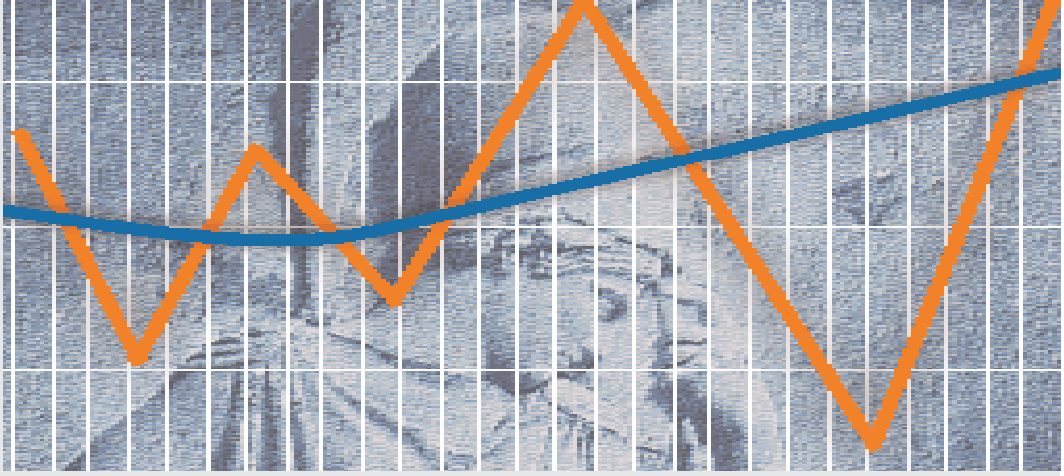

ifo Beiträge zur Wirtschaftsforschung

66

The Sovereign Default Problem in the Eurozone

Why Limited Liability Resulted in Excessive Debt Accumulation and How Insurance Can Counteract

Nadjeschda Katharina Arnold

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Leibniz-Institut für Wirtschaftsforschung

an der Universität München e.V.

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Schriftleitung: Chang Woon Nam

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Preface

This thesis was written by Nadjeschda Katharina Arnold while having been a research assistant at the Center for Economic Studies (CES) at the University of Munich. It was completed in December 2014 and accepted as a doctoral thesis by the Department of Economics at the University of Munich in May 2015.

Since 2009, only a decade after its formation, the European Monetary Union has been confronted with serious sovereign debt problems in several of its member states. At the time of writing, this has been for seven years, and there is no end in sight.

The origin of the Eurozone crisis can be found in the US financial crisis; its extent and permanence in a commitment problem of the Union to no bailouts. Despite provisions to the contrary in the Maastricht Treaty, the Union has granted bailout measures in the higher three-digit billion euro range to struggling member states in the Eurozone crisis, which may have resulted in incentives for excessive debt accumulation in its member states; if anticipated, not only since the crisis, but already with monetary unification.

This thesis will analyse the commitment problem in more detail and present an insurance-based approach to solve it. It is therefore divided into two main parts.

Part I theoretically substantiates the link between the commitment problem of a monetary union to no bailouts and the incentives for excessive debt accumulation in its member states. It develops a multi-stage model, in which the benevolent governments of n countries decide on their debt levels, before risk neutral investors choose their portfolios consisting of these sovereign debts and risk free assets. It shows that the formation of a monetary union, which is assumed to have a commitment problem to no bailouts in case of default, increases debt levels and interest rates of its member states, and decreases overall welfare. Intuitively, member states are induced to choose too high debt levels since

they no longer have to compensate the investors in their debt for their default risk with an interest rate risk premium. In the end, this reflects a limited liability problem in the sense that monetary union member states are induced to ignore a part of their original repayment obligation in their debt decision.

Part II proposes for the first time an insurance-based approach to solve the commitment problem. It builds on the model in Part I and shows that the formation of a mutual insurance fund between member states of the monetary union, which offers full insurance for a fair premium and reserves, restores the optimal incentives of debt accumulation. Intuitively, member states are reinduced to choose the optimal debt levels as they now have to compensate the fund for their default risk with an insurance premium.

The two main parts of the thesis are preceded by an introduction and stylised facts on the sovereign default problem of the Eurozone; they are rounded off with an overall conclusion.

Keywords: European debt crisis, sovereign debt, bailout, monetary union, debt management.

JEL classification: G11, G12, G22, H63, H77.

Acknowledgements

At the time of submission of this thesis, the sovereign debt crisis in the Eurozone has already lasted for six years. It broke out about a half year before I started my PhD, and now it seems as if it will outlast my time as a PhD candidate.

The crisis has accompanied me during my PhD time in various aspects of both my academic and non-academic life. It has become the topic of my thesis and been the subject of many lectures, seminars, workshops and conferences in which I have participated. The crisis has also been the main topic of several meetings and reports of the European Economic Advisory Group (EEAG) as well as the book "Die Target-Falle" (English: "The Target Trap"), written by my doctoral supervisor, Hans-Werner Sinn. I am very fortunate to have enjoyed the privilege of assisting both. Beyond university, like many other people, I have been faced with the crisis in the news, political conversations with family and friends, visits to the ailing countries, and by the side effect that Germany, and in particular Munich, has become much more international and multicultural due to migration from southern Europe.

Six years of crisis and five years of PhD research and study is a long time. And it is a hard time. A time in which it is of decisive importance to have good guidance and support in order to emerge successfully therefrom. While the question whether the crisis countries have had the right guidance and support is yet to be discussed in this thesis, I can say at this point with all due certainty that I have been lucky to have had both during my time as a PhD candidate.

In the following, I would like to thank those persons to whom this is due.

First of all, I am particularly grateful to Hans-Werner Sinn for his guidance and support during my PhD time, the pleasant working atmosphere at the Center for Economic Studies

(CES), the unparalleled academic exchange with economists from all over the world under the CES visiting programme, and all of the other great opportunities that have helped me to move forward and which have been enabled by him. At this point, I would especially like to mention the various workshops and conferences that I have visited throughout my PhD time as well as a research stay at the University of California Santa Cruz (UCSC), none of which I take for granted and all of which I am very thankful for. I would also like to thank Hans-Werner Sinn for his confidence in my skills and for entrusting me with several interesting tasks that go beyond the work of a research assistant. Among these tasks has been the assistance in the EEAG group and the book "Die Target-Falle", as mentioned above.

Secondly, special gratitude goes to Ray Rees, with whom I have had the privilege of working together and who has supported me also beyond our joint project.

Thirdly, I would like to thank Kenneth Kletzer for having invited me to UCSC. He has been a great host and provided me with valuable feedback on my research.

Fourthly, I would like to thank my former and present colleagues at University of Munich, Ifo Institute for Economic Research and UCSC for valuable comments and discussions. In particular, I wish to mention Christian Beermann, Andreas Blöchl, Florian Buck, Jakob Eberl, Darko Jus, Can Kadirgan, Richard Peter, Niklas Potrafke, Risto Rönkkö, Alexandra Semrad, Michael Stimmelmayr, Christoph Trebesch and Christopher Weber.

Finally, I am eternally grateful to my family—my parents Peter and Marietta Arnold, my brother Grischa Arnold and my sister Ronja Arnold. They have supported and encouraged me in everything I have ever done and always believed in me. I would like to thank my father and my brother, who are also economists, for always having shown interest in my work and helped to improve it by listening to and discussing my arguments; my mother for having always found the right words to give me the energy to keep going; and my sister for having kept me sane.

I dedicate this book to my family because it certainly would not exist in this form without their unconditional support and love.

Nadjeschda Katharina Arnold

The Sovereign Default Problem in the Eurozone

Why limited liability resulted in excessive debt accumulation and how insurance can counteract

Inaugural-Dissertation
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Introduction

"Es wird nicht so sein, daß der Süden bei den sogenannten reichen Ländern abkassiert. Dann nämlich würde Europa auseinanderfallen. [...] Es gibt eine 'no bail out rule'. Das heißt, wenn sich ein Land durch eigenes Verhalten hohe Defizite zulegt, dann ist weder die Gemeinschaft noch ein Mitgliedstaat verpflichtet, diesem Land zu helfen."

(English: "It will not happen that the South makes the so-called rich countries cough up money. Then Europe would break up. [...] There is a 'no-bailout rule'. That is, if a country acquires high deficits by its own behaviour, neither the union nor a member state is obligated to help this country.")

Horst Köhler, April 1992.[1]

Unfortunately, the view of the then State Secretary of the Ministry of Finance and later President of Germany has proven to be wrong. In the course of the current European sovereign debt crisis, Southern Europe[2] and Ireland have received aid funds to the amount of 833 billion euros (as of end of November 2014). They have been granted a further 83 billion euros (also as of end of November 2014) and it cannot be excluded that further rescue packages will follow.[3] Even though there is a "no-bailout rule", this could not prevent the European Monetary Union (EMU) and its member states from jumping to the aid of countries when it came to the crunch. That said, it can only be hoped that Köhler also errs in the point that Europe would break up if the union or its solvent member

[1] H. Martens, R. Augstein und M. Schreiber (1992). Stabilität oder mehr Inflation? Finanzstaatssekretär Horst Köhler über die Folgen einer EG-Währungsunion. *Der Spiegel*, *15*, 44f.

[2] Greece, Portugal, Spain, Italy and Cyprus.

[3] Ifo Institute, *The Exposure Level: Bailout measures for the Eurozone Countries and Germany's exposure*, http://www.cesifo-group.de/ifoHome/policy/Haftungspegel.html, last accessed on 7 December 2014.

states were to pay the bill of defaulting countries. In this regard, however, the hope disappears with each further rescue measure that is adopted. It has been observed that the resistance of rich countries to grant aid, and the discontent of defaulting countries due to the conditions connected therewith, have steadily increased. This has been expressed in several demonstrations in the crisis countries and not least in the results of the last European Parliament election. Here, far-right and Eurosceptic parties made big gains and even formed the largest fraction in France, the United Kingdom and Denmark. In France, the far-right Front National became the strongest party with 24.86 percent; in the United Kingdom, the anti-European UKIP ranked first with 26.77 percent; and in Denmark, the right-wing populist Danish People's Party gained the lead with 26.60 percent. In Austria, the right-wing populist FPÖ was "only" the third strongest party with 19.72 percent but gained about 7 percent and one rank since the previous election. In Germany, the Eurosceptic AfD received 7.10 percent of the votes.[4]

Christine Lagarde, former French finance minister and current President of the International Monetary Fund (IMF), admitted that the Eurogroup had been aware that it would breach the no-bailout rule by adopting diverse rescue programmes. It nevertheless did so, purportedly so as to "rescue the euro zone".[5] Irrespective of whether the euro was in danger, the readiness with which the no-bailout rule has been breached is alarming. It reveals a commitment problem of the EMU and its member states to the no-bailout rule that may result in a behavioural change on the side of governments which in economics is generally defined as "moral hazard".

In my PhD thesis, I will take a closer look at this commitment problem and present possible solutions thereto.

Accordingly, my PhD thesis is split into two main parts.

In Part I, I will deal with the questions whether, and if so, how the commitment problem to no bailouts may have increased the Eurozone countries' incentives to accumulate debt, thereby contributing to the sovereign default problems they are currently experiencing. I

[4]European Parliament, *Results of the 2014 European elections*, http://www.results-elections2014.eu/en/country-introduction-2014.html, last accessed on 7 December 2014.

[5]B. Carney and A. Jolis (2010). Toward a United States of Europe. *The Wall Street Journal*, 17 December, http://online.wsj.com/article/SB10001424052748704034804576025681087342502.html.

will set out a multistage model in which the benevolent governments of n countries decide on their bond issuance before risk neutral agents choose asset portfolios consisting of these bonds and risk free assets. I will show that if a monetary union has a commitment problem to no bailouts, its formation will increase the countries' incentives of debt accumulation since they no longer have to compensate the investors in their bonds for their default risk in the form of an interest rate risk premium, and consequently a limited liability problem emerges. This type of modelling the commitment problem is new in that it takes into account the disciplining effect of financial markets that may be offset by the formation of a monetary union. It is based on a train of thoughts by Sinn (2010)[6] but adds to this, inter alia, in that it identifies the kind of market failure at work.

In Part II, which is partially based on joint work with Ray Rees[7], I will turn to the question of what kind of arrangements should be put in place in the EMU to deal with sovereign default risk. Building on the model presented in Part I, I will show that a mutual insurance fund can be established that prevents the excessive debt accumulation diagnosed in Part I for a commitment problem of the monetary union to no bailouts by requesting compensation from the countries for their default risk in the form of an insurance premium. This type of solution may be a third way for the EMU, in addition to the two ways identified by Sinn (2012a), which are the current path towards a transfer union and the restoration of the credibility of the no-bailout rule.[8] It may be the Pareto dominant way by uniting the advantages of the other two ways, which are requesting compensation from the governments, thereby containing their incentives of debt accumulation, and providing investors with a safe payment, resulting in a prevention of panic in the market due to "haircuts".

The two main parts of my PhD thesis are framed by stylised facts on the sovereign default problem in the Eurozone, which have been the starting and reference point for all of my formal analyses, and an overall conclusion.

[6] Sinn (2010), pages 11–14.
[7] Arnold & Rees (2014).
[8] Sinn (2012a), Chapters 11 and 12.

The Sovereign Default Problem in the Eurozone: An Overview of Bailout Measures and Stylised Facts on Financial Developments

To motivate the topic of my PhD thesis and to demonstrate its relevance, this chapter firstly presents an overview of the policy measures taken by European Union leaders and the European Central Bank (ECB) since the outbreak of the US financial crisis in 2007. It then provides some stylised facts on the development of public and external sector finances in Europe before and after the introduction of the euro.

The first shall demonstrate that at least in retrospect, the EMU has shown a commitment problem to no bailouts that, if it had been anticipated by economic agents, may already have affected the debt accumulation in Europe before the financial crisis, in particular maybe even in the years surrounding the introduction of the euro, and, as it became evident thereafter, certainly has done so since, and will do so in the future.

The latter shall show that when accounting for other factors and events that may have affected debt accumulation in Europe, there is indeed good reason to presume that a commitment problem to no bailouts was already assumed at the time of the introduction of the euro and has resulted in increased incentives to accumulate debt in both the public and private sector since then.

The no-bailout provisions in the Maastricht Treaty and the Statute of the European System of Central Banks and of the ECB. Before we have a look at the bailout measures taken by European Union leaders and the ECB in the course of the European sovereign debt crisis, we should mention the provisions in the Maastricht Treaty (formally, then: Treaty on establishing the European Community; now: Treaty on the Functioning of the European Union, TFEU[9]) as well as the Statute of the European System of Central Banks (ESCB) and of the ECB[10], which were set up to prevent precisely these types of policy measures.

These provisions are the so-called no-bailout clause of the Maastricht Treaty, which prohibits European Union states from giving financial support to each other (Article 125 TFEU), and its respective equivalent for the ECB in the Statute of the ESCB and of the ECB, which prohibits the Eurosystem from stepping in for the liabilities of governments (Article 21 Statute of the ESCB and of the ECB).

Although the provisions clearly identify bailouts as taboo, they could not prevent these being granted on a massive scale in the course of the European sovereign debt crisis, as shown in Figure 1 on page 8.

Bailout measures in the course of the European sovereign debt crisis suggesting a commitment problem to no bailouts. Figure 1 gives an overview of the bailout measures taken by the Eurozone and European Union states, the IMF and the ECB to support the crisis countries Greece, Ireland, Portugal, Spain, Italy and Cyprus (GIPSIC countries).

The bailout measures are presented in three columns: as net amounts that have been paid out to date, "bailout funds" that have been pledged to date, and potential credit volume.

The columns are disaggregated into guarantees and/or credit volumes granted to the individual GIPSIC countries via the rescue packages and mechanisms of the Eurozone countries (first rescue package for Greece, EFSF and ESM), contributions from the IMF and loans by the European Union (EFSM); funds provided to the GIPSIC countries altogether via purchases of their government bonds by the ECB; Target credits provided

[9] European Union (2012a).
[10] European Union (2012b).

to their national central banks (NCBs) by those of other euro countries; and claims and/or liabilities against the Eurosystem related to the under/over-proportionate issuance of banknotes (relative to their NCBs' shares in the ECB's capital).

The net amounts for the funds not provided by the ECB and/or the NCBs in the first column are bailout funds received by a country minus the country's contribution thereto. Since Italy has not yet received any funds outside the Eurosystem but has indeed contributed to such bailouts, its net amount is negative and noted on the right side of the first column.

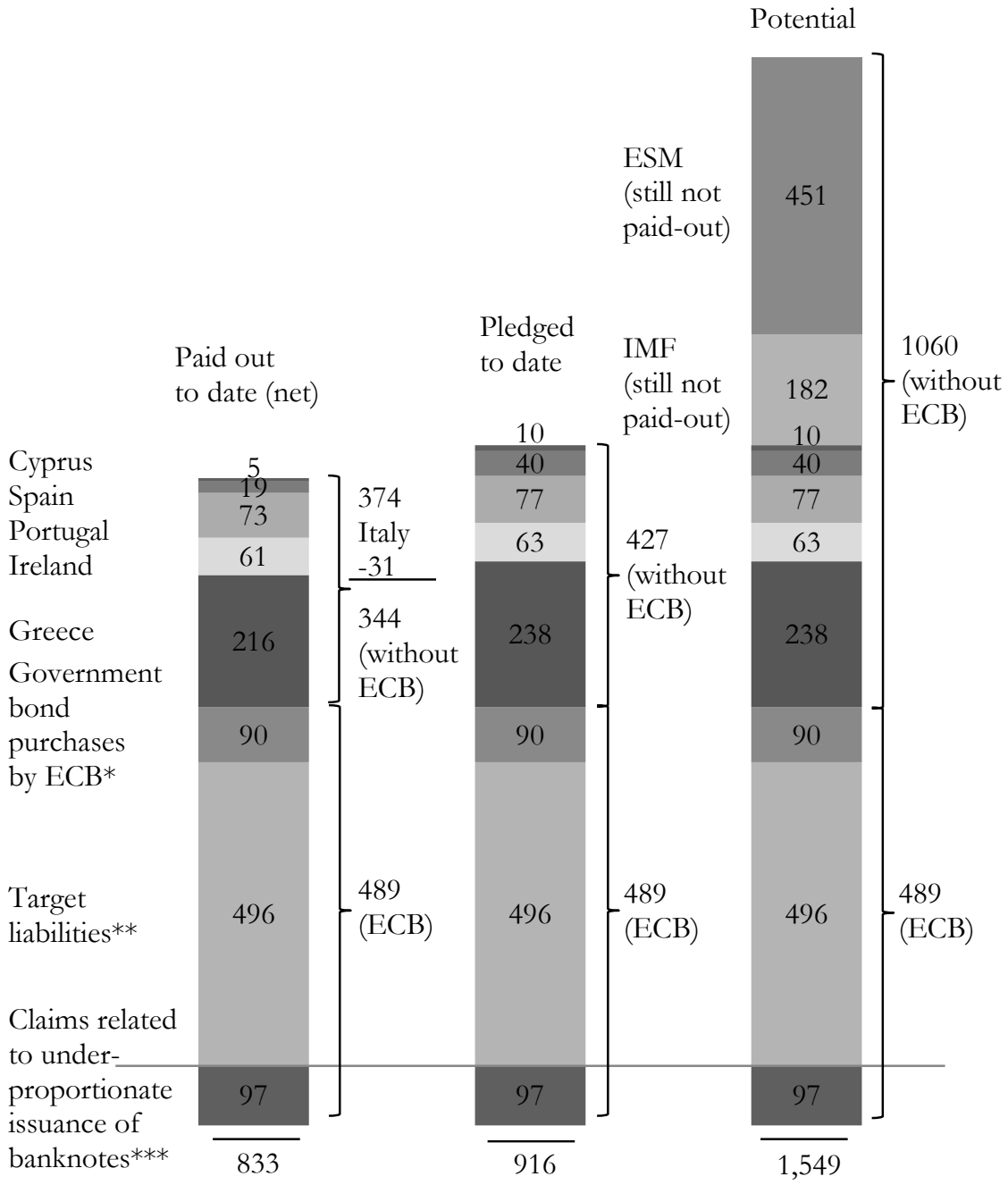
Figure 1 shows that aid funds of an incredible amount of 833 billion euros have been paid out to date, another 83 billion euros have been pledged, and that both figures could potentially increase to 1,549 billion euros.

The data also reveals that so far, funds supplied by the ECB and/or the NCBs have lightly outweighed aid offered by the Eurozone and European Union states and the IMF. However, provided that the funds by the Eurosystem will not continue to rise, the relation could reverse in the future. The aid by countries and the IMF could potentially assume a share in overall aid that is twice as high as the aid of the Eurosystem.

In light of the enormous amounts, one can only conclude that in the course of the European sovereign debt crisis, the EMU has shown a commitment problem to no bailouts. As will be explained later, theory has good reason to assume that this kind of problem, if economic agents were aware thereof, may have increased debt accumulation. In particular, if the commitment problem to no bailouts had been anticipated by economic agents, it may already have increased the debt accumulation in Europe before the crisis, and maybe even in the years surrounding the introduction of the euro. In either case, since it has been revealed during the crisis, it may have done so since, and may do so in the future.

In the remainder of this chapter, we wish to find out whether this assumption is generally confirmed by the data. In particular, we are curious about whether there is an indication of an effect already at the time surrounding the introduction of the euro.

Figure 1: Bailout measures



* Data as of 21 November 2014.

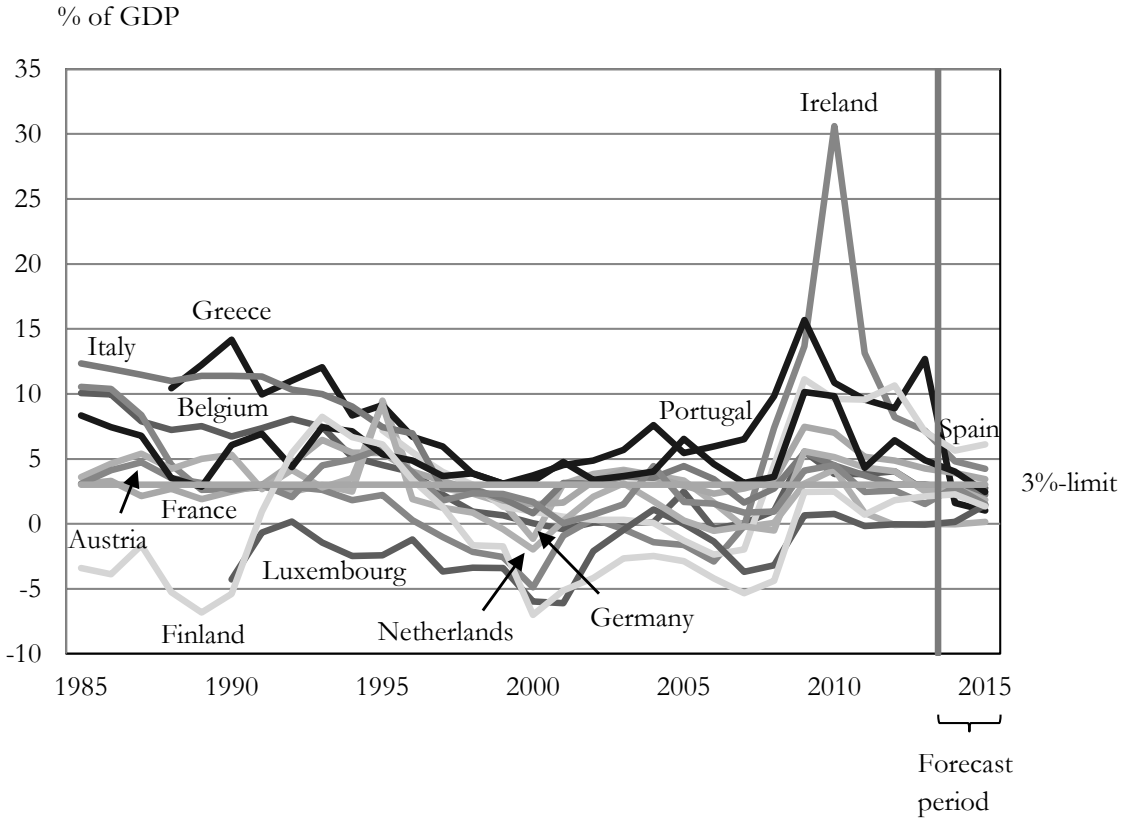
** Data as of end of September 2014 (Greece, Ireland, Portugal and Cyprus); Italy and Spain: end of October 2014.

*** Data as of end of August 2014.

Source: Ifo Institute, *The Exposure Level: Bailout measures for the Eurozone Countries and Germany's exposure*, last accessed on 7 December 2014.

Initial improvement of public sector finances, later increasing worsening. Figure 2 illustrates the development of fiscal deficits since 1985 as a percentage of gross domestic product (GDP) in the twelve European Union states which first introduced the euro (EA12 countries). The EA12 countries include Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal and Finland, which introduced the euro on 1 January 1999, and Greece, which joined the euro area two years later.

Figure 2: Fiscal deficits



Source: AMECO, last accessed on 3 November 2014.

Figure 2 shows that in the years from 1985 to 1995, i.e. the time before the euro was announced at the Madrid Summit in December 1995, all EA12 countries but Luxembourg and Finland consistently had fiscal deficits. Further still, many of the EA12 countries had deficits that were much higher than 3 percent for most of the years. In particular, Greece

and Italy had incredibly high deficits of more than 10 percent on average[11] that never undercut 8 and 7 percent, but even exceeded 14 and 12 percent, respectively. Belgium and Portugal's deficits were also quite substantial in size, amounting to 7.45 and 6.02 percent on average and ranging from 10.07 to 4.52 and 8.34 to 2.86 percent, respectively. In view of these figures, the deficits of Germany, France, the Netherlands and Austria appear to be almost moderate, amounting to about 3 to 5 percent on average.[12] In Germany, the deficit usually lingered at just below 3 percent, and in the other countries, it usually varied between 2 and 6 percent. Ireland also had an average deficit of this magnitude (4.67 percent). In contrast to the deficits of the afore-mentioned countries, its deficit did not, however, go up and down but almost consistently decreased from 10.54 percent in 1985 to 1.83 percent in 1994.

In the years from 1996 to 1997, all countries reduced their deficits, most of them to below 3 percent. Greece, Spain, France and Portugal did not succeed in bringing their deficits below this level; their deficits, however, went below 6 percent.

In the years from 1998 to 2000, most of the countries (all but Austria and Portugal) continued to reduce their deficits. In 1999, when the euro was introduced, Spain and France were able to undercut 3 percent as well; Greece and Portugal exceeded it by less than 0.1 percentage points.

In the years from 2001 to 2007, many of the countries in turn increased their deficits. In addition to Greece and Portugal, which had deficits over 3 percent in every year from 1985 to 2013 and 2014 respectively (except for Portugal in 1989), Germany and Italy had deficits over 3 percent from 2001 to 2005 and 2006 respectively, and France from 2002 to 2004. The Netherlands exceeded this level in 2003, and Austria in 2004.

In 2008, one year after the US financial crisis, the balances of Ireland and Spain moved from a surplus in the previous years to a deficit of 7.39 and 4.51 percent respectively. France once again had a deficit greater than 3 percent.

If the years from 1996 to 2008 are considered as a whole, it can be said that on average, all countries had lower deficits than in the years from 1985 to 1996, and all countries

[11] Greece: average from 1988 since data is not available before this year.

[12] Germany: average from 1991 since data for the whole of Germany is not available before reunification.

but Greece, Portugal and Italy had deficits less than 3 percent. In particular, Belgium, Ireland, Greece, Spain, Italy and the Netherlands decreased their deficits substantially by more than 3 to almost 8 percentage points.[13]

Since 2009, almost all countries have returned to their (high) deficit levels before 1996. Alone Belgium, Ireland and Italy had average deficits from 2009 to 2015[14] that differed strongly (by more than 3 percentage points) from those encountered between 1985 and 1996; Ireland in the positive direction (by more than 7 percentage points), and Belgium and Italy in the negative direction (by more than 3.5 and 7 percentage points respectively).

The development of fiscal deficits is reflected in the development of public debt levels, as Figure 3 on page 12 indicates.

Figure 3 illustrates the development of public debt levels as a percentage of GDP in the EA12 countries since 1990.

Figure 3 shows that in the years from 1990 to 1995, i.e. the time in which countries had rather high fiscal deficits, the debt levels of all countries but Ireland and the Netherlands increased. In particular, Greece and Italy, which had the highest deficits in this period, had huge increases in their debt levels by more than 26 percentage points. Spain and France's increases in debt were also high, amounting to more than 20 percentage points. Ireland, which substantially decreased its deficit during this time, in turn reduced its debt level by almost 12 percentage points, and the Netherlands kept it almost constant with a decrease of less than 1 percentage point.

In the years from 1996 to 2008, i.e. the time in which countries had rather low deficits, the debt levels of most of the countries in turn decreased. In particular, Belgium, Ireland and Spain had substantial decreases in their debt levels by 23.16, 35.31 and 41.01 percentage points respectively. Greece and Portugal, which did not manage to decrease their deficits below 3 percent, Germany and France, whose fiscal discipline was on the wane in between, and Luxembourg in turn increased their debt levels by 7 to 15 percentage points.

Since 2008, when the deficits of countries were higher again, the debt levels of all countries

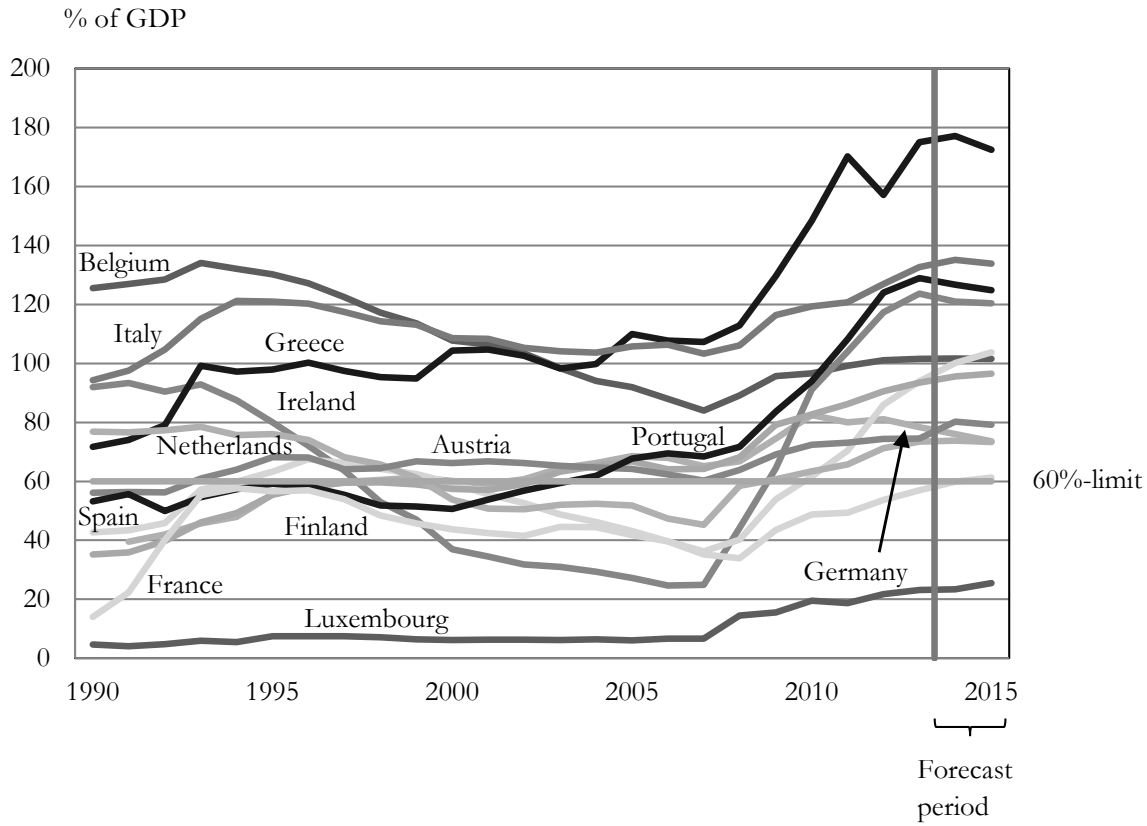
[13] Spain: comparison of average fiscal deficit 1996–2008 to fiscal deficit in 1995 since data is not available before this year.

[14] 2014 and 2015: forecasts.

increased, for most of them beyond the levels in 1995. Ireland, Greece, Spain, France and Portugal had extraordinary increases by about 40 to 75 percentage points in 2015 (forecast) compared to 1995. Only Belgium and the Netherlands succeeded in keeping their debt levels below the levels in 1995; the Netherlands by less than 3, Belgium by more than 28 percentage points.

Although the countries apparently had lower deficits and also decreasing debt levels in the first years of the euro, and not continuously higher deficits (though increasing debt levels) thereafter, it would be premature to interpret this as evidence against the hypothesis that a commitment problem of the EMU to no bailouts has increased the Eurozone countries' incentives to accumulate debt at the time of the introduction of the euro, or even at all. This is due to various reasons, as outlined in the following paragraphs.

Figure 3: Public debt levels



Source: AMECO, last accessed on 3 November 2014.

Fiscal discipline in the years around the introduction of the euro due to debt and deficit limits. First of all, it should be clear that the introduction of the euro may have affected incentives of debt accumulation not only in bringing about a commitment problem to no bailouts, but also in a variety of other ways.

In particular, the participation in the euro was made conditional upon the compliance with debt and deficit criteria set out in the Maastricht Treaty which, if low enough, might have limited incentives of debt accumulation before the introduction of the euro.

The debt and deficit criteria provide that at the time of the examination, the public debt levels and fiscal deficits in the European Union states must not exceed 60 and 3 percent of GDP respectively (Article 140 in conjunction with Protocol 13 TFEU).

Table 1 gives the unrevised figures of fiscal balances and public debt levels of the EA12 countries for the examination year 1997.

Table 1: Fiscal balances and public debt levels in 1997

	Fiscal balance (% of GDP)	Public debt level (% of GDP)
Belgium	−2.1	122.2
Germany	−2.7	61.3
Ireland	0.9	66.3
Greece	−4.0	108.7
Spain	−2.6	68.8
France	−3.0	58.0
Italy	−2.7	121.6
Luxembourg	1.7	6.7
Netherlands	−1.4	72.1
Austria	−2.5	66.1
Portugal	−2.5	62.0
Finland	−0.9	55.8

Source: Eurostat (1999), page 442.

The table shows that according to the unrevised figures, only three countries (France, Luxembourg and Finland) were able to meet the debt criterion of 60 percent of GDP in 1997. Nevertheless, another eight countries were allowed to introduce the euro in 1999, among them Belgium and Italy, whose debt levels were about twice as high as originally requested. According to Sinn (2012a, 2014), this may have been the result

of an unfortunate formulation in the Maastricht Treaty[15] and the political pressure of southern European countries and France on Germany to drop the debt limit to which the latter had to yield. This was because Germany itself was unable to achieve the debt limit due to having to include the Treuhand obligations that emerged from the German reunification in the government debt.[16] As the table shows, the deficit criterion of 3 percent of GDP was met by all countries but Greece. Greece satisfied the criterion with a declared value of 1.8 percent of GDP in 1999 and joined the EMU in 2001 despite a declared public debt level of 104.6 percent of GDP in 1999.[17]

As mentioned above, Table 1 shows the unrevised figures. In contrast, Figures 2 and 3 present the revised figures. According to these figures, two further countries (Germany and Portugal) achieved the debt criterion in 1997. In the case of Germany, this may be considered as bitter since in retrospect it removes the basis of any political pressure that may have induced it to drop the debt limit. Moreover, and as indicated above, the revised figures suggest that in addition to Greece, three further countries (Spain, France and Portugal) did not achieve the deficit criterion. Finally, they also show that with a fiscal deficit of 3.1 percent of GDP, Greece also failed to meet the deficit criterion in 1999.

Irrespective of whether the debt and deficit criteria were ultimately complied with or not, it can be taken for sure that they made a great contribution to the countries' decrease in deficits and debt levels around the examination year 1997. If comparing the change in incentives of debt accumulation before and after the introduction of the euro due to a commitment problem to no bailouts, the effect of debt and deficit limits on incentives of debt accumulation ought to be eliminated.

For the EMU, this is not only true for the examination year 1997 but every year thereafter. This is because the debt and deficit limits of 60 and 3 percent of GDP, respectively, should also be respected after the introduction of the euro, as stated in the Stability and Growth Pact (Article 126 in conjunction with Protocol 12 TFEU). If the deficit limit of 3 percent is exceeded, the rules envisage the imposition of financial sanctions.

[15]The explicit mentioning of the deficit limit at the participation criterion of a sustainable financial position in Article 140 TFEU allows the conclusion that its fulfilment is attached greater importance than the fulfilment of the debt limit and sufficient.

[16]Sinn (2012a), pages 44f, and Sinn (2014), pages 31f.

[17]Eurostat (2000), page 430.

Gradual decline in fiscal discipline due to breaches of the Maastricht Treaty without penalties. As indicated above, the fiscal discipline of countries after the introduction of the euro has not lasted for long. While all countries initially endeavoured to keep their path of fiscal discipline, since the turn of the millennium, their endeavour has decreased substantially. According to a counting by the Ifo Institute, the deficit ceiling had been exceeded 148 times by 2013, whereby an exceeding of the deficit ceiling due to a sufficiently severe recession had been allowed only in 51 cases. In the remaining 97 cases, financial sanctions should have been imposed, yet none in fact were.[18]

On the one hand, the reason for the loss in fiscal discipline may be that the prospect of not being allowed to participate in the EMU may have weighed more than the prospect of financial sanctions. More importantly, the allowance of countries to take part in the EMU despite not meeting the debt criterion may have shown a non-credibility of the debt and deficit limits that increased with every further exceeding of the limits and non-imposition of sanctions. In particular, the violation of the deficit criterion by Germany and France in the early 2000s along with the softening of the rules thereafter are supposed to have had a negative effect on fiscal discipline.

All in all, the events and developments of deficits and debt levels allow the conclusion that debt and deficit criteria have limited the incentives of debt accumulation also after the introduction of the euro, although to a decreasing extent. If deficits and debt levels before and after the introduction of the euro are compared, this should be kept in mind as it implies that the figures underestimate the effect of a commitment problem to no bailouts on incentives of debt accumulation as well as future incentives of debt accumulation in general. As a result of debt and deficit limits losing credibility, future incentives of debt accumulation due to the euro might be higher than the deficits and debt levels in the first years of the euro may suggest.

At this point, it should be pointed out that it is conceivable that the credibility of the debt and deficit criteria and the no-bailout rule are linked to each other. Thus, the non-compliance with debt and deficit criteria before and after the introduction of the euro may not only have had a negative impact on their credibility but also on the credibility

[18] Sinn (2014), page 53.

of the no-bailout rule, suggesting that the commitment problem to no bailouts may be larger nowadays than the figures suggest.

Jump in deficits and debt levels due to US financial crisis. Secondly, in addition to the introduction of the euro, other events and changes in the economy may have affected (incentives of) debt accumulation.

The US financial crisis in particular may not have had a negligible contribution to the rise in (additional) debt accumulation. This is not least indicated by the turnaround from rather low to high deficits and slightly decreasing to strongly increasing debt levels that can be dated to around 2009, i.e. two years after the start of the US financial crisis.

Reflection of cyclical fluctuations in deficits and debt levels. In general, when looking at the developments of deficits and debt levels in Figures 2 and 3 respectively, one should bear in mind that they are subject to cyclical fluctuations. The rather low deficits and decreasing debt levels in the years from 1996 to 2008 were certainly also due to the positive economic situation in Europe during these years and their associated high tax revenues.

Preponed effects of euro introduction due to anticipation by economic agents. Thirdly, it should be called to mind that the euro did not fall from the sky but that its introduction and participating countries were determined several years in advance. Therefore, the euro might have changed the incentives of debt accumulation long before its introduction.

In particular, if countries expected bailouts by the EMU, they might have had increased incentives to accumulate debt already before its formation, at least as far as the debt which matured after the introduction of the euro is concerned.

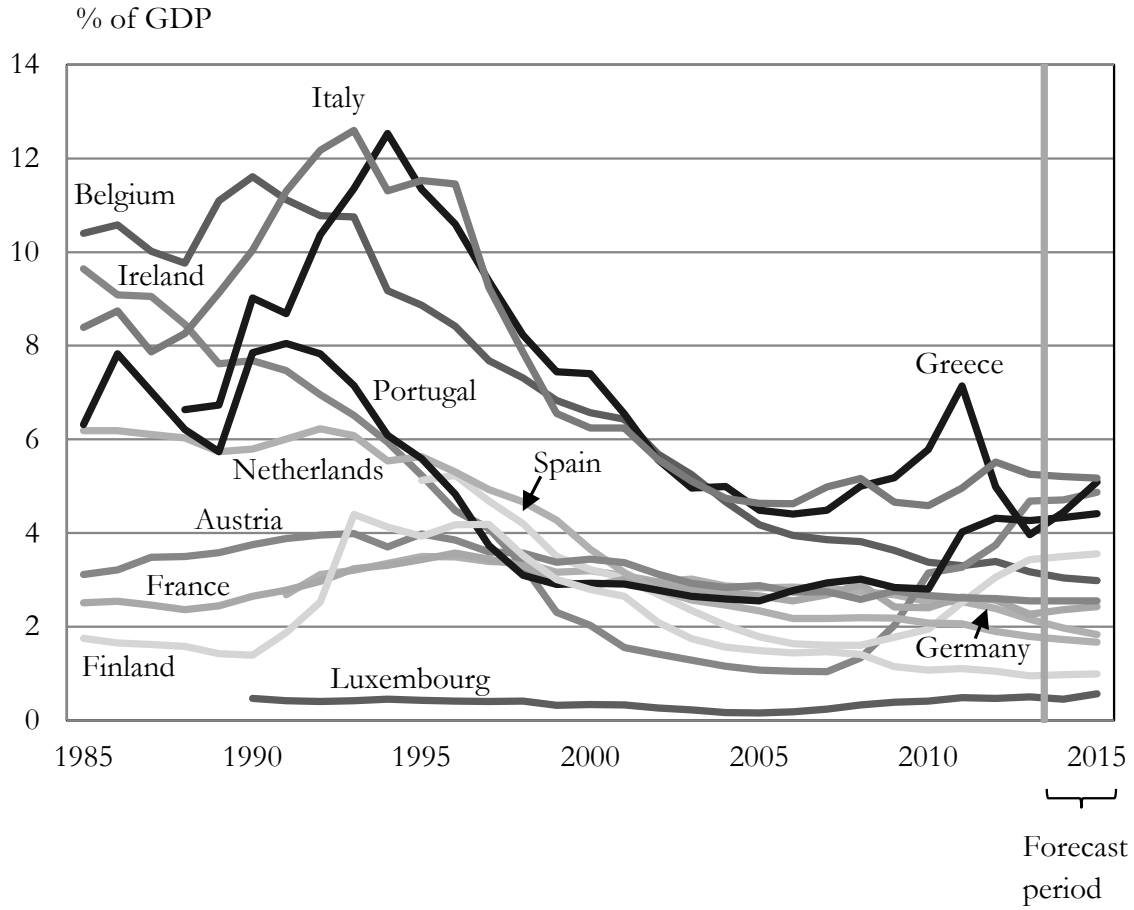
That the incentives of debt accumulation changed with the announcement of the euro rather than its introduction is also indicated by the developments of deficits and debt levels. The first turnaround in the data (from rather high to low deficits and increasing to decreasing debt levels) can be dated to around 1996 (after the euro announcement at

the Madrid Summit) rather than to 1999 (year of euro introduction).

Underestimated effects due to a decrease in interest burden. Fourthly, as Sinn (2012a, 2014) notes, the budget constraint of the countries participating in the EMU has been loosened by the downward convergence in interest rates. Funds that were used for interest payments before the euro was introduced have become available for other expenditures after the introduction of the euro.[19]

Figure 4 presents the development of the interest burden of public debt as a percentage of GDP in the EA12 countries since 1985.

Figure 4: Interest burden



Source: AMECO, last accessed on 3 November 2014.

[19]Sinn (2012a), pages 80–83, and Sinn (2014), pages 49–52.

Figure 4 shows that the interest burden in almost all countries has decreased after 1995, i.e. after the euro announcement, in many of them by substantial amounts. If the average interest burden in the years from 1985 to 1995 is compared with that in the years from 1996 to 2015[20], it can be seen that all countries enjoyed an interest advantage due to the euro. In particular, Belgium, Ireland, Greece, Italy and Portugal, which had to pay interest of about 7 to over 10 percent on average in the years from 1985 to 1995[21], have enjoyed a decrease in the interest burden by 3.5 to 5.5 percentage points on average since then. Even if the years from 1996 to 2008 are disregarded, and just the interest payments from 2009 to 2015 are considered (which due to a recurring divergence of interest rates in the course of the sovereign debt crisis were once again higher), the result will remain that all countries profited from the euro by a decrease in interest payments.

If the reader agrees that Figures 2 and 3 are missing the aspects just described in order to be able to provide substantive evidence for or against the hypothesis that a commitment problem of the EMU to no bailouts has increased incentives of debt accumulation at the time of the euro introduction and thereafter, she will certainly also agree that an attempt to include as many of the aspects as possible may be more able to provide such evidence. The following figure (see page 21) provides such an attempt.

Decrease in cyclically-adjusted primary balances after the announcement of the euro suggesting increased incentives of debt accumulation due to a commitment problem to no bailouts. Figure 5 compares the average cyclically-adjusted fiscal balances of the EA12 countries from 1985 to 1995 with those from 1996 to 2008 and 2009 to 2015[22], taking into account the average interest advantage due to the introduction of the euro. The average cyclically-adjusted fiscal balances are disaggregated into average primary balances and the average interest burden.

Apparently, Figure 5 does not address the first point brought up in the discussion of Figures 2 and 3. In a similar manner to how it is impossible to extract the effect of the commitment problem of the EMU to no bailouts on (additional) debt accumulation, it is impossible to eliminate the effect of debt and deficit limits thereon.

[20] 2014 and 2015: forecasts.
[21] Greece: average from 1988 since data is not available before this year.
[22] 2014 and 2015: forecasts.

Figure 5 does, however, make an attempt to address the other points.

Firstly, by dividing the observation period of 1985 to 2015 into the time periods 1985–1995, 1996–2008, and 2009–2015, it accounts for the second and the third point. The preponed effects of the euro introduction are accounted for by comparing additional debt accumulation before and after the euro announcement at the Madrid Summit in December 1995 (rather than before and after the introduction of the euro on 1 January 1999); the extraordinary effect of the US financial crisis by comparing the period before the euro announcement separately with the period after the euro announcement and before the start of the European sovereign debt crisis in 2009, and with the period thereafter.

Secondly, by considering cyclically-adjusted fiscal balances, as the name already indicates, Figure 5 is adjusted for cyclical fluctuations.

Thirdly, as mentioned previously, Figure 5 also takes account of the fourth point (interest advantage due to the introduction of the euro).

Note that the adding of the average interest advantage due to the euro introduction to the average cyclically-adjusted fiscal balances implies that in relative terms, a comparison of average cyclically-adjusted primary balances between the three periods of time would give the same results. In absolute terms, average cyclically-adjusted primary balances would differ from the sums of average cyclically-adjusted fiscal balances and the average interest advantage due to the euro introduction for all three periods by the average interest payments in the first period.

Figure 5 shows that if the effects of the economic cycle are excluded and the extension of the government budget due to a decrease in interest payments is included, two countries, namely Portugal and Ireland, will show additional debt accumulation that on average has been higher in the period after the euro announcement and before the start of the European sovereign debt crisis than in the period before the euro announcement. The increases by about 1.5 and 2.2 percentage points respectively are, however, relatively small, as are the decreases of the other countries. Italy alone was able to improve its balance by more than 2.5, namely 3.4 percentage points.

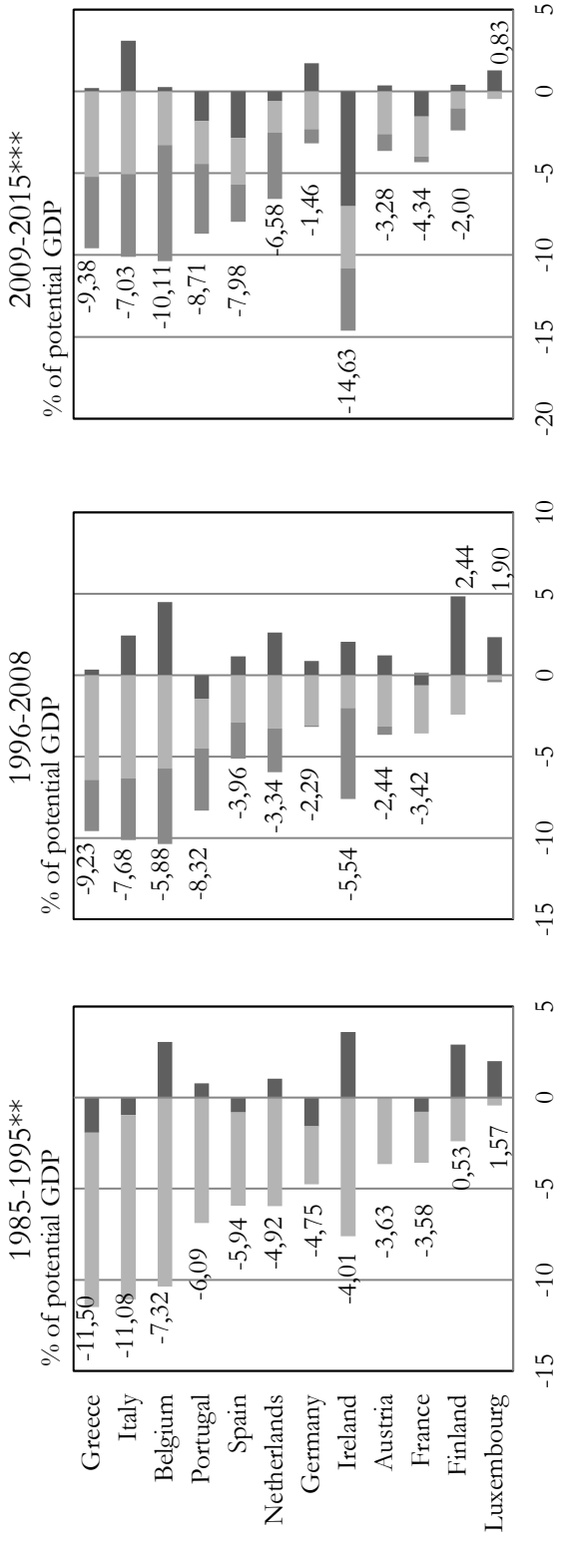
While Portugal and Ireland may be suspected to have been speculated for bailouts by the EMU with its introduction, the other countries cannot be acquitted therefrom. Once

again the reason is that Figure 5 does not exclude the effect of debt and deficit limits on (additional) debt accumulation and allows for the possibility that debt and deficit limits may have contained incentives of (additional) debt accumulation that actually have risen due to the assumption of a commitment problem of the EMU to no bailouts.

While in the first years after the euro announcement the majority of countries showed smaller additional debt accumulation, the opposite can be said for the time thereafter. Taking account of economic circumstances and the decrease in interest payments, two thirds of the EA12 countries are showing additional debt accumulation that on average has been higher after the year 2008 than before the euro announcement.

Thereby, Portugal stayed at about its average additional debt accumulation in the first period after the euro announcement, and that of Ireland has almost trebled since then. Spain, the Netherlands and Finland spent about the percentage points that they had spent less in the first period after the euro announcement more in the second, and Belgium even more than this. In Luxembourg and France, the additional debt accumulation did not change significantly across the three periods; it decreased by less than 0.5 percentage points in the first period and increased by not much more in the second. At first glance maybe most surprisingly, in addition to the rather well-doing countries Germany and Austria, it is the crisis countries Greece and Italy (which are often blamed for having contributed to the emergence of their sovereign debt crises because of their lack of fiscal discipline) that show additional debt accumulation, which on average has been lower in both periods after the euro announcement than in the period before. At second glance, however, this is only to say that the introduction of the euro did not further contribute to the debt accumulation in these countries and the emergence of their sovereign debt crises. It is definitely not to say that Greece and Portugal have impressed with fiscal discipline after the introduction of the euro. Clearly, both countries have had high average additional debt accumulation after the euro announcement, though somewhat smaller compared to their previous levels.

Figure 5: Average cyclically-adjusted fiscal balances plus average interest advantage due to euro introduction*



* The numbers on the bars indicate the sum of the primary balance, the interest burden and the interest advantage due to the euro introduction.

** Greece, Germany and Luxembourg: average from 1988, 1991 and 1990, respectively, since data before this date is unavailable. Spain: data for 1995 for same reason.

*** 2014 and 2015: forecasts.

Source: AMECO and own calculations, last accessed on 3 November 2014.

While the US financial crisis may have made a significant contribution to the increase in average additional debt accumulation since 2009 compared to the period before the euro announcement (and the period in-between), a commitment problem of the EMU to no bailouts (and the worsening thereof) may also have had an impact. In particular, it is possible that the non-compliance with debt and deficit criteria before and after the introduction of the euro has undermined their credibility and therefore reduced their effect on (additional) debt accumulation. Debt and deficit limits may have no longer contained incentives of (additional) debt accumulation that potentially have risen due to the assumption of a commitment problem of the EMU to no bailouts, but given them free rein. As explained above, it is also conceivable that the non-compliance of debt and deficit criteria not only undermined their credibility but the credibility of the whole Maastricht Treaty and therefore the credibility of the no-bailout rule, provided it once had some credibility. The dealing with the no-bailout rule in the course of the European sovereign debt crisis may have done the rest to knock it out.

To sum up, the data on public sector finances provides some indication for an active role of the commitment problem to no bailouts for debt accumulation and its increasing importance over time. In the following, we try to find out whether this indication is confined to just the public sector, or whether the private sector is embraced by it, too.

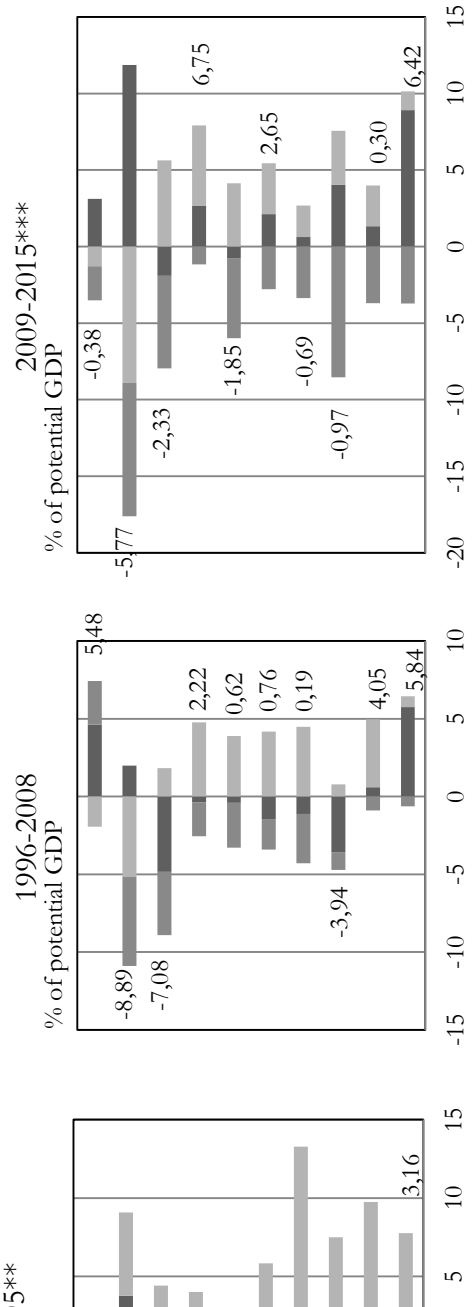
Massive deterioration in external sector finances suggesting an extension of the commitment problem to no bailouts beyond the sovereign sector. Figure 6 compares the average external balances of the EA12 countries (except Ireland and Luxembourg[23]) from 1985 to 1995 with those from 1996 to 2008 and 2009 to 2015[24]. The average external balances are disaggregated into the average balances of households, corporations and the general government.

By again dividing the observation period in three time periods demarcated by the years 1995 and 2008, it is once more aimed at accounting for the preponed effects of the euro introduction and the extraordinary effect that the US financial crisis may have had on (additional) debt accumulation.

[23]Data on corporations' and households' balances is not available for the entire period from 1985 to 1995.

[24]2014 and 2015: forecasts.

Figure 6: Average external balances*



* The numbers on the bars indicate the sum of the three sectors' balances, which is the external balance. A positive number indicates net lending to the rest of the world and a negative number net borrowing from the rest of the world.

** Germany: average from 1991. Greece: average general government's balance from 1988; corporations' and households' balances for 1995. Spain: data for 1995. Austria and Portugal: corporations' and households' balances for 1995.

*** 2014 and 2015: forecasts.

Source: AMECO and own calculations, last accessed on 3 November 2014.

Otherwise, it is rather difficult to include the points that were included in the analysis of sovereign debt in the examination of external debt. The reason is that for private or external sectors there is no data available that corresponds to cyclically-adjusted fiscal balances or the interest burden of public debt.

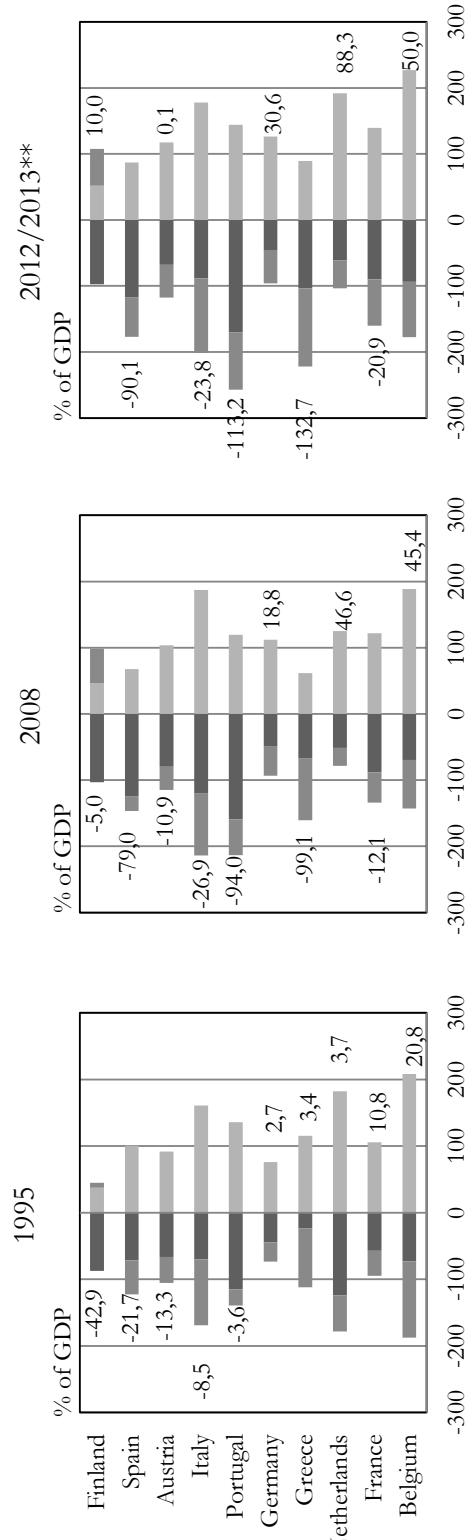
Therefore, when interpreting Figure 6, even more caution must be exercised than was shown in the interpretation of Figure 5.

First of all, Figure 6 shows that three countries, namely Greece, Portugal and Spain, had higher average external deficits in the period after the euro announcement and before the start of the European sovereign debt crisis than in the period before the euro announcement. If the period after 2008 is compared with the period before 1996, France, Italy and Belgium join the group of countries with higher average external deficits.

If, however, only private balances are considered, i.e. fiscal balances which are supposed to have been suppressed by debt and deficit limits are excluded, all countries but Finland, Germany and France show higher average deficits in the period after the euro announcement and before the start of the European sovereign debt crisis than in the period before the euro announcement. Interestingly, the opposite can be observed if the period after 2008 is compared with the period before 1996. Here, it will be two countries, namely France and Spain, less that will show higher average deficits if only private balances are considered. The reason may be that while fiscal balances tend to be procyclical (higher tax revenues when the economy is expanding; lower when it is contracting), private balances tend to be countercyclical (higher consumption and investment during booms; lower during recessions). Nevertheless, it is very probable that a commitment problem of the EMU to no bailouts has increased incentives of additional debt accumulation in the private sector in both periods of time. The reason is that the interest burden of private debt is assumed to have developed in a similar manner to the interest burden of public debt so that the budget constraints of households and corporations have been loosened to a similar extent as the budget constraint of governments—an advantage which does not show up in the figure.

A similar picture to the one in Figure 6 is presented by the following figure.

Figure 7: Net external financial asset positions*



* The numbers on the bars indicate the sum of the three sectors' net financial assets, which is the net external financial asset position. A positive number indicates net external claims and a negative number net external debt vis-à-vis the rest of the world.

** Belgium, Greece and Portugal: 2013. All other countries: 2012.

Source: Eurostat and own calculations, last accessed on 5 November 2014.

Figure 7 compares the net external financial asset positions of the EA12 countries (except Ireland and Luxembourg[25]) in 1995 with those in 2008 and 2012/2013. The net external financial asset positions are disaggregated into the net financial assets of households, corporations and the general government.

Figure 7 shows that all of the listed EA12 countries which are generally regarded as crisis countries in the current European sovereign debt crisis—namely Spain, Italy, Portugal and Greece—and the on-again-off-again struggling country France increased their net external debt during the first period after the euro announcement, partially by very high amounts. In particular, Spain, Portugal and Greece, which had higher average external deficits in this period, increased their net external debt by almost 60, over 90, and over 100 percentage points respectively. If the positive contribution that the boom may have made to the increase in private debt is ignored, this observation may suggest that the euro has increased the incentives of debt accumulation in the crisis countries already since its announcement and contributed to the emergence of their crises, all the more as the interest advantage due to the euro is also not taken into account in this figure. Moreover, the figure shows that the countries that had higher net external debt in 2008 compared to 1995 also had higher net external debt thereafter, in 2012/13, compared to 1995, whereby only Italy managed to go below its level in 2008 and the other four countries even exceeded theirs from then. The rest of the countries in turn improved their net external financial asset position from 1995 to 2008 as well as from 2008 to 2012/13.

If only the net financial assets of the private sector are considered, it can even be found that all countries but Germany and the Netherlands increased their net debt from 1995 to 2008. Although all countries but Greece improved their net position from 2008 to 2012/13, in addition to Germany and the Netherlands, only Finland, Austria and France achieved lower levels of net debt in 2012/13 compared to 1995.

All in all, the data on external sector finances suggests that the commitment problem to no bailouts may extend beyond the sovereign sector and have resulted in excessive debt accumulation in particular also in the private sector. In Part I, we wish to turn to the theory. Apart from answering the question of whether a commitment problem

[25]Data is not available for 1995 (except the general government's net financial assets of Luxembourg).

to no bailouts may have increased incentives of debt accumulation theoretically, we are particularly interested in shedding light on the issue of how this may have occurred. In order to maintain focus, our analysis is initially confined to the public sector and will later be transferred to the private sector.

Part I

Limited Liability and the Problem of Excessive Debt Accumulation

In light of the current sovereign debt crisis in the Eurozone, this part of my PhD thesis deals with the questions whether, and if so, how the formation of a monetary union affects debt levels, interest rates and welfare of its member states. Previous literature on this topic often relies on the commitment problem of central banks to no inflation that will be mitigated by the formation of a monetary union, thereby increasing debt levels. In contrast, this part formally analyses a commitment problem of the monetary union not to give a bailout to defaulting member states with the same consequences on debt levels. It sets up a multistage model in which the benevolent governments of n countries decide on their bond issuance before risk neutral agents choose asset portfolios consisting of these bonds and risk free assets. In the counterfactual situation in which the countries have not formed a monetary union and address default problems through inflation, debt issuance is optimal since the countries' governments have to offer the investors in their bonds an interest rate risk premium for the inflation risk. If a monetary union is able to credibly commit to no bailouts, its formation will leave the equilibrium unaffected since the inflation risk will just be replaced with a risk of restructuring. If it is not, its formation will increase debt levels, equalise interest rates and decrease the welfare of its member states. This part also provides empirical evidence from the formation of the EMU on the model's predictions for interest rates, and transfers the model to private debt and banking crises.

Chapter 1

Introduction

With regard to the findings obtained in the introductory chapter, this part of my PhD thesis tackles the following two questions:

- Does the introduction of a monetary union affect debt levels, interest rates and the welfare of its member states?
- If yes, then how does this occur?

Previous formal literature on this topic often employs the commitment problem of central banks to no inflation. This disciplines governments in their debt accumulation in and out of a monetary union. Since the disciplining effect is, however, weakened in a monetary union due to free riding, its formation increases debt levels (e.g. Beetsma & Bovenberg, 1999; Chari & Kehoe, 2007).

In contrast, this part formally analyses a commitment problem of the monetary union not to give a bailout to defaulting member states, which eliminates the disciplining effect of financial markets with the same consequences on debt levels. This argument has already been presented by some economists in connection with the current sovereign debt crisis in the Eurozone, though, to the best of my knowledge, only in an informal way (e.g. Sinn, 2010; Hellwig, 2011).

The model that will be presented has two types of players: the governments of n countries constituting the world which issue sovereign debt so as to maximise expected national welfare or, since citizens are assumed to be risk neutral, expected national income; and

investors residing all over the world who choose portfolios containing these sovereign debts as well as risk free assets so as to maximise their expected income.

The model is multi-stage. Governments decide on their debt issuance before investors choose their portfolios.

There are four cases to be considered and compared: the benchmark case of an optimal capital allocation; the counterfactual scenario in which the countries have not formed a monetary union; and two possible factual situations; the first in which $m \leq n$ countries have formed a monetary union but its commitment to no bailouts is assumed to be credible, and the second in which $m \leq n$ countries have formed a monetary union and its threat of no bailouts is seen as non-credible.

The results are as follows. In the cases of no monetary union and a monetary union with a credible no-bailout policy, all countries choose the optimal debt levels. While the interest rates differ across countries, they are the same in both cases. The countries choose the optimal debt levels since they have to compensate the investors for default risk either through inflation or restructuring in the form of an interest rate risk premium. Interest rates differ across countries according to differences in default risk. In the case of a monetary union with a non-credible no-bailout policy, monetary union member states choose too high debt levels. Their interest rates are lower than in the case of no monetary union, and equalised. The reason why monetary union member states choose too high debt levels is that they no longer have to compensate the investors for default risk, and a limited liability problem emerges. Since interest rate risk premiums are missing, interest rates are the same across countries.

Therefore, in reference to the research questions, the answer will be that if a monetary union is able to credibly commit to no bailouts, its formation will affect neither debt levels and interest rates nor welfare. If, however, it is not able to, its formation will increase debt levels, equalise interest rates and decrease welfare of its member states.

The model should not be viewed as a mere theoretical construct. After it is presented, empirical evidence from the formation of the EMU is provided on its predictions for interest rates.

Further, the model will be transferred to private debt and banking crises.

The remainder of this part is structured as follows. Chapter 2 relates this work to earlier work in the field. Chapter 3 presents the theoretical model examining the impact of monetary unification on debt levels, interest rates and welfare due to a commitment problem of the monetary union not to give a bailout to defaulting member states. Chapter 4 provides empirical evidence from the formation of the EMU on the model's predictions for interest rates. Chapter 5 transfers the model to private debt and banking crises. Chapter 6 concludes.

Chapter 2

Literature Review

Previous formal literature on the effects of monetary unification on debt levels, interest rates and welfare often relies on the commitment problem of central banks to no inflation and is reviewed in Section 2.1. In contrast, this part formally analyses a commitment problem of the monetary union not to give a bailout to defaulting member states. The problem of commitment to no bailouts has been analysed inter alia in the context of fiscal federalism. The main contributions on the role of fiscal federalism in debt accumulation, if suitable to the context of the Eurozone crisis, are reviewed in Section 2.2. The model that will be presented in this part differs in focus from the bailout models in that literature. While previous literature focuses on analysing the reasons for bailouts and their effects on debt demand, this part's model aims at investigating the effects of bailouts on both market sides of debt so as to be able to comment on the effects on the debt market equilibrium. Thereby, it builds on a line of argument that was put forward by some economists in the course of the current sovereign debt crisis in the Eurozone. The most comprehensive contributions are presented in Section 2.3.

2.1 Major Contributions to the Theory of Monetary Union

The literature on commitment problems of central banks to no inflation includes the work of Beetsma & Bovenberg (1999), Beetsma & Uhlig (1999), Chari & Kehoe (2007, 2008),

Cooper & Kempf (2004), Cooper et al. (2010), and Uhlig (2003). In the following, a short overview is provided about the models, their similarities and differences, followed by an assessment of the models with respect to their explanatory power for the Eurozone crisis and a distinction from the model presented in this part.

Overview of the models. What the above mentioned papers have in common is that they all model the commitment problem of central banks to no inflation as a time consistency problem. Benevolent central banks choose inflation after countries have chosen their debt accumulation. Although they want to commit themselves to price stability if countries choose to accumulate debt in order to discourage them from debt accumulation, they are not able to do so in a credible way because it will be in their own interest to inflate if the countries accumulate debt.

The commitment problem to no inflation disciplines governments in their debt accumulation in and out of a monetary union. The disciplining effect is, however, weakened in a monetary union due to free riding. The governments anticipate that their debt accumulation will induce inflation and related welfare costs, which encourage fiscal discipline. However, since costs of inflation are shared with other countries in a monetary union, the disciplining effect will be lower for this case. The time consistency problem results in a common pool or free rider problem for a monetary union.

The answer of the models to the questions whether and how monetary unification affects debt levels and interest rates is therefore clear-cut. Monetary unification increases debt accumulation and increases nominal interest rates (for given real interest rates).

While there is consensus on the type of market failure and the effects of monetary unification on debt levels and interest rates, there is less agreement on the central banks' reasons to inflate when faced with debt accumulation and the effects on welfare.

According to Chari & Kehoe (2007), for instance, central banks inflate so as to reduce the real value of government debt repayment, whereas Beetsma & Bovenberg (1999) state that they do so in order to reduce distortionary taxation and government spending cuts, and Cooper & Kempf (2004) assert that this is to finance fiscal deficits.

As presented by Chari & Kehoe (2007), debt accumulation is optimal in the case of no

monetary union and excessive in the case of a monetary union. In contrast, Beetsma & Bovenberg (1999) state that if governments are not myopic (an assumption that Chari and Kehoe, 2007, make throughout their model), the disciplining effect of the commitment problem of central banks to no inflation is so strong that debt accumulation is too small in terms of welfare in either case and monetary unification increases welfare. If, instead, governments are myopic, debt accumulation will be higher in both cases so that monetary unification will decrease welfare if governments are sufficiently myopic or the monetary union is sufficiently large.

In the end, the differences in the welfare effects are due to a different refinement of the time consistency problem described above. While Chari & Kehoe (2007) extend the sequential game only slightly by posing investors between the moves of governments and central banks, Beetsma & Bovenberg (1999) introduce a labour market with labour unions acting as Stackelberg leaders to governments and central banks, and political distortions.

Similar to Beetsma & Bovenberg (1999), Cooper & Kempf (2004) also introduce a labour market, though without labour unions. In their model, like in the model of Chari & Kehoe (2007), the common pool problem resulting from monetary unification clearly reduces welfare. Nonetheless, monetary unification may increase welfare since the model also includes transaction costs that cease to exist in the case of a monetary union.

Assessment with regard to the situation in the Eurozone. After the models have been presented, the question is how far they apply to the Eurozone context and therefore contribute to explaining the latter's current sovereign debt crisis. In answering the question, the following first clarifies whether the commitment problem described above concerns the ECB at all and then assesses to what extent the ECB can be compared with a common central bank that maximises overall welfare.

Regarding the first matter, it should firstly be made clear that the Statute of the ESCB and of the ECB[26] established the ECB as a central bank for which price stability is first priority (Article 2) and, as mentioned in the introductory chapter, government financing taboo (Article 21). Therefore, if credence is given to the Statute, the ECB should be

[26]European Union (2012b).

immune to commitment problems as described in the models presented since these are, after all, about price stability being given up for government financing. On the other hand, the behaviour of the ECB since the outbreak of the US financial crisis in 2007 has shown that it has a clear disposition to give defaulting member states a helping hand. Although the ECB didn't inflate the sovereign debt problems away, it substantially reduced them by a variety of other measures, among them being the lowering of collateral standards for refinancing credit (which resulted in the huge accumulation of Target liabilities as illustrated in Figure 1) and the purchase of government bonds. Therefore, while the ECB has not violated its mandate of price stability, it has breached Article 21 Statute of the ESCB and of the ECB. In any case, the behaviour of the ECB has shown that it has a commitment problem. Unlike in the papers presented, this does not relate to price stability in particular but to the promise not to take measures of government financing in general. Nevertheless, if the commitment problem that became apparent in the crisis was anticipated by the euro area member states and the investors in their bonds before the crisis, it may well have contributed to the crisis in a way described by the presented models.

In regard to the second matter, it should firstly be recalled that the ECB was established as a central bank that is independent of national governments (Article 7 Statute of the ESCB and of the ECB) and therefore acts in the common interest. If this is believed to be the case, the ECB can be represented by a common central bank that maximises overall welfare. On the other hand, the ECB is directed by a governing council, which consists of the members of an executive board and the presidents of the NCBs. The Governing Council acts by simple majority whereby each member has one vote (Article 10 Statute of the ESCB and of the ECB). The Executive Board comprises the President, the Vice-President and four other members and is appointed by the European Council (Article 11 Statute of the ESCB and of the ECB). In contrast, the NCB presidents are chosen through domestic political processes. Therefore, while it may be argued that the Executive Board acts in the common interest, it is rather doubtful that the NCB presidents are independent of national interests. The doubts are confirmed by the decision of the Governing Council with regard to the Securities Markets Programme (SMP). The SMP enables the ECB to purchase sovereign bonds of euro area member states in an unlimited

amount provided that these participate in either an EFSF or ESM programme.[27] It presumably benefits the crisis countries to the detriment of the solvent countries. It is known that the NCB presidents of solvent countries, namely Germany, the Netherlands and Luxembourg, voted against the SMP while those of crisis countries did not.[28] It would be quite astonishing if this was just a matter of chance. With the doubts regarding the independence of NCB presidents, there is also doubt that the decisions that are reached by simple majority are of common interest. The reason is that majority votings do not take the intensity of interest into account. In the case of the ECB, simple majority voting ignores the amount of welfare gain or loss by each country. Above all, it therefore takes greater account of the interests of smaller countries than of larger countries. The over-representation of small countries in decision-making could be overcome if the number of votes were related to the population size. Yet even then the decisions that are reached would usually not be of common interest since the amount of welfare gain or loss by each individual is still ignored.

Distinction from the model in this part. The current sovereign debt crisis in the Eurozone has demonstrated not only the willingness of the ECB but also the willingness of solvent euro area countries to jump to the aid of defaulting member states. Similar to the ECB, the EMU was willing to help out defaulting member states despite the existence of legal provisions that prohibit such an assistance. Although Article 125 of the Treaty on the Functioning of the European Union (TFEU)[29] prohibits European Union states from giving financial support to each other, the EMU has granted rescue packages in billions in the course of the crisis. The behaviour of the EMU therefore suggests that it also has a commitment problem. While the commitment problem of the ECB has been related to the promise not to grant monetary bailouts, the commitment problem of the EMU, however, relates to the promise not to grant fiscal bailouts. If this commitment problem was foreseen by the euro area member states and their investors, it may also

[27] European Central Bank (2012). Technical features of Outright Monetary Transactions. Press release, 6 September, http://www.ecb.europa.eu/press/pr/date/2012/html/pr120906_1.en.html.

[28] A. Kunz (2011). EZB-Chefvolkswirt Stark tritt zurück. *Wirtschaftswoche*, 9 September, http://www.wiwo.de/politik/ausland/europaeische-zentralbank-ezb-chefvolkswirt-stark-trittzurueck/5212924.html.

[29] European Union (2012a).

have contributed to the crisis. The model in this part aims at analysing the commitment problem of the EMU to no fiscal bailouts.

2.2 Lessons from Fiscal Federalism

The problem of commitment to no fiscal bailouts has been analysed in the context of fiscal federalism. In this literature, this commitment problem concerns a central government vis à vis defaulting regional governments. Of particular note are the contributions made by Cooper et al. (2008), Crivelli & Staal (2013), Goodspeed (2002), and Wildasin (1997). The following again provides a short overview over the models, followed by an assessment of the models and a distinction from the model in this part.

Overview of the models. Similar to the papers presented in Section 2.1, the papers just mentioned have in common that they all model the commitment problem as a time consistency problem. A welfare-maximising or vote-maximising central government decides whether or not to bail out defaulting regional governments after the regional governments have chosen their debt. It wants to commit itself to not granting bailouts if regional governments suffer a default in order to discourage them from debt accumulation. However, it may not be able to do so credibly. If regional governments do in fact default, it may find that it is now in its interest to give bailouts given the fact that the sovereign defaults have already occurred and there is no longer any point in trying to discourage the regional governments from debt accumulation.

If the central government has a commitment problem to no bailouts, the regional governments will have increased incentives to accumulate debt. The regional governments anticipate that they will receive a bailout in case of default, which is equal to an extension of their budget. The time consistency problem results in a "soft budget constraint".

While in all models the existence of a time consistency problem increases the incentives to accumulate debt, the reasons for bailouts, and the conditions under which they occur and a time consistency problem and increased incentives of debt accumulation actually exist, are different.

According to Wildasin (1997) and Crivelli & Staal (2013), the central government's reason to bail out a local government is due to externalities, and its incentive depends on the size of the locality. Yet while Wildasin (1997) contends that the incentive to bail out is larger the larger the locality is, i.e. the "too big to fail" hypothesis is theoretically confirmed, Crivelli & Staal (2013) derive the opposite result. The reason is that in Wildasin (1997) the externalities from the provision of local public goods in a given locality also depend on the externalities from the provision of local public goods in all other localities, which gives additional weight to the externalities from big localities, while in Crivelli & Staal (2013) they only depend on the amount of public goods provided in that locality. Goodspeed (2002) states that the reason for a bailout is also of a political nature. The central government maximises its expected votes by increasing grants in response to local borrowing. According to Cooper et al. (2008), the motives for bailouts are consumption or tax smoothing.

Assessment with regard to the situation in the Eurozone. After their presentation, the models are again assessed with regard to their application to the Eurozone context and explanatory power for the Eurozone crisis. Since it has already been explained in Section 2.1 that the EMU has a commitment problem to no bailouts, the following focuses on the questions whether the EMU can be considered as a federation in the sense of the papers just presented, to what extent its decision-making with regard to bailouts can be represented by a central government that maximises overall welfare, and how far the bailout motives of the papers presented may also have played a role in its bailout decisions.

Firstly, it is important to clarify that the European (Monetary) Union is not a federation in the strict sense. The European Union has no power to tax but receives its revenues indirectly by payments from treasuries of member states. Moreover, its budget relative to the size of the European Union economy is extremely low compared to the federal budgets of typical federations. In 2012, while central governments of typical federations had expenditures between 14 and 36 percent of GDP (compare Table 1), the EU had expenditures of 1.12 percent of the EU-27's gross national income (GNI).[30]

[30]European Commission, *Budget 2012 in figures*, http://ec.europa.eu/budget/figures/2012/2012_en.cfm,

Table 2: Central government expenditure in 2012

	Central government expenditure (% of GDP)
Austria	35.94
Belgium	35.08
Germany	27.39
Spain	28.63
Switzerland	14.33
United States	21.09

Source: OECD, *Consolidated government expenditure as percentage of GDP*, http://www.oecd.org/ctp/federalism/oecdfiscaldecentralisationdatabase.htm, last accessed on 7 December 2014.

For the application of the models, the European (Monetary) Union does not, however, need to be a federation in the strict sense. It is sufficient that its behaviour in the current sovereign debt crisis justifies a consideration as a federation in the sense of the presented papers. At the end of the day, what counts is that the EMU has been able to grant bailouts to defaulting member states, which are backed by the taxpayers of its member states. It has tied up rescue packages amounting to billions—billions which show up neither in the figure above nor in national accounts since a promise of repayment stands behind them, but will be borne by the member states, i.e. their taxpayers, in proportion to their capital share in the ECB if the repayment promise is reneged.

While the EMU can be considered as a federation in the sense of the presented papers, it is questionable that its decision-making with regard to bailouts can be represented by a central government that maximises overall welfare. In the euro crisis, the decisions on rescue loans by the EMU have essentially been taken by groups of national representatives, usually the Eurogroup, i.e. the finance ministers of the Eurozone. The decisions are claimed to have been made unanimiously.[31] If this is the case, and assuming that national representatives act in the national interest, a bailout decision would only coincide with that of a welfare maximising central government if all countries were to benefit from the bailout or if the monetary union as a whole were to lose from it. Moreover, the

last accessed on 7 December 2014.

[31] Compare for the Greek loan facility, EFSF and ESM: Eurogroup (2010). Statement by the Eurogroup. Brussels, 2 May, http://www.eurozone.europa.eu/media/368686/100502-_eurogroup_statement_greece.pdf; European Financial Stability Facility (2011), page 6; and European Council (2012a), page 13.

granting of any rescue package in the euro crisis would have to be a Pareto improvement for each individual member state. Yet even if the latter is considered as unlikely and it is rather expected that the national representatives in reality negotiate with each other so as to reach a common agreement, the decisions that are reached would usually not maximise welfare since, similar to the ECB, the interests of small countries would be over-represented in decision-making.

Although the EMU, unlike the central government in the presented papers, has presumably not maximised overall welfare when deciding on bailouts, it may nevertheless have had similar motives for granting them. In particular, similar to the central government discussed by Wildasin (1997) and Crivelli & Staal (2013), the EMU may have been motivated to grant bailouts by preventing negative externalities. Yet while the central government as detailed by Wildasin (1997) and Crivelli & Staal (2013) fears negative externalities from the under-provision of regional public goods, politicians in the Eurozone may rather have feared negative spillover effects of defaults from individual countries to other countries. At least, they have made the prevention of panic and contagion effects into a justification for each further rescue package that they have granted. In addition to externalities, the EMU, similar to the central government examined by Goodspeed (2002), may also have been led by political motives. Ultimately, it cannot be denied that politicians do not act solely on behalf of national interest but also think ahead to the next elections.

Distinction from the model in this part. The model that will be presented in this part and the aforementioned bailout models can be distinguished from each other mainly in the focus. In the bailout models presented above the focus is placed on shedding light on the motives for bailouts; the effects of bailouts are confined to the demand side of debt. In contrast, this part's model is interested in an equilibrium analysis, therefore also embracing supply-side effects of bailouts. Thus, while the models presented above model the commitment problem explicitly, this paper's model simply presumes its existence. The existence of the commitment problem can be justified with an over-representation of countries at high risk of default in decision-making or the fear of negative spillover effects of defaults from individual countries to other countries. This was discussed in the previous

paragraph but will not be considered further. Still, this part's model considers a time consistency problem. This, however, models the disciplining effect of financial markets. Since the supply side of debt is considered in addition to the demand side, the effects of bailouts on equilibrium debt levels, interest rates and welfare can be determined.

2.3 Informal Explanatory Approaches for the Eurozone Crisis

The model presented in this part builds on a line of argument that was put forward by some economists in the course of the sovereign debt crisis. The most comprehensive contributions thereto are Sinn (2010)[32] and Hellwig (2011). In the following, a short summary is given of explanations made by Sinn (2010), followed by a distinction from this part's model.

Summary of Sinn (2010). According to Sinn (2010), there is both an optimistic and a pessimistic theory of how the interest rate convergence that followed the introduction of the euro has changed Europe's economy.

The optimistic theory argues that the interest rate convergence affected the optimal allocation of capital in Europe and therefore resulted in a gain in GDP. It assumes that the interest rate spreads that had been observed before the euro introduction distorted the capital allocation because they were due to differences in unnecessary exchange rate risk. Due to the stability of the Deutsche Mark and the peg of the Austrian schilling and the Dutch guilder to the Deutsche Mark, investors assigned a lower exchange rate risk to Germany, Austria and the Netherlands (GANL countries) than to the rest of Europe (ROE countries) and therefore requested higher nominal interest rates from the latter than from the former. With the introduction of the euro, differences in exchange rate risk ceased to exist, meaning that the interest rate spreads and the capital distortion also ceased to exist.

In contrast, the pessimistic theory argues that the interest rate convergence affected a

[32] Sinn (2010), pages 11–14.

distortion in the capital allocation and therefore resulted in a GDP loss. It assumes that the interest rate spreads observed ensured an optimal capital allocation because they were due to differences in inflation and corresponding currency devaluation risk that reflected an implicit default risk. Because of their lower fiscal stability and higher readiness to use inflation to get rid of their sovereign debt problems, the investors requested higher nominal interest rates from the ROE countries. With the introduction of the euro, the devaluation risk disappeared and interest rates converged. The latter was, however, a mistake insofar as it has not been anticipated that the implicit default risk had now been replaced by a formal default risk.

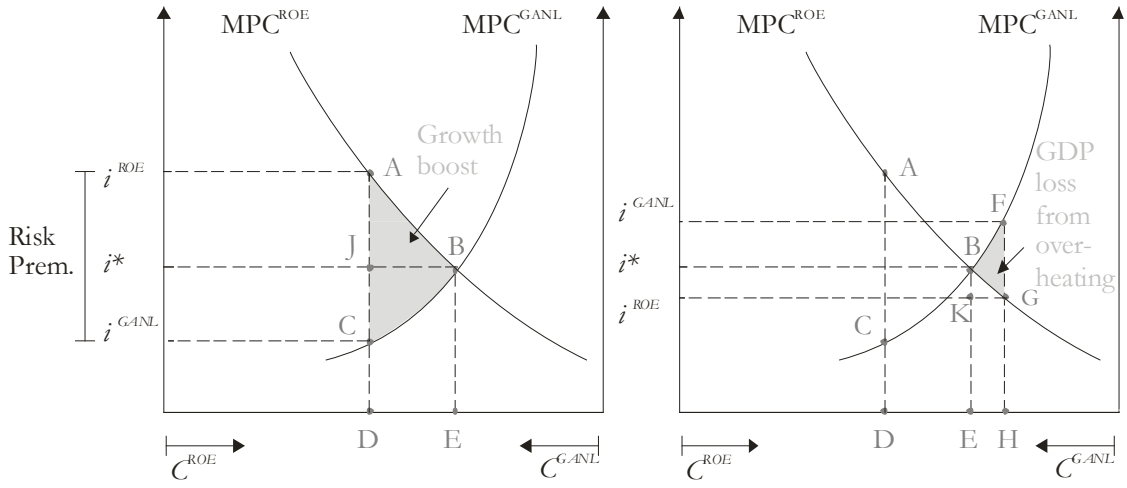
The left and right diagram found in Figure 8 (see page 46) illustrate the optimistic and pessimistic theory respectively. Both diagrams compare the actual history of Europe with a counterfactual scenario had the euro not been introduced. The horizontal lengths of the diagrams are given by the available capital in the Eurozone. The capital that is invested in the ROE countries C^{ROE} is measured from left to right; the capital that is invested in the GANL countries C^{GANL} from right to left. Therefore, the marginal product of the ROE countries MPC^{ROE} decreases with the capital invested in the ROE countries from left to right, and the marginal product of the GANL countries MPC^{GANL} with the capital invested in the GANL countries from right to left. The countries will take on investment projects as long as the marginal product of capital is at least as great as their interest rates. For the optimistic theory, interest rates are interpreted in nominal terms; for the pessimistic theory, they are defined in effective terms, i.e. as nominal interest rates minus the expected rates of currency devaluation relative to the Deutsche Mark or default loss per unit of capital invested.

According to the optimistic theory, if the euro had not been introduced, the nominal interest rate of the ROE countries i^{ROE} would have been higher than that of the GANL countries i^{GANL}, which would have resulted in the capital allocation represented by D. This is distorted against ROE countries because overall production could be increased if capital was shifted from GANL countries to ROE countries. Since the euro was introduced, the interest rates, however, converged to i^*, which resulted in the capital allocation represented by E. This is optimal, since overall production cannot be increased by changing the capital allocation. The interest rate convergence increased overall production

by the area ABC.

According to the pessimistic theory, if the euro had not been introduced, the nominal interest rate of the ROE countries would have been higher than that of the GANL countries, but the effective interest rates would have been the same. This would have resulted in the optimal capital allocation represented by E. Since the euro was introduced, the nominal interest rates converged and the effective interest rate of the ROE countries became lower than that of the GANL countries. This resulted in the capital allocation in H, which is distorted towards the GANL countries. The interest rate convergence decreased overall production by the area BFG.

Figure 8: Two theories of how the euro changed Europe's economy



Source: Sinn (2010), pages 12f.

Distinction from the model in this part. As Sinn (2010) notes, it is difficult to judge which of the two theories is right and which is wrong. The truth likely lies somewhere in between. The model presented here abstracts from the optimistic theory and takes a closer look at the pessimistic theory. It adds to the explanations made by Sinn (2010) by describing the arguments put forth in a formal way and providing additional insight, in particular about the kind of market failure at work and the effects on welfare.

Chapter 3

Theoretical Model

Section 3.1 presents the model set-up, Sections 3.2 and 3.3 derive the normative and positive solution respectively, and Section 3.4 discusses possible extensions to the model and the robustness of the results.

3.1 Model Set-up

Subsection 3.1.1 firstly provides a brief overview of the model set-up; Subsections 3.1.2 and 3.1.3 then specify the payoffs of governments and investors respectively.

3.1.1 Overview

This subsection firstly presents the model's players, their actions and objective functions, then outlines the time structure and finally specifies the cases which will be considered.

Players, actions and objective functions. The model has two types of players: the governments of n countries constituting the world, $i \in N = \{1, ...n\}$, and investors residing all over the world. Governments and investors demand and supply capital on the world capital market, respectively, so as to maximise their respective expected utilities. The details are as follows.

Each of the n countries' governments borrows money on the world capital market by

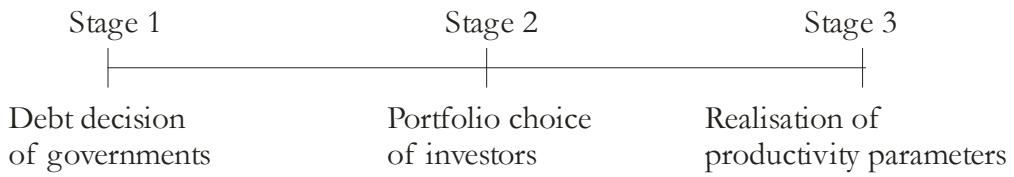
issuing sovereign bonds or debt D_i at the interest rate r_i, $i = 1, ...n$, so as to maximise expected national welfare or, since citizens are assumed to be risk neutral, expected national income $\bar{u}_i$. Concretely, the governments employ the capital in the production of goods Y_i which benefit the consumers among their countries' population. For instance, they use the capital for public investment in infrastructure, education and health services. Thereby, the countries are confronted with uncertain productivity θ_i so that they default with a probability δ_i that is endogenously determined by the debt level, interest rate and production technology.

Each investor has an initial wealth level W^0 and lends money through the world capital market by buying government bonds of the n countries, i.e. acquiring holdings b_i in country i bonds, $i = 1, ...n$, and buying other assets at the risk free interest rate r_f so as to maximise her expected end of period wealth level or income $\bar{W}^1$. For simplicity, the investors are assumed to benefit only from private investment. They are not consumers, i.e. they are neither beneficiaries nor cost bearers with regard to public investment. Moreover, they do not pay for potential bailouts—here, it is the consumers who foot the bill.

The n countries' governments and the investors have no market power. They are assumed to be many in number so that they act as price takers.

Time strucure. Figure 9 illustrates the sequence of events.

Figure 9: Schematic illustration of the sequence of events



There are three stages of time. In stage 1, governments issue bonds. In stage 2, investors buy these bonds and risk free assets. In stage 3, after the governments have invested the capital in goods production, the veil of uncertainty is lifted, i.e. the productivity

parameters are realised.

Cases. There are four cases to be considered and compared: the benchmark case of an optimal capital allocation, the counterfactual scenario of no monetary union, and the two possible factual situations of monetary union with and without a credible no-bailout policy. In the benchmark case, the available capital is allocated to the various productive processes so that the overall expected welfare is maximised. In the case of no monetary union, all n countries have their own currencies so that they can solve their default problems not only through debt restructuring but also through inflation. Also beyond monetary policy, countries are considered to be independent states that do not step in for each other but are on their own in case of default. In contrast, in the case of monetary union, $m \geq 2$ countries, $i \in M = \{1, ...m\} \subseteq N$, have a common currency so that they can solve their default problems only through debt restructuring and not through inflation. Moreover, with a non-credible no-bailout policy, investors consider the monetary union to be a "community of common destiny" that will step in for its member states in case of default even if it promises not to do so. To distinguish the case of no monetary union from the case of monetary union with a credible no-bailout policy more clearly, it is assumed that if countries have their own currencies they will only use inflation to get rid of their default problems.

3.1.2 Governments

After the brief overview of the model, this and the next subsection give more detail regarding the payoffs of governments and investors respectively.

In stage 1, each country's government issues bonds at the nominal interest rate r_i, $i = 1, ...n$, and employs the capital in the real production of goods.

Production uncertainty. The production process involves uncertainty and is described by

$$Y_i = \int_{\theta_i^0}^{\theta_i^1} Y_i\left(D_i, \theta_i\right) dF_i\left(\theta_i\right) \tag{3.1}$$

where Y_i is real production and D_i capital = nominal debt. The parameter $\theta_i \in [\theta_i^0, \theta_i^1]$ with cumulative distribution function $F_i\left(\theta_i\right)$ introduces uncertainty. The production function $Y_i\left(\cdot\right)$ satisfies the Inada conditions.[33] Y_i is therefore increasing at a decreasing rate in D_i for given θ_i; Y_i and $\partial Y_i/\partial D_i$ are increasing in θ_i for given D_i. For simplicity, the countries' risks as expressed by the $F_i(\theta_i)$ are assumed to be statistically independent. As later argued in Section 3.4, the relaxation of this assumption should not, however, yield (qualitatively) different results.

A country will suffer a default if the productivity of the government's investment turns out to be so low that it cannot repay its debt plus interest,

$$Y_i\left(D_i, \theta_i\right) < \left(1 + r_i\right) D_i \tag{3.2}$$

The default probability of country $i = 1, ...n$ is then defined as

$$\delta_i = \int_{\theta_i^0}^{\hat{\theta}_i} dF_i\left(\theta_i\right) = F_i\left(\hat{\theta}_i\right) \tag{3.3}$$

where $\hat{\theta}_i$ is a critical value of θ_i that satisfies

$$Y_i\left(D_i, \hat{\theta}_i\right) - \left(1 + r_i\right) D_i = 0 \tag{3.4}$$

i.e. a realisation of θ_i sufficiently low that the country can only just meet its debt repayment obligations.

$\hat{\theta}_i$ is therefore an implicit function of r_i and D_i. From the Implicit Function Theorem it follows that

[33] The Inada conditions for the production function $Y_i\left(\cdot\right)$ are: [1] $Y_i\left(D_i = 0\right) = 0$, [2] $Y_i\left(\cdot\right)$ is continuously differentiable, [3] $\frac{\partial Y_i}{\partial D_i} > 0$, [4] $\frac{\partial^2 Y_i}{\partial D_i^2} < 0$, [5] $\lim\limits_{D_i \to 0} \frac{\partial Y_i}{\partial D_i} = +\infty$, and [6] $\lim\limits_{D_i \to +\infty} \frac{\partial Y_i}{\partial D_i} = 0$. Compare Inada (1963).

$$\frac{\partial \delta_i}{\partial D_i} = f_i\left(\hat{\theta}_i\right)\frac{\partial \hat{\theta}_i}{\partial D_i} = -f_i\left(\hat{\theta}_i\right)\left(\frac{\partial Y_i\left(D_i,\hat{\theta}_i\right)}{\partial D_i} - (1+r_i)\right)/\frac{\partial Y_i\left(D_i,\hat{\theta}_i\right)}{\partial \theta_i} \tag{3.5}$$

$$\frac{\partial \delta_i}{\partial r_i} = f_i\left(\hat{\theta}_i\right)\frac{\partial \hat{\theta}_i}{\partial r_i} = f_i\left(\hat{\theta}_i\right)D_i/\frac{\partial Y_i\left(D_i,\hat{\theta}_i\right)}{\partial \theta_i} > 0 \tag{3.6}$$

Thus, the default probability will increase with the debt level if the marginal product of debt, $\partial Y_i/\partial D_i$, in state $\hat{\theta}_i$ is less than the rate of return that has to be paid on it, $1+r_i$ (this is fulfilled with the Inada conditions), while an increase in the interest rate always increases default risk.

If, for instance, a Cobb-Douglas production function $Y_i\left(D_i,\theta_i\right) = D_i^{\alpha}\theta_i$ and a uniform distribution of the productivity parameters $F_i\left(\theta_i\right) = \frac{\theta_i-\theta_i^0}{\theta_i^1-\theta_i^0}$ are assumed, the default probability of country i will be given by

$$\delta_i = \frac{(1+r_i)\,D_i^{1-\alpha} - \theta_i^0}{\theta_i^1 - \theta_i^0} \tag{3.7}$$

and increases with the debt level at a decreasing rate (compare Appendix 7.1 on pages 85f).

If country i defaults, it will renege on its debt by inflation if it has its own currency, and by restructuring if it shares a currency with other countries.

Case of no monetary union. In the case of no monetary union, all countries have their own currencies so that the utility of country $i = 1, ...n$ is given by

$$u_i = \begin{cases} W_i^1 + Y_i - \frac{1+r_i}{1+\pi_i}D_i & if \quad \theta_i < \hat{\theta}_i \\ W_i^1 + Y_i - (1+r_i)\,D_i & if \quad \theta_i \geq \hat{\theta}_i \end{cases} \tag{3.8}$$

where W_i^1 denotes the end of period wealth level of investors who reside in country i, which will be determined in the next subsection. The parameter π_i is the inflation rate. The utility of country i comprises the income of its investors and the net income of its consumers whereby the latter is revenue from debt issuance less repayment of debt. If country i does not suffer a default, it will repay the total of its debt plus interest. If, in

contrast, it defaults, it will renege on its debt by inflation.

Note that the inverse of the inflation factor, $\frac{1}{1+\pi_i}$, gives the proportion of debt claims that are met given default. Therefore, the complementary share, $1-\frac{1}{1+\pi_i}$, models the haircut in that it gives the proportion of debt claims that are not met given default.

Theoretically, repayment of debt can range from nothing to the part that is covered by revenues from debt accumulation. In what follows, only the two extreme cases are considered in which countries either default on their entire debt if they cannot repay any of it, or repay whatever they can and default on the rest. If countries renege on their total debt in the case of no monetary union, they will set π_i to infinity. If, instead, they repay debt to the extent they are able to, they will set π_i so that it satisfies

$$\frac{1+r_i}{1+\pi_i}D_i - Y_i\left(D_i,\theta_i\right) = 0 \tag{3.9}$$

i.e. depreciates their repayment obligations until these are met by their revenues from debt issuance. From the Implicit Function Theorem it follows that

$$\frac{\partial \pi_i}{\partial D_i} = -\left[\frac{1+r_i}{1+\pi_i} - \frac{\partial Y_i\left(D_i,\theta_i\right)}{\partial D_i}\right] / \left[-\frac{1+r_i}{\left(1+\pi_i\right)^2}D_i\right] \tag{3.10}$$

$$\frac{\partial \pi_i}{\partial \theta_i} = \frac{\partial Y_i\left(D_i,\theta_i\right)}{\partial \theta_i} / \left[-\frac{1+r_i}{\left(1+\pi_i\right)^2}D_i\right] < 0 \tag{3.11}$$

$$\frac{\partial \pi_i}{\partial r_i} = -\frac{1}{1+\pi_i}D_i / \left[-\frac{1+r_i}{\left(1+\pi_i\right)^2}D_i\right] > 0 \tag{3.12}$$

Thus, the inflation rate will increase with the debt level if the marginal product of debt in state θ_i is less than its remuneration (this, too, is fulfilled with the Inada conditions), while it always decreases with the productivity and increases with the interest rate.

Case of monetary union. In the case of monetary union, countries $1,...m$ share a common currency while countries $m+1,...n$ have their own currencies. Therefore, while the utility of country $i = m+1,...n$ is again given by (3.8), the utility of country $i = 1,...m$

is now given by

$$u_i = \begin{cases} W_i^1 + Y_i - \gamma_i (1 + r_i) D_i & if \quad \theta_i < \hat{\theta}_i \\ W_i^1 + Y_i - (1 + r_i) D_i & if \quad \theta_i \geq \hat{\theta}_i \end{cases} \tag{3.13}$$

where γ_i is the proportion of debt claims that are met given default in the case of restructuring. Again, if country i does not suffer a default, it will repay the total of its debt plus interest. If, in contrast, it defaults, it will renege on its debt by restructuring.

Note that inflation and restructuring will have the same effect on the utility of country i's government if the inverse of the inflation factor is equal to the repayment rate in the case of restructuring, $\frac{1}{1+\pi_i} = \gamma_i$ (this will be assumed in the following).

If countries renege on their total debt in the case of monetary union, they will set $\gamma_i = 0$. If, instead, they repay debt to the extent they are able to, they will set γ_i so that it satisfies

$$\gamma_i (1 + r_i) D_i - Y_i (D_i, \theta_i) = 0 \tag{3.14}$$

i.e. in such a way that the revenues from debt issuance suffice to repay debt plus interest. From the Implicit Function Theorem the following relationships result, which are inverse to those of π_i in the case of no monetary union.

$$\frac{\partial \gamma_i}{\partial D_i} = -\left[\gamma_i (1 + r_i) - \frac{\partial Y_i (D_i, \theta_i)}{\partial D_i}\right] / \left[(1 + r_i) D_i\right] \tag{3.15}$$

$$\frac{\partial \gamma_i}{\partial \theta_i} = \frac{\partial Y_i (D_i, \theta_i)}{\partial \theta_i} / \left[(1 + r_i) D_i\right] > 0 \tag{3.16}$$

$$\frac{\partial \gamma_i}{\partial r_i} = -\gamma_i D_i / \left[(1 + r_i) D_i\right] < 0 \tag{3.17}$$

The repayment rate in the case of restructuring will decrease with the debt level if the marginal product of debt in state θ_i is less than its remuneration (as mentioned previously, this is fulfilled with the Inada conditions), while it always increases with the productivity

and decreases with the interest rate.

3.1.3 Investors

In stage 2, each investor buys government bonds of the n countries and risk free assets. Concretely, she chooses holdings b_i in country i bonds, $i = 1, ...n$, while the capital that she invests in risk free assets is determined as residual of her initial wealth level W^0.

Purchasing power parity. It is assumed that purchasing power parity holds so that the exchange rate in indirect notation from country i's point of view is given by

$$e_{j,i} = \frac{p_j}{p_i} \tag{3.18}$$

i.e. the price of country j divided by the price of country i.

Moreover, it is assumed that countries have constant prices, except they have their own currencies and suffer a default, in which case they will inflate some, if not the total amount, of their debt away.

Case of no monetary union. In the case of no monetary union, all countries have their own currencies so that the income of an investor with initial wealth level W^0 is given by

$$W^1 = \sum_{i=1}^{n} \zeta_i (1 + r_i) b_i + (1 + r_f) \left[W^0 - \sum_{i=1}^{n} b_i \right] \tag{3.19}$$

where

$$\zeta_i = \begin{cases} \frac{1}{1+\pi_i} & if \quad \theta_i < \hat{\theta}_i \\ 1 & if \quad \theta_i \geq \hat{\theta}_i \end{cases} \tag{3.20}$$

If the investor invests one monetary unit in government bonds of country i in the current period and country i does not suffer a default, she will get $1 + r_i$ in the subsequent period. If, instead, country i suffers a default, she will get $\frac{1+r_i}{1+\pi_i}$.

Note that this is independent of whether the investor resides in country i or not, and if she does not, whether her country of residence suffers a default or not.

If the investor resides in country i and country i suffers a default, her real wealth will be reduced by inflation.

If, instead, the investor resides in a country $j \neq i$ and invests one monetary unit of her home currency in government bonds of country i in the current period, she has to exchange the home currency into the country i's currency at the current exchange rate $e^0_{j,i}$ and buy the government bonds of country i with country i's currency. In the subsequent period she gets $\frac{1+r_i}{e^0_{j,i}}$ and has to exchange this amount into the home currency at the future exchange rate $e^1_{j,i}$ so that she receives $\frac{e^1_{j,i}(1+r_i)}{e^0_{j,i}}$. As purchasing power parity holds, $\frac{e^1_{j,i}(1+r_i)}{e^0_{j,i}} = \frac{\frac{p^1_j}{p^1_i}(1+r_i)}{\frac{p^0_j}{p^0_i}}$.

If the investor resides in a country $j \neq i$ that does not suffer a default, $\frac{\frac{p^1_j}{p^1_i}(1+r_i)}{\frac{p^0_j}{p^0_i}} = \frac{p^0_i}{p^1_i}(1+r_i)$, since prices will be constant in country j for this case. If, in contrast, the investor resides in a country $j \neq i$ that suffers a default, as prices will now change by the inflation rate π_j in country j, $\frac{\frac{p^1_j}{p^1_i}(1+r_i)}{\frac{p^0_j}{p^0_i}} = \frac{p^0_i}{p^1_i}(1+\pi_j)(1+r_i)$. However, since inflation in the residence country reduces the real wealth of the investor, the rate of return will be $\frac{p^0_i}{p^1_i}\frac{(1+\pi_j)(1+r_i)}{1+\pi_j} = \frac{p^0_i}{p^1_i}(1+r_i)$ and therefore the same as if the residence country does not suffer a default. The appreciation of the exchange rate $e_{j,i}$ will be offset by the reduction in real wealth.

Then, if country i does not suffer a default, $\frac{p^0_i}{p^1_i}(1+r_i) = 1+r_i$, since prices will be constant in country i for this case. If, instead, country i suffers a default, as prices will now change by the inflation rate π_i in country i, $\frac{p^0_i}{p^1_i}(1+r_i) = \frac{1+r_i}{1+\pi_i}$. The real value of debt repayment will be reduced by the depreciation of the exchange rate $e_{j,i}$.

Note that if countries renege on their total debt in case of default, $\frac{1+r_i}{1+\pi_i} = \frac{1+r_i}{1+\infty} = 0$. If, instead, they repay debt to the extent they are able to, $\frac{1+r_i}{1+\pi_i} \geq 0$.

Finally, if the investor invests one monetary unit in the risk free assets, she will get $1+r_f$ in the subsequent period for certain.

Case of monetary union and credible no-bailout policy. In the case of monetary union, countries $1, ...m$ share a common currency while countries $m+1, ...n$ have their own currencies. The income of an investor in the case of monetary union with a credible no-bailout policy is given by

$$W^1 = \sum_{i=1}^{m} \vartheta_i (1+r_i) b_i + \sum_{i=m+1}^{n} \zeta_i (1+r_i) b_i + (1+r_f) \left[W^0 - \sum_{i=1}^{n} b_i \right] \tag{3.21}$$

where

$$\vartheta_i = \begin{cases} \gamma_i & if \quad \theta_i < \hat{\theta}_i \\ 1 & if \quad \theta_i \geq \hat{\theta}_i \end{cases} \tag{3.22}$$

and ζ_i satisifies (3.20). If the investor invests one monetary unit in government bonds of country i and country i does not suffer a default, she will get $1 + r_i$ in the subsequent period. If, in contrast, country i suffers a default, she will get only $\gamma_i(1 + r_i)$ if country i is a member state of the monetary union, and $\frac{1+r_i}{1+\pi_i}$ if it is not.

Again, this is independent of whether country i is the residence country or not, and if it is not, whether the residence country suffers a default or not. In particular, if country i is a member state of the monetary union and suffers a default, the investor's nominal debt repayment will be cut by restructuring no matter where she resides. Beyond that, the explanations from above also apply here.

Note that analogous to the utility of country i's government, inflation and restructuring will have the same effect on the investor's income if $\frac{1}{1+\pi_i} = \gamma_i$ (this was assumed before).

If countries renege on their total debt in case of default, $\gamma_i(1 + r_i) = 0$. If, instead, they repay debt to the extent they are able to, $\gamma_i(1 + r_i) \geq 0$.

As in the case of no monetary union, if the investor invests one monetary unit in the risk free assets, she will certainly get $1 + r_f$ in the subsequent period.

Case of monetary union and non-credible no-bailout policy. Finally, the income of an investor in the case of monetary union with a non-credible no-bailout policy is given by

$$W^1 = \sum_{i=1}^{m}(1+r_i)b_i + \sum_{i=m+1}^{n}\zeta_i(1+r_i)b_i + (1+r_f)\left[W^0 - \sum_{i=1}^{n} b_i\right] \tag{3.23}$$

where ζ_i satisifies (3.20). If the investor invests one monetary unit in government bonds of a monetary union member state, she assumes that she will get $1+r_i$ in the subsequent period for certain because she expects the monetary union to step in for its member states in case of default. In contrast, if the investor invests one monetary unit in government bonds of a country that is not a member state of the monetary union, she assumes to get $1+r_i$ in the subsequent period only if this country does not suffer a default. If the country suffers a default, she expects to get only $\frac{1+r_i}{1+\pi_i}$ in the subsequent period. Both are again independent of the residence country and its solvency. In principle, the explanations from above apply once more. Finally, as in the other two cases, if the investor invests one monetary unit in the risk free assets, she knows that she will get $1+r_f$ in the subsequent period for certain.

3.2 Normative Solution

As a benchmark, this section determines the optimal capital allocation by solving the optimisation problem of a social planner.

A social planner allocates capital to the various productive processes so as to maximise overall expected production

$$\sum_{i=1}^{n}\int_{\theta_i^0}^{\theta_i^1} Y_i\left(D_i,\theta_i\right)dF_i + Y_f \tag{3.24}$$

subject to the resource constraint

$$\sum_{i=1}^{n} D_i + D_f = W_N^0 \tag{3.25}$$

where Y_f represents the production technology behind the risk free assets. This production technology is certain and described by

$$Y_f = Y_f\left(D_f\right) \tag{3.26}$$

where Y_f is real production and D_f capital. The production function $Y_f\left(\cdot\right)$ satisfies the Inada conditions. Y_f is therefore increasing at a decreasing rate with D_f. Although the production technology is certain, its real rate of return depends on the capital invested therein. The risk free interest rate is therefore not exogenous but endogenous in the model. The parameter W_N^0 denotes the available capital in the world, i.e. the sum of all investors' initial wealth levels.

The first order conditions (FOCs) imply that the optimal capital allocation satisfies

$$\int_{\theta_i^0}^{\theta_i^1} \frac{\partial Y_i}{\partial D_i} dF_i = \int_{\theta_j^0}^{\theta_j^1} \frac{\partial Y_j}{\partial D_j} dF_j = \frac{\partial Y_f}{\partial D_f} \ \forall i, j \in N \tag{3.27}$$

i.e. the equivalence of expected marginal products in the n countries, and the resource constraint.

If a Cobb-Douglas production function $Y_i\left(D_i, \theta_i\right) = D_i^{\alpha}\theta_i$ and a uniform distribution of the productivity parameters $F_i\left(\theta_i\right) = \frac{\theta_i - \theta_i^0}{\theta_i^1 - \theta_i^0}$ are assumed, the optimal debt level of country i will be given by

$$D_i^* = \frac{\left(\frac{\theta_i^0 + \theta_i^1}{2}\right)^{\frac{1}{1-\alpha}}}{\theta_f^{\frac{1}{1-\alpha}} + \sum_i \left(\frac{\theta_i^0 + \theta_i^1}{2}\right)^{\frac{1}{1-\alpha}}} W_N^0 \tag{3.28}$$

and the investment in the certain production technology

$$D_f^* = \frac{\theta_f^{\frac{1}{1-\alpha}}}{\theta_f^{\frac{1}{1-\alpha}} + \sum_i \left(\frac{\theta_i^0 + \theta_i^1}{2}\right)^{\frac{1}{1-\alpha}}} W_N^0 \tag{3.29}$$

where the ratios represent the relation of a country's average productivity or the certain technology's productivity to overall average productivity whereby all average productivities are appreciated by output elasticity (compare Appendix 7.2 on pages 86f).

3.3 Positive Solution

After the optimal capital allocation has been determined as a benchmark, this section derives the market outcomes for the cases of no monetary union and monetary union with a credible and a non-credible no-bailout policy and compares them with regard to their welfare. The model is solved by backward induction. Accordingly, Subsection 3.3.1 firstly considers the portfolio choice of investors, and Subsection 3.3.2 then the debt decision of governments. Finally, Subsection 3.3.3 undertakes a welfare comparison.

3.3.1 Portfolio Choice

In stage 2, each investor invests in government bonds of the n countries and risk free assets, i.e. chooses holdings b_i in country i bonds, $i = 1, ...n$, so as to maximise her expected income.

Cases of no monetary union and monetary union with a credible no-bailout policy. In the cases of no monetary union and monetary union with a credible no-bailout policy, all countries expose the investors in their bonds to a haircut in case of default.

If countries renege on their total debt in case of default, the expected income of an investor is given by

$$\bar{W}^1 = \sum_{i=1}^{n} [1 - \delta_i] (1 + r_i) b_i + (1 + r_f) \left[W^0 - \sum_{i=1}^{n} b_i \right] \tag{3.30}$$

and if they repay debt to the extent they are able to,

$$\bar{W}^1 = \sum_{i=1}^{n} [1 - \delta_i + \int_{\theta_i^0}^{\hat{\theta}_i} \gamma_i(\theta_i) dF_i] (1 + r_i) b_i + (1 + r_f) \left[W^0 - \sum_{i=1}^{n} b_i \right] \tag{3.31}$$

where $\gamma_i = \frac{1}{1+\pi_i}$ for $i = 1, ...n$ in the case of no monetary union and for $i = m + 1, ...n$ in the case of monetary union with a credible no-bailout policy. If the investor invests one monetary unit in government bonds of country i, she will get $1+r_i$ in the subsequent period with the probability $1 - \delta_i$. She will get nothing with the complementary probability if

countries renege on their total debt in case of default, and $\gamma_i(\theta_i) \in \left[\gamma_i\left(\theta_i^0\right), \gamma_i\left(\hat{\theta}_i\right)\right]$ with cumulative distribution function $F_i\left(\theta_i\right)$ if they repay debt to the extent they are able to. If the investor invests one monetary unit in the risk free assets, she will get $1 + r_f$ in the subsequent period for certain.

The FOCs imply that an interior solution of the portfolio choice problem requires

$$[1 - \delta_i](1 + r_i) = 1 + r_f \ \forall \ i \in N \tag{3.32}$$

and

$$[1 - \delta_i + \int_{\theta_i^0}^{\hat{\theta}_i} \gamma_i(\theta_i) dF_i](1 + r_i) = 1 + r_f \ \forall \ i \in N \tag{3.33}$$

respectively, i.e. we have an arbitrage condition on the equivalence of expected interest payments. The investors request an interest rate risk premium over the risk free interest rate from countries, which in expectation compensates for defaulting interest payments. The interest rate risk premium that the investors require from a country is higher the higher the latter's default risk is. From the Implicit Function Theorem it follows that

$$\frac{\partial r_i}{\partial D_i} = \frac{\frac{\partial \delta_i}{\partial D_i}(1 + r_i)}{1 - \delta_i - \frac{\partial \delta_i}{\partial r_i}(1 + r_i)} \tag{3.34}$$

and

$$\frac{\partial r_i}{\partial D_i} = \frac{[\frac{\partial \delta_i}{\partial D_i} - \int_{\theta_i^0}^{\hat{\theta}_i} \frac{\partial \gamma_i}{\partial D_i} - \gamma_i\left(\hat{\theta}_i\right) \frac{\partial \hat{\theta}_i}{\partial D_i}](1 + r_i)}{1 - \delta_i - [\frac{\partial \delta_i}{\partial r_i} - \int_{\theta_i^0}^{\hat{\theta}_i} \frac{\partial \gamma_i}{\partial r_i} - \gamma_i\left(\hat{\theta}_i\right) \frac{\partial \hat{\theta}_i}{\partial r_i}](1 + r_i)} \tag{3.35}$$

respectively. The interest rate that the investors charge to a country will increase with the latter's debt level if the additional interest income in case of no default is expected to be higher than the interest loss due to an increase in the default probability (this will be assumed in the following).

The optimal bondholdings are any elements of the interval between 0 and W^0, $b_i \in [0, W^0]$ $\forall \ i$, with $\sum_{i=1}^{n} b_i \leq W^0$, and the expected indirect income is given by

$$\bar{W}^1 = (1 + r_f)\, W^0 \tag{3.36}$$

Case of monetary union with a non-credible no-bailout policy. In the case of monetary union with a non-credible no-bailout policy, countries $1, ...m$ are bailed out in case of default.

If countries renege on their total debt in case of default, the expected income of an investor is given by

$$\bar{W}^1 = \sum_{i=1}^{m}(1 + r_i)b_i + \sum_{i=m+1}^{n} [1 - \delta_i]\,(1 + r_i)b_i + (1 + r_f)\left[W^0 - \sum_{i=1}^{n} b_i\right] \tag{3.37}$$

and if they repay debt to the extent they are able to,

$$\bar{W}^1 = \sum_{i=1}^{m}(1+r_i)b_i + \sum_{i=m+1}^{n} [1-\delta_i + \int_{\theta_i^0}^{\hat{\theta}_i} \gamma_i(\theta_i)dF_i](1+r_i)b_i + (1+r_f)\left[W^0 - \sum_{i=1}^{n} b_i\right] \tag{3.38}$$

with $\gamma_i = \frac{1}{1+\pi_i}$. If the investor invests one monetary unit in government bonds of country $i = 1, ...m$ or the risk free assets, she will get $1 + r_i$ and $1 + r_f$, respectively, in the subsequent period for certain. If the investor invests in government bonds of country $i = m + 1, ...n$, she will be fully repaid, plus interest, only with the probability $1 - \delta_i$.

The FOCs imply that an interior solution of the portfolio choice problem requires

$$1 + r_i = [1 - \delta_j](1 + r_j) = 1 + r_f \;\forall\; i \in M \wedge j \in N \setminus M \tag{3.39}$$

and

$$1 + r_i = [1 - \delta_j + \int_{\theta_j^0}^{\hat{\theta}_j} \gamma_j(\theta_j)dF_j](1 + r_j) = 1 + r_f \;\forall\; i \in M \wedge j \in N \setminus M \tag{3.40}$$

respectively, i.e. the equivalence of interest rates for countries $1, ...m$ and of expected interest payments for countries $m + 1, ...n$. While the investors still request an interest rate risk premium from countries $m + 1, ...n$, they no longer ask for an interest rate risk

premium from countries $1, ...m$. Since the monetary union steps in for defaulting interest payments of member states, the investors do not ask for compensation from the latter. Independent of the default risk and the level of debt, investors simply demand the risk free interest rate from country $i = 1, ...m$.

The optimal bondholdings are again any $b_i \in [0, W^0] \ \forall \ i$ with $\sum_{i=1}^{n} b_i \leq W^0$, and the expected indirect income is again given by (3.36).

3.3.2 Debt Decision

In stage 1, each country's government issues bonds, i.e. chooses its debt level D_i, $i = 1, ...n$, so as to maximise its expected national income anticipating the portfolio choice of investors.

Cases of no monetary union and monetary union with a credible no-bailout policy. In the cases of no monetary union and monetary union with a credible no-bailout policy, the expected national income of country $i = 1, ...n$ if it reneges on its total debt in case of default is given by

$$\bar{u}_i = \bar{W}_i^1 (D_i) + \int_{\theta_i^0}^{\theta_i^1} Y_i(D_i, \theta_i) dF_i - [1 - \delta_i (D_i)](1 + r_i) D_i \tag{3.41}$$

and if it repays debt to the extent it is able to,

$$\bar{u}_i = \bar{W}_i^1 (D_i) + \int_{\theta_i^0}^{\theta_i^1} Y_i(D_i, \theta_i) dF_i - \left[1 - \delta_i (D_i) + \int_{\theta_i^0}^{\hat{\theta}_i} \gamma_i(D_i, \theta_i) dF_i\right] (1 + r_i) D_i \tag{3.42}$$

where $\bar{W}_i^1$ denotes the expected income of investors who reside in country i that is obtained by summing up (3.30) and (3.31), respectively, over the investors residing in country i. Again, $\gamma_i = \frac{1}{1+\pi_i}$ for $i = 1, ...n$ in the case of no monetary union and for $i = m+1, ...n$ in the case of monetary union with a credible no-bailout policy.

Equation (3.14) simplifies (3.42) to

$$\bar{u}_i = \bar{W}_i^1 (D_i) + \int_{\hat{\theta}_i}^{\theta_i^1} Y_i(D_i, \theta_i) dF_i - [1 - \delta_i (D_i)] (1 + r_i) D_i \tag{3.43}$$

If country i reneges on its total debt in case of default, it will keep its production. If, in contrast, it repays debt to the extent it is able to, it will give the production to the investors in its bonds. Without taking account of the investors' portfolio choice, country i's choice of debt, if it reneges on its total debt in case of default, will affect its expected national income in four ways: expected income of its investors, production, default probability, and repayment of debt in case of no default. If country i repays debt to the extent it is able to, its choice of debt will additionally affect its expected national income by the critical value of the productivity parameter below which it cannot meet the total of its repayment obligations.

Conditions (3.36) and (3.32), and (3.36) and (3.33) respectively, simplify the objective function to

$$\bar{u}_i = (1 + r_f) W_i^0 + \int_{\theta_i^0}^{\theta_i^1} Y_i(D_i, \theta_i) dF_i - (1 + r_f) D_i \tag{3.44}$$

in either case, where W_i^0 is the sum of initial wealth levels of the investors residing in country i. Thus, taking into account the investors' portfolio choice, country i's debt choice impacts its expected national income in only two ways: production and repayment of debt.

The FOC is therefore given by

$$\int_{\theta_i^0}^{\theta_i^1} \frac{\partial Y_i}{\partial D_i} dF_i = 1 + r_f \tag{3.45}$$

i.e. the equivalence of the expected marginal product to 1 plus the risk free interest rate. As $1+r_f = [1-\delta_i](1+r_i)$, and $1+r_f = [1-\delta_i+\int_{\theta_i^0}^{\hat{\theta}_i} \gamma_i(\theta_i) dF_i](1+r_i)$ respectively, country i pays debt, in expectation, according to its expected marginal product.

The optimal debt level is implicitly determined by (3.45). From the Implicit Function Theorem it follows that

$$\frac{\partial D_i}{\partial r_f} = 1/\int_{\theta_i^0}^{\theta_i^1} \frac{\partial^2 Y_i}{\partial D_i^2} dF_i < 0 \tag{3.46}$$

The optimal debt level of country i decreases with the risk free interest rate r_f. The expected welfare of country i is given by (3.44) whereby D_i is implicitly determined by (3.45).

Case of monetary union with a non-credible no-bailout policy. In the case of monetary union with a non-credible no-bailout policy, the expected national income of country $i = 1, ...n$ is again given by (3.41) and (3.42)/(3.43), though with the difference that $\bar{W}_i^1$ is obtained by summing up (3.37) and (3.38), respectively, over the investors residing in country i and will not depend on D_i if country i is a member state of the monetary union, i.e. $\bar{W}_i^1(D_i) = \bar{W}_i^1$ for $i = 1, ...m$. Without taking account of the investors' portfolio choice, country i's expected national income in this case differs from the one in the previous two cases in quantitative terms only in that the investors' expected income is higher due to the bailout of monetary union member states in case of default. Qualitatively, it also differs in that country i's choice of debt no longer affects the expected income of its investors if country i belongs to the monetary union.

Conditions (3.36) and (3.39), and (3.36) and (3.40) respectively, simplify the objective function for country $i = m + 1, ...n$ again to (3.44). In contrast, they alter the objective function for country $i = 1, ...m$ to

$$\bar{u}_i = (1 + r_f) W_i^0 + \int_{\theta_i^0}^{\theta_i^1} Y_i(D_i, \theta_i) dF_i - (1 - \delta_i(D_i))(1 + r_f) D_i \tag{3.47}$$

and

$$\bar{u}_i = (1 + r_f) W_i^0 + \int_{\hat{\theta}_i}^{\theta_i^1} Y_i(D_i, \theta_i) dF_i - (1 - \delta_i(D_i))(1 + r_f) D_i \tag{3.48}$$

respectively. Thus, taking into account the investors' portfolio choice, the expected national income of country i in this case differs from the one in the previous two cases in that country i's choice of debt still affects the default probability if country i belongs to the monetary union. If country i moreover repays debt to the extent it is able to,

it also differs in that country i's choice of debt will still affect the critical value of the productivity parameter below which it cannot meet the total of its repayment obligations.

While the FOC for country $i = m+1, ...n$ is therefore again given by (3.45), the FOC for country $i = 1, ...m$ is now given by

$$\int_{\theta_i^0}^{\theta_i^1} \frac{\partial Y_i}{\partial D_i} dF_i \geq \left[1 - \delta_i - \frac{\partial \delta_i}{\partial D_i} D_i\right] (1 + r_f) \tag{3.49}$$

and

$$\int_{\theta_i^0}^{\theta_i^1} \frac{\partial Y_i}{\partial D_i} dF_i \geq \left[1 - \delta_i - \frac{\partial \delta_i}{\partial D_i} D_i\right] (1 + r_f) + \int_{\theta_i^0}^{\hat{\theta}_i} \frac{\partial Y_i}{\partial D_i} dF_i + Y_i\left(D_i, \hat{\theta}_i\right) \frac{\partial \hat{\theta}_i}{\partial D_i} \tag{3.50}$$

respectively, i.e. the equivalence or excess of the expected marginal product to an expression that is smaller than 1 plus the risk free interest rate. Since $1 + r_f = 1 + r_i$ country $i = 1, ...m$ pays less than the expected marginal product for capital. If country $i = 1, ...m$ reneges on its total debt, it has to trade off two positive effects and one negative effect of a debt increase on welfare. An increase in debt increases production and also reduces the probability that the country will actually incur the cost of debt repayment. However, it also increases this cost in the event of no default, which occurs with probability $1 - \delta_i$. If country $i = 1, ...m$ repays debt to the extent it is able to, it must take into account two further negative effects. An increase in debt increases the income that it has to hand over to investors in case of default as well as the range of productivity parameters for which this will happen.

The optimal debt level of country $i = m+1, ...n$ is again implicitly determined by (3.45) and decreases with the risk free interest rate r_f. On the contrary, the optimal debt level of country $i = 1, ...m$, if the FOCs hold with equality, will be implicitly determined by (3.49) and (3.50) respectively. Since the right hand side of (3.49) and (3.50) is smaller than the right hand side of (3.45), the optimal debt level of country $i = 1, ...m$ is higher for this case than for the previous two cases. Moreover, since the right hand side of (3.50) is higher than the right hand side of (3.49), the optimal debt level will be lower if country $i = 1, ...m$ reneges only on some of its debt. If the FOCs do not hold with equality, the debt demand will go to infinity and be independent of the risk free interest rate.

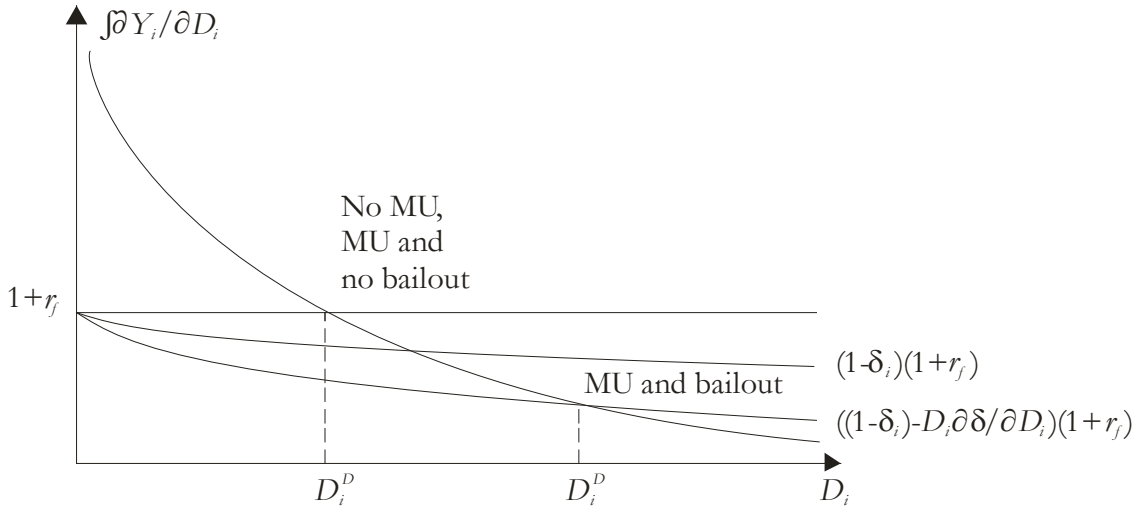
While the expected welfare of country $i = m + 1, ...n$ is again given by (3.44) with D_i being implicitly determined by (3.45), the expected welfare of country $i = 1, ...m$ is given by (3.47) and (3.48) whereby D_i will be implicitly determined by (3.49) and (3.50) respectively if the FOCs are binding, and equal to infinity if they are not. Since the utilities in (3.47) and (3.48) are higher than the utility in (3.44) for all debt levels and optimal debt levels are different, the expected welfare of country $i = 1, ...m$ is higher for this case than for the previous two cases.

The FOCs reveal that the choice of higher debt by country $i = 1, ...m$ is ultimately due to the emergence of a limited liability problem. When choosing its debt, country $i = 1, ...m$ ignores some or the total of its repayment obligations in case of default—as expressed in terms of the risk free interest rate—which increases its incentives to accumulate debt. The difference to the cases of no monetary union and monetary union with a credible no-bailout policy is that country $i = 1, ...m$ does not have to compensate the investors for higher debt levels in terms of a higher interest rate as the monetary union will intercede in case of default and bail out country $i = 1, ...m$. In the cases of no monetary union and monetary union with a credible no-bailout policy, a limited liability problem does not occur because country i anticipates that it has to offer higher interest rates to investors for higher debt levels. The interest rate risk premium induces country i to take into account the total of its debt repayment obligations in case of default, as expressed in terms of the risk free interest rate.

Graphical illustration. Figure 10 illustrates the debt choice for the case in which governments will renege on their total debt in case of default.

In the cases of no monetary union and monetary union with a credible no-bailout policy, country i's debt level is determined by the intersection point of the expected marginal product curve and the straight line at $1 + r_f$. In the case of monetary union with a non-credible no-bailout policy, however, if an interior solution is assumed, the debt level of country $i = 1, ...m$ will be given by the intersection point of the expected marginal product curve and a curve that lies strictly below $1 + r_f$, and thus be higher.

Figure 10: Graphical illustration of the debt choice



3.3.3 Welfare Comparison

After the model has been solved for all cases, this subsection compares the solutions of the different cases with regard to their welfare.

Cases of no monetary union and monetary union with a credible no-bailout policy. In the cases of no monetary union and monetary union with a credible no-bailout policy, the countries' FOCs imply that

$$\int_{\theta_i^0}^{\theta_i^1} \frac{\partial Y_i}{\partial D_i} dF_i = 1 + r_f = \int_{\theta_j^0}^{\theta_j^1} \frac{\partial Y_j}{\partial D_j} dF_j \ \forall \ i, j \in N \tag{3.51}$$

In both cases, the normative and positive analyses achieve the same result. As country i has to compensate the investors for its risk, no market failure arises and the market gives the optimal capital allocation.

Case of monetary union with a non-credible no-bailout policy. In the case of monetary union with a non-credible no-bailout policy, the FOCs imply

$$\int_{\theta_i^0}^{\theta_i^1} \frac{\partial Y_i}{\partial D_i} dF_i / \left[1 - \delta_i - \frac{\partial \delta_i}{\partial D_i} D_i\right] \geq 1 + r_f = \int_{\theta_j^0}^{\theta_j^1} \frac{\partial Y_j}{\partial D_j} dF_j \; \forall \; i \in M \wedge j \in N \setminus M \quad (3.52)$$

and

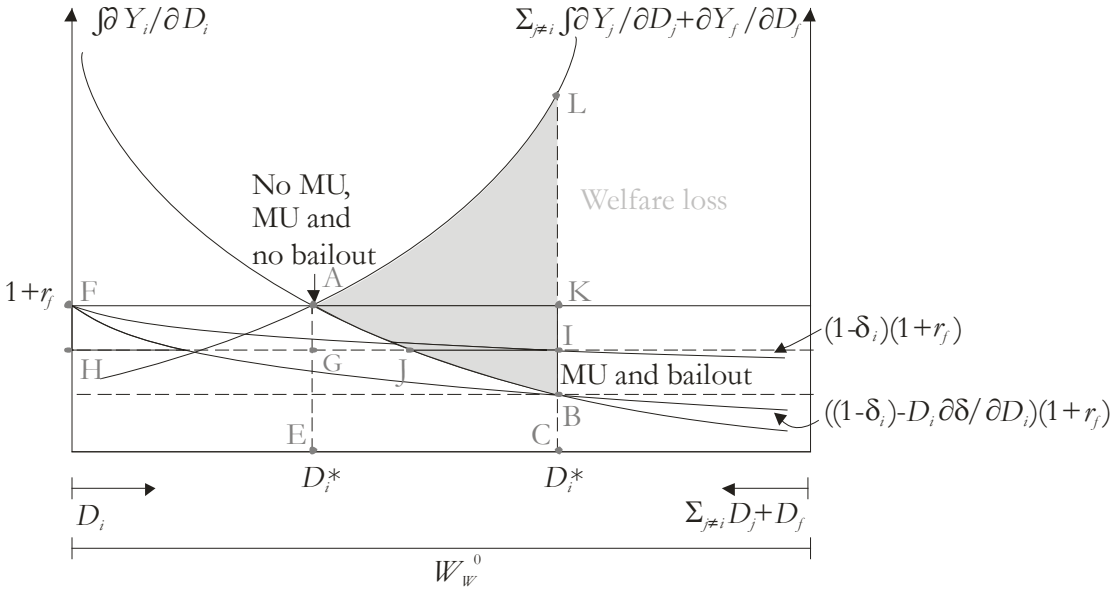
$$\left[\int_{\hat{\theta}_i}^{\theta_i^1} \frac{\partial Y_i}{\partial D_i} dF_i - Y_i\left(D_i, \hat{\theta}_i\right) \frac{\partial \hat{\theta}_i}{\partial D_i}\right] / \left[1 - \delta_i - \frac{\partial \delta_i}{\partial D_i} D_i\right] \geq 1 + r_f = \int_{\theta_j^0}^{\theta_j^1} \frac{\partial Y_j}{\partial D_j} dF_j \quad (3.53)$$
$$\forall \; i \in M \wedge j \in N \setminus M$$

respectively. The countries' expected marginal products are not equalised. Since country $i = 1, ...m$ does not have to offer a higher interest rate to investors for its risk, it issues too much debt. Overall welfare or production is reduced as some capital that is invested in country $i = 1, ...m$ would achieve higher production if it was invested somewhere else.

Graphical illustration. Figure 11 illustrates the debt market equilibrium for the case in which governments will renege on their total debt in case of default.

The diagram shows some similarities but also significant differences to the right diagram of Figure 8 (see page 46), which is the graphical representation of the pessimistic theory by Sinn (2010). While both compare the capital allocations with and without a monetary union, Figure 8 focuses on the capital allocation within the monetary union and Figure 11 on the capital allocation between a monetary union member state and the rest of the world. The horizontal length of the diagram of Figure 11 is therefore given by the available capital in the world and not by the available capital in the monetary union. Moreover, it is the capital that is invested in a monetary union member state and the capital that is invested in the rest of the world that is measured from the left to the right and the right to the left, respectively, and not the capital of a group of monetary union member states and the rest of the monetary union. The most important difference is, however, that the interest rates in Figure 11 are defined in nominal terms and not in effective terms. The effective interest rates can be determined by subtracting the expected default loss due to inflation or restructuring from the nominal interest rates.

Figure 11: Graphical illustration of the debt market equilibrium



The optimal capital allocation is determined by the intersection point of the expected marginal product curves.

In the cases of no monetary union and monetary union with a credible no-bailout policy, expected marginal products are equal to $1 + r_f$ so that the optimal capital allocation is achieved by the market.

In the case of monetary union with a non-credible no-bailout policy, however, if an interior solution is assumed, the capital allocation will be given by the intersection point of the expected marginal product curve of country $i = 1, ...m$ and a curve that lies below $1 + r_f$.

If investors expect that a monetary union bails out defaulting member states, its formation has the following effects.

Expected production of country $i = 1, ...m$ increases by the area ABCE. Its expected interest costs decrease by the area FAGH and increase by the area GICE. In sum, the expected national income or welfare of country $i = 1, ...m$ increases by the difference of the areas FAJH and JIB.

Expected bailout costs of the monetary union are given by the area FKIH. Adding the

changes in expected welfare for country $i = 1, ...m$, the expected welfare in the monetary union decreases by the area AKB.

Expected production of the rest of the world decreases by the area ALCE and expected interest costs by the area AKCE. In sum, the expected welfare of the rest of the world therefore decreases by the area ALK.

Adding the changes in expected welfare for the monetary union, overall expected production or welfare decreases by the grey area ALB.

3.4 Model Modifications

Without analytically deriving the equilibriums, this section gives some intuition on why the relaxation of the assumptions of risk neutrality of investors and statistical independence of default risks would not yield (qualitatively) different results.

Risk aversion of investors. Risk neutrality is an assumption that is often made in models of decision-making under uncertainty but may be viewed as critical, since in reality people are typically risk averse.

In the cases of no monetary union and monetary union with a credible no-bailout policy, the risk neutrality of investors has implied that an interior solution of the portfolio choice problem requires the equivalence of expected interest payments of government bonds and the interest payment of the risk free asset, i.e. an interest rate risk premium for government bonds over the risk free interest rate, which in expectation compensates the investors for defaulting interest payments. The interest rate risk premium has induced governments to take into account the costs of the default risk that they create for the investors in their bonds by their debt choice, therefore ensuring that they choose the optimal levels of debt.

If investors are assumed to be risk averse, not much will change to that. Although, for the investors to be willing to invest in both government bonds and risk free assets, the expected interest payments of governments are now required to exceed the interest payment of the risk free asset, the now higher interest rate risk premium for government bonds still ensures that governments choose the optimal debt levels. The higher interest

rate risk premium is required to compensate the investors also for their dislike of taking risk; the consideration of the higher interest rate risk premium by governments induces them to account also for these costs of their debt choice. The difference is then one of magnitude. Since the costs of default risk are higher, optimal debt levels are lower.

In the case of monetary union with a non-credible no-bailout policy, the risk attitude of the investors does not play any role. Since both government bonds and risk free assets do not include any risk in view of the investors, for them to be willing to include both in their portfolios, the interest rates are required to be the same, irrespective of the risk attitude assumed. Since no interest rate risk premium is required, the governments do not take account of the costs of default risk and will choose higher, excessive debt levels which are also independent of the assumed risk attitude.

All in all, the relaxation of the assumption of risk neutrality of investors has therefore only a quantitative effect on the results in that the formation of a monetary union that has a commitment problem to no bailouts will have a stronger impact on debt levels, interest rates and welfare.

Correlation of default risks. In addition to risk neutrality, the statistical independence of default risks may be viewed as a critical assumption. Given the economic integration, shocks in productivity are likely to affect various countries simultaneously or spill over from one country to another so that countries' default risks are presumably positively correlated.

If the assumption of risk neutrality is adhered to, the correlation of default risks will not matter. In all the cases to be considered, the portfolio choice and the debt decision will be taken according to the same conditions under the assumptions of correlated and statistically independent default risks.

If the assumption of risk neutrality is replaced by risk aversion, the correlation of default risks will only matter in the cases of no monetary union and monetary union with a credible no-bailout policy. If default risks are assumed to be positively correlated, an interior solution of the portfolio choice problem requires an even higher interest rate risk premium for the now even riskier government bonds, inducing the governments to choose

even lower, optimal levels of debt. In the case of monetary union with a non-credible no-bailout policy, an interior solution still does not require any interest rate risk premium and induces governments to choose the same, excessive levels of debt.

To summarise, a relaxation of the assumption of statistical independence of default risks alone does not have any effect on the results. Together with the relaxation of the risk neutrality assumption it has an effect in quantitative terms in that it further amplifies the effects of monetary unification on debt levels, interest rates and welfare.

Chapter 4

Empirical Evidence

A theory for increased incentives of debt accumulation due to a commitment problem of the EMU to no bailouts is all well and good but it needs to be backed up by empirical facts.

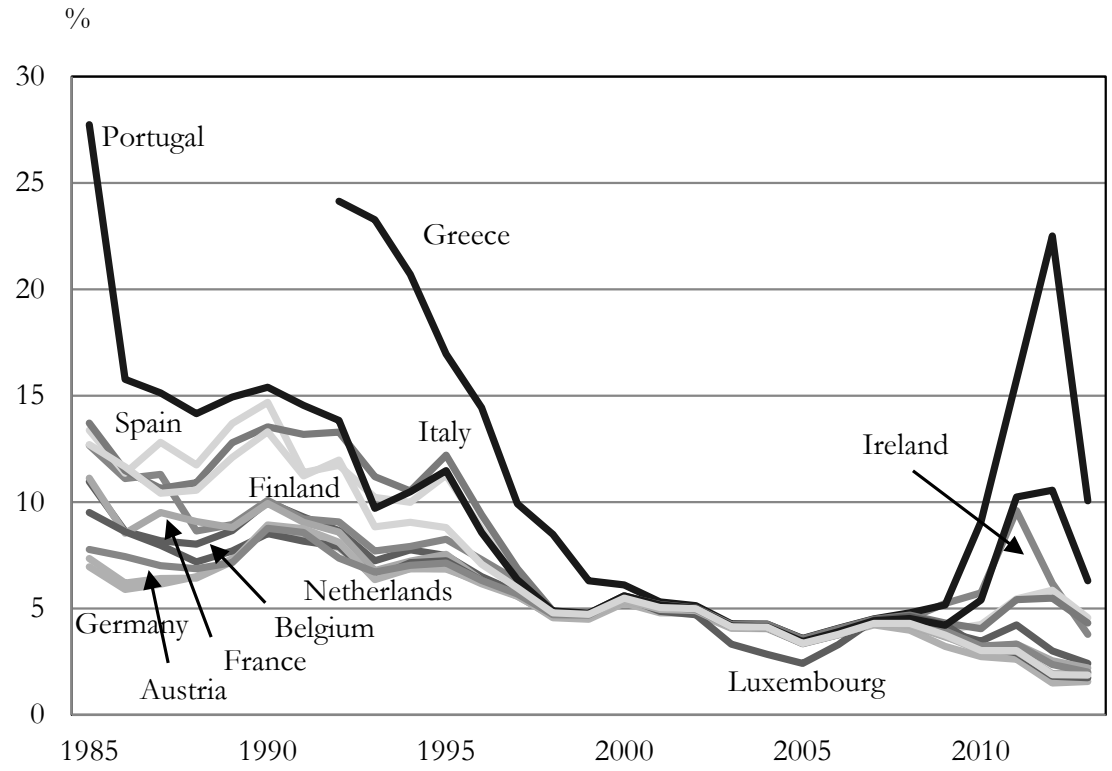
At this point, readers with an economics background or education may wish to see a difference-in-differences (DID) analysis with the euro introduction as treatment variable. However, I have deliberately decided against such an analysis; a DID estimation in the Eurozone context would be subject to many biases that make its usage and the high level of effort connected therewith hard to justify.

In particular, the fact that the euro introduction did not come as a surprise but was announced several years in advance, as well as the impossibility to control for the effect of debt and deficit limits on fiscal balances and public debt levels may distort the results to an extent that these become useless.

Accordingly, I will limit myself to just checking whether the development of interest rates in the Eurozone is consistent with the model's predictions for a non-credible no-bailout policy, therefore supporting my theory.

Figure 12 illustrates the development of interest rates of public debt in the EA12 countries since 1985.

Figure 12: Interest rates



Source: AMECO, last accessed on 3 November 2014.

Figure 12 shows that in the years from 1985 to 1995, i.e. the time before the euro announcement at the Madrid Summit in December 1995, the interest rates differed strongly between the EA12 countries. While Greece, Spain, Italy, Portugal and Finland had very high interest rates of over 10 to almost 22 percent on average, Germany, Luxembourg, the Netherlands and Austria had relatively low interest rates of between 7 and 8 percent on average. Belgium, Ireland and France had interest rates in between these percentages.

From 1996 to 1997, the interest rates of all EA12 countries but Greece converged downward to about 6 percent on average and retained low levels of at times less than 4 percent on average, with deviations of consistently less than one percentage point, for the following eleven years. In accordance with the delay in the euro entry, the interest rate of Greece converged to those of the other EA12 countries two years later. While in 1997 and 1998 the

interest rate of Greece still exceeded the average interest rate of the other EA12 countries by almost 4 percentage points, the upward deviations amounted to just 1.6 percentage points in 1999 and 0.6 percentage points in 2000.

From 2009 to 2012, i.e. the time when the US financial crisis spilled over to Europe, the interest rates diverged again, though (with the exception of Greece) to levels below the interest rates that were normal before the time of the euro announcement. In Greece and Portugal in particular, the interest rates increased by over 17 and 6 percentage points, respectively, in 2012 compared to the average levels from 1998 to 2008. The other crisis countries Ireland, Spain and Italy also had to bear higher interest rates, yet the differences between about 0.5 and 2 percentage points have been less strong. The rest of the EA12 countries in turn enjoyed lower interest rates by over 1.5 to almost 3 percentage points.

Finally, the year 2013 shows signs of a returning interest rates convergence. In particular, Greece and Portugal were able to again reduce a large part of the difference to the interest rates of the rest of the EA12 countries by having decreases in their interest rates by over 12 and 4 percentage points respectively.

All in all, the development of interest rates conforms to the raised theory. The announcement of the euro resulted in an interest rate convergence that may have been caused by the assumption of investors that the EMU would be willing to grant bailouts, despite provisions to the contrary, in a way as set out in the previous section. The US financial crisis in turn brought interest rate differentials back, which may have been due to the emergence of doubts about whether the EMU will actually be able to bear the bailouts. The massive and unrestricted aid provided by European Union leaders and the ECB may have reduced doubts so that interest differentials diminished again, though not as completely as they did before, which may have been due to the two haircuts in Greece.

Chapter 5

Transference of the Model to Private Debt and Banking Crises

The analysis has so far referred to sovereign debt crises. This chapter shows that it also applies to private debt and banking crises. Section 5.1 firstly sets up a model of a market for bank intermediation; Section 5.2 then argues that its results coincide with the ones of the sovereign debt model.

5.1 Model Set-up

In order to be comparable, the banking model is set up in a way that it comes as close as possible to the sovereign debt model, yet still reflects the specific characteristics of a banking market.

Players, actions and objective functions. The players of the banking model are borrowers of number n, lenders and banks. Borrowers and lenders seek for debt capital and interest income, respectively, so as to maximise their respective utilities, and banks act as intermediaries. The details are the following.

The borrowers can be governments as in the sovereign debt model, or businesses. They receive money D_i from banks at the nominal interest rate r_i, $i = 1, ...n$, by selling government bonds and by taking out loans, respectively. They do so in order to finance

a risky project with an expected gross return that is described by (3.1). As explained in Subsection 3.1.2, if the expected gross return turns out to be smaller than the debt repayment plus interest, borrowers will suffer a default, in which case they can either renege on the total of their debt or repay it to the extent they are able to.

The lenders can be investors as in the sovereign debt model, or depositors. They take their money W^0 to banks for some interest rate by buying debt securities and paying into deposit accounts, respectively, or they invest it elsewhere in the economy at the risk free interest rate r_f. They do so in order to maximise their expected income.

Banks are intermediaries. They borrow money from investors or depositors by issuing debt securities and accepting deposits, respectively, and lend it to governments or businesses by buying government bonds and granting loans, respectively. For didactic purposes, there are n banks and every bank has exactly one borrower, whereby banks are assigned to borrowers according to their index, i.e. borrower i borrows from bank i, $i = 1, ...n$. To keep things simple, banks do not (have to) own capital.[34]

The capital market and the banking market are characterised by perfect competition. The latter brings about the selection of agreements between banks and their borrowers and lenders that result in zero expected profits for banks and maximum expected profits for borrowers and lenders.

Time structure. The sequence of events is that in stage 1, borrowers take money from banks; in stage 2, lenders bring their money to banks or invest it elsewhere in the economy; and in stage 3, after the borrowers have invested the capital in the risky project, productivity parameters are realised.

[34]The similarity between the banking and sovereign debt model will be particularly visible if borrowers are governments and linked to their banks. While the latter sounds to be just a theoretical construct, figures on shares of bank-held sovereign bonds held by domestic institutions indicate that it is much more than that. Although no data is available before 2010, i.e. before or at the outbreak of the European sovereign debt crisis in 2009, a share of 64 percent in December 2010 and an increase of 4 percent from then to June 2013 for the euro area should make it safe to assume that figures had not been that different before the crisis and that governments are indeed linked to a large extent to their banks (for the figures, see European Banking Authority, 2013, page 13). It will be explained below why capital does not have any effect on the results.

Cases. The cases that will be considered and compared are again those of an optimal capital allocation, no monetary union, monetary union with a credible no-bailout policy and monetary union with a non-credible no-bailout policy. In the case of no monetary union, countries have their own currencies so that they may address the default problems of their private sectors, public sectors and banking systems through inflation. In the case of monetary union with a credible no-bailout policy, monetary union member states have a common currency so that their defaulting businesses, governments and banks have no option other than restructuring. In the case of monetary union with a non-credible no-bailout policy, the monetary union steps in for defaulting governments and banks.

5.2 Model Solution

In the following, the model is solved for the different cases in a rather argumentative way.

Optimal capital allocation. Also in the amended model framework, a social planner allocates the available capital to the various productive processes so as to maximise overall expected production so that the optimal capital allocation is again given by (3.27).

Cases of no monetary union and monetary union with a credible no-bailout policy. In the cases of no monetary union and monetary union with a credible no-bailout policy, in order to break even banks will offer their lenders exactly the same interest rates that they request from their borrowers, and they will default in exactly the same cases as the latter. Thus, the expected income of a lender is given by (3.30) and (3.31) and her portfolio choice by (3.32) and (3.33), where δ_i now denotes the default probability of a bank or borrower and r_i the interest rate of the agreement between a bank and its borrower or its lenders. The borrowers' expected income, on the other hand, will be given by (3.44) if borrowers are governments, and differ slightly therefrom if borrowers are businesses in that it will not include the investors' expected indirect income $(1+r_f)W_i^0$. In either case, their debt choice will be given by (3.45), since the investors' expected income is independent thereof. Therefore, the capital allocation in the market equilibrium is given by (3.51) and efficient. Similar to the sovereign debt model, the borrowers choose

the efficient levels of debt because they have to compensate the bearers of costs in case of default for their risk in terms of an interest rate risk premium. Since banks only act as intermediaries that break even, the bearers of costs in case of default are, as in the sovereign debt model, ultimately the investors.

Case of monetary union with a non-credible no-bailout policy. In the case of monetary union with a non-credible no-bailout policy, governments and banks of monetary union member states are bailed out in case of default, which prevents a haircut for their lenders. The expected income of a lender is given by (3.37) and (3.38) and her portfolio choice by (3.39) and (3.40). Since lenders anticipate that governments and banks of monetary union member states will be bailed out in case of default, they have to be offered just the risk free interest rate by banks. In order to break even in expectation, banks will also demand the risk free interest rate from their borrowers. If the borrowers are governments and bailed out in case of default, banks will receive the risk free interest rate from their borrowers and pass it on to their lenders in any case. Contrary to the cases of no monetary union and monetary union with a credible no-bailout policy, banks will not default if their borrowers default. If the borrowers are businesses, banks will receive the risk free interest rate from their borrowers only if these do not suffer a default. As in the cases of no monetary union and monetary union with a credible no-bailout policy, if the borrowers suffer a default, banks will default as well. Nevertheless, banks will repay their lenders in any case because it is now them, which are bailed out in case of default. Thus, the borrowers' expected income will be given by (3.47) and (3.48) if borrowers are governments, and differ slightly therefrom if borrowers are businesses in that it will not include the investors' expected indirect income $(1+r_f)W_i^0$. In either case, the debt choice will be given by (3.49) and (3.50), since the investors' expected income is independent thereof. Therefore, the capital allocation in the market equilibrium is given by (3.52) and (3.53) and distorted. Similar to the sovereign debt model, if lenders assume that the governments or banks to which they lend their money will be bailed out by the monetary union in case of default, they will request no interest rate risk premium from the banks for their risk, or that of their borrowers. Therefore, in order to break even, banks will not have to request any interest rate risk premium from their borrowers. This will result in

moral hazard on the side of borrowers. Borrowers issue more debt than is optimal.

The role of capital. In the last two paragraphs, it was argued that the results of the banking model coincide with those of the sovereign debt model. Note that these results would not change that much if banks were to own capital.

As shown by Sinn (2003) for the absence of a non-credible no-bailout policy and full information (an assumption implicitly made in the above analysis), investors would not request an interest rate risk premium for the part of the repayment obligation that is covered by capital. However, since banks would instead take into account the loss of capital in case of default, the outcome would not lose efficiency.

The banking model outlined by Sinn (2003) differs from the banking model presented above in two main respects. Firstly, it is the banks and not the borrowers that win through loan agreements, i.e. the banking market is not perfectly competitive. Secondly—connected to the first point—it is the banks and not the borrowers that decide on the banks' risk and are prone to moral hazard. Thereby, it is irrelevant that banks, unlike the borrowers in this part's model, do not decide on the volume of funds, but on their return, since a higher return of the considered business loans implies a lower success probability of the business. This is similar to how higher lending in this part's model implies a higher default probability of borrowers. In any case, if lenders are able to observe the banks' risk taking, banks will make the optimal investment decision. The reason is that they will take into account the total debt repayment obligations in case of default as expressed in terms of the risk free interest rate. Banks have to pay an interest rate risk premium to investors for the part of the repayment obligations that is not covered by capital, which in expectation is equal to its haircut in case of default, and lose capital for the other part in case of default.

In this part's model, in order to break even, banks will request an interest rate risk premium from borrowers for the interest rate risk premium to lenders, and the loss of capital in case of default. It is thus the borrowers who will take into account the total debt repayment obligations in case of default as expressed in terms of the risk free interest rate, and therefore choose the optimal levels of debt.

If credibility problems of the no-bailout policy are allowed for and borrowers are governments, the existence of capital will not affect the size of the moral hazard problem. Since banks cannot default and lose capital if governments are bailed out in case of default, there is no reason for them to request an interest rate risk premium for the part of the repayment obligation that is covered by capital. If the borrowers are businesses, a distinction must be made between the case in which the lack of credibility only concerns no bailouts to lenders and the case in which it also concerns no bailouts to capital owners. In the first case, the existence of capital will weaken the moral hazard problem in that borrowers have to compensate the bank for the loss of capital in case of default in terms of an interest rate risk premium. In the latter case, the moral hazard problem will be with capital as large as without, since capital is propped up by aid in case of default.

Chapter 6

Conclusion

The first part of my PhD thesis addressed the questions whether, and if so, how the formation of a monetary union affects debt levels, interest rates and welfare of its member states.

For this purpose, it set up a multistage model in which the benevolent governments of n countries decide on their debt levels before risk neutral agents choose asset portfolios consisting of these debts and risk free assets.

Within the model, Part I found that if countries do not belong to a monetary union and solve sovereign default problems through inflation, their governments will choose the optimal levels of debt because they have to compensate the investors in their bonds with an interest rate risk premium for the risk of inflation.

If a monetary union is able to credibly commit to no bailouts, its formation will change nothing to that, since governments of monetary union member states still have to offer an interest rate risk premium to the investors in their bonds, though now for a risk of restructuring instead of for an inflation risk.

If, to the contrary, a monetary union has a commitment problem to no bailouts, its formation will induce the governments of its member states to choose higher, excessive debt levels because they no longer have to pay the investors compensation for the restructuring risk and will therefore disregard their repayment obligations in case of default, as expressed in terms of the risk free interest rate, in their debt decision. The

commitment problem of the monetary union to no bailouts results in a limited liability problem in that sense.

Since the interest rate risk premiums will drop out, interest rates of monetary union member states will be lower and equalised. Moreover, welfare will also be lower, not only globally, but also within the monetary union due to the fact that the latter's costs of bailouts will exceed the benefits that its individual member states will enjoy therefrom.

The model's predictions for interest rates were confirmed by the downward convergence of interest rates of public debt in the EA12 countries after the announcement of the euro.

Furthermore, the model was applied to private debt and banking crises.

After the problem of excessive debt accumulation for a commitment problem of the monetary union to no bailouts has been identified, the question arises of how to solve it. In the second part of my PhD thesis, we will take an insurance-based approach to this question.

Chapter 7

Appendix

7.1 Default Probability

Assuming a Cobb-Douglas production function $Y_i(D_i, \theta_i) = D_i^{\alpha}\theta_i$ and a uniform distribution of the productivity parameters $F_i(\theta_i) = \frac{\theta_i - \theta_i^0}{\theta_i^1 - \theta_i^0}$, the default probability of country i will be given by

$$\delta_i = \int_{\theta_i^0}^{\hat{\theta}_i} dF_i(\theta_i) = F_i\left(\hat{\theta}_i\right) = \frac{\hat{\theta}_i - \theta_i^0}{\theta_i^1 - \theta_i^0} \tag{7.1}$$

where $\hat{\theta}_i$ is a critical value of θ_i that satisfies

$$D_i^{\alpha}\hat{\theta}_i - (1 + r_i) D_i = 0 \tag{7.2}$$

Rearranging (7.2) yields

$$\hat{\theta}_i = (1 + r_i) D_i^{1-\alpha} \tag{7.3}$$

and inserting (7.3) in (7.1)

$$\delta_i = \frac{(1 + r_i) D_i^{1-\alpha} - \theta_i^0}{\theta_i^1 - \theta_i^0} \tag{7.4}$$

with

$$\frac{\partial \delta_i}{\partial D_i} = \frac{(1+r_i)(1-\alpha) D_i^{-\alpha}}{\theta_i^1 - \theta_i^0} > 0 \tag{7.5}$$

and

$$\frac{\partial^2 \delta_i}{\partial D_i^2} = -\frac{(1+r_i)(1-\alpha)\alpha D_i^{-\alpha-1}}{\theta_i^1 - \theta_i^0} < 0 \tag{7.6}$$

7.2 Optimal Capital Allocation

The expected production of country i and the gross return on the certain production technology under a Cobb-Douglas production function $Y_i(D_i, \theta_i) = D_i^\alpha \theta_i$ and a uniform distribution of the productivity parameters $F_i(\theta_i) = \frac{\theta_i - \theta_i^0}{\theta_i^1 - \theta_i^0}$ will be given by

$$\int_{\theta_i^0}^{\theta_i^1} Y_i(D_i, \theta_i)\, dF_i = \int_{\theta_i^0}^{\theta_i^1} D_i^\alpha \frac{\theta_i}{\theta_i^1 - \theta_i^0} d\theta_i = \frac{D_i^\alpha}{\theta_i^1 - \theta_i^0} \left[\frac{\theta_i^2}{2}\right]_{\theta_i^0}^{\theta_i^1} = \frac{D_i^\alpha}{\theta_i^1 - \theta_i^0} \frac{\theta_i^{1^2} - \theta_i^{0^2}}{2} = D_i^\alpha \frac{\theta_i^0 + \theta_i^1}{2} \tag{7.7}$$

with

$$\int_{\theta_i^0}^{\theta_i^1} \frac{\partial Y_i}{\partial D_i} dF_i = \alpha D_i^{\alpha-1} \frac{\theta_i^0 + \theta_i^1}{2} \tag{7.8}$$

and

$$Y_f = D_f^\alpha \theta_f \tag{7.9}$$

with

$$\frac{\partial Y_f}{\partial D_f} = \alpha D_f^{\alpha-1} \theta_f \tag{7.10}$$

respectively. The condition on the equivalence of expected marginal products thus writes

$$\int_{\theta_i^0}^{\theta_i^1} \frac{\partial Y_i}{\partial D_i} dF_i = \alpha D_i^{\alpha-1} \frac{\theta_i^0 + \theta_i^1}{2} \stackrel{!}{=} \frac{\partial Y_f}{\partial D_f} = \alpha D_f^{\alpha-1} \theta_f \; \forall i \in N \tag{7.11}$$

and gives

$$D_i = \frac{\left(\frac{\theta_i^0+\theta_i^1}{2}\right)^{\frac{1}{1-\alpha}}}{\theta_f^{\frac{1}{1-\alpha}}} D_f \tag{7.12}$$

Inserting (7.12) in the resource constraint

$$\sum_i D_i + D_f = W_N^0 \tag{7.13}$$

gives

$$\sum_i \frac{\left(\frac{\theta_i^0+\theta_i^1}{2}\right)^{\frac{1}{1-\alpha}}}{\theta_f^{\frac{1}{1-\alpha}}} D_f + D_f = W_N^0 \tag{7.14}$$

Rearranging (7.14) we obtain

$$\frac{\sum_i \left(\frac{\theta_i^0+\theta_i^1}{2}\right)^{\frac{1}{1-\alpha}} + \theta_f^{\frac{1}{1-\alpha}}}{\theta_f^{\frac{1}{1-\alpha}}} D_f = W_N^0 \tag{7.15}$$

or

$$D_f = \frac{\theta_f^{\frac{1}{1-\alpha}}}{\theta_f^{\frac{1}{1-\alpha}} + \sum_i \left(\frac{\theta_i^0+\theta_i^1}{2}\right)^{\frac{1}{1-\alpha}}} W_N^0 \tag{7.16}$$

Inserting (7.16) in (7.12) results in

$$D_i = \frac{\left(\frac{\theta_i^0+\theta_i^1}{2}\right)^{\frac{1}{1-\alpha}}}{\theta_f^{\frac{1}{1-\alpha}} + \sum_i \left(\frac{\theta_i^0+\theta_i^1}{2}\right)^{\frac{1}{1-\alpha}}} W_N^0 \tag{7.17}$$

Part II

An Insurance-Based Approach*

In light of the sovereign default problem in the Eurozone, this part of my PhD thesis handles the question what arrangements should be put in place in the EMU to deal with sovereign default risk. Attempts to enforce constraints on public sector deficits and promises not to bail out countries ex post are inadequate to resolve a problem of excessive debt accumulation due to financial market expectations of bailouts because they lack credibility, as experience has shown. This part argues that it is a useful approach to apply the economics of insurance markets to this issue. It sets up a model that builds on the multistage model presented in Part I in which the governments of n countries decide on their bond issuance before risk neutral agents choose asset portfolios consisting of these bonds and risk free assets. In contrast, it assumes that a subset $m \geq 2$ of the countries has already formed a monetary union. In the benchmark case of a credible no-bailout policy, debt issuance is optimal because the countries' governments have to compensate the investors in their bonds with an interest rate risk premium for their default risk, as shown in Part I. Part II shows that by establishing a mutual insurance fund optimal debt issuance can also be ensured in the opposite case. This is if the mutual insurance fund offers full insurance for a fair insurance premium, which replaces the interest rate risk premium, and a reserve payment. This part also deals with the necessary institutional arrangements, assesses the concept of a "banking union" and crisis management by the ECB, and discusses other currently popular proposals in light of the obtained results.

* Chapters 8, 9, 10 and 12 of this part are partially based on joint work with Prof. Ray Rees (Arnold & Rees, 2014).

Chapter 8

Introduction

In view of the results obtained in the first part of my PhD thesis, this part turns to the following question:

> What arrangements should be put in place in the EMU to deal with the risk of sovereign default?

The approach of trying to place constraints on risky actions of Eurozone countries as stipulated by the Maastricht Treaty, e.g. on the choice of public sector deficits, is clearly inadequate to resolve a problem of excessive debt accumulation due to financial market expectations of bailouts because it lacks credible incentives and punishments. Likewise, the promise not to bail out countries ex post as stated in the no bailout clause of that treaty is also inadequate as economic agents in financial markets do not see the promise as credible. The recent experience simply leaves a legacy of ambiguity and uncertainty about the extent to which haircuts may be demanded or bailouts granted.

This part argues that a more fruitful approach is to draw on the economics of insurance markets to provide a conceptual basis for the design of the Eurosystem that will deal with this issue in the future.

The model set up in this part builds on the multistage model presented in Part I. It has the same two types of players: the governments of n countries which issue sovereign debt so as to maximise expected national income, and investors who choose portfolios consisting of these sovereign debts as well as risk free assets so as to maximise their

expected income. The model also has the same time structure: Governments decide on their debt issuance before investors choose their portfolios.

Contrary to Part I, however, this part assumes that a subset $m \geq 2$ of the countries has already formed a monetary union which is assumed to have a commitment problem to no bailouts that we aim to solve with an insurance-based approach. Beyond the model in Part I, this part's model therefore establishes the case of insurance—concretely, the case of a mutual insurance fund that offers full insurance for a fair insurance premium and a reserve payment—and compares it to the benchmark case of no commitment problem, i.e. the case of a credible no-bailout policy discussed in Part I.

The result is that the countries choose the optimal levels of debt in both situations and that only the countries' interest rates differ. The countries choose the optimal debt levels because they have to compensate either, in the case of a credible no-bailout policy, the investors in the form of an interest rate risk premium or, in the case of insurance, the mutual insurance fund by payment of their insurance premiums. Their interest rates differ across the two situations exactly by their interest rate risk premiums.

Consequently, the main conclusion of this part is that an appropriately designed mutual insurance scheme against the risk of sovereign default, where insurance premiums are risk-based, is effectively equivalent to a system in which the no-bailout promise is fully credible. The insurance premiums replace the risk premiums on interest rates that would prevail if investors fully believed in the no-bailout commitment. Therefore, an important aspect of the insurance scheme is that it eliminates the ambiguity that persists under purely bond-based proposals of the kinds that have been made recently, and which are further discussed below. It also removes the risk of the kind of political and economic crises that have been observed to follow when sovereign defaults, or the imminent occurrence of them, have to be dealt with ex post in an ad hoc way. Finally, it avoids the political controversy and inflation risks involved in a "whatever it takes" type of solution through the central banking system.

The simple form of insurance model that will be presented should not be taken too literally. Once the principles of the mutual insurance fund are clarified, the possibilities of "realistic" implementation and the institutional arrangements necessary for that will

be dealt with.

Moreover, the model will be transferred to banking crises, and the concept of a banking union and the policy measures taken by the ECB since the outbreak of the US financial crisis in 2007 will be assessed in light of the results.

Finally, it will be discussed whether and to what extent currently popular proposals such as Eurobonds, a distinction between "blue" and "red" bonds (von Weizsäcker & Delpla, 2010), debt repayment funds (Sachverständigenrat zur Begutachtung der Gesamtwirtschaftlichen Entwicklung, 2011), "stability bonds" (European Commission, 2011), partial sovereign bond insurance by the European Stability Mechanism (Dübel, 2011), and a multi-stage crisis mechanism (European Economic Advisory Group, 2011) are appropriate tools to stabilise and structure the sovereign debt problem in the euro area.

The remainder of this part is organised as follows. Chapter 9 explains the basic economics of the insurance proposal. Chapter 10 deals with institutional issues. Chapter 11 assesses the concept of a banking union and crisis management by the ECB. Chapter 12 discusses other currently popular proposals. Chapter 13 concludes.

Chapter 9

The Basic Economics of the Insurance Proposal

Section 9.1 presents the model set-up; Section 9.2 the solution thereof.

9.1 Model Set-up

Subsection 9.1.1 firstly gives a brief overview of the model set-up; Subsections 9.1.2, 9.1.3 and 9.1.4 then specify the elements of the mutual insurance fund and the payoffs of governments and investors, respectively, for the case of insurance.

9.1.1 Overview

This part's model builds on the multistage model presented in Part I.

Players, actions and objective functions. The model has the same two types of players: the governments of n countries constituting the world, $i \in N = \{1, ...n\}$, and investors residing all over the world, which and who, respectively, demand and supply capital on the world capital market, respectively, so as to maximise their respective expected utilities.

The model also has the same details connected therewith: The governments still issue debt

D_i at the interest rate r_i, employ the capital in the production of goods Y_i, $i = 1, ...n$, and will suffer a default if production turns out to be smaller than the debt repayment plus interest, in which case they will renege on their debt by inflation π_i if they have their own currency and by restructuring if they share a common currency. The production process is still described by (3.1), the default probability δ_i by (3.3) where the critical value $\hat{\theta}_i$ still satisfies (3.4), and the inflation rate and the restructuring rate γ_i if countries repay debt to the extent they are able to in case of default by (3.9) and (3.14), respectively. The countries' risks of default are still assumed to be statistically independent. The consequences of relaxing this assumption are considered from Subsection 9.2.3 onward. The investors, on the other hand, still have an initial wealth level W^0 which they invest in the countries' debt by acquiring bonds holdings b_i, $i = 1, ...n$, or elsewhere in the economy at the risk free interest rate r_f. Governments are still benevolent; consumers and investors risk neutral. Moreover, investors still only benefit from private investment. It is again not the investors but the consumers who benefit and pay with regard to public investment, and it is also the consumers who will bear the costs if it comes to the insurance solution. Finally, both governments and investors still act as price takers.

Time structure. Moreover, the model assumes the same time structure: In stage 1, governments decide on their debt; in stage 2, investors choose their portfolios; and in stage 3, productivity parameters are realised.

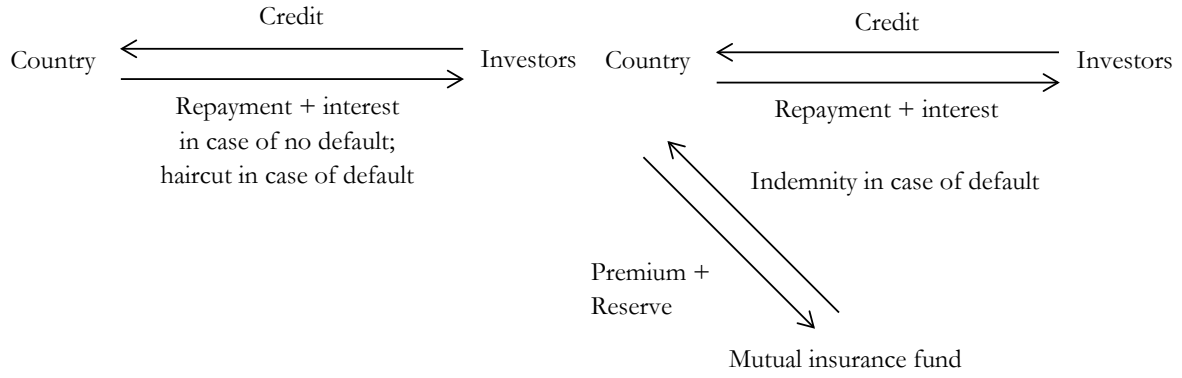
Cases. Contrary to Part I, however, this part assumes that $m \geq 2$ countries, $i \in M = \{1, ...m\} \subseteq N$, have already formed a monetary union. This is assumed to have a commitment problem to no bailouts; its formation thereby having increased incentives to accumulate debt in a way as described in Part I.

The main concern of this part is to present an insurance solution to the commitment problem which prevents the excessive debt accumulation connected therewith; or, in other words, to design an insurance proposal which, if implemented, will result in the same incentives of debt accumulation as would exist if the commitment problem to no bailouts did not exist. Beyond the model in Part I, this part's model therefore discusses the case of insurance and compares it to the benchmark case of no commitment problem, i.e. the

case of a credible no-bailout policy discussed in Part I.

Figure 13 gives a schematic representation of the cases of a credible no-bailout policy and insurance.

Figure 13: Schematic comparison between the cases of a credible no-bailout policy and a mutual insurance fund



In the case of a credible no-bailout policy, investors are faced with a haircut if a monetary union member state defaults; in the case of insurance, monetary union member states pay insurance premiums and reserves into a fund from which they receive indemnities in case of default sufficient to pay off debt and prevent a haircut for the investors in their bonds.

9.1.2 Mutual Insurance Fund

After the brief overview, this subsection gives more detail on the elements of the mutual insurance fund, and the following two subsections specify the payoffs of governments and investors, respectively, in the case of insurance.

The mutual insurance fund offers full insurance to monetary union member states in the form of an indemnity that covers the member states' haircut in the event of default for a fair insurance premium and a reserve payment.

Full insurance. The indemnity function of country $i = 1, ...m$, if it reneges on its total debt in case of default, is therefore given by

$$I_i = \begin{cases} (1+r_i)D_i & if \quad \theta_i < \hat{\theta}_i \\ 0 & if \quad \theta_i \geq \hat{\theta}_i \end{cases} \tag{9.1}$$

and if it repays debt to the extent it is able to,

$$I_i = \begin{cases} (1+r_i)D_i - Y_i(D_i, \theta_i) & if \quad \theta_i < \hat{\theta}_i \\ 0 & if \quad \theta_i \geq \hat{\theta}_i \end{cases} \tag{9.2}$$

Fair insurance premium. As the insurance premium is fair, it is equal to the expected value of the indemnity,

$$\pi_i = \int_{\theta_i^0}^{\theta_i^1} I_i(D_i, \theta_i) dF_i \tag{9.3}$$

Thus, the insurance premium of country $i = 1, ...m$, if it reneges on its total debt in case of default, is given by

$$\pi_i = \delta_i \left(D_i\right) (1+r_i)D_i \tag{9.4}$$

and if it repays debt to the extent it is able to,

$$\pi_i = \delta_i \left(D_i\right) (1+r_i)D_i - \int_{\theta_i^0}^{\hat{\theta}_i} Y_i(D_i, \theta_i) dF_i \tag{9.5}$$

Reserve payment to ensure solvency of mutual insurance fund. The reserve payment ε_i is independent of a country's debt level and serves the purpose of ensuring that the mutual insurance fund can meet accruing indemnities with almost certainty. We consider its necessary average level in the following section.

9.1.3 Governments

In stage 1, each country's government issues bonds and employs the capital in the real production of goods.

In the case of insurance, countries $1, ...m$ participate in a mutual insurance fund while countries $m+1, ...n$ do not. Therefore, while the utility of country $i = m+1, ...n$ is again given by (3.8), the utility of country $i = 1, ...m$ is now given by

$$u_i = \begin{cases} W_i^1 + Y_i - \gamma_i (1 + r_i) D_i - \pi_i - \varepsilon_i & if \quad \theta_i < \hat{\theta}_i \\ W_i^1 + Y_i - (1 + r_i) D_i - \pi_i - \varepsilon_i & if \quad \theta_i \geq \hat{\theta}_i \end{cases} \tag{9.6}$$

where W_i^1 again denotes the end of period wealth level of investors who reside in country i that will be determined in the next subsection. As is usual in insurance, country i has to pay the insurance premium and the reserve payment in all states of the world, which reduces the net income of its consumers. Just as usual, country i will receive the indemnity only in case of loss, i.e. in case of default. This increases the net income of the investors in their bonds, as the following subsection shows.

9.1.4 Investors

In stage 2, each investor buys government bonds of the n countries and risk free assets.

As in the case of a non-credible no-bailout policy, the income of an investor in the case of insurance is given by equation (3.23) where ζ_i satisifies (3.20). If the investor invests one monetary unit in government bonds of a monetary union member state, she will get $1 + r_i$ in the subsequent period for certain because the mutual insurance fund will pay for monetary union member states in case of default. If the investor instead invests in government bonds of a non-monetary union member state, she will be fully repaid only if this country does not suffer a default. In the opposite case, she has to accept a haircut on her debt claims due to inflation. Finally, if the investor invests in risk free assets, she can take a repayment of $1 + r_f$ for granted.

9.2 Model Solution

This section derives the solution in the case of insurance by backward induction and compares it to the solution in the case of a credible no-bailout policy. Accordingly,

Subsection 9.2.1 firstly considers the portfolio choice of investors, and Subsection 9.2.2 then the debt decision of governments. Following that, Subsection 9.2.3 determines the necessary average level of the reserve payment, and Subsection 9.2.4 undertakes a comparison between the cases of a credible no-bailout policy and insurance.

9.2.1 Portfolio Choice

In stage 2, each investor acquires holdings b_i in country i bonds, $i = 1, ...n$, so as to maximise her expected income.

As in the case of a non-credible no-bailout policy, the investor's expected income in the case of insurance if countries renege on their total debt in case of default is given by (3.37), and if they repay debt to the extent they are able to, by (3.38) with $\gamma_i = \frac{1}{1+\pi_i}$. If the investor invests one monetary unit in government bonds of country $i = 1, ...m$ or the risk free assets, she will get $1 + r_i$ and $1 + r_f$, respectively, in the subsequent period for certain. If the investor invests in government bonds of country $i = m + 1, ...n$, she will get full debt repayment, plus interest, only with the probability $1 - \delta_i$.

The FOCs imply that an interior solution of the portfolio choice problem requires (3.39) and (3.40) respectively, i.e. the equivalence of interest rates for countries $1, ...m$ and of expected interest payments for countries $m + 1, ...n$. While the investors request an interest rate risk premium from country $i = m + 1, ...n$, they do not request one from country $i = 1, ...m$. The reason is that the mutual insurance fund steps in for defaulting interest payments of member states.

As always before, the optimal bondholdings are again any $b_i \in [0, W^0]\ \forall\ i$ with $\sum_{i=1}^{n} b_i \leq W^0$ and the expected indirect income is again given by (3.36).

9.2.2 Debt Decision

In stage 1, each country's government chooses its debt level D_i, $i = 1, ...n$, so as to maximise its expected national income anticipating the portfolio choice of investors. In the case of insurance, country $i = 1, ...m$ additionally takes into account the effect of its choice of debt on its insurance premium.

While the expected national income of country $i = m+1, ...n$ is again given by (3.41) and (3.42)/(3.43), the expected national income of country $i = 1, ...m$, if it reneges on its total debt in case of default, is given by

$$\bar{u}_i = \bar{W}_i^1 + \int_{\theta_i^0}^{\theta_i^1} Y_i(D_i, \theta_i) dF_i - [1 - \delta_i(D_i)](1 + r_i)D_i - \pi_i - \varepsilon_i \tag{9.7}$$

and if it repays debt to the extent it is able to,

$$\bar{u}_i = \bar{W}_i^1 + \int_{\hat{\theta}_i}^{\theta_i^1} Y_i(D_i, \theta_i) dF_i - [1 - \delta_i(D_i)](1 + r_i)D_i - \pi_i - \varepsilon_i \tag{9.8}$$

where $\bar{W}_i^1$ still denotes the expected income of investors who reside in country i that is obtained by summing up (3.37) and (3.38), respectively, over the investors residing in country i. Without taking account of the investors' portfolio choice (and the effect on the insurance premium), country i's choice of debt, if it reneges on its total debt in case of default, will affect its expected national income in three ways: production, default probability, and repayment of debt in case of no default. If country i repays debt to the extent it is able to, its choice of debt will additionally affect its expected national income by the critical value of the productivity parameter. Moreover, if country i is not a member state of the monetary union, its choice of debt will also affect the expected income of its investors.

Conditions (3.36) and (3.39), and (3.36) and (3.40) respectively, simplify the objective function for country $i = m+1, ...n$ again to (3.44), where W_i^0 is still the sum of initial wealth levels of the investors residing in country i. With almost the same result, the same conditions plus equations (9.4) and (9.5) respectively simplify the objective function for country $i = 1, ...m$ to

$$\bar{u}_i = (1 + r_f)W_i^0 + \int_{\theta_i^0}^{\theta_i^1} Y_i(D_i, \theta_i) dF_i - (1 + r_f) D_i - \varepsilon_i \tag{9.9}$$

in either case; the difference lying only in the reserve payment ε_i. Thus, taking into account the investors' portfolio choice (and the effect on the insurance premium), country i's debt choice impacts its expected national income in only two ways: production and

repayment of debt.

As in the case of a credible no-bailout policy, the FOC is therefore for all countries given by (3.45), i.e. the equivalence of the expected marginal product to 1 plus the risk free interest rate. With (3.39) and (3.40) respectively, debt in country $i = m + 1, ...n$ is, in expectation, again paid according to the expected marginal product. Similarly, since $1 + r_f = 1 + r_i$, debt in country $i = 1, ...m$ is paid according to its expected marginal product; the slight difference being that it is paid that way not only in expectation but for all realisations of productivity.

The optimal debt level is implicitly determined by (3.45) and decreases with the risk free interest rate r_f.

While the expected welfare of country $i = m + 1, ...n$ is again given by (3.44) whereby D_i is implicitly determined by (3.45), the expected welfare of country $i = 1, ...m$ is given by (9.9), also with D_i being implicitly determined by (3.45). Since the utility in (9.9) is lower than the utility in (3.44), the expected welfare of a monetary union member state is lower in the case of insurance than in the case of a credible no-bailout policy.

All in all, the FOCs show that setting up a mutual insurance fund with the mentioned elements solves the limited liability problem of monetary union member states. Since country $i = 1, ...m$ has to pay an insurance premium to the mutual insurance fund for its default risk, it no longer ignores any of its repayment obligations in case of default—as expressed in terms of the risk free interest rate—in its debt decision, and therefore does not have increased incentives of debt accumulation.

9.2.3 Reserves

The sum of indemnities is a random variable, the realised value of which may exceed the sum of insurance premiums. To reduce the probability that the mutual insurance fund is not able to meet accruing indemnities to almost zero, countries have to pay reserves in addition to insurance premiums. While the distribution of the reserves does not matter, i.e. it makes no difference whether reserves are the same for each country or whether they vary, for instance in country size, their sum has to be larger the smaller the number

of countries in a monetary union and the higher the correlation of default risks is. This is best explained with the weak law of large numbers (WLLN), which for uncorrelated default risks states that

$$\frac{\sum_{i=1}^{n} I_i}{n} \xrightarrow{P} \frac{\sum_{i=1}^{n} \mu_i}{n} \quad if \quad n \to \infty \tag{9.10}$$

or

$$\sum_{i=1}^{n} I_i \xrightarrow{P} \sum_{i=1}^{n} \mu_i \quad if \quad n \to \infty \tag{9.11}$$

where $\mu_i = E(I_i) = \int_{\theta_i^0}^{\theta_i^1} I_i(D_i^*, \theta_i) dF_i$ is the mean or expected value of the indemnity in country i and D_i^* satisfies $\int_{\theta_i^0}^{\theta_i^1} \frac{\partial Y_i(D_i, \theta_i)}{\partial D_i} dF_i = 1 + r_f$. The WLLN states that the sample average of indemnities will converge in probability towards the average expected indemnity if the sample size goes to infinity. That is equivalent to saying that the sum of actual indemnities will converge in probability towards the expected sum of indemnities if the number of countries participating in the mutual insurance fund goes to infinity. As insurance premiums are fair, the expected sum of indemnities is equal to the sum of insurance premiums, so that the WLLN also states that the insurance fund is about to just break even if the number of countries in the monetary union approaches infinity. The WLLN can also be expressed as

$$\lim_{n \to \infty} \Pr\left(\left| \frac{\sum_{i=1}^{n} I_i}{n} - \frac{\sum_{i=1}^{n} \mu_i}{n} \right| > \varepsilon \right) = 0 \tag{9.12}$$

or

$$\lim_{n \to \infty} \Pr\left(\left| \sum_{i=1}^{n} I_i - \sum_{i=1}^{n} \mu_i \right| > \sum_{i=1}^{n} \varepsilon_i \right) = 0 \tag{9.13}$$

where ε is any positive number and ε_i the reserve of country i with $\varepsilon = \frac{1}{n} \sum_{i=1}^{n} \varepsilon_i$ (see Appendix 14.1 on pages 159f). The WLLN essentially states that for any nonzero margin specified, no matter how small, the probability that the average of actual indemnities will

be close to the average expected indemnity, i.e. within the margin, will approach one if the sample size increases. That is equivalent to saying that for any reserves, irrespective of how small they are on average, the probability that the sum of actual indemnities exceeds the sum of insurance premiums by these reserves will approach zero if the number of countries in the monetary union increases. As the number of countries in a monetary union is far away from being equal to infinity (the EMU currently has eighteen member states), and countries' default risks are not independent from one another, an infinitesimally small reserve will of course be insufficient to guarantee that the mutual insurance fund can cover haircuts with almost certainty. Rather, reserves have to be sufficiently large and they have to be larger the smaller the number of countries that participate in the mutual insurance fund (see Appendix 14.1) and the higher the correlation of default risks is.

9.2.4 Comparison of the Cases of a Credible No-Bailout Policy and Insurance

This subsection looks for similarities and differences between the cases of a credible no-bailout policy and a mutual insurance fund.

Efficiency equivalence and first best solution. In Subsection 9.2.2, we found that countries $1, ...n$ choose the same debt levels in the cases of a credible no-bailout policy and a mutual insurance fund. Note that they also choose the efficient levels of debt as their FOCs imply (3.51), i.e. the equivalence of expected marginal products, in either case (see Section 3.2 for the derivation of the efficiency condition). Consequently, a credible no-bailout policy and full insurance are not only equally good but also first best in terms of efficiency. The reason why the countries choose the optimal debt levels is that they have to internalise the costs of the risk that they create by choice of their debt levels. In the case of a credible no-bailout policy, the costs in case of default are borne by the investors; the countries have to compensate the investors for their risk in terms of an interest rate risk premium. In the case of full insurance, the bearer of costs in case of default is the mutual insurance fund; the countries must compensate the fund for their risk in terms of an insurance premium. As countries have to compensate someone for their risk, they are

forced to internalise its costs and no market failure arises.

Moral hazard due to a lack of credibility. The problem with a no-bailout policy is, however, that it usually lacks credibility and thus results in moral hazard on the side of governments. Investors use to expect that defaulting countries are bailed out from other countries or a supernational institution and thus do not request an interest rate risk premium for a country's risk. Governments anticipate this and issue more debt than is optimal. If investors' expectations are met, they have certainly done everything right. Then it's the countries or the international institution that bail out that must acknowledge a mistake in the sense that they pay for something ex post for which they did not request compensation ex ante (incomplete insurance contract). If investors' expectations are not fulfilled, they appear foolish for having not requested compensation ex ante.

In the case of the European sovereign debt crisis, investors certainly believed in bailouts as the interest rate convergence has shown. They were partly correct, since bailout measures with a volume of 833 billion euros have been put in place (as of end of November 2014).[36] However, they were also incorrect, since two haircuts, the first of which having been of an outstanding size, were implemented in Greece in 2012.[37]

Although a no-bailout policy usually lacks credibility, it is not clear that a mutual insurance fund is the better alternative as it also has its problems. These problems certainly are less moral hazard issues due to information asymmetry with regard to the insureds' decision variable as is often considered in insurance literature. In the end, debt levels are observable and thus can be part of the insurance contracts underlying the mutual insurance fund. If the insurance premiums are related to the insured countries' debt levels

[36]The figure includes credit provided via the bailout packages and mechanisms of the Eurozone countries (EFSF and ESM), contributions from the IMF and European Union loans (EFSM), as well as the sums that the ECB has spent on purchasing government bonds and the Target credits granted to the national central banks of Greece, Ireland, Portugal, Spain, Italy and Cyprus. Compare Ifo Institute, *The Exposure Level: Bailout measures for the Eurozone countries and Germany's exposure*, http://www.cesifo-group.de/ifoHome/policy/Haftungspegel.html, last accessed on 7 December 2014.

[37]The first haircut in Greece occurred in March/April 2012 within the framework of a debt exchange; the second haircut in December 2012 when Greece bought a large portion of the newly exchanged sovereign bonds back. While the press reported haircuts of 75 percent due to the debt exchange, Zettelmeyer, Trebesch & Gulati (2013) show that haircuts were much lower, namely in the order of 59–65 percent depending on which methodology is applied. Still, in comparison to other defaults in modern history, the haircut was one of the highest. With regard to its size it was even the largest. The buyback of debt, on the contrary, resulted only in small haircuts.

and the insured countries anticipate that they have to pay penalties if they issue more debt than they announced to issue when they had to pay their insurance premiums, the insured countries will announce their optimal debt levels and stick to them. By compensating the mutual insurance fund for their risk, ex ante by an insurance premium or ex post by penalties, debt levels are made incentive compatible. Hence, a mutual insurance fund rather faces the same problem as a no-bailout policy. It also bears moral hazard due to a lack of credibility. For the insured countries anticipating penalties, it must be credible that the mutual insurance fund will claim them. If penalties are non-credible, the insured countries will have the incentive to announce debt levels of zero, therefore paying insurance premiums of zero, although they intend to realise positive debt levels. Note that in fact they will issue the same levels of debt as in the case of a non-credible no-bailout policy because indemnities for free insurance premiums are nothing but bailouts. As with the no-bailout policy, the efficiency of the mutual insurance fund depends on the credibility of its implementation.

Consequently, the question whether a mutual insurance fund is the better alternative to a no-bailout policy can be reduced to the question whether there is reason to believe that it can be made more credible.

Moral hazard due to information asymmetry with regard to production technologies. Still, the observability of debt levels should not blind us to the fact that a mutual insurance fund puts strong information requirements on its underlying contracts and thus can suffer from serious moral hazard problems due to information asymmetry.

In addition to the countries' debt levels, the contracts specify their indemnities in case of default, their insurance premiums, and their reserves. Their efficiency requests that indemnities just cover the haircut of investors, that insurance premiums are exactly equal to expected indemnities, and that reserves are sufficiently high with regard to the size of the monetary union and the correlation of default risks. The determination of indemnities that just provide full coverage, but not less or more, requests that not only debt levels but also production is observable, and the determination of fair insurance premiums that complete information on production technologies exists. In contrast, the determination of sufficiently high reserves places no information requirements. Reserves, in principle, could

be set independent of any information to infinity and it could be taken as granted that they will be sufficiently high irrespective of how small the size of the monetary union and how large the correlation of default risks are.[38] While production certainly is observable and thus appropriate indemnities should be determinable, it is more than doubtful whether information on production technologies is even close to being complete and therefore appropriate insurance premiums can be determined with any reasonable accuracy. Rather, it is to be expected that moral hazard issues due to information asymmetry with regard to production technologies constitute a problem of non-negligible size.

If information on production technologies is incomplete, the insured countries may like to pretend to be more productive than they actually are, in order to enjoy lower insurance premiums. In the extreme case of no information, they will even tend to promise that an investment in them will be safe even when it is not, therefore paying insurance premiums of zero. Note that in this case the insured countries will issue the same levels of debt as in the case of a non-credible no-bailout policy, since again they enjoy indemnities for free insurance premiums.

However, it should be kept in mind that for the credible no-bailout policy to achieve the optimal result, the information requirements, which for a mutual insurance fund are put on its underlying contracts, must then be put on the investors. Investors will only be able to demand adequate interest rate risk premiums if they have complete information on governments' production technologies. If they have less, or none, they can be led to believe making investments at little or zero risk, misled into offering capital for low or zero interest rate risk premiums, thereby driving governments' debt accumulation.

Thus, including the asymmetric information problem, the question whether a mutual insurance fund is the better alternative to a no-bailout policy also concerns the question whether there are grounds for assuming that the people who would be in charge of

[38]It would of course be desirable if reserves were not higher than necessary. The determination of appropriate reserves requests complete information on production technologies and the joint probability distribution for the countries' productivities. There are strong doubts as to whether either of the two requirements is even close to being fulfilled in reality, meaning that the determination of appropriate reserves can be considered as rather difficult. Nevertheless, the available information on production technologies and their interdependencies, of course, should be used for the determination of reserves. It is just advised to apply the necessary degree of generosity. As long as reserves are overestimated, they do not imply a loss of efficiency.

calculating the insurance premiums under a mutual insurance fund would be better informed on the participating countries' production technologies than investors.

On the one hand, it is to be expected that investors have stronger incentives to inform themselves about governments' production technologies than anyone else, as it is their wealth that is at stake and not the wealth of someone else. On the other hand, it is not unlikely that the people in charge of calculating the insurance premiums under a mutual insurance fund will have the better means to do so. Therefore, the question whether the latter will be better informed about the participating countries' production possibilities than investors cannot be conclusively answered.

Inferiority of partial insurance. Note that partial insurance cannot be a solution in the model.

Focusing on moral hazard problems due to a lack of credibility, the following applies. If a mutual insurance fund can be made more credible than a no-bailout clause, insurance represents a means to reduce moral hazard on the side of governments whereby moral hazard would be minimised with full insurance. If, instead, the mutual insurance fund cannot be made more credible than the no-bailout clause, insurance would not reduce but increase moral hazard and thus should not be introduced. Thus, partial insurance is either dominated by full insurance or the no-bailout clause and cannot be a solution in the model.

Including moral hazard problems due to information asymmetry with regard to production technologies, partial insurance can still not be a solution in the model. Unlike in standard insurance models, partial insurance as compared to full insurance does not return risk to the policyholders but to the investors. Therefore, it is not a cost for governments, which can act as a counterbalance to moral hazard.

Superiority of mutual insurance fund if haircuts cause panic. One of the main justifications that politicians have put forward for why they have granted bailouts in the current European sovereign debt crisis is that bailouts would prevent panic in the market. Panic among investors due to haircuts is also a main issue in many of the proposals for

crisis management that are discussed in Chapter 12. For reasons of simplicity and clarity, the effects of panic have not been included in the presented model. Nevertheless, it should be clear that if the model allowed for panic and abstracted from moral hazard problems, insurance would dominate no bailouts. In the end, that is the main reason why this part favours a mutual insurance fund and will focus on its implementation in the following chapter. Still, the no-bailout policy and its credibility will not be completely ignored. The reason is that they will continue to play an important, though passive role if one likes to see countries participating in the mutual insurance fund on a voluntary basis. This will become clear in the following paragraphs.

Voluntariness of mutual insurance fund. It has so far been implicitly assumed that countries are forced to participate in the mutual insurance fund, since the option of no participation, i.e. being exposed to the no-bailout policy, has not been taken into account at any point.

In reality, compulsory insurance is only feasible if there is an authority above national governments that can force the latter to insure themselves against their will. Since in the case of the EMU a European central government is still missing, insurance would have to be voluntary for its member states.

If countries are assumed to participate in the mutual insurance fund on a voluntary basis, the option of no participation will play an important role insofar as it imposes a participation constraint on the mutual insurance fund and therefore may restrict the feasibility of equilibria with a mutual insurance fund.

If welfare in the case of no participation is the same as or less than the one in the case of participation, countries will not mind or prefer to participate in the mutual insurance fund and an equilibrium with a mutual insurance fund will be feasible. If, however, it is higher, countries will refuse to participate in the mutual insurance fund and an equilibrium with a mutual insurance fund will not be feasible.

Abstracting from moral hazard problems, a comparison of (3.44) with (9.9) in conjunction with (3.45) indicates that welfare in the case of no participation is higher than the one in the case of participation, implying that countries will prefer not to participate in the

mutual insurance fund.

What seems to be a death sentence for the mutual insurance fund at first glance is due to an incompletion in the insurance contract as specified in Subsection 9.1.2. Since nothing about the ownership of the mutual insurance fund is stated there, countries have so far taken into account the reserves that they have to pay, but not the profits that the mutual insurance fund will reap, which in expectation are equal to the sum of reserves.

As noted above, countries have to pay reserves in addition to fair insurance premiums in order to ensure that the mutual insurance fund can meet accruing indemnities with almost certainty. Since the number of countries in the monetary union is usually small, and default risks are presumably correlated, there is a risk that actual indemnities turn out to be higher than collected insurance premiums so that the mutual insurance fund would not be able to fulfil its payment obligations if it did not collect reserves in addition to fair insurance premiums. Although it was not noted explicitly, it presumably was clear to the reader that the opposite can happen equally, i.e. there is an equal chance that collected insurance premiums turn out to be larger than actual indemnities so that the mutual insurance fund would be able to fulfil all obligations, even if it had no reserves. As a consequence, the mutual insurance fund will make profits, which in expectation are equal to the sum of reserves.

Thus, to bring the mutual insurance fund back to life the question of ownership has to be approached. Countries have to be granted shares in profits that compensate them for paying reserves. If countries are provided with shares of ownership the same as or higher than the shares with which they contribute to reserves, they will participate in gains with shares the same as or higher than the shares with which they contribute to reserves, therefore achieving welfare the same as or higher than in the case of a credible no-bailout policy so that they will not mind, or even prefer, to participate in the mutual insurance fund. If, instead, they are provided with lower shares, they will refuse to participate in the mutual insurance fund because they would participate in gains with a lower share than they contribute to reserves and would therefore achieve lower welfare than in the case of a credible no-bailout policy.

As reserves and profits, in expectation, are equally high, and shares of reserves and

ownership by definition sum to one, there is only one distribution of ownership for which all countries are participating in the mutual insurance fund, namely the one that is equal to the distribution of reserves. For this distribution of ownership, all countries participate in gains with exactly the same share as they contribute to reserves and therefore achieve, in expectation, exactly the same welfare as in the case of a credible no-bailout policy so that they do not mind participating in the mutual insurance fund. For any other distribution, there will be countries which would participate in gains with a lower share than they contribute to reserves, and therefore would lose from the mutual insurance fund so that they will refuse to participate in it.

Note that a distribution of ownership equal to the one of reserves is moreover the only distribution for which an equilibrium with a mutual insurance fund is feasible. The reason is that any other distribution will result in an adverse selection of countries in the mutual insurance fund: Only those countries which expect to gain or at least not to lose from the mutual insurance fund will participate in it. The mutual insurance fund, however, will not be able to fulfil these expectations.

If moral hazard problems are allowed for, the voluntariness of the mutual insurance fund will bring about an adverse selection of equilibria: Governments will choose the option which offers the higher welfare for them, i.e. the option which has the larger moral hazard problem.

Therefore, abstracting from panic in the market, there is no longer a point to introducing a mutual insurance fund. If it has more moral hazard problems than a no-bailout policy, it still should not be introduced due to the fact that governments would prefer to participate in it to being exposed to a no-bailout policy—the outcome being an inferior result. If, instead, it has less moral hazard problems, its introduction, while for mandatory insurance having had a positive effect, would now be useless for the simple reason that governments would refuse to participate in it. Finally, if it has the same moral hazard problems, countries would not mind participating in it, but it would not improve the outcome.

Thus, the conclusion for a monetary union that has to rely on voluntary insurance and suffers from a non-credible no-bailout policy like the EMU is that even the best worked out mutual insurance fund will bring about nothing if the problem of a non-credible

no-bailout policy is not tackled with the same rigour and determination because countries would simply refuse to participate in such a fund.

At first glance this conclusion seems to be discouraging. After all, there has for a short time been the hope that the non-credibility of the no-bailout policy can be circumvented by creating a more credible mutual insurance fund. Now it turns out that the credibility of the no-bailout policy has to go hand in hand with the credibility of the mutual insurance fund for the latter to be effective. Is there, then, no chance of improvement? The answer depends on whether it is believed that the no-bailout policy can be made more credible. While the reasons for the non-credibility of a no-bailout policy are diverse, and will be discussed in more detail below, it should be anticipated at this point that there is good reason to believe that the creation of a mutual insurance fund will itself increase the credibility of the no-bailout policy. One main reason for the no-bailout policy having been that non-credible is certainly that it prohibits any aid in case of default. If aid is permitted within the framework of a mutual insurance fund, and in exchange for fair ex ante insurance premiums and reserves, this may help to increase the credibility that aid outside the fund will indeed no longer be provided in the future.

Chapter 10

Institutional Issues of a European Default Risk Pool

On the basis of the analysis in Chapter 9, this chapter proposes that the EMU establishes a European default risk pool (EDRP), i.e. a mutual insurance fund for dealing with sovereign default risk as discussed in Subsection 9.1.2 for the Eurozone.

Section 10.1 deals with the key principles that should underlie the set-up of such an important new institution. It outlines how such an organisation can be established and exposes how it shall be designed to ensure economic efficiency as well as cope with political and legal realities. Section 10.2 then analyses how an EDRP can be integrated in the current institutional system. It elaborates in how far it fits into the current institutional system or to what extent the latter has to be changed to be consistent with it.

10.1 Institutional Set-up Determined by a Treaty Establishing the European Default Risk Pool

The first step in the direction of an EDRP would be to formulate a treaty that establishes it and sets out the details of how it would operate.

Subsection 10.1.1 firstly deals with the general provisions of such a treaty; Subsections 10.1.2, 10.1.3, and 10.1.4 then take a closer look at necessary institutions, operational

procedures, and transitional arrangements respectively.

10.1.1 General Provisions

As a mutual insurance contract the treaty must include at the very least the following elements: identification of participating parties, the particular subject and risk covered, subjects and risks not covered (exclusions), the period of coverage, amounts of coverage, insurance premiums, reserve payments, the periodicity of insurance premiums and reserve payments, rules of conduct, penalties for misconduct, the distribution of ownership, and outside options. Clearly, it is beyond the scope of this PhD thesis to formulate in detail such a treaty, but it may be useful to make the following points on the basis of the analysis in the previous chapter.

Participation of Eurozone countries. The participating parties are all those countries in the Eurozone, although it could be argued that the EDRP should also be open to the other member states of the European Union. On the one hand, as interest rates in the European Union were quite heterogeneous before the euro was introduced, and the interest rate convergence after its introduction took place primarily for euro area countries and much less for other member states, the problem of commitment to no bailouts seems to concern the Eurozone rather than the European Union as a whole so that, focused on this aspect, the participation of non-euro area member states would not bring any improvement for them or the European Union as a whole. On the other hand, there are external effects on all European Union countries arising from a default of one or more non-euro area countries which would be prevented, and a larger risk pool has the advantage of needing less reserves. Furthermore, under the mutual insurance system, what matters is the projected debt creation of the country concerned rather than monetary policy per se. It should, however, also be noted that there would be an element of foreign exchange risk that does not apply within the Eurozone. Most probably, the best approach would be to restrict at least initially membership to Eurozone countries with the possibility, once the insurance pool is tried and tested, to extend it to other European Union countries.

Insurance for new debt and risk of default due to productivity shocks. Cover is provided for debt that is issued after the EDRP has started its operations if its repayment plus interest is affected by defaults due to productivity shocks. Debt that was issued before the EDRP's start of operation is not covered, nor are defaults that are due to extraordinary situations like natural disasters.

Insurance until the maturity of debt. Cover is granted until the maturity of the insured debt.

Full insurance. If a Eurozone country is likely to default due to productivity shocks, it will receive an indemnity from the EDRP sufficient to pay off its insured debt so that there is no haircut for the investors in its insured bonds.

Fair insurance premiums and appropriately high debt-independent reserves. In exchange for the full insurance of debt, Eurozone countries pay insurance premiums and reserves to the EDRP. Insurance premiums depend on the countries' prospective issuance of debt and are calculated as being equal to the expected value of indemnities the countries will claim. Reserves are independent of the countries' prospective debt issuance, and in sum sufficiently high with regard to the number of countries participating in the EDRP and the correlation of default risks. The distribution of reserves does not matter. It may be based on some measure such as GDP or on the capital share in the ECB, similar to the capital stock of the European Stability Mechanism (compare Subsection 10.2.3).

Periodical insurance premiums. Insurance premiums are paid at regular intervals, most likely annually. This is because, given the prospective debt issuance, the probabilities of default and therefore the insurance premiums depend on macroeconomic parameters which vary over time (as expressed by the parameters determining the production function Y_i and the cumulative distribution function F_i in the theoretical model) and this creates the need for frequent review of the insurance contract. The process can be made to fit in with the timing of the countries' own national budgeting cycles (see Subsection 10.1.3).

One-time reserve payment at the EDRP's start of operations. Reserves are collected as a one-time payment at the EDRP's start of operations. The reason is that their volume will be sustained by fluctuations in expected indemnities above and below their expected value to equal extent.

Debt issuance stated in advance; penalty payment for debt creation in excess of that stated. In addition to insurance premiums, the debt issuance in the interval ahead is stated in the regular agreements. Any subsequent debt creation in excess of that stated will entail a penalty payment. Penalties have to be paid immediately and automatically. They may be based on GDP, similar to the penalties of the Stability and Growth Pact and the New Fiscal Compact (compare Subsection 10.2.2). As an alternative kind of penalty, it is also conceivable to exclude subsequent debt creation for which an ex ante insurance premium has not been paid from cover. In this case, any subsequent debt creation in excess of that stated will only be covered by an extension of the indemnity if an additional insurance premium is paid at or before the time the debt is created. Otherwise the debt increase will not be covered by the insurance and investors in that debt must reckon with a haircut in case of default. Furthermore, such additional debt will be junior to that covered by the indemnity. As a rule, a country's actual debt creation should not, however, exceed that specified before in the agreement.

Distribution of ownership according to contribution in reserves. Eurozone countries own the EDRP with the same share as they contribute in reserves.

No aid outside the EDRP. The EMU refrains from granting bailouts for debt that is issued after the EDRP's start of operation. In addition to ensuring that Eurozone countries are willing to participate in the EDRP, this will also be to prevent countries from having incentives to announce lower prospective debt issuance than they actually intend to undertake if the penalty in the form of an exclusion from cover is chosen.

10.1.2 Necessary Institutions

After having presented the elements of the treaty, the question is addressed regarding which institutions should determine which element.

Choice of debt issuance by countries. To take due account of the principle of subsidiarity, which states that "economic decisions should be left to the lowest possible level"[39], the choice of the level of debt creation should be left to the individual countries. If insurance premiums are determined on this choice and the system overall is credible, countries will choose the optimal levels of new debt in their own interest as shown in Subsection 9.2.2. Importantly, this implies that fiscal policies remain to be determined at the national level and thus the EMU does not have to be extended into a fiscal union.

Determination of insurance premiums, indemnities and penalties by technocrats rather than politicians. Given a country's proposed level of debt creation, the calculation of insurance premiums will be essentially a technical matter involving a short run macro-economic forecast of likely shocks, and their translation into default probabilities of individual countries. In contrast to the theoretical model, it is unlikely that default risks of these countries are entirely statistically independent. They are more likely to be positively correlated, possibly with a complex system of cross-correlations among countries, and so the risk calculations will necessarily be more complex than those that were presented in the model, though certainly not beyond the capacity of the actuaries who work in the insurance sector. It does, however, imply that the EDRP should be an agency staffed by experts in economics, statistics, insurance and finance. The EDRP should be regarded as a technically competent mutual insurance pool rather than as a bailout agency subject to political control. Finally, not to be forgotten, in addition to the insurance premiums, the EDRP should also determine the indemnities and penalties.

[39] Sinn (2014), pages 355f.

10.1.3 Operational Procedures

After having determined the necessary institutions, this subsection summarises the procedures for their operations.

Specification of prospective debt creation and determination of insurance premiums before start of new cover period. Before a new period of cover commences, the Eurozone countries are required to submit their proposed debt creation plans to the EDRP. On the basis of the debt creation plans, the EDRP determines the insurance premiums for the period ahead by assessing the risk of default and the expected value of indemnities that will be claimed in this period. Finally, the Eurozone countries pay the insurance premiums. Since the payment of insurance premiums must also be made before the start of a new cover period, the submission of debt creation plans has to take place sufficiently in advance to allow the EDRP enough time for the determination of appropriate insurance premiums. If insurance premiums are paid annually and the process is made to fit in with the timing of the countries' own national budgeting cycles, Eurozone countries may reveal their plans of debt creation to the EDRP by announcing their annual budgets.

Determination of penalties after end of cover period. After the end of a cover period, the EDRP is required to check whether the Eurozone countries stuck to their debt creation plans and to initiate penalties whenever actual debt creation is higher than planned. Penalties are paid immediately and automatically. If the alternative kind of penalty in the form of an exclusion from cover is chosen, the duty to act will be on the side of the Eurozone countries. They will be required to notify the EDRP as soon as they intend to go beyond their submitted debt creation plans to ensure that a reassessment of the insurance premium and the payment of the difference can be carried out before the debt creation in excess of that stated takes place. If this is no longer possible, the excess in debt creation will no longer be insurable and investors in that debt must accept a haircut in the event of default.

Granting of indemnities on request. If a Eurozone country is likely to default, it has to address a request for indemnity to the EDRP. On receipt of such a request, the EDRP determines the actual financing needs of the Eurozone country to pay off its insured debt and prevent a haircut for the investors in its insured bonds, and then makes the corresponding payment.

10.1.4 Transitional Arrangements

Since insurance premiums have to be agreed upon and paid before debt issuance, the EDRP can only be applied for new debt. Debt that has been issued before the establishment of the EDRP cannot be insured ex post. This leads directly to the question of how defaults on old debt should best be dealt with. Should the EMU provide full bailouts? Or should investors accept maximal haircuts? In terms of efficiency, it does not make a difference. The question, therefore, rather addresses aspects of justice. Which parties made mistakes? Should they assume the consequences? And can they bear them? Subsection 9.2.4 indicated that an identification of the culprit in the current sovereign debt crisis is difficult. The reason is that it requests an assessment of whether investors' beliefs on the credibility of the no-bailout clause were justified. However, such an assessment is almost impossible; due to its relatively brief history, the Eurozone had lacked examples of defaults where the no-bailout clause had been maintained or bailouts had been carried out. The muddling through in the current sovereign debt crisis, however, proves investors partly right, blaming not only them but also the shortcomings in the Maastricht Treaty for the crisis. Still, the question of guilt cannot be conclusively clarified. It may therefore be favoured that both the investors and the EMU participate in losses because both made mistakes. The EMU should provide some help and investors should accept a limited haircut. The question also remains regarding who was to gain from risk taking. Although the mistakes can be found on the side of investors and in the Treaty of Maastricht, and it is the investors or the EMU as a whole who bear the consequences if excessive risk taking goes wrong, it is not they who reap the profits if everything goes well. Rather, it is the countries who engaged in excessive debt accumulation. While they cannot be asked to remargin insurance premiums for capital whose productivity has already been realised, it

would only be fair to let them remargin for capital whose productivity has not yet been realised.

10.2 Integration into the Current Institutional System

In light of what was proposed in Section 10.1, Subsection 10.2.1 argues that the no-bailout clause should be maintained and strengthened in order to ensure that Eurozone countries support the EDRP and insure themselves on a voluntary basis. In contrast, Subsection 10.2.2 argues that the debt and deficit criteria in the Stability and Growth Pact and European Fiscal Compact should be abandoned. The reason is that countries will choose the efficient levels of debt issuance in their own interest if the EDRP is implemented properly so that debt and deficit criteria unnecessarily restrict countries in their sovereignty and reduce efficiency. Finally, Subsection 10.2.3 explains why the EDRP is superior to the European Stability Mechanism.

10.2.1 Maintenance and Strengthening of No-Bailout Clause

As explained in Subsection 9.2.4, for the Eurozone countries to back an EDRP, it is crucial to make it credible to them that the alternative to insurance is no bailouts. To this end, the rule of the Treaty on the Functioning of the European Union (TFEU)[40] that prohibits European Union states from giving financial support to each other (the so-called no-bailout clause of Article 125 TFEU) should not be abandoned but maintained. Moreover, it should be strengthened, since past experience has proved no bailouts to be far away from credibility.

Credibility problem at the time of the euro introduction due to a natural lack of examples and soft formulation. As already mentioned, investors no longer requested interest rate risk premiums after the euro had been introduced since they

[40] European Union (2012a).

expected bailouts in case of default, and they have not been proved completely wrong since bailouts of an enormous size have been granted in the course of the European sovereign debt crisis. On the one hand, the lack of credibility of no bailouts at the time of the introduction of the euro and the establishment of the TFEU can be attributed to the natural lack of default examples where the no-bailout clause had been maintained. After the two haircuts in Greece in 2012, it can be doubted that the possibility of no bailouts is underestimated to that extent ever again. This can also be seen in the development of interest rates, which differ nowadays, albeit only slightly. On the other hand, no bailouts have also lacked credibility due to the unfavourable wording of the no-bailout clause, which offers loopholes, as the measures taken to deal with the European sovereign debt crisis have shown. The no-bailout clause of Article 125 TFEU reads

"The Union shall not be liable for or assume the commitments of central governments, regional, local or other public authorities, other bodies governed by public law, or public undertakings of any Member State, without prejudice to mutual financial guarantees for the joint execution of a specific project. A Member State shall not be liable for or assume the commitments of central governments, regional, local or other public authorities, other bodies governed by public law, or public undertakings of another Member State, without prejudice to mutual financial guarantees for the joint execution of a specific project."

If the no-bailout clause is interpreted in the broadest sense, it prohibits *any* financial support from European Union states to one another, also—and important to note since it concerns this part's proposal of establishing an EDRP—indemnities of insurance mechanisms. In the past, however, politicians tended to understand the no-bailout clause in a much more restrictive sense. For instance, by establishing the European Financial Stability Facility (EFSF), they implicitly assumed that the no-bailout clause only refers to direct, unconditional financial support but not to lending money subject to conditionality.[41] As the no-bailout clause allows for such narrow interpretations, it can only prevent a few of the possible forms that bailouts can take and is therefore non-credible.

[41] de Witte (2011), page 6.

Further weakening by a treaty amendment. A fact, which could not be changed despite that doubts and criticism on the interpretation of politicians were expressed and continued. On the contrary, the controversy surrounding the compatibility of the EFSF with the no-bailout clause, together with the controversy regarding the legal basis of the European Financial Stability Mechanism (EFSM)[42], prompted the Eurozone states to envisage an amendment in the TFEU for creating a permanent crisis mechanism, the European Stability Mechanism (ESM), that would replace the EFSM and EFSF but weaken the no-bailout clause even further since it makes bailouts under certain conditions legally acceptable. The amendment (Article 136 TFEU) reads

"The Member States whose currency is the euro may establish a stability mechanism to be activated if indispensable to safeguard the stability of the euro area as a whole. The granting of any required financial assistance under the mechanism will be made subject to strict conditionality."

New strength possible by stricter formulation; distinction of bailouts from insurance important for the establishment of an EDRP. For the no-bailout clause to be strengthened, it is advisable to refrain from legalising exceptions and to add to its soft formulation instead. Moreover, for authorising an EDRP it is necessary to differentiate bailouts from insurance indemnities. The no-bailout clause should be rewritten to

"The Union shall not be liable for or assume *any* commitments of central governments, regional, local or other public authorities, other bodies governed by public law, or public undertakings of any Member State, *unless it received compensation ex ante*, without prejudice to mutual financial guarantees for the joint execution of a specific project. A Member State shall not be liable for or assume *any* commitments of central governments, regional, local or other public authorities, other bodies governed by public law, or public undertakings of another Member State, *unless they received compensation ex ante*, without

[42]The EFSM was based on Article 122 (2) TFEU which reads

"Where a Member State is in difficulties or is seriously threatened with severe difficulties caused by natural disasters or exceptional occurrences beyond its control, the Council, on a proposal from the Commission, may grant, under certain conditions, Union financial assistance to the Member State concerned. The President of the Council shall inform the European Parliament of the decision taken."

It was often doubted that the EFSM is within the scope of Article 122 (2) TFEU since it seems to be doubtful that Greece and Ireland were facing exceptional occurences beyond their control and more likely that their governments contributed to the emergence of their sovereign debt crises.

prejudice to mutual financial guarantees for the joint execution of a specific project."

In addition, in order to give further strength to the establishment of an EDRP, an explicit provision should be inserted into the TFEU with the following or similar content.

"The Member States whose currency is the euro may establish a European default risk pool to safeguard the stability of the euro area as a whole. The granting of any required financial assistance will be made subject to payments of adequate premiums and reserves."

Setting up an EDRP as an institutional commitment to no bailouts. Finally note that the existence of the EDRP itself may also contribute to making credible what is in effect a no-bailout clause! As anticipated in Subsection 9.2.4, the no-bailout clause was non-credible not least because it prohibited any aid in case of default. If aid is permitted within the framework of an EDRP and in exchange for fair ex ante insurance premiums and reserves, aid outside of it may seem less imaginable since countries contributing to the pool might feel less sorry for defaulting countries if they did not contribute to the pool. In this case, contributing countries are perhaps more likely to decide to leave defaulting countries to themselves. In the end, there is a chance to insure against sovereign default risk and it has to be regarded as being the countries' fault if they do not use the insurance opportunity.

10.2.2 Abolition of Debt and Deficit Criteria in Stability and Growth Pact and European Fiscal Compact

As shown in Subsection 9.2.2, if the EDRP is implemented properly, countries will choose the efficient levels of debt issuance in their own interest, so that debt and deficit criteria become economically redundant, or even detrimental if they are binding, i.e. restrict countries in their debt issuance. It is exactly for this reason why the debt and deficit criteria in the Stability and Growth Pact and European Fiscal Compact should be abandoned.

Justification of Maastricht criteria by a debt sustainability analysis. This will be at least the conclusion if one refers to the point of view taken by the presented model. To be fair, however, it should be noted that there are other perspectives for which a different conclusion can be drawn and which also have their justifications and thus should not be ignored.

For instance, the debt and deficit criteria in the Stability and Growth Pact, which provide that the European Union states' fiscal deficit and public debt level must not exceed 3 and 60 percent of GDP respectively (Article 126 in conjunction with Protocol 12 TFEU), derive their justification from a debt sustainability analysis. Domar (1944) shows that the ratio of debt to GDP approaches the ratio of the percentage of GDP borrowed to the percentage rate at which nominal GDP increases.[43] Assuming that nominal GDP grows at a rate of 5 percent per year on average, countries can achieve debt levels at 60 percent of GDP in the long run by running annual deficits at 3 percent of GDP.

The debt sustainability analysis is a macroeconomic approach and considers the interaction of debt accumulation and GDP growth of a specific country over time. The analysis in Chapter 9 is a microeconomic approach and concerns the optimal allocation of capital over countries in a specific point in time. Both analyses and their conclusions have their justifications and it just would not be right to give priority to one or the other.

Poor performance due to over-optimistic expectations about nominal GDP growth and lack of credibility. Irrespective of that, the debt and deficit criteria of the Stability and Growth Pact have put in a poor performance so far. One problem has been that the assumption of an average annual nominal GDP growth rate of five percent was too optimistic. An average annual nominal GDP growth rate of 4.15 percent in the current euro area member states over the period from 1999 to 2008 would have requested deficits of 2.48 percent of GDP so that debt levels converge to 60 percent of GDP.[44] Another problem has been that the debt and deficit criteria, or rather the sanctions to be imposed in case of their non-compliance, turned out to be non-credible. The Stability and Growth Pact provides that sanctions can involve annual fines for euro area member

[43] Domar (1944), page 810.

[44] Own calculation based on data accessed from Eurostat, *GDP and main components*, on 5 November 2014.

states (Article 126 TFEU). The fact is, however, that the deficit criterion was not fulfilled 148 times by 2013. While the failure to fulfil the deficit criterion could be justified by a sufficiently serious recession in 51 cases, sanctions should have been applied in the remaining 97 cases. In fact, sanctions were not given in any single case.[45] The reason is that fines are not imposed automatically but negotiated ex post, i.e. after the violation of the criteria, by the treaty violators. It is understandable that culprits do not impose sanctions on themselves.

New strength by Fiscal Compact. To approach both problems, the euro area member states introduced the Fiscal Compact (Article 3 Treaty on Stability, Coordination and Governance in the Economic and Monetary Union, TSCG[46]), which requires them to enshrine in national law a balanced budget rule that prohibits running structural deficits of more than 0.5 percent of GDP and envisages automatic correction mechanisms and independent institutions for monitoring compliance. The TSCG was signed by all European Union member states except the United Kingdom and Czech Republic, and entered into force on 1 January 2013.[47] It applies to all euro area member states upon ratification and to other European Union member states that have ratified it once they adopt the euro, or earlier if they wish (Articles 1 and 14 TSCG).

10.2.3 Superiority over European Stability Mechanism

Chapter 9 explained that the main reason why an EDRP will be efficient is that countries have to compensate it for their risk ex ante by paying appropriate insurance premiums. This subsection argues that the ESM mainly differs from an EDRP by requesting this compensation ex post by repaying aid plus interest. While this provision certainly has the right intention it is expected to have the wrong results since it suffers from time inconsistency and above all credibility problems. Therefore, the conclusion will be that the ESM is clearly inferior to an EDRP. But let us start at the beginning and first summarise and schematically represent the main features of the ESM.

[45] Sinn (2014), page 53.

[46] European Council (2012b).

[47] European Commission, *Stability and Growth Pact*, http://ec.europa.eu/economy_finance/economic_governance/sgp/index_en.htm.

Roundup of main features. As already noted, the ESM was created as a permanent rescue fund for the Eurozone that would replace the EFSF and EFSM.

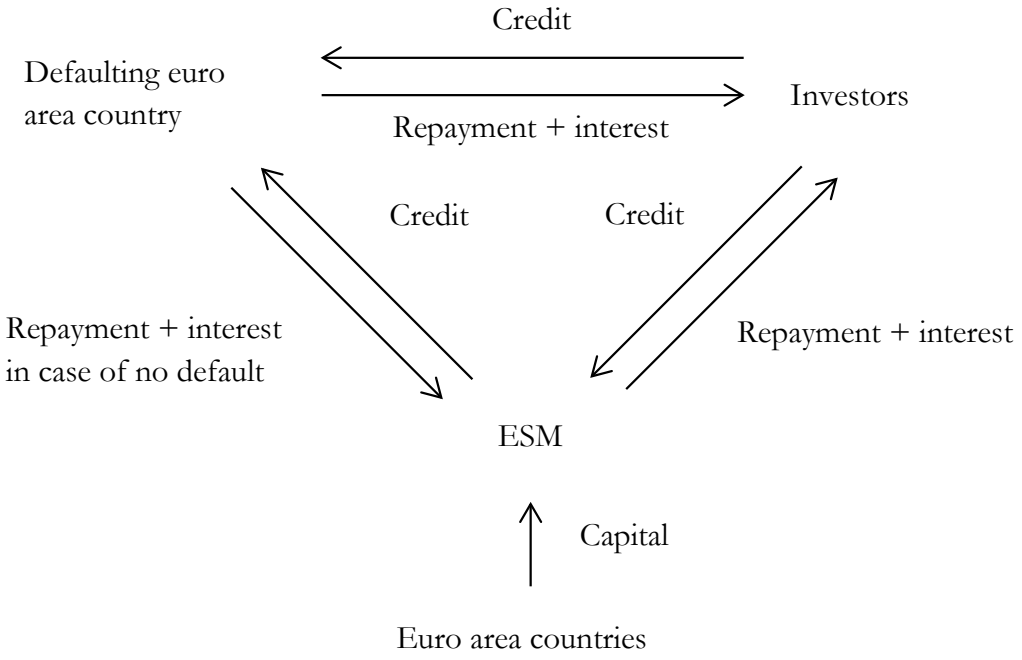
While the amendment to Article 136 TFEU authorised the establishment of the ESM under European Union law, the ESM itself was established by a treaty among the euro area member states (Treaty establishing the European Stability Mechanism[48]). The Treaty establishing the ESM entered into force on 27 September 2012; the ESM started its operations on 8 October 2012.

The ESM aims at providing emergency financial assistance to euro area member states in financial distress under strict conditionality (Article 3 Treaty establishing the ESM). Financial assistance comprises loans, credit lines, loans for the purpose of re-capitalisation of financial institutions, and sovereign securities purchased either in the primary or secondary market (Articles 14–18 Treaty establishing the ESM). Conditionality depends on the financial assistance instrument chosen and may range from a macroeconomic adjustment programme to continuous respect of pre-established eligibility conditions, negotiated between the troika (consisting of the European Commission, the ECB and the IMF) and the ESM member concerned; the first of which being also in charge for monitoring its compliance (Article 12 Treaty establishing the ESM). Pricing also depends on the financial assistance instrument chosen and shall cover the financing and operating costs including an appropriate margin (Article 20 Treaty establishing the ESM). In order to be able to provide financial assistance, the ESM raises funds by issuing financial instruments or by entering into financial or other agreements or arrangements with ESM members, financial institutions or other third parties (Article 3 Treaty establishing the ESM). The initial maximum lending volume of the ESM is set at 500 billion euros[49] and the liable capital stock at 700 billion euros (Article 8 Treaty establishing the ESM). Each country is liable in the amount of its share in the ECB's capital (Article 11 Treaty establishing the ESM). Only 80 billion of the capital stock will be paid in (Article 8 Treaty establishing the ESM); the remaining share can be called in the event of credit losses (Article 9 Treaty establishing the ESM).

Figure 14 provides a schematic representation of the ESM.

[48] European Council (2012a).
[49] European Council (2012a), page 5.

Figure 14: Schematic representation of the ESM



Defaulting euro area countries receive loans from the ESM that prevent a haircut for the investors in their bonds. The ESM gets the money for the loans from investors by issuing financial instruments. Countries are expected to repay the loans plus interest. If they are not able to do so, the euro area countries have to compensate for defaulting payments by injecting capital since the ESM promises to repay the investors in their financial instruments without default.

Ex post compensation by repayment plus interest. The ESM differs from an EDRP in two important respects. Firstly, countries do not have to pay an insurance premium. Since the investors in their bonds will be repaid plus interest in case of default, they do not require an interest rate risk premium. Thus, countries do not have to compensate anybody for their risk ex ante. Secondly, countries are expected to repay aid plus interest with a positive probability and to compensate the ESM for the risk that they might not be able to do so, so that the ESM, in expectation, breaks even. The chance of repayment shall be ensured by granting aid under strict conditionality; the risk of no

repayment compensated by granting it at appropriate prices. Note that if countries share the expectations placed on them and nevertheless seek aid by the ESM, they will take into account the total debt repayment obligations in case of default since the repayment of aid plus interest is, in expectation, equal to the aid which prevents the haircut for investors in case of default. In this case, although the compensation of the ESM for their risk takes place ex post, countries will choose the efficient levels of debt.

Time inconsistency. There is, however, good reason to doubt that the ESM will work in this way. First of all, if countries expect that they will have to compensate the ESM for aid by repaying aid plus interest, they will prefer to receive no aid if they are about to default, since the costs of aid would only be borne by them or, more concretely, by their taxpayers while the benefits would be shared by their investors with investors from the rest of the world so that the deal with the ESM would mean a deterioration in net terms for them. Since it is up to the countries whether they use the ESM or not (Article 13 Treaty establishing the ESM), they will simply decide not to use it, thereby avoiding the repayment of aid plus interest. However, it should be noted that if bailouts outside the ESM are excluded, investors will on the other hand expect the haircuts, which will then be put on them if countries are to default, and request an appropriate interest rate risk premium so that countries will nevertheless choose the efficient levels of debt. The right of the ESM to exist would then be limited to making other bailouts non-credible. If it is preferred that the ESM is used to prevent haircuts and panic in the market, countries would have to be forced to ask for aid.

Lack of credibility. Secondly, it may be doubted that countries using the ESM will have to compensate the ESM fully for their aid or expect that they will have or are able to do this. The fact alone that there have already been countries that considered aid by the ESM to be worthwhile suggests that either the ESM grants aid at more favourable interest rates than the defaulting countries' prospects to repay it justify, or that countries do not expect that they have or are able to compensate the ESM fully for the aid. In both cases, the ESM will in expectation make losses which have to be borne by its capital providers, i.e. the euro area member states. Of even more concern is that countries will

issue more debt than is optimal since they calculate with too low compensation payments, or none at all.

Chapter 11

Implications for Crisis Mechanisms Concerning Banking Crises and Crisis Management by Monetary Institutions

The analysis has so far referred to crisis mechanisms concerning sovereign debt crises and crisis management by governments. Section 11.1 shows that it also applies to crisis mechanisms concerning banking crises and assesses the idea of a banking union in light of the obtained results. Section 11.2 evaluates the policy measures taken by the ECB since the outbreak of the US financial crisis in 2007.

11.1 Banking Union

Subsection 11.1.1 firstly presents the model set-up of a market for bank intermediation; Subsection 11.1.2 then states that its solution concurs with the one of the sovereign debt model. Finally, Subsection 11.1.3 presents and evaluates the current proposal of a banking union.

11.1.1 Model Set-up

This section's model resorts to the banking model of Part I, which was built on the sovereign debt model of that part.

Players, actions and utilities. The model has the same players: borrowers of number n, and lenders, which and who, respectively, seek for debt capital and interest income, respectively, so as to maximise their respective utilities; and banks acting as intermediaries.

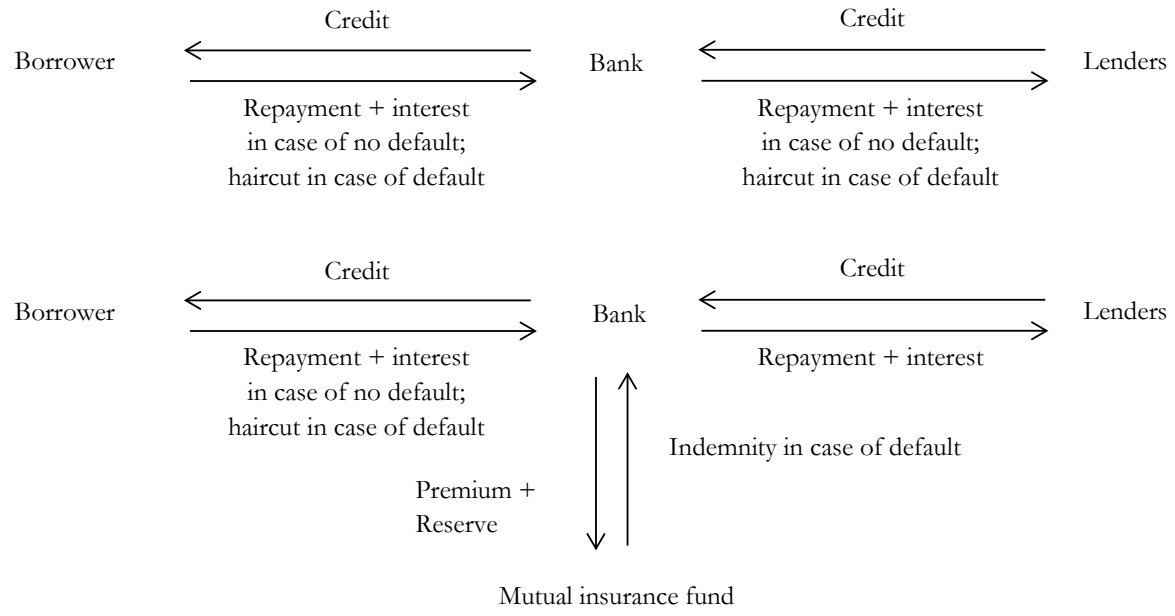
The model also has the same details: The borrowers can still be governments or businesses, borrow money D_i from banks at the nominal interest rate r_i, invest the money in a risky project with an expected gross return that is described by (3.1), and will suffer a default if the expected gross return turns out to be smaller than the debt repayment plus interest, in which case they can either renege on the total of their debt or repay it to the extent they are able to. The lenders can still be investors or depositors, lend their money W^0 to banks for some interest rate or invest it elsewhere in the economy at the risk free interest rate r_f. They do so in order to maximise their expected income. Banks are still n in number, assigned to borrowers according to their index and initially assumed not to own capital. The capital market and the banking market are still characterised by perfect competition.

Time structure. Furthermore, the model has the same sequence of actions: In stage 1, borrowers borrow money from banks; in stage 2, lenders lend money to banks or invest it elsewhere in the economy; and in stage 3, productivity parameters are realised.

Cases. As in Chapter 9, the model discusses the case of insurance and compares it to the case of a credible no-bailout policy discussed in Part I.

Figure 15 gives a schematic representation of the cases of a credible no-bailout policy and insurance for banks.

Figure 15: Schematic comparison between the cases of a credible no-bailout policy and a mutual insurance fund between banks



In the case of a credible no-bailout policy, lenders are faced with a haircut in case of default; in the case of insurance, banks $1, ...m$ pay insurance premiums and reserves into a fund from which they receive indemnities in case of default, which prevent a haircut for their lenders. The difference to the sovereign debt model is that the mutual insurance fund is fed by banks and not by borrowers.

11.1.2 Model Solution

As in Part I, the model is solved argumentatively.

Case of a mutual insurance fund between banks. In the case of insurance, the expected income of a lender is given by (3.37) and (3.38), and her portfolio choice by (3.39) and (3.40). Since lenders anticipate that the repayment of their money plus interest is ensured by indemnities from the mutual insurance fund to banks in case of default, they have to be offered just the risk free interest rate by banks. In order to

break even in expectation, banks, however, will demand the same interest rates as in the case of a credible no-bailout policy from their borrowers; the expected value of the interest rate risk premiums offsets the insurance premiums to the fund. The banks' role of intermediation is cut back in favour of a new role, i.e. providing lenders with insurance. Thus, the borrowers' expected income will not be given by (9.7) and (9.8) but by (3.41) and (3.42)/(3.43) if borrowers are governments, and differ therefrom by the investors' indirect income if borrowers are businesses. Their debt choice in turn coincides with (3.45). The outcome for the case of a mutual insurance fund differs from the one in the sovereign debt model only in that borrowers face higher interest rates; the interest rates faced by lenders and debt levels are the same.

Comparison to the case of a credible no-bailout policy. In the previous paragraph, it was argued that the choice of debt levels in the banking model coincides with the one in the sovereign debt model. Moreover, we found that it is the same in the cases of a credible no-bailout policy and a mutual insurance fund between banks. Note that it is thereby also efficient. The reason is again that borrowers have to compensate the bearers of costs in case of default for their risk. In the case of a credible no-bailout policy, the bearers of costs in case of default are, as in the sovereign debt model, the investors; the borrowers have to compensate them for their risk in terms of an interest rate risk premium. In the case of a mutual insurance fund, the bearer of costs in case of default is, also analogously to the sovereign debt model, the mutual insurance fund. Yet while in the sovereign debt model borrowers compensate the fund for their risk directly, in terms of an insurance premium, in the banking model they do so indirectly, in terms of an interest rate risk premium: Borrowers accept interest rate risk premiums which compensate their banks for compensating the fund directly by paying insurance premiums.

As for sovereign debt, there is, however, the problem that a no-bailout policy usually lacks credibility. If lenders assume that the banks to which they lend their money, or the governments to which their money is passed on, will be bailed out by the countries in which the banks are based, by other countries, or by a supernational institution in case of default, they will request no interest rate risk premium from the banks for their risk or that of their borrowers. Therefore, in order to break even, banks will not have to request

any interest rate risk premium from their borrowers. This will result in moral hazard on the side of borrowers. Borrowers will issue more debt than is optimal. The establishment of a mutual insurance fund between banks may be desirable. The prerequisite is that it does not suffer from other credibility problems like those concerning penalties that are equal to or greater than those of a no-bailout policy. If penalties for excessive lending to borrowers are non-credible and banks are connected with their borrowers (as may be the case if borrowers are governments and linked to their banks), banks may, on behalf of their borrowers, pretend to undertake less lending than intended, therefore paying lower insurance premiums and thus having to demand lower interest rate risk premiums from their borrowers in order to break even, resulting in excessive borrowing from banks.

Furthermore, moral hazard problems due to information asymmetry with regard to production technologies considered in the framework of the sovereign debt model also play a role in the banking model. Again under the assumption that banks are connected with their borrowers, if the mutual insurance fund is unable to observe the banks' lending decisions, banks may, in the interest of their borrowers, pretend to have more productive borrowers at hand than is actually the case, causing the same effects as just described. Something similar can be said for the no-bailout policy. If lenders are unable to observe their banks' lending decisions, they can be led to believe facing a good bank, affecting the same result. Note that if banks themselves are not able to observe their borrowers' production technologies, they do not have to be in collaboration with their borrowers in order for moral hazard on the side of borrowers to emerge since they themselves can be deceived into believing to make a better investment than is actually the case, with the same consequences.

The role of capital. If banks own capital, a mutual insurance fund can be used to insure the part of the repayment obligation that is not covered by capital, whereby the insurance premium substitutes for the interest rate risk premium that lenders will request in the case of a credible no-bailout policy. Since banks request an interest rate risk premium from their borrowers for the other part of the repayment obligation in any case, the inclusion of capital does not change the finding that the choice of debt levels is the same in the cases of a credible no-bailout policy and insurance.

As already explained in Part I, if credibility problems of the no-bailout policy are allowed for, the existence of capital will reduce the size of the moral hazard problem only if borrowers are businesses and the lack of credibility only concerns no bailouts to lenders. In this case, banks will request an interest rate risk premium from their borrowers for the loss of capital in case of default. If borrowers are governments that are bailed out in case of default, or the lack of credibility also concerns no bailouts to capital owners, the size of the moral hazard problem will be unaffected by the existence of capital. Since banks will not lose capital under any circumstances, they will not require an interest rate risk premium for it. As far as the credibility problems of a mutual insurance fund are concerned, the existence of capital will reduce the size of the moral hazard problem in that insurance only concerns the part of the repayment obligation which is not covered by capital.

The situation is similar if moral hazard problems due to information asymmetry are considered. If the mutual insurance fund is unable to observe the banks' lending decisions, the existence of capital will reduce the size of the moral hazard problem for the same reason as in the case of a mutual insurance fund with credibility problems. Regarding the no-bailout policy, if the lenders are unable to observe the banks' lending decisions, the existence of capital will weaken the problem of moral hazard in that the feint to make only safe investments is of no use for banks, or rather their borrowers, for the part of the repayment obligation that is covered by capital. For that, investors did not request an interest rate risk premium even when information was assumed to be complete. This is also confirmed by Sinn (2003), who has shown for the absence of a mutual insurance fund and incomplete information on the side of bank lenders that the moral hazard problem concerns only the part of the repayment obligation that is not covered by capital in that bank lenders cannot request an appropriate interest rate risk premium from their banks for that. Due to the two main differences in the models mentioned in Part I, the moral hazard problem is, however, on the side of banks. Finally, note that if banks themselves are not able to observe their borrowers' production technologies, the existence of capital will not play a role for the size of the moral hazard problem since the banks can be misled into believing that they make safe investments, thereby requesting no interest rate risk premium for the total debt repayment obligations.

11.1.3 Improvement Potential for the Banking Union

After having shown that the results of the banking and sovereign debt model coincide, this subsection presents the current plans of a banking union and evaluates them in light of the obtained results.

According to the European Commission, there are four pillars of a banking union: single rulebook, supervision, deposit guarantees, and bank resolution.[50] For each of the pillars, the European Commission has clear ideas, of which some have already been implemented.[51]

While the first two pillars deal with the prevention of banking crises, the latter two concern the management and resolution of such crises, and it is therefore only their concepts and realisation which can be evaluated in light of the obtained results. For the sake of completeness, the status quo of the first two pillars will be nonetheless briefly discussed in the following.

Single rulebook. Concerning a single rulebook, a new regulatory framework including a Capital Requirement Regulation (CRR) and a Capital Requirement Directive (CRD IV) entered into force in July 2013, which replaced the former Capital Requirement Directive (CRD). It is based on the international regulatory framework for banks published in December 2010 (Basel III) and therefore extends the supervision and regulation with CRD that focused on capital requirements in that it also lays down requirements on liquidity and leverage ratios. This is important since it covers the whole balance sheet of the banks. Moreover, capital requirements were strengthened. With regard to a banking union, however, it is more important that the CRR has introduced a single rulebook, i.e. a single set of harmonised prudential rules which all banks in the European Union must respect. This shall ensure a uniform application of Basel III rules in all member states and remove national options and discretions that have prevailed with CRD.[52] Banks were

[50] European Commission (2012). Towards a Banking Union. Press release MEMO/12/656, Brussels, 10 September, http://europa.eu/rapid/press-release_MEMO-12-656_en.htm.

[51] Also compare European Economic Advisory Group (2014), Chapter 4, for a compact overview and an assessment of other aspects.

[52] European Commission (2013). Capital Requirements - CRD IV/CRR – Frequently Asked Questions. Press release MEMO/13/690, Brussels, 16 July, http://europa.eu/rapid/press-release_MEMO-13-690_en.htm?locale=en.

required to apply the new rules from 1 January 2014, with full implementation on 1 January 2019 (Article 521 CRR and Article 162 CRD IV[53]).

Supervision. Regarding supervision, a European System of Financial Supervision (ESFS) was set up to deal with micro-prudential supervision. It comprises three European supervisory authorities (ESAs) which started work on 1 January 2011: the European Banking Authority (EBA), which deals with banking supervision and the coordination and dispute settlement of national supervisors; the European Securities and Markets Authority (ESMA), which deals with the supervision of capital markets; and the European Insurance and Occupational Pensions Authority (EIOPA), which deals with insurance supervision.

Moreover, a European Systemic Risk Board (ESRB) was created in December 2010 to deal with macro-prudential supervision.[54]

Furthermore, a Single Supervisory Mechanism (SSM) came into force in November 2012, which promotes the ECB as having the ultimate responsibility for supervision of all euro area banks, and a particular responsibility for direct supervision of banks that have assets exceeding 30 billion euros or constituting more than 20 percentage of their home country's GDP, or which have requested or received direct public financial assistance from the EFSF or the ESM. National supervisors were demoted to supervising less significant banks, as well as to carrying out instructions by the ECB and notifying the latter of supervisory decisions of material consequence (Article 6 SSM Regulation[55]). The ECB was required to fully assume its new role on 4 November 2014 (Article 33 SSM Regulation).

Finally, it is worth noting that the EBA is entrusted with developing a single supervisory handbook to complement the single rulebook mentioned above, and to ensure consistency in bank supervision across the 28 countries in the single market.[56]

Deposit guarantees. As far as deposit guarantees are concerned, new rules were agreed on national Deposit Guarantee Schemes (DGS) in December 2013 to make them more

[53]European Parliament & Council of the European Union (2013a,b).

[54]European Commission (2012). Towards a Banking Union. Press release MEMO/12/656, Brussels, 10 September, http://europa.eu/rapid/press-release_MEMO-12-656_en.htm.

[55]Council of the European Union (2013).

[56]European Parliament & Council of the European Union (2013c).

similar and robust. The national DGS were introduced in 1994 and protect deposits of up to 100,000 euros. The proposed modified directive envisages that payments from the schemes will be carried out more quickly and with ease; the time for them to occur shall be gradually reduced from 20 to 7 working days in 2024. Moreover, it requires that ex ante funds of national DGS amount to 0.8 percent of covered deposits. They shall be collected from banks over a period of 10 years, whereby contributions of banks shall reflect their individual risk profiles.[57]

Looking at national DGS in light of the previous analysis, it is found that they meet the requirements of being efficient mutual insurance funds. Contributions depend on the banks' individual risk profiles and are based on covered deposits. It is difficult to assess whether funds that amount to 0.8 percent of covered deposits will be sufficient to cover accruing losses. It is, however, clear that a euro area-wide DGS would need much less reserves than national DGS so that a potential for improvement can be seen here in particular.

Bank resolution. With regard to bank resolution, a Single Resolution Mechanism (SRM) and a Single Resolution Fund (SRF) came into force in August 2014, which envisage the establishment of a Single Resolution Board (SRB) that would prepare resolution plans and directly resolve all banks directly supervised by the ECB, cross-border banks, and banks whose resolution involves the use of the fund. National resolution authorities are designated to prepare resolution plans and resolve the remaining banks supervised by the SSM (Article 7 SRM and SRF Regulation[58]).

The resolution tools shall include: the sale of business tool, enabling the sale of all or part of a bank to another; the bridge institution tool, envisaging a temporary sale; the asset separation tool, allowing for the sale of impaired assets to an asset management vehicle (bad bank); and the bail-in tool, providing for a bail-in of a bank's creditors, whereby, however, several classes of liabilities are exempted from bail-in (Articles 22, 24–27 SRM and SRF Regulation).

[57]European Commission (2013). Commissioner Barnier Welcomes Agreement between the European Parliament and Member States on Deposit Guarantee Schemes. Press release MEMO/13/1176, Brussels, 17 December, http://europa.eu/rapid/press-release_MEMO-13-1176_en.htm.

[58]European Parliament & Council of the European Union (2014).

The resolution fund shall only be touched if resolution requires funds that the failed bank is unable to provide even after a bail-in of at least 8 percent (Article 27 SRM and SRF Regulation). It shall amount to at least 1 percent of the covered deposits and shall be paid into by banks by the end of an initial period of 8 years from 1 January 2016 (Article 69 SRM and SRF Regulation), whereby

"each year the calculation of the contributions for individual institutions shall be based on: (a) a flat contribution, that is pro-rata based on the amount of an institution's liabilities excluding own funds and covered deposits, with respect to the total liabilities, excluding own funds and covered deposits, of all of the institutions authorised in the territories of the participating Member States; and (b) a risk-adjusted contribution [...]" (Article 70 SRM and SRF Regulation).

The SRB shall become fully operational by 1 January 2015; the bail-in and resolution function shall apply from 1 January 2016 (Article 98 SRM and SRF Regulation).

Taking a look at the SRM and SRF in light of the foregoing analysis, they are perceived as a combination of the two cases no bailout (=bail-in) and insurance. On the one hand, the SRM gives a high priority to bail-ins, on the other hand, several classes of liabilities are exempted therefrom (Article 27 SRM and SRF Regulation) and will thus require funds if a bail-in of non-exempted liabilities is not sufficient to guarantee their repayment. For the funds not to be tantamount to a bailout with its inherent problems of moral hazard, a mutual insurance fund as analysed above must be created. The question is whether the SRF meets its requirements on efficiency. While it is to be evaluated positively that contributions depend on the banks' risk profiles, the provision that they are based on the banks' liabilities excluding own funds and covered deposits can be seen as suboptimal. According to the conducted analysis, they should be based on the liabilities that are exempted from bail-in. Moreover, the size of the fund should rely on all liabilities that are exempted from bail-in and not on covered deposits. In view of the extent of liabilities that are exempted from bail-in, it may also be doubted that a fund that amounts to 1 percent of the covered deposits will suffice to cover accruing losses.

11.2 Crisis Management by the European Central Bank

This section uses the results of the analysis that has so far referred to crisis management by governments to assess the policy measures taken by the ECB since the outbreak of the US financial crisis in 2007. Subsection 11.2.1 argues in line with Sinn (2014)[59] that the ECB's refinancing policy has very much the same effects as aid granted by the ESM and must therefore be considered as suboptimal. Subsection 11.2.2 evaluates the ECB's outright monetary transactions.

11.2.1 Refinancing Policy

To understand the parallel between the ECB's refinancing policy and the ESM's aid, this subsection firstly presents the purpose of the Eurosystem's refinancing operations and their potential function creep by defaulting banks. It then draws some parallels to the ESM's intended mode of functioning, and finally compares the effects of the ECB's refinancing policy with the effects of the weaknesses of the ESM, as discussed above.

Purpose of refinancing operations and their function creep. To their original purpose, the refinancing operations of the Eurosystem serve as a monetary policy instrument to provide the Eurozone's economy with liquidity.[60] The NCBs issue money to commercial banks by granting refinancing credit to them against eligible assets as collateral and at a given interest rate, typically the main refinancing rate (Article 18.1 Statute of the ESCB and of the ECB[61]). On the other hand, the commercial banks put the money into circulation as cash or keep it as reserves for sight deposits. In principle, the commercial banks get back the money that they lend out to borrowers from their lenders, who have received the money from their clients. The money comes from the Eurosystem and flows back to it, too. The commercial banks, therefore, do not have to increase with any new credit to borrowers the stock of refinancing credit from their NCBs, but only

[59] Sinn (2014), Chapter 5.
[60] Governing Council of the European Central Bank (2011), page 13.
[61] European Union (2012b).

have to ensure that enough money is circulating to maintain the flow of money between themselves, their lenders, and their borrowers. Moreover, they have to hold money as reserves since depositors can withdraw money from their sight deposits at any time, or transfer it to persons whose accounts are at other commercial banks, and there is in neither case reason to assume that money flows equally back to the banks. It should, however, be noted that growing economies entail an increasing number of payment transactions and hence request an increasing amount of money that is circulating. They therefore also need an increasing stock of refinancing credit that yields an increasing amount of interest revenue to the NCBs, the so-called seignorage.[62] The NCBs participate in income from monetary policy in proportion to their paid-up shares in the capital of the ECB (Article 32.5 Statute of the ESCB and of the ECB). The capital of the ECB currently amounts to 10.83 billion euros (as of 1 January 2014).[63] Each NCB is liable to a fixed share of this, the so-called capital key mentioned above. The capital key is determined by the respective country's share in the total population and GDP of the European Union, whereby the two determinants are equally weighted (Article 28.2 and 29.1 Statute of the ESCB and of the ECB). The paid-up capital currently amounts to 7.58 billion euros (as of 1 January 2014).[64]

What has been said so far concerns the functioning of the Eurosystem's refinancing operations if they are used to their original purpose. Contrary to their original purpose, the refinancing operations of the Eurosystem can, however, also be used by defaulting banks to receive money that prevents a haircut for their lenders.

Figure 16 provides a schematic representation.

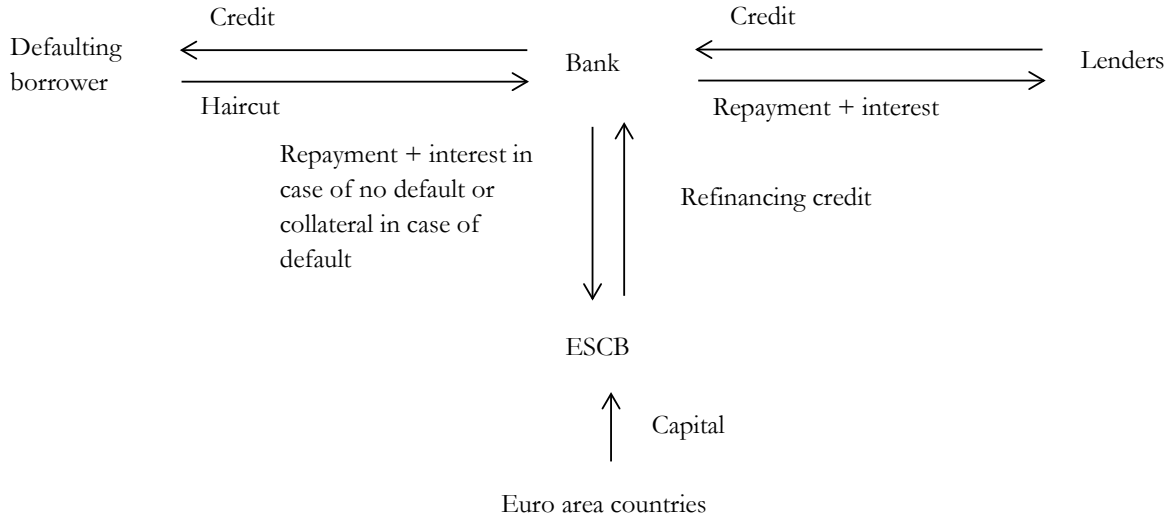
Defaulting banks can obtain refinancing credit from the NCBs of their jurisdictions against adequate collateral and at a given interest rate, and pass the money on to their lenders so that these are fully repaid.

[62] Sinn (2014), pages 148f.

[63] European Central Bank, *Capital subscription*, https://www.ecb.europa.eu/ecb/orga/capital/html/index.en.html, last accessed on 7 December 2014.

[64] European Central Bank, *Capital subscription*, https://www.ecb.europa.eu/ecb/orga/capital/html/index.en.html, last accessed on 7 December 2014.

Figure 16: Schematic representation of the European System of Central Banks



Ex post compensation assured by collateral. A comparison to Figure 14 (see page 127) points to several parallels with the ESM's intended mode of functioning. Firstly, it must be recognised that similar to the way defaulting euro area member states can approach the ESM for aid, defaulting banks can approach the NCBs of their jurisdictions for refinancing credit. While the ESM declares to provide aid to euro area member states in financial distress under strict conditionality and to appropriate prices, an NCB declares to grant refinancing credit to commercial banks in its jurisdiction against adequate collateral and at a given interest rate, typically the main refinancing rate. Thereby, both the ESM as well as an NCB endeavour to break even by their operations. Both expect the recipients of their funds to repay the money granted plus interest with a positive probability, and both envisage compensation for the risk that they might not be able to do so. While the ESM envisages compensation in the form of an appropriate interest rate risk premium, an NCB envisages compensation in the form of adequate collateral.

Note that similar to the way countries will choose the efficient levels of debt if they expect that they have to compensate the ESM for its aid, and nevertheless seek it, the borrowers of banks will choose the efficient levels of debt if the banks expect that they have to compensate the NCBs for their refinancing credit, and nevertheless take it up

in order to prevent a haircut for their lenders. While in the first case the countries take into account their total debt repayment obligations in case of default by anticipating the repayment of aid plus interest, in the second case the borrowers of banks do so by an interest rate risk premium. In order to break even in expectation, defaulting banks will demand an appropriate interest rate risk premium from their borrowers from the outset; the expected value of the interest rate risk premium being equal to the collateral. The borrowers will take into account the total debt repayment obligations in case of default since the interest rate risk premium is, in expectation, equal to the collateral which is equal to the refinancing credit which prevents the haircut for lenders.

Time inconsistency. As for the ESM there is, however, good reason to doubt that the Eurosystem works this way. In a similar way to how defaulting countries will decide not to use the ESM if they expect to have to compensate it for aid, defaulting banks will decide not to find remedy through the Eurosystem if they expect to have to compensate the NCBs for refinancing credit. While in the first case the decision boils down to a comparison of costs and benefits of aid for the respective countries' citizens, in the second case it is due to the fact that banks will have to bear the full costs of refinancing credit but will in no way benefit from it.

Nevertheless, similar to the way countries will choose the efficient levels of debt if bailouts outside the ESM are excluded, borrowers of defaulting banks will choose the efficient levels of debt if the no-bailout policy is credible. In both cases, the providers of funds expect the haircuts, which will then be put on them, and therefore request an appropriate interest rate risk premium. In the case of the ESM, investors request the interest rate risk premium directly from the countries; in the case of a remedy through the Eurosystem, the lenders will request it from the banks, which will pass it on to their borrowers. While it was found to be somewhat unfortunate that an ESM that meets all of its high requirements regarding compensation will fail to display its effects towards an efficient outcome because countries will no longer be willing to ask for aid, it is to be welcomed that the use of refinancing credit as a resolution tool fails due to time inconsistency. The ESM was set up as a crisis mechanism and it would simply be a pity if it descended into an accessory of a credible no-bailout policy. The Eurosystem, in contrast, was entrusted with ensuring that the

Eurozone's economy is provided with enough liquidity. Therefore, it should be used in temporary liquidity crises, if at all, but never in solvency crises as considered here.

Lack of credibility. Furthermore, similar to the doubts shown regarding whether defaulting countries have to compensate the ESM fully for its aid, there are doubts as to whether defaulting banks have to compensate the Eurosystem fully for its refinancing credit. While doubts have concerned the appropriateness of interest rates in the case of the ESM, they concern the adequacy of collateral in the case of the Eurosystem. The reason is that it could be observed that the ECB successively lowered the collateral standards of refinancing credit in the course of the European sovereign debt crisis. While banks had to provide agency-rated collateral with a minimum rating of single A before the crisis, the ECB reduced the minimum rating to triple B in the course of the sovereign debt crisis, initially excluding but later including asset backed securities (ABS). Moreover, it waived the rating requirements for government bonds of several crisis countries and countries that are under a European Union-IMF programme, and accepted securities issued by banks on non-regulated markets. At a later point in time, the ECB even allowed the NCBs to give their commercial banks Emergency Liquidity Assistance (ELA) credit, i.e. refinancing credit at their own risk.[65] The problem with a lowering of collateral standards is that it means a decrease in the costs for banks of solving their default problems via the Eurosystem. If banks are linked to their countries and therefore take into account that the investors of their jurisdictions will benefit from the refinancing credit, they may find it worthwhile to use the Eurosystem as a resolution tool if they are about to default. That this has become the case in the course of the European sovereign debt crisis is confirmed by the data on Target balances. According to Sinn (2014), Target deficits reflect the amount of refinancing credit issued in excess of the liquidity needs for transactions within the NCBs' jurisdictions and can be interpreted as aid by the Eurosystem, which was used

[65]Sinn (2014), 153–175. Sinn (2014) devotes a separate chapter (Chapter 5) to the changes in the ECB's refinancing policy, which provides a good overview in table form, as well as intricite details regarding the individual steps along the way to an increasingly softer refinancing policy. In addition to the lowering of collateral standards, the ECB's refinancing policy changes also include the change from an auction procedure by which limited amounts of money were granted to commercial banks to a policy of granting unlimited refinancing credit, the so-called full allotment policy, and the extending of maturities.

by countries because NCBs provided refinancing credit at too low collateral standards.[66] The Target deficits of the central banks of Greece, Ireland, Portugal, Spain, Italy, and Cyprus currently amount to 496 billion euros (as at end of November 2014)[67] and indicate that countries used the Eurosystem as a resolution tool to a large extent.

This should be considered as a dangerous development. Firstly, as mentioned above, the Eurosystem was not set up to resolve solvency crises of banks. Least of all, it was set up to resolve sovereign crises. On the contrary, Article 21 Statute of the ESCB and of the ECB even prohibits the Eurosystem from stepping in for the liabilities of governments. If banks, however, default because they lent money to defaulting governments, the banking crisis will be in essence a sovereign crisis. If they then receive aid from the NCBs in their jurisdictions, the Eurosystem will in the end step in for the liabilities of governments and breach Article 21 Statute of the ESCB and of the ECB.

Secondly, similar to the case of the ESM, the Eurosystem will in expectation make losses by granting refinancing credit against too low collateral, which will reduce the seignorage of NCBs and therefore ultimately have to be borne by countries according to their capital share in the ECB.

Much worse than the breach of contract and the emergence of losses is, however, that aid by the Eurosystem increases the incentives of debt accumulation by private borrowers as well as governments.

11.2.2 Outright Monetary Transactions

In August 2012, the ECB announced the possibility of undertaking outright open market operations in secondary sovereign bond markets to ensure the appropriate transmission

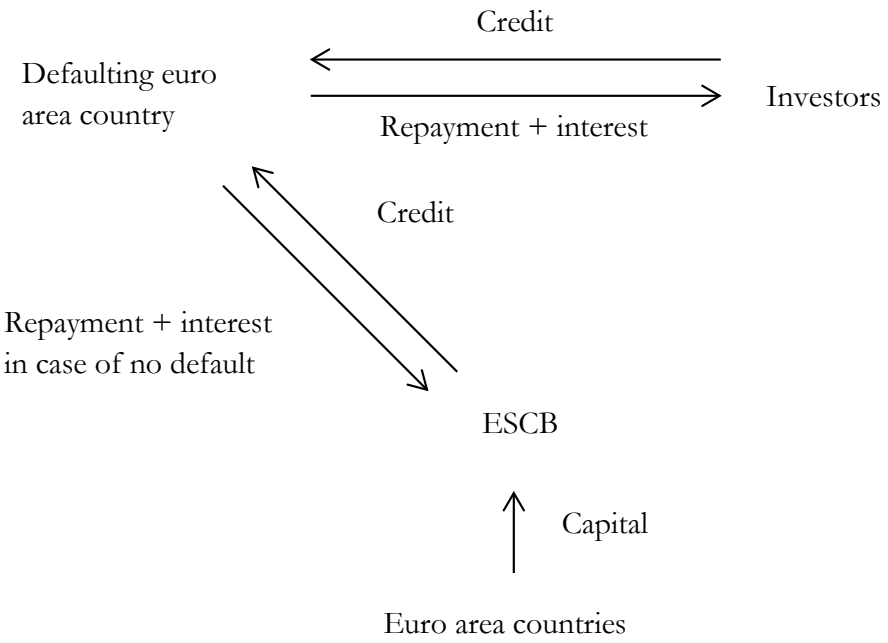
[66] Sinn (2014), page 180. Sinn (2011a) was the first to bring the issue of the increasing Target balances to public attention. Several studies by Sinn as well as others followed shortly thereafter. Particular mention should be made of Sinn (2011b, 2012b), which make a first interpretation of the Target balances; Sinn & Wollmershäuser (2012), which compiles the first panel database; Bernholz, P. et al. (2012), which provides different views on Target balances; European Economic Advisory Group (2013), Chapter 4, which draws a comparison to the US settlement system; and two books, Sinn (2012a, 2014), which mainly deal with this topic.

[67] Compare Ifo Institute, *The Exposure Level: Bailout measures for the Eurozone countries and Germany's exposure*, http://www.cesifo-group.de/ifoHome/policy/Haftungspegel.html, last accessed on 7 December 2014.

and the single nature of monetary policy.[68] In September 2012, the ECB announced the technical features it had decided upon for such operations, named Outright Monetary Transactions (OMTs), that would replace the Securities Market Programme (SMP). The features provide that the Eurosystem may purchase sovereign bonds of euro area member states in secondary sovereign bond markets in an unlimited amount provided that the countries concerned participate in either an EFSF or ESM programme.[69]

Figure 17 provides a schematic representation of the OMT programme's expected mode of functioning.

Figure 17: Schematic representation of the OMT programme



If a country is about to default, it may—formulated somewhat exaggeratedly—avoid a haircut for its investors by first agreeing to an ESM programme and then issuing new governments bonds which will be purchased by the Eurosystem in the framework of the OMT programme.

[68]M. Draghi (2012). Introductory statement to the press conference (with Q&A). Press conference, Frankfurt am Main, 2 August, https://www.ecb.europa.eu/press/pressconf/2012/html/is120802.en.html#qa.

[69]European Central Bank (2012). Technical features of Outright Monetary Transactions. Press release, 6 September, http://www.ecb.europa.eu/press/pr/date/2012/html/pr120906_1.en.html.

Since the Eurosystem buys government bonds under similar conditions to the conditions under which the ESM grants aid (at the least it requests the same structural adjustments from countries and presumably similar interest rates), and since NCBs participate in losses of monetary operations to the same extent as countries participate in losses of the ESM, the OMT programme is expected to have similar undesired effects on the debt accumulation of countries as well as the level and distribution of losses. The good news is that so far, the OMT programme has not yet been used by any member state (as of 5 December 2014).[70] As pointed out previously, there are, however, enough other comparable alternatives which are not yet exhausted, therefore making the use of OMTs not (yet) necessary.

[70]European Central Bank, *Open market operations*, http://www.ecb.europa.eu/mopo/implement/omo/html/index.en.html, last accessed on 7 December 2014.

Chapter 12

Distinction from Other Proposals

The Eurozone crisis has of course stimulated considerable discussion and debate as well as a number of proposed solutions to deal with the future problem of sovereign default risk in Europe. The approach of this part was based on the view that the problem is essentially one of risk management, and that a mutual insurance system organised and run by the Eurozone countries is the most appropriate solution. This chapter presents the alternative proposals and discusses them in light of the insurance-based approach. Section 12.1 considers the proposals of Eurobonds, blue bonds, debt repayment funds, stability bonds and partial sovereign bond insurance by the ESM. It finds that all of them have similarities to the ESM and therefore concludes that they are inferior to this part's proposal of a European default risk pool (EDRP). Section 12.2 deals with the EEAG crisis mechanism which goes the way of a credible no-bailout policy for insolvency. Although taking the opposite way, the EEAG crisis mechanism is assessed to be equally efficient to this part's proposal provided that its approach of gradually reducing aid with the stage of the crisis succeeds in making no bailouts at the stage of insolvency credible as well as preventing panic and contagion effects due to haircuts.

12.1 Superiority over European Union-guaranteed Bonds and Proposals Including the European Stability Mechanism

Subsection 12.1.1 argues that Eurobonds do not greatly differ from aid granted by the ESM and are therefore clearly inferior to the proposed insurance solution. Subsections 12.1.2, 12.1.3 and 12.1.4 conclude that the proposals of blue bonds, a debt repayment fund, and stability bonds, respectively, represent variants of Eurobonds so that the same devastating judgment applies to them. Since the proposal of partial sovereign bond insurance discussed in Subsection 12.1.5 envisages the ESM providing the partial insurance, its implementation would not achieve the optimal result either.

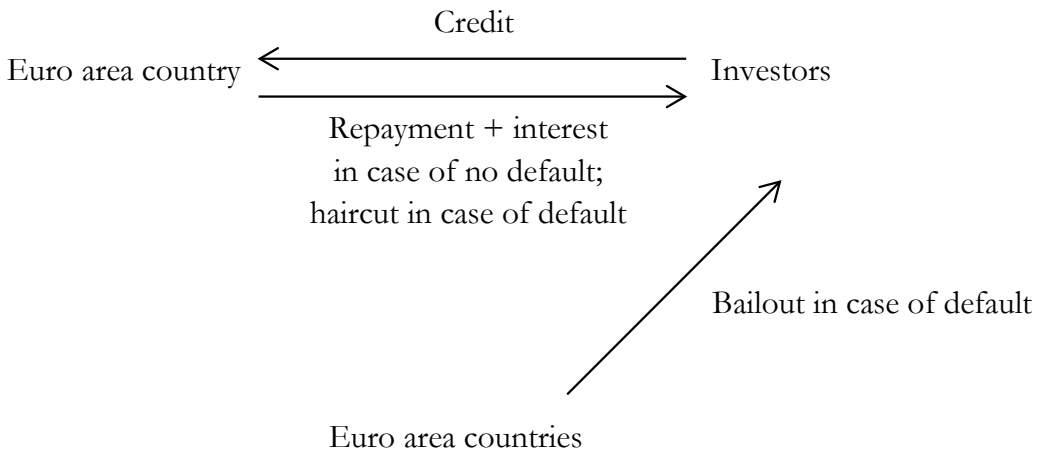
12.1.1 Eurobonds

Eurobonds are government bonds which are guaranteed by the euro area member states either severally, or jointly and severally. The guarantee means that if a euro area member state is not able to service the Eurobonds it has issued, the investors can request repayment plus interest from all other member states. "Severally" means that euro area member states are only liable for a part of the Eurobonds, e.g. in relation to their size; "jointly and severally" means that they can also be charged for the part of the debts of other member states if these default.

Figure 18 provides a schematic representation of Eurobonds.

A comparison to Figure 14 (see page 127) reveals that Eurobonds mainly differ from aid by the ESM in that defaulting euro area member states have neither to repay the bailout costs plus interest nor compensate the other euro area countries in any other manner. They may therefore lead to even higher debt accumulation of countries as well as higher losses.

Figure 18: Schematic representation of Eurobonds



12.1.2 Blue and Red Bonds

Von Weizsäcker & Delpla (2010) distinguish between two types of government bonds: *blue bonds*, which are issued under joint and several liability of European Union member states as senior debt; and *red bonds*, which are issued as national and junior debt. They propose that European Union member states are allowed to issue up to 60 percent of their national debt as blue bonds and that any debt beyond this must be issued as red bonds. They expect that blue bonds will reduce the borrowing cost for this part of debt and that red bonds will increase the marginal cost of public borrowing which will enhance fiscal discipline, i.e. decrease debt levels, and mitigate the increase in the marginal cost of public borrowing.

Obviously, blue bonds are nothing other than Eurobonds and the proposal of von Weizsäcker & Delpla (2010) will have the effects they describe, rather than the effects described for Eurobonds, only if the limit of 60 percent is credible, i.e. if countries do indeed have to issue red bonds once they exceed this limit. As Sinn (2012a)[71] and Dübel (2011)[72] note, it is doubtful that this will be the case; rather it is to be expected that as soon as the 60 percent level is reached the limit will be extended due to political pressure.

[71] Sinn (2012a), pages 347–349.
[72] Dübel (2011), page 2.

12.1.3 Debt Repayment Fund

In 2011, the German Council of Economic Experts proposed the creation of a debt repayment fund with joint and several liability of European Union member states in which debt that exceeds the Maastricht Treaty reference value of 60 percent of GDP is outsourced. The outsourcing of debt is not to happen all at once, but successively within a period of about five years (roll-in-phase) in the course of outstanding debt repayment and new borrowing until the funding framework is fully used. Countries are required to repay their outsourced debt within a period of between 20 and 25 years according to a previously specified consolidation path. Debt that is not outsourced is to be contained by the introduction of national "debt brakes".[73]

The proposal of the German Council of Economic Experts can be seen as a variant of the proposal of von Weizsäcker & Delpla (2010). Debt that is outsourced in the debt repayment fund is obviously comparable to the blue bonds or Eurobonds, and debt that is not outsourced to the red bonds. Accordingly, the same criticism applies. As Sinn (2012a)[74] argues, it is to be expected that as soon as the roll-in-phase is over, the contingent component of the debt repayment fund will be extended due to political pressure with the effects described in Subsection 12.1.1.

12.1.4 Stability Bonds

Also in 2011, the European Commission put forward a proposal to introduce so-called stability bonds, which would be issued jointly by the euro area member states. Its green paper lists three options based on the degree of substitution of national issuance and the nature of the underlying guarantee: full substitution with joint and several guarantees, partial substitution with joint and several guarantees, and partial substitution with several but not joint guarantees.[75]

The first option is equivalent to Eurobonds and the second similar to the proposals of blue

[73] Sachverständigenrat zur Begutachtung der Gesamtwirtschaftlichen Entwicklung (2011), Chapter 3.VI.

[74] Sinn (2012a), pages 349f.

[75] European Commission (2011), page 12.

bonds and a debt repayment fund, even though the European Commission does not state a specific level or share of debt that would be covered by stability bonds. Therefore, the same analysis applies and stability bonds have to be considered as leading to excessive debt accumulation.

12.1.5 Partial Sovereign Bond Insurance by the European Stability Mechanism

Dübel (2011) proposes to partially insure sovereign bonds under the ESM by dividing them into two parts: a predetermined uninsured part that is treated as junior debt, spun off as a marketable bond on the ESM application day and subject to a haircut; and the insured part that is treated as senior debt and amortised as scheduled.

According to Dübel, the difference between his proposal and the blue bond proposal is that the marginal cost of partially insured debt would have a floor while the marginal cost of uninsured red bonds would explode in a financial crisis, thereby driving a country out of the bond market and into the ESM. Since the ESM does nothing other than issue blue bonds, all sovereign bonds would have to be assumed to be blue bonds which would result in moral hazard, as discussed above.

While Dübel's assessment of the blue bond proposal is certainly correct, it is doubtful that his proposal will be the optimal alternative. Even if it succeeded in avoiding panic in the market, it would not achieve the optimal result since it is the ESM that provides the partial insurance with the undesirable effects on debt accumulation discussed above.

12.2 Equality to EEAG Crisis Mechanism

In its tenth report on the European economy, the European Economic Advisory Group (EEAG) proposes a crisis mechanism that distinguishes between various stages of crisis and differentiates the degree of help that the European Union should provide to a member country according to the stage of crisis that it faces. It suggests that the higher the stage of crisis that a country has reached the lower the degree of help by the European

Union should be. Concretely, the crisis mechanism distinguishes between three stages of crisis—*illiquidity*, *pending insolvency* and *actual insolvency*—and proposes the following measures by the European Union at the various stages:

- At the stage of *illiquidity* the European Union should provide short-term loans without creditors participating in losses which in the end is equivalent to a full bailout by the European Union.
- In contrast, at the stage of *actual insolvency* a country should restructure its entire outstanding debt without the European Union providing any help whatsoever, so that creditors are made to participate in losses through haircuts.
- Finally, as a logical consequence, at the interim stage of *pending insolvency*, the European Union should provide some help while creditors should bear limited losses. The concrete proposal is that the European Union offers replacement bonds that it partially guarantees in exchange for maturing bonds after a limited haircut on these bonds has taken place. It is important that at this stage it is not the total outstanding debt that is at stake but only the debt that is maturing. Debt that will mature later is not subject to a haircut and not involved in the exchange for replacement bonds. The question of whether this debt can be serviced in the regular way or also needs to face a haircut and be converted is postponed to its maturity date.

This breakwater procedure involves solving the payment problems step by step as they emerge. However, for it to work Collective Action Clauses need to be included in debt contracts that permit a majority agreement of creditors whose debt matures at a particular point in time that becomes generally binding for them, without owners of debt instruments with other maturities being able to call in their claims prematurely.[76]

The insurance model as presented above deals with only one of these three stages of crisis, namely actual insolvency. Since the EEAG proposes to leave the countries on their own at the stage of actual insolvency, it is essentially arguing for taking the opposite way of a credible no-bailout policy, which shall be achieved by the downward graduation of

[76]European Economic Advisory Group (2011), Chapter 2.

aid with the stage of crisis. This does not, however, imply that the EEAG shows the wrong way. As explained in Subsection 9.2.4, a credible no-bailout policy and a mutual insurance fund do not have great advantages or disadvantages over one another, except for the following: Full insurance has the great advantage of avoiding panic in the market. Consequently, the proposal of the EEAG has to be assessed as to whether its provisions for the first two stages of crisis are able to make no bailouts at the last stage credible and to prevent panic. If it is believed that the approach of gradually reducing aid with the stage of the crisis makes for credibility of no bailouts at the stage of actual insolvency, and nips panic in the bud, the EEAG proposal has to be assessed as being equally efficient to this part's proposal of a mutual insurance fund.

Finally, note that the stages of illiquidity and pending solvency can also be incorporated into the presented insurance model. There is nothing to say that the events insured against could not consist of illiquidity or pending insolvency, this is really a matter of scale on which ex post a sovereign debt crisis occurs. The premium at which full indemnity for all insured events, including illiquidity or merely "pending insolvency", can be offered will then depend on the probabilities of all those events.

Chapter 13

Conclusion

The second part of my PhD thesis concerned the question what arrangements should be implemented in the EMU to handle sovereign default risk.

Building on the model presented in Part I, Part II showed that a mutual insurance fund can be established for a monetary union with a commitment problem to no bailouts that reinduces the governments of its member states to choose the optimal debt levels by requesting compensation for their restructuring risk in the form of an insurance premium.

The idea of introducing a mutual insurance fund in the EMU as a means to cope with sovereign defaults was further concretised in the proposal of a European default risk pool (EDRP) in Chapter 10. Here, the necessary institutional arrangements and changes for the implementation of such a pool were discussed. In particular, the importance of maintaining and strengthening the no-bailout rule of the Maastricht Treaty to ensure a voluntary participation of Eurozone countries in the pool was pointed to. Moreover, arguments as to why debt and deficit limits might be reconsidered were provided, and the ESM was found to be an inferior alternative to the EDRP since it lacks ex ante compensation for the aid that it offers and therefore gives rise to excessive incentives to accumulate debt.

Furthermore, the analysis was applied to assess the concept of a banking union and crisis management by the ECB. The concept of a banking union was assessed overall as positive. Nonetheless, a potential for improvement was found in the determination of contributions by individual countries as well as overall contributions to the SRF: These should be based

on liabilities that are exempted from bail-in rather than liabilities excluding own funds plus covered deposits, and covered deposits respectively. The crisis management by the ECB in the form of lowering collateral standards for refinancing credit and government bond purchases, in contrast, was found to be completely unacceptable since it extends far beyond the ECB's mandate of price stability and, from an economic point of view much worse, results in excessive incentives of debt accumulation.

Finally, the proposal of an EDRP was compared to other currently popular proposals. It was found to be superior to the proposals of Eurobonds, a distinction between blue and red bonds, debt repayment funds, stability bonds, and partial sovereign bond insurance by the ESM since these proposals are missing ex ante compensation for the aid that they offer and therefore bring about disincentives of excessive debt accumulation. In contrast, it was found to be equally as good as the EEAG proposal of a multistage crisis mechanism, which envisages a downward graduation of aid with the stage of crisis, provided that the latter is able to establish credibility of no bailouts at the stage of insolvency and to prevent panic from emerging in financial markets after haircuts have taken place.

Chapter 14

Appendix

14.1 Proof of Weak Law of Large Numbers Using Chebyshev's Inequality

The independence of default risk implies no correlation between indemnities, so that the variance of the sample average of indemnities is given by

$$Var\left(\frac{\sum_{i=1}^{n} I_i}{n}\right) = \frac{1}{n^2}\sum_{i=1}^{n} Var\left(I_i\right) = \frac{1}{n^2}\sum_{i=1}^{n}\sigma_i^2 \tag{14.1}$$

where $Var\left(I_i\right) = \int_{\theta_i^0}^{\theta_i^1}\left[I_i(D_i^*,\theta_i) - \mu_i\right]^2 dF_i = \sigma_i^2$ is the variance of the indemnity in country i and assumed to be finite.

The mean of the sample average of indemnities is given by the sample average of means of indemnities

$$E\left(\frac{\sum_{i=1}^{n} I_i}{n}\right) = \frac{1}{n}\sum_{i=1}^{n} E\left(I_i\right) = \frac{1}{n}\sum_{i=1}^{n}\mu_i \tag{14.2}$$

Using Chebyshev's inequality[77] on $\frac{\sum_{i=1}^{n} I_i}{n}$results in

[77]See Chebyshev (1867).

$$\Pr\left(\left|\frac{\sum_{i=1}^{n} I_i}{n} - \frac{1}{n}\sum_{i=1}^{n}\mu_i\right| \geq \varepsilon\right) \leq \frac{\frac{1}{n^2}\sum_{i=1}^{n}\sigma_i^2}{\varepsilon^2} \tag{14.3}$$

or

$$\Pr\left(\left|\frac{\sum_{i=1}^{n} I_i}{n} - \frac{1}{n}\sum_{i=1}^{n}\mu_i\right| < \varepsilon\right) = 1 - \Pr\left(\left|\frac{\sum_{i=1}^{n} I_i}{n} - \frac{1}{n}\sum_{i=1}^{n}\mu_i\right| \geq \varepsilon\right) \geq 1 - \frac{\frac{1}{n^2}\sum_{i=1}^{n}\sigma_i^2}{\varepsilon^2} \tag{14.4}$$

As n approaches infinity, the expression approaches 1. By definition of convergence in probability, we obtain

$$\sum_{i=1}^{n} I_i \xrightarrow{P} \sum_{i=1}^{n}\mu_i \quad if \quad n \to \infty \tag{14.5}$$

Likewise, the expression approaches 1 as ε approaches infinity.

Overall Conclusion

Figure 19: Euro rescue parachute

(English: "Hurray—we are saved!")
Source: H. Haitzinger (2011). Rettungsschirmvariante Nr. 2011. *Badische Zeitung*, 28 October.

How nice it would be if the results of my PhD thesis allowed us to lay aside the irony implicit in this caricature by Horst Haitzinger and to conclude by rejoicing with the people in the boat about the measures taken to rescue the euro.

But alas, the conducted analysis rather confirms the picture that the caricaturist has drawn and therefore gives only little reason to rejoice.

Since the euro rescue parachute in the form of funding granted to the crisis countries via diverse bailout packages and mechanisms has been opened, it has nurtured the hope that the European sovereign debt crisis is solved, or will soon be solved, once and for all.

This is a deceptive hope since the euro rescue parachute will presumably provide only a temporary solution, if at all, and result in a worsening of the sovereign debt problems in the long run.

The reason for this presumption was given in Chapter 10 of this thesis. The euro bailout packages and mechanisms like the ESM have the shortcoming of not requiring an ex ante payment for aid, thereby presumably causing moral hazard on the side of the recipients of aid: Governments are supposed to have increased, excessive incentives to accumulate debt since they do not have to compensate anybody—neither investors nor the providers of aid in case of default—for their risk.

It is likely, however, that this kind of moral hazard problem did not just come into existence with the euro rescue parachute, but already with the introduction of the euro, and to this effect contributed to the emergence of the current sovereign debt crisis.

This issue was analysed in detail in Part I of my PhD thesis. Here, a multistage model was set out in which the welfare-maximising governments of n countries decide on the issuance of sovereign debt before risk neutral investors choose asset portfolios consisting of these debts and risk free assets. Within the model, it was shown that alone the expectation to receive aid in case of default, without having had to pay anything for it beforehand, will result in moral hazard on the side of governments: The formation of a monetary union that has a commitment problem to no bailouts increases the countries' incentives of debt accumulation since these countries no longer have to compensate the investors for their default risk in the form of an interest rate risk premium, and no equivalent compensation has to be offered to the envisaged providers of bailouts. The moral hazard problem was identified as being a problem of limited liability at the heart in the sense that governments ignore their repayment obligations in case of default, as expressed in terms of the risk free interest rate.

In view of the above, the solution to the moral hazard problem is straightforward. If aid is provided in case of default, it has to be provided in exchange for ex ante compensation,

i.e. it must be designed as insurance.

A concrete insurance solution in the form of a mutual insurance fund was presented in Part II of this thesis.

There, building on the model in Part I, it was shown that the setting up of a mutual insurance fund that mainly differs from the current euro rescue packages and mechanisms by requesting ex ante compensation from countries for aid will prevent moral hazard on the side of governments. Since countries have to compensate the fund for their risk in the form of an insurance premium equivalent to the interest rate risk premium that countries would have to offer as compensation if the commitment problem to no bailouts did not exist, their incentives of debt accumulation are contained.

In comparison to the alternative obvious solution of returning to a no-bailout policy and restoring its credibility, the insurance solution was found to have the advantage of preventing panic in the market due to haircuts.

At the same time, it was clarified that if the mutual insurance fund is supposed to be based on voluntary involvement, a restoration of the credibility of no bailouts will still be indispensable. If no bailouts continued to be non-credible, countries would refuse to participate in the mutual insurance fund and hold on to hope for (free) aid.

Note that the prospect of receiving bailouts has also been the reason why a private insurance solution has not come out in the Eurozone. Although countries have certainly had possibilities to insure themselves against sovereign default risk in private insurance markets, they have not used them, simply because the prospect of bailouts has not required insurance, and moreover made it unattractive.

It was argued that the establishment of the mutual insurance fund itself may make a good contribution in the restoration of the credibility of no bailouts. This is because the non-credibility of the no-bailout policy in the past may also have been largely due to the prohibition of any aid in case of default. The permission of aid within the framework of the mutual insurance fund and in exchange for ex ante payments may increase the credibility that aid outside will no longer be provided because countries contributing to the pool might feel less sorry for defaulting countries that did not contribute to the pool and therefore more likely decide to leave these countries to themselves.

While the above findings give little reason to rejoice about the current situation in the Eurozone and the handling thereof, they give good reason for hope by showing a way out of the problem of excessive debt accumulation, which also happens to solve the apparent dilemma of having either moral hazard problems by granting bailouts, or panic and contagion effects by demanding haircuts. And that is how we conclude: with the hope that policy makers will finally become aware of this way, and take it.

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