Westerlund (2007) with H_0: No cointegration			
	Statistics based on weighted avg. of individual estimates		Statistics based on pooled information	
VARIABLES	G_τ	G_α	P_τ	P_α
NCB Credit, HCPI, Unemployment	-2.25	-10.11	-7.13	-9.17
	(0.002)	(0.003)	(0.002)	(0.000)
with constant	-3.05	-15.69	-9.71	-14.77
	(0.000)	(0.000)	(0.000)	(0.000)
with constant and trend	-3.34	-17.1	-10.78	-17.91
	(0.000)	(0.051)	(0.001)	(0.000)

Notes: Probability values in parentheses. Lags and leads have been selected using AIC. Additionally, we performed a simple Kao type cointegration test based on the residual of a regression of NCB credit on unemployment and the HCPI. An ADF test statistic of $\chi_{24}^{-1} = 39.89$ and a respective p-value of 0.022 indicate that the residuals indeed do not contain a unit root, thus pointing to a cointegrating relationship.

In Table 23, we present the results for our benchmark regressions. In columns 1-4, we explain the amount of credit that is awarded by the respective national central banks to domestic commercial banks, by inflation and unemployment - a classical Phillips curve trade-off. Furthermore, we include a dummy variable that takes a value of 0 before the crisis and a value of 1 after the crisis. The beginning of the crisis, which marks a regime change in monetary policy, as discussed above, is identified in several ways. We use (1) the beginning of 2007, as many

other authors have done in the literature. We furthermore use August 2007, where the Target2 clearing system was introduced, September 2008, where Lehman brothers collapsed and October 2008, where the ECB moved to full allotment tenders as robustness tests.

In Table 23, the coefficients β_1 and β_3 measure the significance of the variables before the 2007 financial crisis. β_2 and β_4 measure the partial effect of each variable after the crisis - here the respective variable is interacted with the dummy variable for the crisis. Finally, the sums of $\beta_1 + \beta_2$ and $\beta_3 + \beta_4$measure the total effect of each variable during the crisis period.

This regression results are consistent with the stylized facts presented above, where the graphs clearly show a positive correlation between central bank credit and unemployment in the post-2007 period.

In the pre-crisis period, it is interesting that central bank credit apparently followed inflation. The variable for prices is highly statistically significant, but the unemployment variable is insignificant. This is consistent with the official goal of the ECB to achieve price stability. In the aftermath of the crisis, however, this pattern appears to have changed. The F-tests in the end of Table 23 indicate that prices are no longer a significantly correlated with central bank credit. On the other hand, the unemployment variable has been highly significant during this period. This result indicates a regime shift in monetary policy.

Table 23 (Appendix): Benchmark Regression and Varying Crisis Dates

Dependent Variable: Central Bank Credit				
	(1)	(2)	(3)	(4)
Variables	Jan 07	Aug 07	Sep 08	Oct 08
HCPI (β_1)	4.870***	4.502***	5.110***	5.282***
	(4.09)	(3.71)	(5.17)	(5.37)
HCPI x Crisis Dummy (β_2)	-3.454	-7.365	-8.652	-8.657
	(0.58)	(1.15)	(1.40)	(1.42)
Unemployment (β_3)	0.327	0.162	0.026	0.021
	(0.84)	(0.41)	(0.06)	(0.05)
Unemployment x Crisis Dummy (β_4)	1.278*	1.579**	1.740**	1.764**
	(1.95)	(2.33)	(2.43)	(2.45)
Crisis Dummy	13.885	31.835	37.499	37.434
	(0.50)	(1.07)	(1.31)	(1.33)
Fixed Effects	yes	yes	yes	yes
F-test ($\beta_1 + \beta_2 = 0$)	0.06	0.21	0.33	0.31
F-test ($\beta_3 + \beta_4 = 0$)	22.51***	17.53***	14.44***	14.56***
R^2 (overall)	0.16	0.18	0.19	0.19
Observations	1800	1800	1800	1800

Notes: All variables in logged levels. Robust t-statistics in parentheses account for possible within- and between-cluster correlation as well as serial correlation (see e.g. Williams (2000)); *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively.

We test for the robustness of this main empirical result in several ways. Firstly, in Table 24, we perform an outlier analysis. To see whether our results are driven by any individual countries, we re-estimate our benchmark regression above on a subset of countries that leave one of the crisis countries out of the analysis, at a time. We see that the regression coefficients and confidence intervals do not change substantially, when leaving out any individual country.

Table 24 (Appendix): Outlier Analysis

Dependent Variable: Central Bank Credit					
	(1)	(2)	(3)	(4)	(5)
Variables	GRC	IRL	ITA	PRT	ESP
HCPI (β_1)	4.414***	4.564***	5.318***	5.564***	5.333***
	(3.56)	(3.39)	(4.13)	(4.87)	(3.69)
HCPI x Crisis Dummy (β_2)	-6.753	-3.333	-4.878	-6.005	-3.948
	(1.11)	(0.54)	(0.77)	(1.07)	(0.64)
Unemployment (β_3)	0.501	0.355	0.263	0.321	0.246
	(1.40)	(0.90)	(0.64)	(0.77)	(0.58)
Unemployment x Crisis Dummy (β_4)	1.013	1.315*	1.305*	1.231*	1.579*
	(1.79)	(1.89)	(1.99)	(1.86)	(2.19)
Crisis Dummy	29.829	13.269	20.462	25.881	15.623
	(1.07)	(0.47)	(0.70)	(1.00)	(0.55)
Fixed Effects	yes	yes	yes	yes	yes
F-test ($\beta_1+\beta_2=0$)	0.18	0.04	0.01	0.31	0.01
F-test ($\beta_3+\beta_4=0$)	25.99***	15.52***	23.33***	14.56***	23.27***
R^2 (overall)	0.14	0.13	0.15	0.18	0.12
Observations	1661	1649	1649	1649	1649

Notes: All variables in logged levels. Robust t-statistics in parentheses account for possible within- and between-cluster correlation as well as serial correlation (e.g. Williams (2000)). *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively.

We furthermore estimate our benchmark regression with different estimation methods. In our benchmark regression we used a simple panel regression with fixed effects. In Table 25, we also implement (1) a random effects model, (2) a simple pooled OLS regression and (3) a fixed effects regression with alternative robust standard errors based on Driscoll and Kraay (1998). In our case, the additional orthogonality condition imposed in random effects models does not hold, however, as a Sargan-Hansen test based on an artificial regression approach rejects the random effects model in favor of the fixed effects model with a $\chi_5^2=82.08$ at the 1% level of significance.

In Columns (4) and (5) of Table 25 we present two regressions that control for endogeneity. In regression (4) we use lagged values as instruments in a 2-stage least squares regression. In regression (5), we exploit the heteroscedasticity of our data set for identification, following Lewbel (2012). Both 2SLS regressions do not seem to be under- or

overidentified at the 5% level of significance as indicated by Kleibergen-Paap rk LM statistics and J-statistics, respectively. F-Statistics > 10 in the first stage regressions additionally suggest that weak identification is not a problem either. Furthermore, a modified Wald test rejecting homoscedasticity at the 1% level in the first stage regression of column (5) indicates that the Lewbel (2012) is indeed a valid approach for our data set.

The significance levels of some coefficients changes somewhat across different estimation techniques. However, the Wald-test at the bottom of each table that measures the impact of the variables in the crisis period remains remarkably robust.

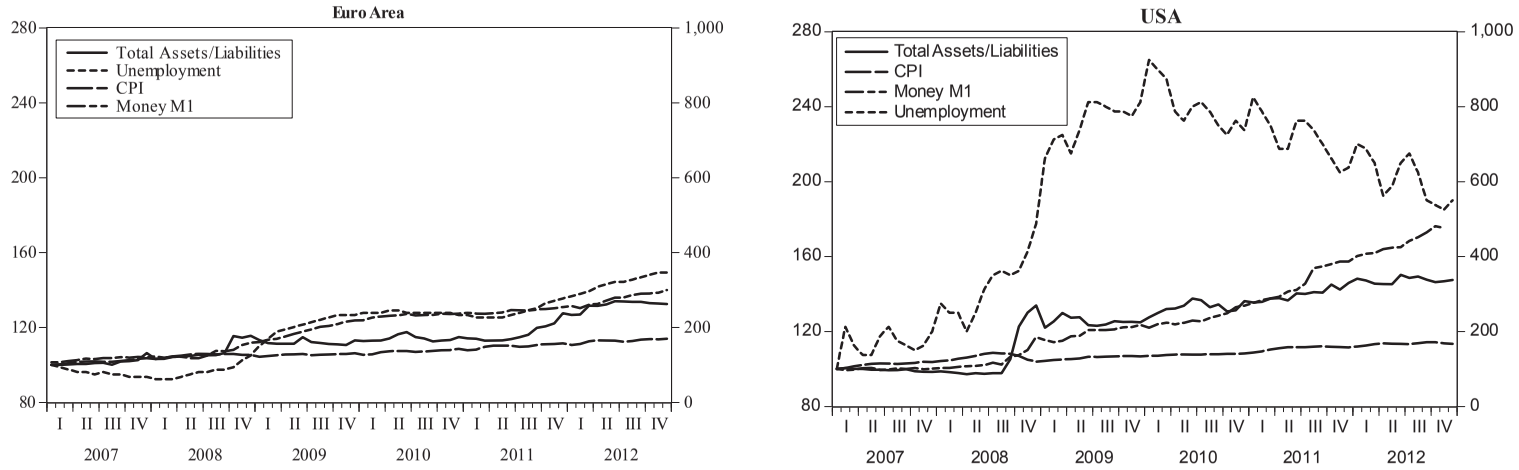
Table 25 (Appendix): Different Estimation Methods

Dependent Variable: Central Bank Credit					
	(1)	(2)	(3)	(4)	(5)
Variables	RE	P-OLS	DK	2SLS IV Set A	2SLS IV Set B
HCPI (β_1)	4.876***	4.366***	4.870***	2.533	7.519**
	(4.10)	(4.94)	(6.24)	(1.24)	(2.27)
HCPI x Crisis Dummy (β_2)	-3.468	-6.080***	3.454	-4.985	-11.935
	(0.58)	(3.79)	(1.28)	(0.81)	(0.91)
Unemployment (β_3)	0.322	-0.008	0.327***	0.375	0.24
	(0.82)	(0.07)	(2.94)	(0.91)	(0.53)
Unemployment x Crisis Dummy (β_4)	1.279*	1.200***	1.278***	1.073*	1.485*
	(1.96)	(3.59)	(5.24)	(1.66)	(1.90)
Crisis Dummy	13.947	26.487***	13.885***	-25.026	52.953
	(0.51)	(3.59)	(1.13)	(0.89)	(0.88)
Fixed Effects	yes	yes	yes	yes	yes
F-test ($\beta_1+\beta_2=0$)	0.06	1.64	0.32	2.04	0.18
F-test ($\beta_3+\beta_4=0$)	22.60***	110.19***	52.34***	16.43***	19.40***
R^2	0.16	0.16	0.16	-	-
Observations	1800	1800	1800	1789	1789

Notes: All variables in logged levels. Again *, **, *** indicate variables significant at 10%, 5%, and 1% level respectively. The first column shows the results of a random effects model with the same robust t-statistics used in the benchmark regression. Column (2) shows a simple pooled OLS regression. Column (3) presents a fixed effect regression with Driscoll and Kraay (1998) standard errors. Column (4) presents a 2SLS regression using the first lagged value of the explanatory variables as instruments. Additionally, column (5) uses instruments based on the Lewbel (2012) identification approach.

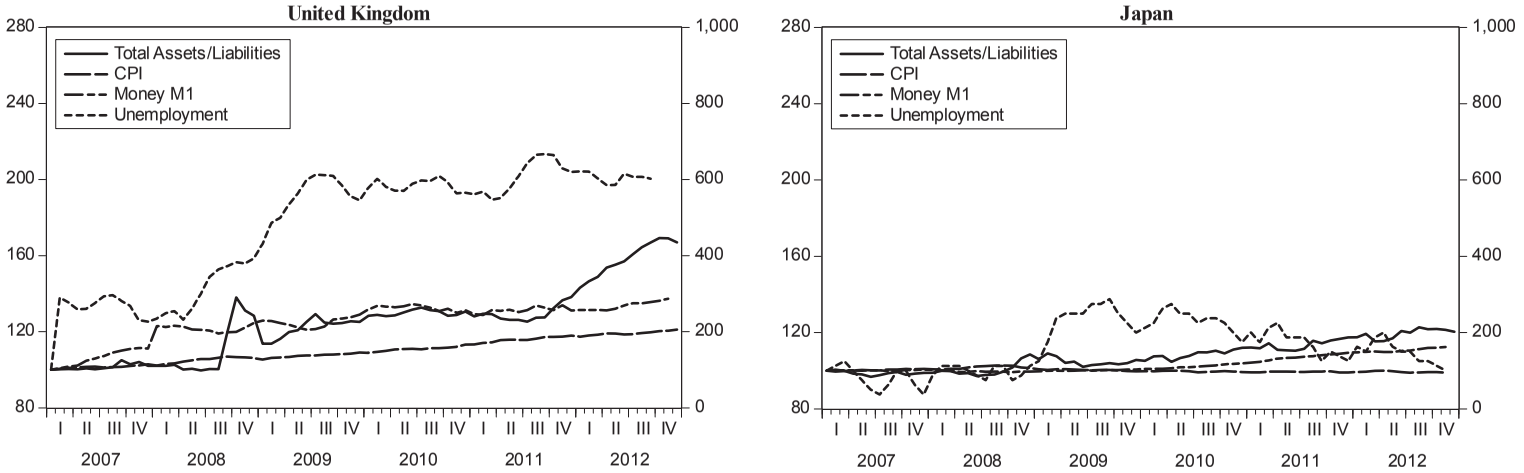
Appendix A.2.4: Monetary policy of major central banks

Figure 17 (Appendix): Monetary Expansion, Unemployment and Inflation I



Notes: Figures show central banks total assets/liabilities (right scale), the unemployment rate, the price level and monetary aggregate M1 (left scale). All series as index (01/2007 = 100). Data sources: International Financial Statistics, Central Banks Balance Sheets.

Figure 18 (Appendix): Monetary Expansion, Unemployment and Inflation II



Notes: Figures show central banks total assets/liabilities (right scale), the unemployment rate, the price level and monetary aggregate M1 (left scale). All series as index (01/2007 = 100). Data sources: International Financial Statistics, Central Banks Balance Sheets.

Appendix A2.5: Data sources

Table 26 (Appendix): Data Sources

Time Series	Source	Code/Name
Unemployment	Eurostat	une_rt_m
Harmonized Consumer Price Index (HCPI)	Eurostat	prc_hicp_midx
TARGET2 Balances	Euro Crisis Monitor (see Steinkamp & Westermann (2014) or Essay I)	
Central Bank Credit	International Financial Statistics	12E..ZK
Central Bank Deposits	International Financial Statistics	14C..ZK
Total Bank Lending	International Financial Statistics	32A..ZK, 32S..ZK
Monetary Aggregate M1	Datastream (National Central Banks)	National contr. to M1

Notes: We focus on member countries of the euro area, which joined the common currency before 2007 and for which data are available (i.e. Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain). For Greece data are from 01/2001 onwards, for all other countries the series are available from 01/2000 until 07/2012.

ESSAY III

SPECULATIVE ATTACK IN THE EURO AREA: FACTS AND EXPLANATION

1. Introduction

It is conventional wisdom among researchers and policy makers that corner solutions in the choice of the exchange rate regime safely protect against any form of speculative attack; Countries should either let the exchange rate freely float or commit to a currency union. We argue that specific institutional characteristics of the euro area make it theoretically possible for ongoing capital flight to end in a speculative attack. Furthermore, such an attack may already have taken place in December 2011.

Currency crises are usually a result of inconsistent monetary policy, with the central bank trying to achieve two or more incompatible targets. Prior to the enormous liquidity injection via long-term refinancing operations (LTRO) of 2011, the ECB followed an exit-strategy in the aggregate, by raising interest rates and tightening collateral requirements. At the same time, the continued full allotment policy led to sizable monetary expansions in some member countries. We point out the conflicts arising from this dichotomy.

First, we document key stylized facts taking account of fundamental and policy variables. We show that the empirical patterns surrounding the first LTRO in December 2011 are reminiscent of a speculative attack on a fixed exchange rate system – such as Mexico 1994.

Secondly, we rationalize these developments in a portfolio balance model of capital flight in a currency union. While no *technical* limit for capital flight exists, investors engaging in a flight-to-safety will at some point anticipate a situation in which they can no longer avoid taking losses.

In the presence of internal capital flight, the stock of refinancing credit at the national central banks of the receiving countries plays a role similar to international reserves in fixed exchange rate regimes. As long as refinancing credit in the receiving country is available, investors can buy high quality assets in exchange for low quality ones at a discounted effective rate of exchange. This discount at least equals the price effect of the marginal decrease in demand for lower quality assets. With refinancing credit at zero, on the other hand, investors would have to write-down losses. Once refinancing credit reaches a critically low limit and investors extrapolate its steady depletion, they will at some point try to be among the first 'to get their money out'; a speculative attack occurs. Our results suggest that such a situation may have forced the ECB to either abandon the common exchange rate or to give up on its monetary target. With the decision to conduct the LTRO, it decided for the latter.

The essay is structured as follows. In Section 2 we present empirical patterns that are reminiscent of a speculative attack on a fixed exchange rate system. Section 3 describes the interaction of central bank policies and capital flight, and compares it to the Mexican tequila crisis. In Section 4, we present a portfolio balance model of capital flight. In Section 5, we link the model to the stylized facts. We then discuss the possibility of additional political limits in Section 6. Section 7 concludes.

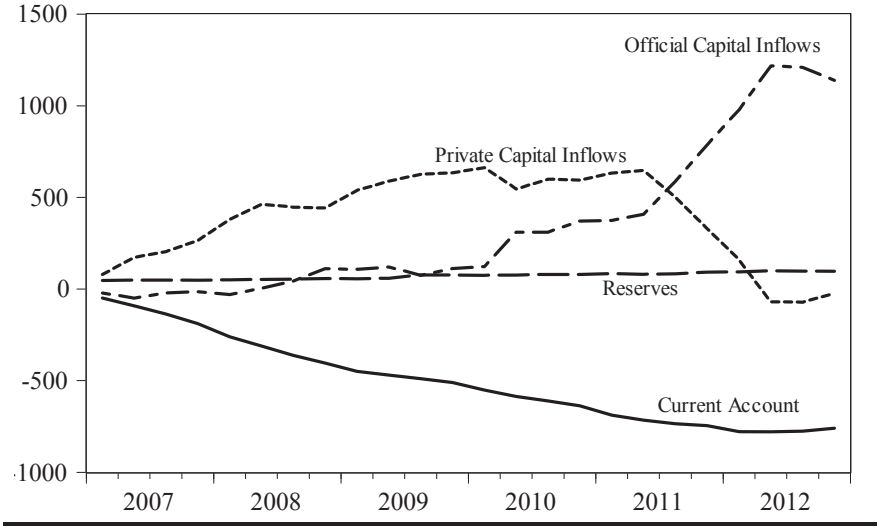
2. Stylized facts

We start our analysis by taking account of the pattern of key macroeconomic variables. In the next section these empirical facts will be used as a basis for the theoretical analysis.

STYLIZED FACT 1: *Since the beginning of the crisis, there has been a continuous path of current account deficits.*

The first empirical observation is that there has been a continuous process of current account deficits in Greece, Ireland, Italy, Portugal and Spain - GIIPS for short. The current account deficit is the 'usual suspect' that has been identified as the fundamental cause of balance of payments crises in the literature. In Figure 19, which adds up current account deficits in the GIIPS, one can clearly see that there has been a uninterrupted, continuous decline of the cumulative current account balance until 2012, when the process appears to have stabilized at about 760 bn €. The two dashed lines show how this current account deficit has been financed. Up to 2011 private capital inflows have been the largest source of financing. Since mid-2009, public flows have also become an important source of financing. Public flows in this graph include all components of the public rescue funds (i.e. bilateral loans, IMF lending, EFSF, EFSM, ESM and TARGET2 balances). Since the third quarter of 2011 public flows have been the largest source of current account financing, while private flows have even reversed since the first quarter of 2012.

Figure 19: Balance of Payments and Reserves of GIIPS Countries

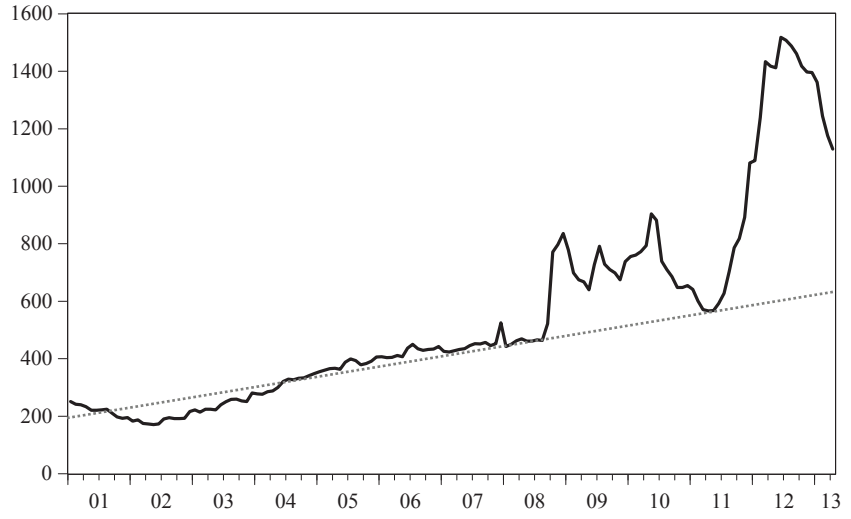


Notes: The figure shows the cumulative current account, the cumulative capital account split into private and public sector, and the change in central banks' reserves. All series in bn. €. Sources: IFS, ECB, Euro Crisis Monitor.

STYLIZED FACT 2: *The ECB has increased refinancing credit to private banks in 2008, but it has returned to trend-growth by the beginning of 2011.*

At the peak of the financial crisis, in October 2008, the ECB had reacted with a full allotment policy, which led to an expansion of refinancing credit to private banks by 372 bn. €. However, since then, it has managed to return aggregate lending to private banks back to its trend growth. The return to trend growth was not only due to a reduced demand for refinancing credit, but rather a result of an aggregate policy reversal of the ECB.

Figure 20: Refinancing Credit



Notes: Figure shows total refinancing credit of Eurosystem central banks (solid line). The dotted line represents a projection of the ESCB refinancing credit based on its pre-crisis trend. All series in bn. €. Source: ECB.

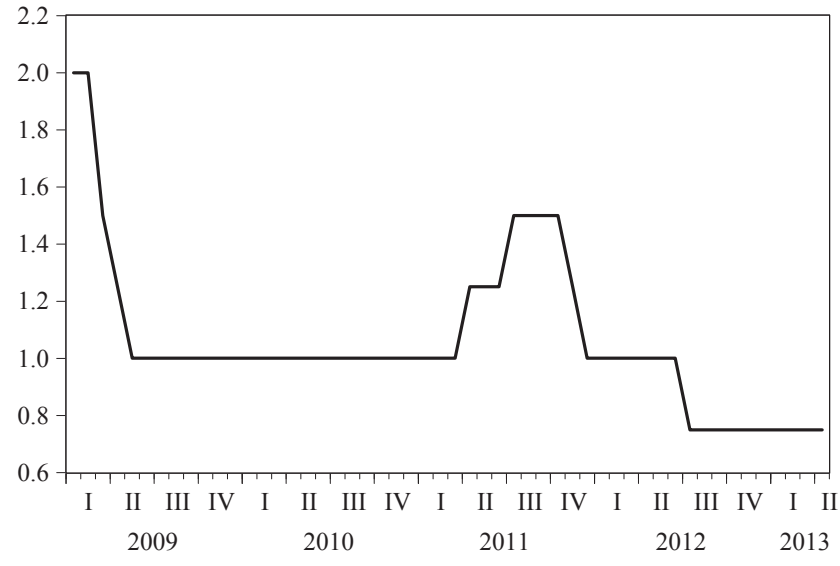
Stylized Fact 3: *Since mid-2009, the ECB has started to pursue an exit-strategy.*

Since about mid-2009, it has gradually started an exit-strategy that can be seen by the tightening of collateral standards, as well as the increase in the refinancing rates in the beginning of 2011. For example the ECB decided on additional requirements for Asset-backed securities (November 2009), suspended the use of foreign-currency debt instruments (April 2010), applied higher haircuts (July 2010) and underlined that the ECB is able to "suspend, limit or exclude counterparties' access to monetary policy instruments on the grounds of prudence" and to reject or limit the use of assets submitted as collateral by specific banks (October 2010).[74] Moreover, ECB officials started

[74] A complete description of changes in collateral requirements is given in Eberl & Weber (2014).

talking about exit-strategies and increased the main refinancing rate from 1.0% in the first quarter of 2011, to 1.5% in the third quarter.[75] By mid-2010 the media widely regarded the ECB monetary policy as in the process of exiting from its exceptional credit measures.[76] [77]

Figure 21: Refinancing Rate



Notes: Figure shows Eurosystem's refinancing rate [%]. Source: ECB.

STYLIZED FACT 4: *Aggregate refinancing credit in the Eurosystem masks asymmetries at the national central banks of the Eurosystem.*

This aggregate exit-strategy, however, has been masking asymmetries across countries' national central banks. While raising the interest rate and tightening collateral requirements, the ECB has

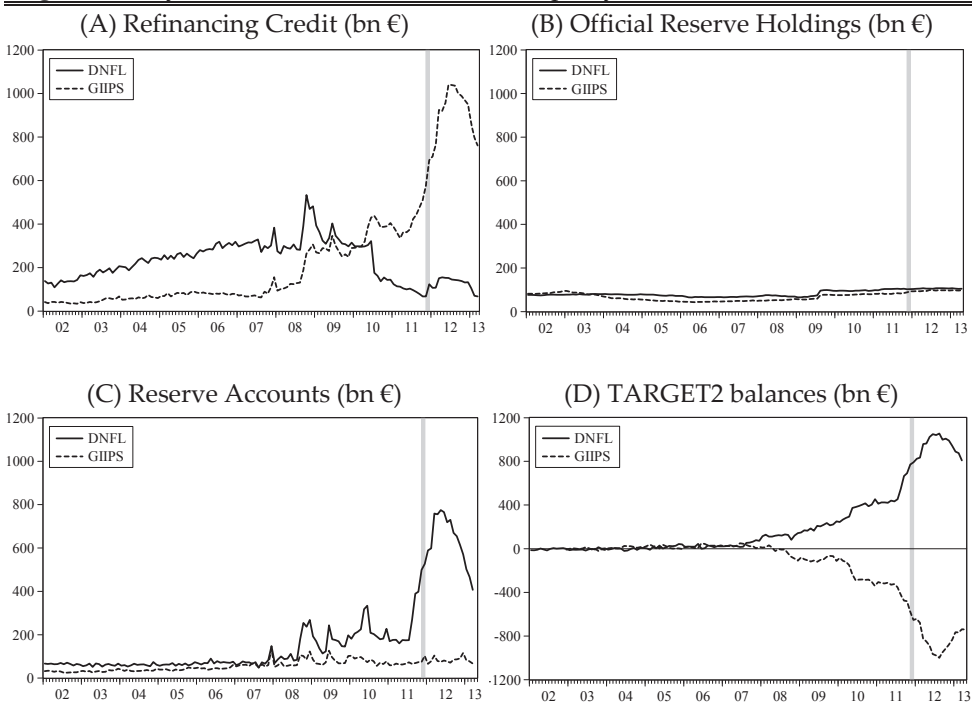
[75] See e.g. the speech "The ECB's exit strategy" of former ECB President Trichet on September 4th, 2009, in Frankfurt.

[76] See e.g. "ECB sticks to its plan for `exit strategy'", Financial Times, October 2010.

[77] Throughout the crisis period, official reserves and currency in circulation stayed rather constant compared to their pre-crisis trends.

maintained its full allotment policy; and even reduced collateral standards for some specific countries[78]. As a consequence, refinancing credit in some countries kept expanding, even though the aggregate policy was getting more restrictive.

Figure 22: Asymmetries between Core and Periphery Central Banks



Sources: IFS, Euro Crisis Monitor.

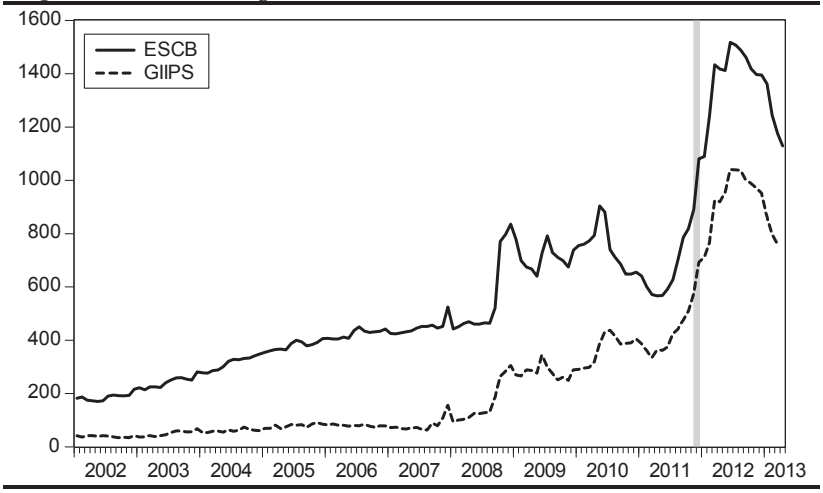
Figure 22 displays the main patterns of national central banks' (NCB) balance sheets in the GIIPS and Germany, Netherlands, Finland and Luxembourg (DNFL). In the upper left quadrant, one can see that central bank credit has been expanding continuously in the GIIPS, while - after a peak in 2008/9, it has been falling in the DNFL. As official reserve holdings where nearly unaffected - unlike in other balance of

[78] For example on May 3rd, 2010, the ECB suspended the minimum credit rating threshold in the collateral eligibility requirements in the case of marketable debt instruments issued or guaranteed by the Greek government.

payments crises - this process of asymmetric liquidity provision has led to large claims and liabilities across national central banks, the so-called TARGET2 balances (See Sinn & Wollmershäuser (2012)). At their peak in August 2012 DNFL had accumulated 1056 bn. € in TARGET2 claims, while GIIPS had 1000 bn. € liabilities.

Asymmetries also existed on the liability side of the balance sheets. While in the GIIPS, excess reserves - reserves that exceeded the minimum reserve requirement - have been close to zero, banks in DNFL have accumulated excess reserves on a scale that is nearly identical to their respective central banks' TARGET2-claims, i.e. the banks appear to have borrowed the liquidity in GIIPS and transferred it to DNFL. As there was no additional demand for such liquidity, the money has been "parked" at the central banks, in particular the Bundesbank, which in mid-2012 had around 465 bn. € of private bank deposits. As discussed in Sinn and Wollmershäuser (2012) and Garber (1999, 2010) this pattern can be interpreted as a process of intra-Euro Area capital flight.

Figure 23: Refinancing Credit (bn €)



Notes: The figure shows the actual refinancing credit of the European System of Central Banks (solid) and the GIIPS (long dashes). Sources: ECB, Euro Crisis Monitor, own calculations.

STYLIZED FACT 5: *Without monetary expansion in the aggregate, the process of capital flight would have reached a limit in the end of 2011.*

This double strategy - a contraction in the aggregate with a parallel expansion in some countries - was bound to lead to a conflict eventually, when the total refinancing credit provided by the GIIPS would have exceeded the trend growth of aggregate refinancing credit, to which the ECB had returned by the beginning of 2011. Figure 23 shows that by the fourth quarter of 2011 the two developments would have clashed, and would have been incompatible to each other.

Ex ante, markets could not have known how the ECB would react to such a conflict point: Would it enforce the aggregate exit strategy, or would it accommodate the expansionary path of the NCB's in the GIIPS by providing liquidity in the aggregate? When the gap between refinancing credit in the GIIPS and the trend-growth projection of the aggregate reached a critically low level, there was tension in the markets.

STYLIZED FACT 6: *Market sentiment surged in the first week of December 2011.*

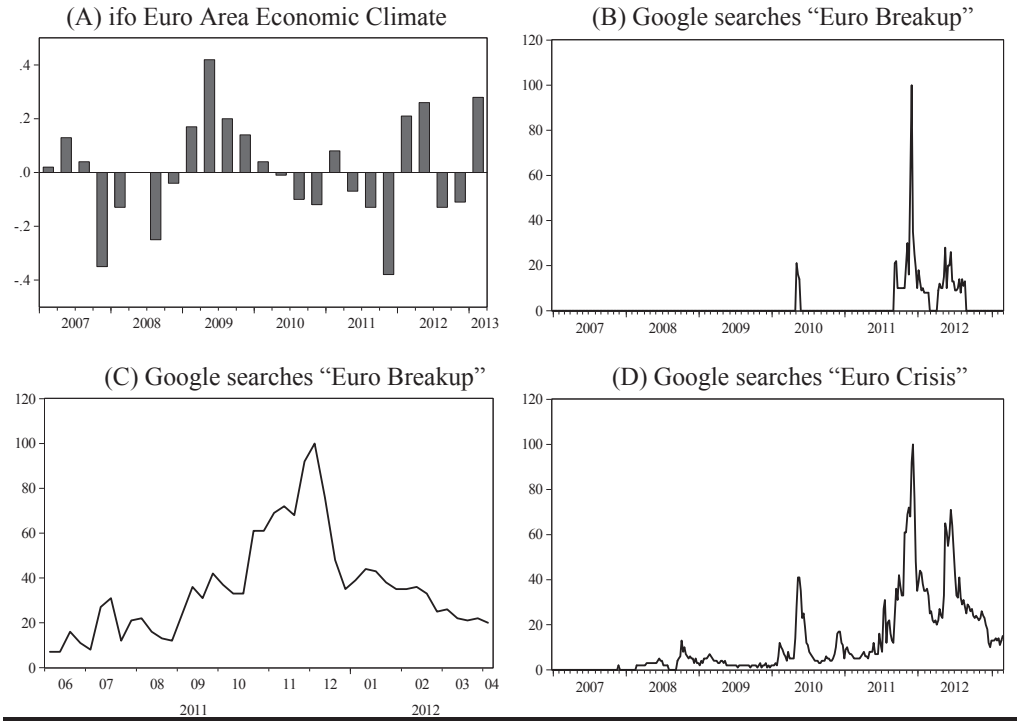
Tension in the markets was visible in several variables of market sentiment. Panel (B) of Figure 24 shows the changes in the Economic Climate Index of the ifo Institute. The index fell more sharply in the fourth quarter, than in any other quarter during the crisis. Also Google searches on terms like *euro breakup* (Panel (B)) or, more generally, *euro crisis* (Panel (D)) have their global maximum in the end of 2011.[79]

To identify the exact timing, Panel (C) plots the relative search volume for the term *euro breakup* in weekly data. The spike in market

[79] This is consistent with evidence of Shambaugh et al. (2012), who document that the implicit breakup probability in private betting markets reached its maximum in December 2011. At this time, 65% of participants predicted the exit of at least one country from the euro area.

sentiment, visible in quarterly and monthly data, mainly seems to be attributable to a surge in the first week of December.

Figure 24: Market Sentiment



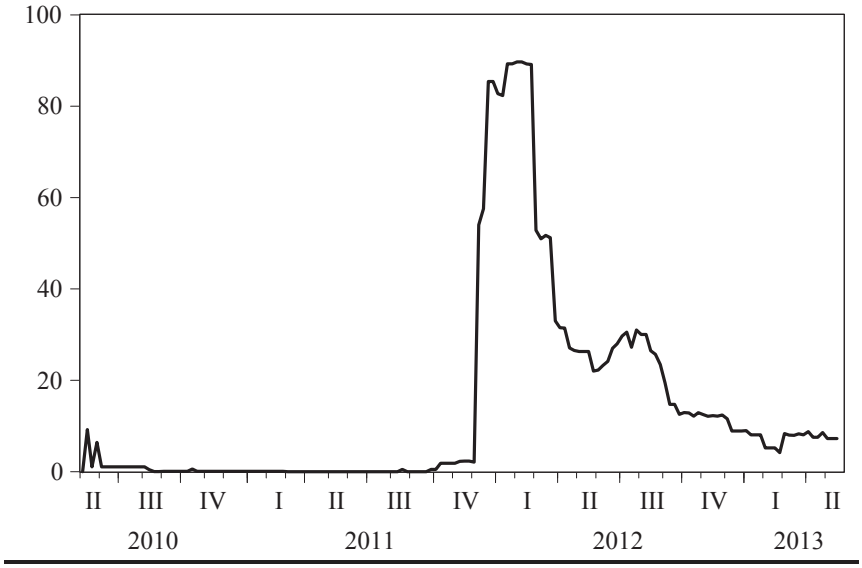
Sources: ifo Institute, Google Application *Trends*.

STYLIZED FACT 7: *Markets started using the ECB-FED swap-line on December 7th, 2011.*

The tension in the markets was also visible in the use of the ECB-FED swap line. The markets' understanding that the NCBs' expansionary course - that was crucial for sustaining the current account deficits illustrated in Figure 19 above - would soon no longer be consistent with the aggregate ECB exit-strategy, has generated what in our view is best described as a speculative attack in the Euro Area. The knowledge that not everyone might be able to 'get his money out' has triggered an attack where uncoordinatedly market participants tried to get their money out

at once, when the space between aggregate refinancing and NCB's refinancing hit a critically low level.

Figure 25: ECB - U.S. Dollar Liquidity Swap Operations [bn. USD]



Source: Federal Reserve Bank of New York.

The timing of the attack is best illustrated in weekly data on the Euro-USD swap line, which is displayed in Figure 25. This swap-line was re-opened in May 2010 when central banks where already sensing some tension in the financial markets. Figure 25 shows that, since then, this swap-line has hardly been used until the early days of December 2011. In order to interpret this graph which shows a sharp spike on December 8th, 2011, it is important to be aware of the exact institutional timing of monetary policy operations.

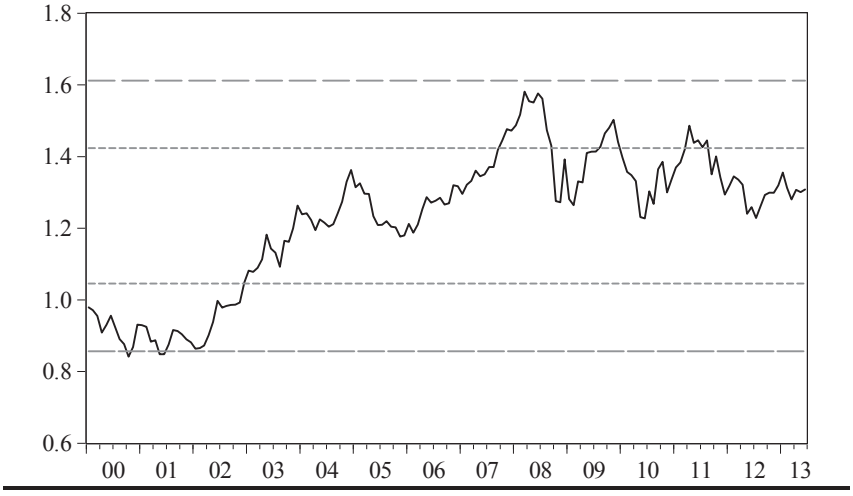
In order to borrow from the NCBs in regular open market operations or swap-lines, private banks need to place their requests for funding already the day before the day of the allotment, i.e. the policy makers at the ECB knew the demand for FX-loans via the swap-line the evening before the monetary expansion often referred to as 'big bazooka' has been announced. A big jump in FX-lending would have been

interpreted as a sign of the beginning process of currency substitution, a clear signal of an imminent balance of payments crisis of the Euro Area as a whole: As capital flight from the GIIPS to DNFL would soon no longer be feasible, there was the apparent beginning of capital flight outside of the Euro Area.

STYLIZED FACT 8: *The ECB abandoned its aggregate exit strategy in the morning of December 8th, 2011.*

To prevent this path of events, the ECB was forced to abandon its exit-strategy, and announced in the morning of December 8th that it would flood the markets with liquidity by (a) reducing the minimum reserve requirement, (b) lowering the collateral standards and (c) offering a 3-year LTRO. In the following weeks, the demand for FX-loans declined again. During the whole time, the exchange rate relative to the US dollar remained stable (See Figure 26).

Figure 26: Exchange Rate [$/€]



Notes: The graph shows the euro area exchange rate [$/E]. Short and longer dashed lines represent one, respectively two, standard deviations from the mean. Source: International Financial Statistics (IFS).

3. Types of capital flight

To explain some of the stylized facts theoretically, it is useful to first look at different types of capital flight and ask i) when do investors engage in capital flight and ii) how does capital flight might interact with the central bank's policy objectives.

The unsuccessful type

A simple thought experiment exemplifies that successful capital flight is usually not possible from an investor's point of view.[80] Suppose an Italian investor wants to sell Italian government bonds, and invest in German bunds instead. He packs them into his backpack and takes the train from Milano to Frankfurt. Upon arrival, however, he will still find the same old bonds in his backpack. Trading in Frankfurt, however, is only possible at market rates. This for itself may be unfavorably as the investor might be forced to write-off any difference between the nominal and the market value of his bond holdings.

The important thing to note, however, is that the investor's net worth not only decreases if the bond was accounted for using historical cost accounting. Even if the balance sheet discloses the current market value, the investor is likely to suffer a decline in net worth when selling the bond to other investors. The relative supply of bonds does not change short-term, thus any marginal change in demand will completely be offset by price adjustments of both bonds, making (aggregate) capital flight unprofitable.

[80] See also Sinn & Westermann (2005) and Westermann (2012) who both stress this distinction with the help of a similar "Friedmanian" experiment.

Capital flight usually becomes successful (and dangerous) when it is possible for investors to play off different policy objectives of a country against each other. A prime example for this scenario is the Mexican peso crisis in 1994 ("tequila crisis").

The Mexican type[81]

After the assassination of Luis Donaldo Colosio, during the presidential campaign 1994, the inflows of private capital fell precipitously. The Mexican peso devaluated and interest rates increased. This, however, did not stop capital outflows. In order to prevent a recession, the central bank expanded domestic credit to alleviate any further increase in interest rates. More specifically, the Banco de Mexico bought securities from the private as well as the public sector at interest rates lower than what international investors would have been demanded. In this case, capital flight is successful from an investor's perspective – they were able to avoid the price effect of the marginal change in demand. While the expansion of domestic credit kept interest rates low, it also hindered an adjustment of the current account. To cover the excess of imports over exports, Mexicans converted pesos – from their sales to the central bank – into foreign exchange, mainly US Dollar. The Banco de Mexico was committed to a fixed exchange rate regime and thereby sold the importers the needed foreign exchange to cover their deficits. Panel (A) of Figure 28 clearly shows how the fall in foreign reserves has been the mirror image of a rise in domestic credit. The loss of reserves triggered a self-fulfilling crisis and speculative attack in December 1994, when reserves had been run down to 6 bn. US Dollar. Eventually, the peso devalued by 15 percent.

[81] A more detailed description is given in Sachs, Tornell and Velasco (1996).

It is often believed that such an attack is not possible within a currency union. Obviously, current account deficits and capital flight within a currency union do not drain the central bank's foreign reserves. However, capital flight in a currency union may still face limits.

The European type

Suppose our foreign investor wants to change foreign bonds into home bonds, i.e. he wants to engage in capital flight from low to high quality assets.

The investor will now pledge the bonds as collateral to his national central bank to obtain further central bank deposits.[82] The newly created deposits, however, will not stay on the NCB balance sheet for long, as they will now be wire-transferred via the (TARGET2-) clearing system to the reserve account of the other investor at his central bank. This leads to a Target-liability of the sending NCB, and a Target-claim of the receiving one. The investor in the home country now has excess reserves with his central bank. As his demand for central bank liquidity did not change (and because excess reserves pay only very little interest), he will reduce his need for refinancing credit by the same amount. This frees up some of the collateral he pledged to his NCB, which he can now send to the foreign investor. Figure 27 depicts this process of capital flight in the T-accounts of the participating institutions.

[82] Actually, these bonds do not appear on the NCB balance sheets, they are instead simply earmarked in the balance sheets of commercial banks. For our results to hold the way central banks conduct their open market operations is not very important. What matters is that the bonds sold to/or pledged at the central bank i) creates central bank liquidity in the size of the market value of these bonds and ii) that bonds pledged to the central bank are not available to be traded in the market any more.

Figure 27: Capital Flight in the Euro Area

Investor/Bank A*	
B*↓	L
B ↑	EK ↔
D* ↑↓	
M	

NCB*	
B* ↑	M
R	D* ↑/↓
TA	TL ↑

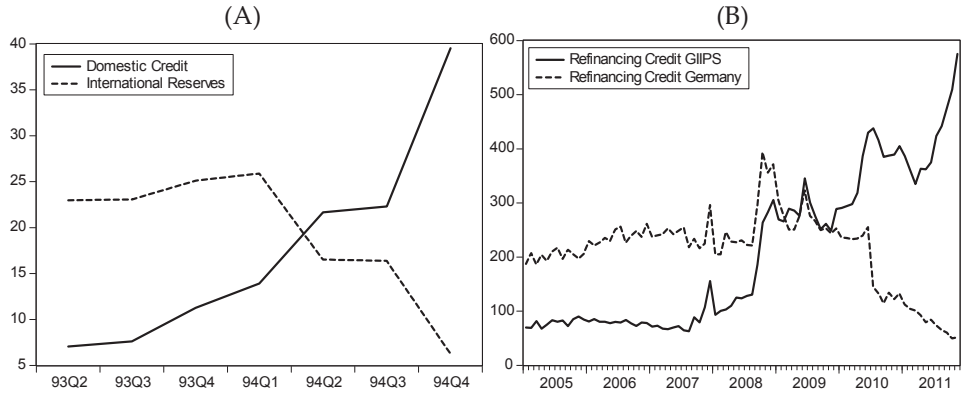
Investor/Bank B	
B*	L
B ↑/↓	
D ↑/↓	EK ↔
M	

NCB	
B ↓	M
R	D ↑/↓
TA ↑	TL

The critical point is that any change in the supply of bonds available in the market exactly matches the increased (or decreased) demand of these two types of bonds. As a consequence, no price adjustment is needed. Put another way, investors are still able to trade at the 'old' exchange ratio of the two bonds, which does not reflect aggregate demand changes. This works as long as refinancing credit does not fall to zero in the receiving country and new bonds get freed up during the process. Thus, the collateral provided for refinancing credit in the home country is reminiscent of reserves in countries with a fixed exchange rate system,[83] like Mexico 1994.

[83] See also Kohler (2012).

Figure 28: Comparison with Mexico 1994



Notes: The figure compares the development of domestic credit and international reserves in Mexico (both in bn. US Dollar) with the refinancing credit in Germany and the GIIPS countries (both in bn. €). Sources: International Financial Statistics (IFS), Euro Crisis Monitor.

Panel (B) of Figure 28, shows the development of refinancing credit in the GIIPS and DNFL countries. The pattern is remarkably similar compared to Mexico shortly before it was hit by a strong speculative attack. Refinancing credit in the crisis countries spiked sharply while banks in DNFL repaid their refinancing credit. This was possible because banks in the core countries received large amounts of central bank liquidity created in the GIIPS.

In contrast to the tequila crisis, the exchange rate between euro area member countries did not change, i.e. the currency union did not break up. However, the ECB suffered from a similar incompatibility of different policy objectives like the Banco de México. In the end of 2011, the Eurosystem was forced to conduct expansionary monetary policy in order to maintain the common currency.

In the following chapter we illustrate in a portfolio balance model the dichotomy of policy objectives the ECB faced in the presence of capital flight.

4. A Portfolio Balance Model of Capital Flight in a Currency Union

We specify a simple portfolio balance model to analyze different policy options in a currency union subject to internal capital flight.[84] Our results suggests, that depending on the size of capital flight, the central bank may be left with two incompatible policy objectives of keeping either the exchange rate among the currency members fixed, or the money supply. Investors' fears of how the central bank would respond to such a predicament may make the currency union vulnerable to speculative attacks.

4.1 The basic model setup

In our model, representative international investors choose between three types of assets to optimize their portfolio in a given period: Bonds (B), deposits or excess reserves at the national central bank (D), and Money (M). Bonds as well as deposits are country specific,[85] whereas there is only one form of cash independent of the country of issue. Variables referring to the foreign country are denoted with asterisks. The international investor is meant to reflect the aggregate of wealth owners living in either of the two countries which constitute a currency union.

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[84] Our formulation is close to the model of Sinn and Westermann (2005), albeit with adaptations to account for the fact that we analyze a currency union, not a flexible exchange rate regime.

[85] As in the numerical example of capital flight in the chapter before, we again model investors and commercial banks as one entity for simplicity purposes.

Investors choose to re-allocate their portfolio subject to a wealth constraint, the net worth of today's portfolio:

$$W = B^* \frac{P^*}{\bar{e}} + \frac{D^*}{\bar{e}} + M + BP + D \tag{10}$$

We introduce a fictive nominal exchange rate, $\bar{e}$, which is fixed at unity in the currency union of our model. Later on, we will also consider cases in which the central banks decide on whether to abandon the current exchange rate regime.

The utility function of our investor depends on the end-of-period wealth and a liquidity service.

$$U\left(\sigma^* \frac{B^* \tilde{P}^*}{\tilde{e}}, \beta^* \frac{D^*}{\tilde{e}}, \mu M, \sigma B \tilde{P}, \beta D\right) \tag{11}$$

The liquidity parameters $\sigma^*, \beta^*, \mu, \sigma, \beta$ capture all sorts of considerations other than pecuniary return. Examples are risk preferences, differences in liquidity, transaction costs, and arbitrary preference changes in general. Tildes mark expected values. For simplicity, we do not impose a specific functional form on the utility function other than it being increasing in its parameters, strictly concave, and additive separable.

The investor now maximizes the following Lagrangean with respect to the volumes of each asset class:

$$L = B^*\frac{1}{\tilde{e}}\left(\tilde{P}^* + r^*\right) + D^*\frac{1}{\tilde{e}}(1 + i^*) + M + B\left(\tilde{P} + r\right) + D(1 + i)$$

$$+ U\left(\sigma^*\frac{B^*\tilde{P}^*}{\tilde{e}}, \beta^*\ \frac{D^*}{\tilde{e}}, \mu M, \sigma B\tilde{P}, \beta D\right) \tag{12}$$

$$+ \lambda(W - B^*P^* - D^* - M - BP - D)$$

The first line captures the wealth after optimizing the portfolio, with r and i, denoting the yield on bonds and the interest rate paid on the deposit facility holdings, respectively. The second line shows the utility derived from the liquidity service, and the third line accounts for the investor's budget constraint.

From the first order conditions, we derive the following marginal conditions:

$$\frac{\bar{e}}{\tilde{e}}\frac{\tilde{P}^*(1 + \sigma^* U_{B^*}) + r^*}{P^*} = \lambda \tag{13}$$

$$\frac{\bar{e}}{\tilde{e}}(1 + i^* + \beta^*\ U_{D^*}) = \lambda \tag{14}$$

$$1 + U_M = \lambda \tag{15}$$

$$\frac{\tilde{P}(1 + r + \sigma U_B)}{P} = \lambda \tag{16}$$

$$1 + i + \beta U_D = \lambda \tag{17}$$

The Lagrangean multiplier, λ, reflects a common yardstick in that the marginal utility derived from every asset ought to be the same in the optimum. In our analysis, we focus on price effects, changes in stocks of assets, and preference changes. To simplify this discussion, we assume fixed expectations. Furthermore, we do not explicitly solve for all variables of the model. Most important insights can be derived by performing comparative statics and simply inspecting the relevant equations.

We frame changes in equilibrium outcomes in a narrative way. While, of course, our model does not state anything about timing or intentions of investors, this helps draw parallels to different forms of capital flight from the previous chapter.

4.2 Capital flight with a passive central bank

As a first step, we assume the central bank to be completely passive. For example, the central bank does not conduct any open market operations. Thus, the stocks of each type of assets are fixed in the short-term. We now ask how the optimum portfolio of our investor changes, when his preferences change. More specifically, we consider the effect of a negative shock in the preference for foreign bonds and a positive shock in the preference for home bonds. This decrease in σ^* with a joint increase in σ may represent a flight-to-safety motive.[86]

With given expectations, only equations (13) and (16) are affected. The change in preferences simply changes the return on both bonds. With supply and demand fixed, the decreased preference for foreign bonds has to be accommodated by an increase in their return, r*/P*. On the other hand, the increase in the preference for home bonds translates

[86] See also Westermann (2012, 2014).

into a decreased return, r/P.[87] No further portfolio adjustments are needed to maintain the portfolio equilibrium. Particularly, neither the exchange rate, nor money, nor the interest rate change. Also our common yardstick, λ, remains the same. This case is similar to the unsuccessful type of capital flight from the previous chapter, thus investors will not engage in capital flight altogether.

To illustrate this point – and as a benchmark for further modifications of this model – it is interesting to look at the relative price of foreign bonds in terms of home bonds:

$$\frac{P^*}{P} = \frac{\bar{e}}{\tilde{e}} \cdot \frac{\tilde{P}^*(1 + \sigma^* U_{B^*}) + r^*}{\tilde{P}(1 + r + \sigma U_B)} \tag{18}$$

Equation (18) describes the effective rate of exchange between both types of bonds. From the perspective of *individual investors holding foreign bonds* this indicates whether capital flight can be successful.

With the stock of assets fixed (and thereby also their marginal utilities, U_B and U_{B^*}, fixed), any shock in preferences simply translates into price (and yield) changes. After an increase in σ and a decrease in σ^*, the return of foreign bonds relative to home bonds is lower than in the pre-shock equilibrium. Holders of foreign bonds cannot avoid taking losses.

[87] This may either mean a change of prices, or of yields, or a combination of both. For the purpose of clarity of our argument, we simply attribute any change in the return of bonds to price changes, i.e. we assume the yield to be fixed. This does not alter any of the results.

4.3 Capital flight with an active central bank

Next, we consider the case of an active central bank like the European System of Central Banks, which we described in the previous chapter. Investors are able to sell bonds to the national central bank and will be credited at least the current market value[88] of these bonds to their deposit facility in return.[89]

In the case of an active central bank, it is useful to distinguish between two phases of capital flight, which differ with respect to the size of the shock.

Phase I

In phase I, we consider the same shock as before – a decrease in σ^* with a joint increase in σ. Selling foreign bonds to the national central bank reduces the supply of foreign bonds available to trade in the markets. Consequently, their marginal utility, U_{B^*}, increases. The investor gets credited deposits at the foreign central bank in return, which decreases the marginal utility of such deposits, U_{D^*}.

From eq. (14) = (17), it is evident that these deposits do not stay within national borders:

$$\frac{\bar{e}}{\tilde{e}}(1 + i + \beta^* U_{D^*}) = 1 + i + \beta U_D \tag{19}$$

[88] Drechsler et al. (2013) document that national central banks in the euro area applied substantially lower haircuts compared to private markets throughout the crisis. While we do not assume such an implicit subsidy in our model, this would further increase incentives to participate in capital flight.

[89] Bonds could alternatively be pledged to the central bank in return for refinancing credit. Again, what matters is that bonds can be used to i) create central bank liquidity in the size of the market value of these bonds and ii) that these bonds are not available to be traded in the market any more.

The transfer of deposits from the foreign NCB to the home NCB frees up collateral, which had previously been pledged at the home NCB, i.e. B rises. The increase in the stock of home bonds, B, in turn, decreases their marginal utility, U_B. Our Lagragean multiplier does not change. With the common interest rate fixed, this implies in equilibrium that all deposits return to their original levels. They are transferred to the home country and invested in home bonds.[90]

Does this portfolio shift also imply that capital flight was successful from the individual investor's perspective? Again, we look at the relative rate of return to answer this question (eq. (18)). Despite the change in preferences, away from foreign bonds into home bonds, their relative rate of return did not change. Changes in demand have completely been offset by changes in supply – without any further need for price adjustments.

Compared to the case with a passive central bank, an individual investor holding foreign bonds is better off now – thus capital flight can be successful. This result, however, hinges critically on the fact that a wire-transfer reduces the need for central bank liquidity and frees up collateral in the receiving country.

[90] In principle, also the interest rate could be raised to avoid a shift of the portfolio from the deposit facility into home bonds. However, this does not seem to be a realistic scenario for practical considerations. First, a change in interest rates is not a short-term response as it requires a meeting and consensus of the ECB board first. Second, a raise in interest rates may intensify a recession in crisis countries. Third, increasing the interest rate would not stop a capital flight out of foreign bonds. The portfolio would only be re-allocated such that investors hold more deposits without holding more cash.

Phase II

When capital flight continues, keeping the exchange rate or the monetary supply fixed become mutually exclusive targets. To illustrate this, we assume the shock in preferences to be strong in phase II.

Capital transfers to the home country still increase home country deposits, D. This time, however, no collateral is freed up in the process because refinancing credit at the receiving country's central bank has already been run down to zero.[91] In other words, we assume the stock of home bonds to be fixed in the short-term, $B = \bar{B}$.

Again, investors sell foreign bonds to the foreign central bank. Therefore, B^* decreases, accompanied by a rise in D^*. Given the expectations and interest rate, there are two possible equilibrium portfolios. The central bank can either i) increase the narrow money supply accompanied by an increase in broad money, i.e. M and $(D + D^*)$ increase, or ii) let exchange rate between the member countries depreciate. We discuss both options in detail:

First, the central banks could forego their monetary target. From eq. (19) can be inferred that the investor will again transfer part of the deposits into the deposit facility of the home country, i.e. D rises. However, deposits will not fall to their original level, as the stock of home bonds remains the same. In equation (16) the marginal increase in demand for home bonds will be offset by an increase in prices. Capital does not flow from the deposits into home bonds, anymore. A rise in deposits reduces the marginal utility derived from these types of assets. According to eq. (14), (15), and (17), the Lagrangean variable and the marginal utility of cash holdings, U_M, must be lower compared to pre-

[91] This is equivalent to a single country with a fixed exchange rate in which central bank reserves dropped to zero.

shock levels, which is due to an increase in the stock of money, M. Summing up, not only cash increases but also the aggregate of both countries deposits. As these deposits were created in open market operations, this also implies – in the European case – an increase of aggregate refinancing credit.

Second, the central bank can hold on the monetary target and let the exchange rate between member countries float. This move would prevent capital flight altogether. A depreciation of the foreign country currency (an increase of the exchange rate, $\bar{e}$) satisfies eq. (19) without a rise in home country deposits. In this case, there is no need for the common yardstick and narrow money to change. With respect to the home country's assets, only the price of home bonds increases according to eq. (16).

Again, we ask if an individual investor holding foreign bonds can successfully engage in capital flight in phase II. Independent of the central bank's decision, P^*/P decreases, according to eq. (18). Compared to the case with an active central bank in phase I, an individual investor holding foreign bonds is worse off now. Holders of foreign bonds cannot engage in capital flight any more without taking losses.

4.4 Discussion of the dynamics and speculative attack

What was modeled as a strong shock in the second phase could also be a series of small shocks, or a continuous process based on fundamental values of a country, like an ongoing balance-of-payments deficit. With such a process in mind, our model implies dynamics similar to first generation speculative attack models.

Table 27 summarizes the changes in stocks of the different asset types, the changes in prices – both nominal and relative –, and the exchange rate given different central bank policies.

As long as refinancing credit in the receiving country is plentiful, foreign bond holders can successfully engage in capital flight and the central bank is able to defend its policy targets (phase 1). With capital flight continuing, the refinancing credit as well as the amount of freed up collateral – home country's quasi-reserves – run down.

Table 27: Summary of comparative statics results

Preference shock: $\sigma^* \downarrow$ and $\sigma \uparrow$				
	Passive Central Bank	Active Central Bank (Phase I)	Active Central Bank (Phase II)	
			$M = \bar{M}$	$e = \bar{e}$
B^*	$\leftrightarrow$	$\downarrow$	$\downarrow$	$\downarrow$
B	$\leftrightarrow$	$\uparrow$	$\leftrightarrow$	$\leftrightarrow$
M	$\leftrightarrow$	$\leftrightarrow$	$\leftrightarrow$	$\uparrow$
$(D + D^*)$	$\leftrightarrow$	$\leftrightarrow$	$\leftrightarrow$	$\uparrow$
P^*	$\downarrow$	$\leftrightarrow$	$\leftrightarrow$	$\leftrightarrow$
P	$\uparrow$	$\leftrightarrow$	$\uparrow$	$\uparrow$
$\frac{P^*}{P}$	$\Downarrow$	$\leftrightarrow$	$\downarrow$	$\downarrow$
e	$\leftrightarrow$	$\leftrightarrow$	$\uparrow$	$\leftrightarrow$

From the point they drop to zero, foreign bond investors cannot avoid loss anymore (phase 2). Thus, capital flight cannot go on successfully forever. In such cases, as usually, Herbert Stein's law applies: *If something cannot go on forever, it will stop*.

When the amount of refinancing credit in the receiving country reaches a critically low limit, investors anticipate that not all of them can trade their foreign bonds into home bonds at a favorable rate of exchange. Because everybody knows, that not everybody 'can get his money out' without losses, everybody will uncoordinatedly try to be among the first: A speculative attack occurs, forcing the central bank to either let the exchange rate in the currency union float, or to give up its independent monetary target.

5. Linking the model to the stylized facts

Section 2 presented stylized facts describing key patterns of capital flight in the Euro Area. The evolution of these variables closely resembles the path implied by our portfolio balance model.

The ongoing current account deficits of the GIIPS countries triggered shocks in the preference of investors. Investors participated in a 'capital-flight-to-safety' (Figure 19).[92] They pledged bonds of the crisis countries to the respective national central banks. Thus, refinancing credit increased in these countries. The newly created central bank deposits, however, did not stay on the NCB balance sheets of the crisis countries. Instead, they were wire transferred to DNFL to buy 'safe' bonds. This is reflected in an increase of Target2-claims and -liabilities of the central banks. As banks in DNFL did not experience any further need for central bank liquidity, they reduced their refinancing credit by roughly the same amount. Until refinancing credits of the receiving countries nearly hit zero in December 2011, central bank liquidity growth remained stable in the aggregate. Furthermore, as capital flight took place *within* the euro area, official foreign reserves were not affected (Figures 22 & 23).

When the supply of 'safe' bonds does not react in the short-term anymore, their prices increase, and investors have to face a rate of exchange between both types of bonds that already reflects changes in

[92] Note that the residency of the investor does not matter.

preferences.[93] This critical point had been foreseen in the end of 2011. While there is no technical limit which forbids investors to further engage in capital flight, they cannot avoid taking losses anymore. This triggered a speculative attack – and capital started to leave the euro area as a whole (Figure 25).

At this point, the European System of Central Banks was caught between a rock and a hard place. It had to decide whether to stick to its monetary policy targets or to avoid a regime change in the exchange rate. On December 8th, 2011, the ECB decided for the latter.

[93] Consistent with our model, the yields on short-term government bonds of Germany reached historically low levels in December 2011. At some auctions they even became negative for the first time.

6. Political limits

In addition to the conflict arising from different policy objectives, the Euro Area also reached sensitive political limits towards the end of 2011. Figure 29 shows that DNFL have become net borrowers vis-à-vis their private banking system in the beginning of 2011.[94] The upper left graph in Figure 29 shows the claims and liabilities of the NCB's in DNFL that result from regular open market operations. As money created in the GIIPS was wire-transferred via the TARGET2 system, there was an abundance of liquidity in DNFL. As domestic banks stopped borrowing from NCB's the central banks needed to accept liabilities to financial markets - in form of private bank deposits - in order to execute the private wire-transfers to DNFL. While not constituting a technical limit as long as banks were willing to hold deposits at their central bank, this process clearly hit a political limit at some point.[95]

The clearest indicator that a political limit has been reached at the Bundesbank is a letter written by the Bundesbank president, Jens Weidmann, to the ECB president, Mario Draghi, on February 29th, 2012, where he asks for better collateral standards in the countries in crisis and points towards the enormous TARGET2 balances that have accumulated during the last five years. This letter is reminiscent of the famous 'Emminger Letter' - also written by a Bundesbank president and directed to Helmut Schmidt, the chancellor of Germany, 1978. In this letter, Emminger pointed out the enormous risk of supporting a two-sided

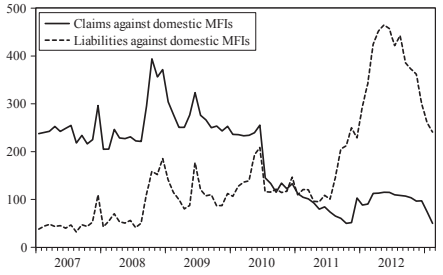
[94] For a short time also in 2010 already.

[95] See also Tornell & Westermann (2011).

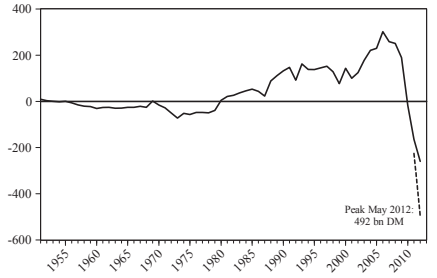
fixed exchange rate regime up to an unlimited amount of exchange rate interventions.

Figure 29: Net Position against Domestic Private Banking System

(A) Bundesbank gross positions against domestic MFIs (bn €)

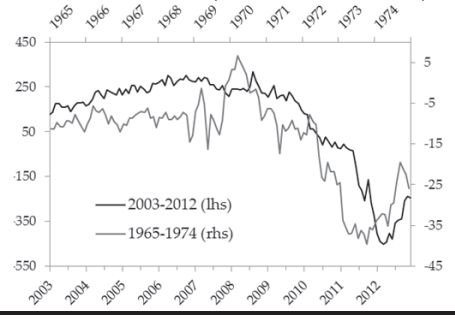


(B) Bundesbank historical net position against domestic MFIs (constant 1990 DM)



(C) Net position of the Eurosystem against domestic MFIs (bn €)

(D) Bundesbank's net position against domestic MFI's (constant 1990 DM)



Sources: Bundesbank, ECB.

Schmidt's answer to Emminger was to sign the treaty, and - if worst comes to worst - argue that the conditions under which the treaty has been signed have changed, and abandon the peg if needed.[96] In fact, 1992 the Bundesbank withdrew its commitment to an unlimited provision of German Mark to the Banca de Italia.[97]

[96] See Marsh (2013).

[97] De Grauwe & Ji (2013b) point out this decision as being fatal for the European Monetary System.

Translating this to current events would mean that the Bundesbank, at any point, could refer to agreements, such as the no-bailout clause, the Maastricht treaty, or the prohibition of monetary financing of sovereigns, and stop executing TARGET2-transfers, if these are deemed to be excessive.

In fact, Sinn & Wollmershäuser (2012) pointed out that the Bretton Woods system had broken apart for a similar reason. In the 1970s, the Bundesbank had become a net borrower with respect to the financial sector and its net position, shown in Panel (B) of Figure 29, reached a value of about 5% of GDP. The peak in its net-borrowing position in the most recent episode has been nearly 15% of GDP in May 2012 - i.e. three times as large as in 1973. In fact, Figure 29D shows that at a weekly frequency, the time pattern of the net position of the Bundesbank prior to the breakup of the Bretton Woods system in March 1973 was very similar to the one prior to the 'big bazooka' in December 2011.

Another political limit has been reached by the Euro Area as a whole. The lower left panel of Figure 29 shows that the Euro Area in total has also become a net borrower for private banks towards the end of 2011. Its net lending position of about 250 bn € prior to the crisis first increased in 2008, but then gradually declined until it hit zero in October 2011. Again, this does not reflect a technical limit, but it certainly marks a turning point that might have needed approval of the governments of the Euro Area. The ECB was constructed to focus on monetary policy only. Borrowing funds in private markets to lend to other banks in specific countries could have been akin to a fiscal bailout that would have been prohibited by the ECB by-laws.

7. Conclusions

The literature on the creation of the European currency union discussed the possibility of a speculative attack linked to the final bilateral conversion rates, the so-called "endgame problem". Flood and Garber (2000) and Kenen (2000) argue that the operational rules of the Target system enable central banks to defend the currency union against any speculative attack. The reason for this is the fact that NCBs provide unlimited amounts of credit to each other. While it is true that Target balances are technically unlimited according to the statutes of the ESCB, we point out other limits.

First, there may be certain political limits, discussed in the previous chapter. Second – and perhaps more importantly – there are limits on how long the process of intra-Euro Area capital flight can continue. In particular, we find that the euro area suffers from a special form of the *impossible trinity*[98]: It may not be feasible at the same time to i) conduct independent monetary policy in the aggregate, ii) allow for unlimited capital flows within the union, and iii) keep the exchange rate between member countries fixed at unity.

These results suggest that it is important for the ECB to regain leeway within incompatible policy objectives. First, a credible commitment to set highest priority to the common currency is needed – above other possible policy targets. This should prevent capital flight outside the EMU. The announcement to do *whatever-it-takes*, and to engage in potentially unlimited outright monetary transaction, can

[98] See Mundell (1960) and Fleming (1962).

already be interpreted as such a move. Second, the ECB could avoid attenuating asymmetric shocks in the bond markets. Applying above-market haircuts in refinancing operations may eliminate market distortions, which would otherwise give rise to ongoing capital flight via the national central banks.

With the decision to inject further liquidity via the LTRO, the ECB successfully fended off a speculative attack against the euro. This victory, however, came at a significant cost: it had to give up part of its monetary independence.

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