

# Essays on the Crisis of Monetary Union



London School of Economics and Political Science

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A thesis submitted for the degree of *Doctor of Philosophy*, London, March 2022

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## Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

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## Statement of co-authored work

I confirm that Chapter 4 was jointly co-authored with Waltraud Schelkle and that Ben Mangeolles assisted with some of the data collection and presentation. I contributed 50% of this work.

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## Acknowledgements

My interest in the functioning of the euro was first ignited in 1997, before it even existed, by Marcus Miller during my M.Sc. at the University of Warwick. At that time, the focus of economic research in this field was on whether a monetary union could finally put to bed the instability of monetary arrangements that had bedevilled Europe since the collapse of the Bretton Woods system. For the Delors' Commission monetary union was seen as a way of resolving the Mundell-Fleming trilemma once and for all. For Anglo-American economists it was a political project that carried significant risks. Some worried it would not be an optimal currency area. Others, and this was the route I took, focused on its potential financial fragilities. Marcus' theories of instability in international monetary arrangements, as well as the LSE's Charles Goodhart's prescience in identifying that the locus of instability could migrate from exchange rates to sovereign bond markets, culminated in my M.Sc. thesis: "Redenomination and the Scope for a Euro Crisis". I owe both Marcus and Charles a debt of thanks for starting me along this challenging but fascinating journey.

The key insight of the model developed in that M.Sc. thesis was that Maurice Obstfeld's 'logic of currency crises' – where multiple equilibria create scope for a crisis driven by self-fulfilling beliefs – could be replicated in sovereign bond markets. The irony for me now is that, while more than two decades later this is now the consensus view of why the euro area's bond markets are vulnerable to crisis, my own view has evolved towards a different, more structural, interpretation. This change reflects a career of working in financial markets and central banking and how it has informed what I now believe is a more plausible view of how investors and policymakers interact to create conditions that lead to instability. I have seen some of the most important of these painful interactions close up: I was at Lehman Brothers when it collapsed, jumped into the lifeboat of the Bank of England's MPC Unit in its immediate aftermath, and collaborated closely with ECB staff during the euro-area sovereign debt crisis. So, strange as it may sound, I thank serendipity for being in the wrong place at the right time.

While my initial interest in the functioning of the euro may have been ignited by the theories of Marcus Miller and the insights of Charles Goodhart, it was re-ignited by the crisis itself. I was fortunate to be responsible for briefing the Bank of England's Monetary Policy Committee on international issues when the crisis was at its most intense. Given the importance of the euro-area economy for the UK, that meant that

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most of my time was directed towards analysing the euro crisis. I was privileged in my role to have access to many great minds both within Bank and beyond. I particularly benefitted from discussions about the crisis with Charlie Bean, Giancarlo Corsetti, Spencer Dale, Paul De Grauwe, Mervyn King, Phillip Lane, David Miles, Patrick Minford, Maurice Obstfeld, Alan Taylor, and Karl Whelan. But it was perhaps on my trips to Frankfurt visiting the ECB that I learnt most. I would like to thank Wolfgang Schill, who chaired the Monetary Policy Committee, and all its members, for a frank and open dialogue at what was a very challenging time for all ESCB central bankers. I particularly valued my discussions with Claus Berg, Mark Cassidy, Pablo Hernández De Cos, Hans-Joachim Klöckers, Peter Moolslechner, George Syrichas, Jens Ulbrich, and Peter van Els.

As the crisis continued, I began to reflect more deeply on it, and decided I would like to take a mid-career break to embark on a Ph.D. on the subject. I remain extremely grateful to both the Bank of England, and my current employer MKP Capital Management LLC, for their support throughout. I would like to thank Fergal Shortall at the Bank for wholeheartedly backing my original application for study leave. And I am also extremely grateful to Ben Mangeolles, MKP's intern in Strategy and Research, for providing exceptional support in data collection and presentation. I should also express my gratitude to Pat MacMahon, Founder and Principal of MKP, for taking over the Bank's sponsorship when I joined the firm. He has been unwavering in giving me flexibility to combine my studies with my role at MKP. While I have not discussed the subject of this thesis at length with Pat, I have learnt a considerable amount from him about the importance of market structures and functioning in the six years we have been colleagues. It has undoubtedly influenced my thinking in key areas.

Above all, of course, like any Ph.D. student, I would like to extend my heartfelt appreciation to my supervisors Paul De Grauwe and Waltraud Schelkle. They have given freely of their time in discussing, and engaging passionately with, the ideas contained within this thesis over a very long period. I cannot imagine that it is easy supervising a part-time student who has heavy work and family responsibilities. This thesis is now almost as old as the euro crisis itself. While the level of interest in the subject matter may now have passed its peak, the issues it raises remain as relevant as ever, and I am certain that it is a better thesis for having been so long in the making. Neither Paul nor Waltraud ever conveyed to me any frustration at my

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sometimes-slow rate of progress or at the interruptions I needed to take when switching jobs or becoming a daddy for a third time. I thank them for that above all else.

While I had already benefitted from my discussions with Paul about the crisis when he passed through the Bank of England as an academic visitor, I have to say it has been a real privilege to have continued the discussion as one of his doctoral students. Paul is indisputably one of the world's leading authorities on the economics of monetary union. I vividly remember taking a well-thumbed 'first edition' of his Economics of Monetary Union textbook to David Vines' lectures on international monetary economics as an undergraduate. Its 14th edition is about to go to print. The first paper in this thesis advocates for an alternative explanation for the vulnerabilities of the euro area's sovereign bond markets to crisis than the one Paul subscribes to in his textbook. I do not know whether I will ever persuade him that the strategic default model is not quite right, but what I do know is that the paper is surely far better for having had Paul's critical eye directed towards it these last few years. Finally, I should like to thank Paul for including an early version of the thesis' second paper in a volume published by Cambridge University Press that he co-edited, Economic Growth and Structural Reforms in Europe.

Waltraud has proved indispensable throughout my Ph.D. journey in so many ways. I should start by saying that she is an outstanding doctoral supervisor, knowledgeable of all the relevant processes and incredibly responsive. Her guidance, encouragement and, yes, sometimes her admonishments have been instrumental in getting me to the finishing line. Waltraud demands, quite rightly, the highest standards of scholarship. But, above all else, Waltraud has been instrumental in my quest to produce an inter-disciplinary approach to the crisis of monetary union spanning economics, finance, and political economy. It is easy to talk loftily about the benefits of inter-disciplinary research, but it is much harder to deliver it in practice. Often, the result can be papers on the same subject but talking completely different languages. I will leave others to judge whether I have succeeded in my quest but, to the extent that I have, it is significantly down to Waltraud who repeatedly pushed me to deliver a coherent set of papers. Her knowledge of the political economy of monetary union is encyclopaedic and she has the rare ability to bridge the gap with economics. I thoroughly enjoyed working with her on the third paper that integrates the analysis of the first two papers into a coherent political economy trilemma.

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Finally, I must express my deepest gratitude to my beautiful wife Rachel and delightful three daughters, Bess (aged 12), Lottie (aged 10), and Sybil (aged 4). They have provided all the love and support any husband and father could ask for in what has turned out to be a nearly decade-long journey. It is sometimes said that behind every great man stands a great woman. While I make no claims whatsoever to being a great man, I am certainly fortunate in having had one great woman and three great girls standing four-square behind me during my Ph.D. journey. So, notwithstanding the fact that none of them have expressed much interest in either the contents or conclusions of this thesis, I dedicate it solely to them!

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## Thesis Abstract

This thesis is an inter-disciplinary analysis of the fundamental causes of the decade-long crisis of monetary union and why it has proved so persistent despite major reforms. The consensus narrative of economists has been that the crisis was caused by policy failures and weaknesses in the policy architecture, notably a lack of crisis management and allowing imbalances to get so large. The first two papers reconsider these failures and weaknesses. Paper 1 challenges the consensus view that the fragility of euro-area sovereign bond markets stems from strategic default risk and a failure of policy to coordinate investor beliefs on a ‘good’ equilibrium in the heat of the crisis. Instead, it argues that interaction between the euro area’s legacy bond market structure with a complex policy risk premium created a structural vulnerability that is still to be addressed. Paper 2 finds that imbalances were predominantly caused by credit supply shocks and that, while macro-prudential policies may have been helpful in attenuating them, the emergence of imbalances prior to the crisis should not be viewed as a policy failure but as a fact of life in a diverse monetary union. Finally, building on the insights of the previous two papers, Paper 3 formulates a political-financial trilemma founded on the policy goals embodied in the Maastricht compromise. It concludes that euro-area policymakers have been circling around the trilemma over the past decade and that only a multi-faceted approach that anticipates how sovereign bond market structures might change is likely to lead to a stable outcome. The overarching conclusion of the thesis is that the contribution of policy failures and weaknesses in the policy architecture to the crisis has been exaggerated and that greater emphasis should be placed on understanding the structure of sovereign bond markets and their associated vulnerabilities.

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# Chapter 1

## Introduction: Essays on the Crisis of Monetary Union

*Our immersion in the details of crises that have arisen over the past eight centuries and in data on them has led us to conclude that the most commonly repeated and most expensive investment advice ever given in the boom just before a financial crisis stems from the perception that “this time is different”*

- Carmen M. Reinhart and Kenneth S. Rogoff

### 1.1 Introduction: This time is different

Financial crises are one of the most interesting and important phenomena studied by economists, financial economists, political economists, and economic historians. The seminal reference on this subject had for a long time been Kindleberger (1978). This study chronicles, using the framework of Minsky (1975), the financial crises over several centuries and countries, stretching back to the South Sea and Mississippi Bubbles of 1719-1720. More recently, Reinhart and Rogoff (2009) went further, conducting an extensive empirical investigation of financial crises stretching all the way back to the twelfth century. The main conclusion of both studies is that financial crises occur because the beliefs and expectations of investors and policymakers become detached from the underlying economic reality. This is the well-known phenomenon of investors



and governments alike claiming, “this time is different”. This detachment creates an unsustainable financial process that comes to an inevitable end, the implications of which depend on the financial arrangements of the contracting parties and the political context.

The crisis of monetary union exhibits this same fundamental, and historically common, cause. With the benefit of hindsight, the growth of intra-euro-area financial imbalances can be thought of as just another example of an unsustainable process coming to an inevitable end. The introduction of the euro, alongside financial liberalization within the Single Market Programme (SMP), spurred financial integration and contributed to growth of imbalances between euro member states. It was thought that these were examples of “good” imbalances, facilitating catch up and convergence in the periphery economies (Eichengreen 2010). These imbalances were on such a scale, and occurred over such a long time, that they could be sustained only through the detachment of beliefs and expectations from the underlying economic reality. The belief that “this time is different” was in full swing, with investors and policymakers maintaining strong confidence in the ability of the periphery countries to repay the debt they were accumulating to finance the growth boom.

Although the euro was introduced with the intention of eliminating the financial instability that had bedevilled currency markets since the demise of Bretton Woods, the nature of the financial arrangements associated with the imbalances were an important factor in its severity when boom turned to bust. This was because financial integration following the launch of the euro was concentrated in the money markets (Hartman et al. 2001, Adam et al. 2002, Galati and Tsatsaronis 2003, and Baele et al. 2004). In equity and corporate bond markets, where risk-sharing potential is greater, integration was more limited (Pagano and von Thadden 2004, Lane and Milesi-Ferretti 2005). The growth of imbalances therefore entailed one of the worst types of financial arrangements between contracting parties from a financial stability perspective: interbank debt. This created enormous contingent liabilities of the public sector in the event of a systemic crisis. The effect was compounded by domestic banks exhibiting considerable home bias in their holdings of sovereign debt. Taken together, this created the so-called sovereign-bank nexus that contributed to making the crisis so costly and difficult to manage (Gros 2013).

At the same time, the euro area’s governance arrangements and broader political context undoubtedly made the crisis harder to manage. Hall (2012: p.366) has asked, “Why has the response to the crisis been so

halting, so focused on imposing the costs of adjustment on southern Europe, and less effective than it might have been?”. He cites four factors that have conditioned the character of the response: “the intractability of the problem; deficiencies in European institutions; divergent diagnoses of the problem; and the boundaries of European solidarity”. The first of these – the intractability of the problem – recognises that policymakers were confronted with an extremely challenging situation. But the last three political economy considerations are consistent with the idea that the crisis was mismanaged.

Economists have latched on to the concept of policy failure and placed it centre stage in the so-called “consensus narrative” of the crisis. More than seventy leading economists across academia, public sector institutions, the private sector and think tanks have subscribed to a view that two of three root causes of the crisis were “policy failures that allowed imbalances to get so large” and “crisis mismanagement” (Baldwin and Giavazzi 2015: p.49)<sup>1</sup>. The consensus narrative of economists implies that the crisis was somehow avoidable and that, if only the correct policies had been followed, it perhaps need not have happened at all or at the very least would not have been nearly as severe. This diagnosis has motivated a succession of policy reforms aimed at preventing similar crises in future. Yet, and this is something that makes the euro-area crisis somewhat different from most financial crises in history, it is still prone to crisis more than a decade after it began. Moreover, these crises bring about seemingly never-ending rounds of further policy reforms. It is really this observation that is motivation for the thesis. Its overarching conclusion is that the role of policy failures as a cause of the crisis may have been exaggerated and that insufficient attention has been given to the intractability of the problems and the need for a successor political-financial settlement to that contained in the Maastricht compromise.

The next section of this introductory chapter sets out the motivation for the thesis in greater detail. Section 1.3 makes the case for an inter-disciplinary approach being needed to fully understand the crisis and provides a summary of the papers and methodologies. Finally, Section 1.4 summarises the papers and the overall conclusion of the thesis.

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<sup>1</sup>The third is a “lack of institutions to absorb shocks at the EZ level”.

## 1.2 Motivation: The never-ending crisis

Policy reforms over the past decade have been extensive and, for the most part, have been targeted at addressing the policy failures identified in the consensus narrative of economists. The policy reform aimed at preventing excessive imbalances is the Macroeconomic Imbalances Procedure (MIP). Alongside this have been important reforms that have added to the capacity of the euro area – mostly through the machinery of the EU – to manage crises. These include the principal lending tool to crisis countries, the European Stability Mechanism (ESM), and this has subsequently been modified to become a more general lending mechanism. In addition, macroeconomic stabilisation tools, notably the Support to Mitigate Unemployment Risks (SURE) and the Next Generation EU (NGEU), the latter encompassing the Resilience and Recovery Facility (RRF), have been created. Supporting reforms, most notably Banking Union (BU), but also Capital Markets Union (CMU), have been developed to address related structural weaknesses. These cannot be described as either small or unambitious reforms. They have certainly been politically challenging to agree and in many cases have exceeded the expectations of what was politically possible by many observers. But questions continue to be asked about their effectiveness, not least because symptoms of instability continue to come to the surface in the face of new shocks or when there is withdrawal of policy support, notably from the ECB.

### 1.2.1 A summary of post-crisis reforms

Starting with the main preventative reform, the MIP, it entered into force on 20 December 2011 and is aimed at identifying macroeconomic imbalances at an early stage and enforcing policy actions to correct them in a timely manner (Regulation (EU) No 1176/2011). It applies to all EU Members States and includes an Annual Alert Mechanism (AAM) report that uses a scoreboard of standardized metrics to detect imbalances in current accounts, competitiveness, house prices, and credit markets (Articles 3 and 4). Employment was added as an additional indicator of imbalances in the 2016 AAM report. For those countries where imbalances are identified, an In-Depth Review (IDR) is triggered (Article 5). Based on that review there is the possibility of corrective measures, backed up with fines in the case of euro-area members (Chapter III on the Excessive Imbalance Procedure). It is evident from these IDRs that the European Commission

continues to place considerable emphasis on structural reforms to manage macroeconomic imbalances. Other policies, such as fiscal and macro-prudential policies, are not presented as policy options by the European Commission (Bénassy-Quéré and Wolff 2020).

The preventative MIP has been accompanied by a sequence of reforms to deal with the lack of crisis management tools. The main crisis tool remains the ESM emergency lending vehicle that was first developed as the European Financial Stability Facility (EFSF) in the heat of the crisis. It provides cheap loans to crisis-hit countries as part of a programme with strict conditionality, although this was softened with the addition of the ESM Pandemic Crisis Support (ESM-PCS) vehicle. The ESM was also supplemented during the pandemic by SURE, which is the EU's re-insurance programme for national job-retention schemes. This is a labour market stabiliser worth close to 1% of EU GDP in 2020. But perhaps the most significant reform has been the launch of the RRF within NGEU. This flagship scheme is a preventative fiscal capacity designed to shield the euro area's most vulnerable members from the effects of the pandemic. It is path breaking in that it provides grants rather than loans on a large scale, amounting to €312.5bn. It entered into force in February 2021 and will finance programmes until the end of 2026.

The EU's lending and grants schemes have been supplemented by substantial actions from the ECB. Perhaps the single most critical action was the Outright Monetary Transactions (OMT) policy which followed shortly after ECB President Draghi's "whatever it takes" speech in London on 26 July 2012. It allows unlimited central bank purchases of short maturity secondary market debt, but under current rules can only be deployed as part of a conditional ESM lending programme. The ECB has also innovated in terms of the regular use of its balance sheet, which has grown enormously since the crisis. Initially, the ECB focused on providing liquidity to the banking system and felt unable to follow other major central banks in making asset purchases in 2008-9. Since the introduction of the ECB's Asset Purchase Programme (APP) in 2014 and its successor Pandemic Emergency Purchase Programme (PEPP) in 2020 its balance sheet has grown much faster. Total assets at the end of 2021 amounted to some 57.4% of GDP and, within that, 14.8% of GDP relates to liquidity provision to banks and 31.5% to asset purchases. A comparison with other central banks shows that the ECB's balance sheet is now larger than all G7 central banks other than the Bank of Japan and its asset purchases are comparable to those made by the Federal Reserve and the Bank of England and

Table 1.1: G7 central bank balance sheets

<b>% GDP, end-2021</b>	<b>Bank lending</b>	<b>Asset purchases</b>	<b>Other balance sheet assets</b>	<b>Total balance sheet assets</b>
Federal Reserve	0.1	36.5	0.3	36.9
European Central Bank	14.8	31.5	11.1	57.4
Bank of Japan	26.8	98.5	8.6	133.9
Bank of England	0.1	37.5	1.1	38.7
Bank of Canada	0.9	18.0	0.1	19.0

Source: National central banks, Haver Analytics, author's calculations

larger than those of the Bank of Canada (Table 1.1).

The key financial sector reform launched by the EU at the euro-area level was the decision at the June 2012 European Council to introduce BU. This placed supervision of the 120 (115 in January 2022) largest euro-area banks under the supervision of the ECB and gives it the right to conduct stress testing. The Single Rulebook was rapidly introduced, followed by the Single Supervisory Mechanism (SSM) in November 2014 and the Single Resolution Mechanism (SRM) by January 2016. The SRM has a Resolution Fund of €55bn, covering at least 1% of deposits of contributing institutions, and while national governments are still the ultimate backstop after the bail in of shareholders and creditors, they do have recourse to the Direct Recapitalization Instrument of the ESM worth €60bn. After that, governments would need to approach the ESM for loans that would add to their own liabilities. Although giving central banks a greater role in bank supervision in this way followed an international trend, with GSIFIs subject to even more stringent regulations and stress testing and a greater focus on macroprudential policies, the introduction of BU was also the ECB's quid pro quo for introducing OMT (Mabbett and Schelkle 2019).

More substantial progress on BU has been held up in three areas. First, while a European Deposit Insurance Scheme was proposed by the European Commission in November 2015 it met with immediate resistance from the then German Finance Minister Schäuble (Schelkle 2017). The main stumbling block is how to deal with legacy risks taken on by the banks, including the large holdings of government bonds

Table 1.2: Bank holdings of own-country government bonds

%	Of total bank assets		Of general government debt	
	January 2008	January 2022	January 2008	January 2022
<b>Germany</b>	2	2	9	9
<b>France</b>	2	2	13	7
<b>Italy</b>	7	10	7	15
<b>Spain</b>	2	7	2	3
<b>Ireland</b>	0	2	1	7
<b>Greece</b>	1	15	2	13

Source: National central banks, ECB Securities Holding Statistics, author's calculations

on their balance sheet. Relatedly, the second issue is the continuing problem of the sovereign-bank nexus. Banks are still able to keep sovereign bonds on their banking book with a zero risk-weight, despite the crisis demonstrating that euro-area government bonds are far from being risk free and it being a blockage to a common deposit insurance scheme. Moreover, due to a continued strong home bias, banks hold large volumes of the sovereign bonds of their own country on their balance sheets. Table 1.2 shows that periphery country banks have tended to see holdings of their own countries' general government debt increase both as a share of bank assets and outstanding general government debt while for core countries there has been little change. Finally, progress on raising bank capital ratios has been limited by responsibility for support resting with national authorities. In those cases where banks might struggle to raise the capital in financial markets, there is only the ESM to provide support to the national authorities on the basis of 'toxic' conditionality.

Despite financial integration having driven imbalances prior to the crisis, it has been pursued further through CMU. Now, however, the focus is on broadening it out beyond inter-bank markets to other segments of capital markets, notably equity and corporate bond markets. More integrated capital markets may also be able to play some role in bolstering risk sharing in monetary unions. Capital markets integration, especially using equity markets, could help to absorb the impact of asymmetric demand shocks on income directly as well as make economic adjustment easier by reducing financial accelerator effects (Anderson et al. 2015).

This could bolster the resilience of sovereign bond markets in an economic downturn and in crisis conditions. However, CMU is primarily seen as a way of supporting long-term growth rather than as a way of addressing vulnerabilities in the sovereign bond markets and, in any case, progress has so far been limited.

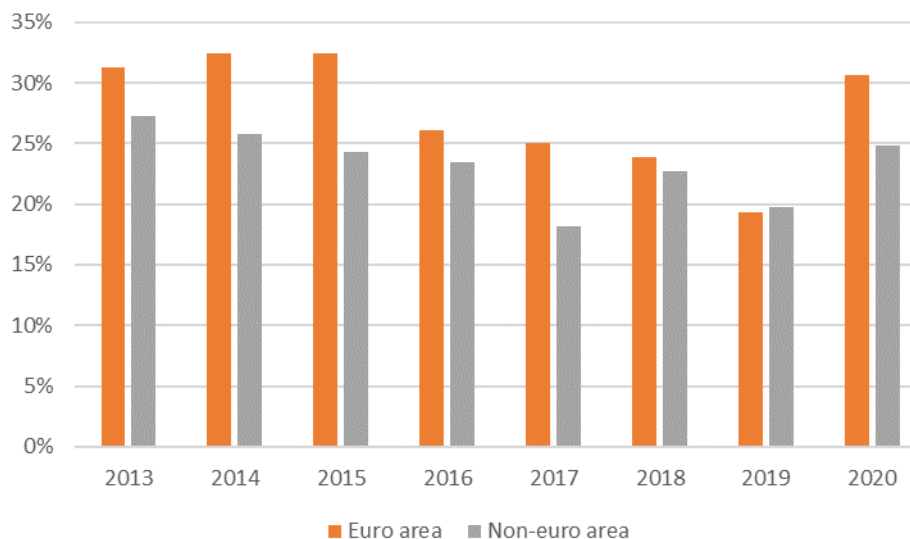
### 1.2.2 The effectiveness of post-crisis reforms

Researchers based in official institutions have tended to take an optimistic view on the effectiveness of the MIP and have emphasised the importance of structural reforms to enhance the flexibility of economies. For example, ECB analysis has suggested that such reforms could have dealt with imbalances before the crisis (Kamps et al. 2014) and has advocated for structural reforms to continue to be used as part of the process of managing imbalances (Pierluigi and Sondermann 2018). The academic literature has been less encouraging. One element has focused on feasibility, with the general view having been that the available policy instruments for managing imbalances are unlikely to be effective (Dabrowski 2015) and, even if they were to be effective, will probably be deployed too late or in an uncoordinated way (Kincaid and Watson 2015). There are also political economy challenges. Alcidi and Gros (2013a) have noted how the recommendations are vague and the politically and financially stronger countries have tended to ignore them and, in a recent report for the European Parliament, Bénassy-Quéré and Wolff (2020: p.5) conclude that “Implementation of the country-specific recommendations is low; their consistency is sometimes missing; despite past reforms the MIP remains largely a country-by-country approach running the risk of aggravating the deflationary bias of the euro area”.

Nonetheless, Figure 1.1 indicates that there has been some progress in reducing imbalances in the years following the introduction of the MIP scoreboard in 2012. For euro-area countries, the proportion of MIP indicators in breach of the threshold levels has declined from 31% in 2013 to 19% in 2019, although this was followed by a sharp reversal to 31% in 2020. Even if this latest reversal is viewed as a distortion from the pandemic, it is unclear to what extent the prior decline in imbalances reflected the effectiveness of the MIP or private-sector deleveraging that would have happened anyway following the stresses of the sovereign debt and global financial crises. One piece of evidence that points towards the latter being important is the fact that a similar pattern of declining imbalances is observed in non-euro area members that are not subject

to the corrective arm of the MIP. Consequently, while the debate is ongoing, there are certainly reasons to think that macroeconomic imbalances remain a threat to the stability of monetary union.

Figure 1.1: Proportion of MIP indicators in breach of threshold

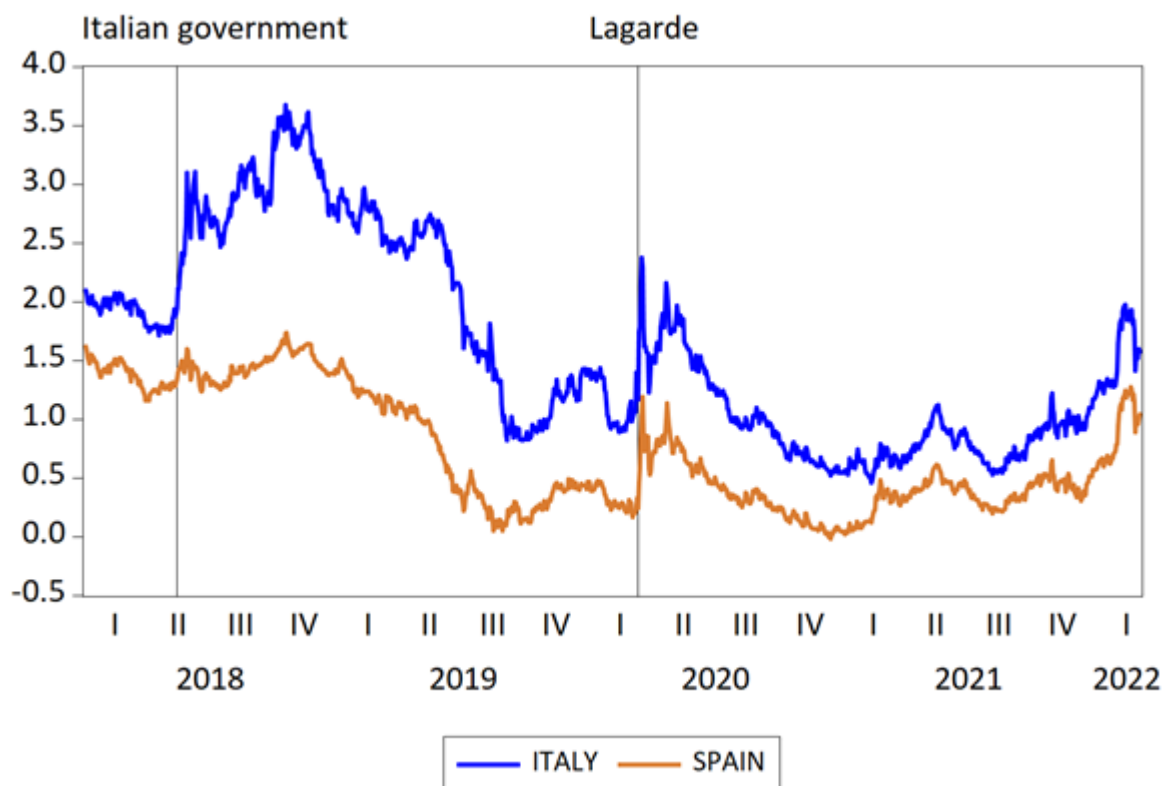


Source: European Commission, author's calculations

Recent experience also suggests that, while the functioning of periphery sovereign bond markets has been improved by recent reforms, they nonetheless remain volatile and at risk of falling into crisis. Two recent episodes stand out (Figure 1.2). First, following the Italian general election in March 2018, after weeks of negotiations, a populist coalition government between Five Star and the Lega was formed in early May. Given the new government's expansionary fiscal plans, and leaks of official papers advocating exiting the euro, investors in the Italian sovereign bond market demanded additional compensation for their risk in holding BTP bonds. At the heart of the problem is that neither the existence of the ESM nor the presence of the ECB's OMT policy removed the risks of these actions by the new Italian government, given that both require conditionality, which the new government rejected. Second, on 12 March 2020 there was upheaval in periphery bond spreads when ECB President Lagarde insisted that the central bank was "not here to close spreads" between members' borrowing costs (Lagarde 2020). Periphery bond yields climbed for six days, reversing only once her statement was retracted, but then remaining both elevated and volatile for several months. This shows just how significant a role the ECB is playing in keeping a crisis at bay.



Figure 1.2: 10-year sovereign bond yields



Source: Tullett Prebon Information, Haver Analytics, author's calculations

### 1.2.3 The quest for stability

The post-crisis EU and euro-area reforms have without any doubt been extensive, creating a whole new range of policy vehicles and instruments. These reforms have significantly addressed the policy failures identified in the consensus narrative with the role of the ECB having been transformed. Yet, the decade-long crisis in the euro area continues, with episodic bouts of instability requiring yet further rounds of policy reforms. So, the question remains: why has the quest for stability not been more fruitful? Is it a case of reforms not being pursued enthusiastically, vigorously, or creatively enough? It is certainly possible this is the case. But the central thrust of this thesis is that there are also some problems with the diagnosis. The choice of approach, papers, and methodologies have all been designed with this in mind.

### 1.3 Approach and paper summaries

This thesis consists of an introduction, three papers, and a conclusion. Reflecting the thesis' motivation, the first paper considers the failure of crisis management; the second looks at the failure to manage imbalances; and the third is focused on how to achieve a stable outcome. The thesis adopts an inter-disciplinary approach in recognition of the powerful interactions and feedback mechanisms between economic, financial, and political influences on all these issues. The crisis in the sovereign bond markets can only really be understood with reference to all three influences interacting simultaneously; the emergence of imbalances is an example of macroeconomics and financial markets strongly interacting with each other and politics playing the role of handmaiden; and the reform efforts to achieve a stable outcome puts politics in the driving seat but subject to significant macroeconomic and financial constraints. The papers in this thesis deploy methodologies from across the disciplines of economics, finance, and political economy and provides a more inter-disciplinary perspective than is typically found in the literature.

The first paper examines the failure in crisis management. The consensus view is that the possibility of strategic default by the sovereign borrower introduces risk premia into bond yields that creates a vulnerability to falling into a “bad” equilibrium in which changes in investor beliefs can generate a self-fulfilling crisis. This view rests on insights from models of previous debt and currency crises, especially the debt repudiation model of Calvo (1988). This class of model has been applied extensively to the euro-area case, notably by Gros (2012a), De Grauwe and Ji (2013), and Corsetti and Dedola (2016). The principal policy failure, according to this model, is one of omission: not coordinating investor beliefs on a “good” equilibrium. The ECB's OMT policy is, in this framework, therefore a mechanism by which the central bank coordinates investor beliefs on a good equilibrium.

Paper 1 challenges the application of the strategic default theory to the euro area on three grounds: (i) the strong incentives of euro-area governments to avoid default; (ii) the low interest rates and market implied probabilities of default at the time of the liquidity crises; and (iii) the clear evidence that fiscal austerity was self-defeating during the crisis. It advances an alternative theory, founded on the euro area's legacy bond market structure and a complex policy risk premium, to explain the crisis. It incorporates these foundations into a fully-articulated formal mathematical model – the Market Structure-Policy Risk (MSPR) model – and

tests its predictions against a unique dataset constructed from the daily market reports from the Financial Times. It applies the Auto-Regressive Distributed Lag/Bounds Testing methodology of Pesaran and Shin (1999) and Pesaran et al (2001) to allow for the possibility of levels relationships between investor beliefs and bond yields as well as short-term dynamic relationships.

The empirical findings of the first paper validate the predictions of the MSPR model and further undermine the strategic default theory. A broad range of factors are found to explain the volatility of bond yields during the crisis and there is clear evidence of investor learning with the role of solvency sunspots declining and solvency fundamentals increasing. This suggests that the scope for a self-fulfilling crisis, while never dominant, diminished over time. The MSPR model therefore supports the idea that the euro-area bond market remains vulnerable to falling into a bad equilibrium. But, due to investor learning about the policy risk premium, the continuing volatility most likely now reflects heightened sensitivity to fundamentals, including policy risks, due to the presence of a non-linearity in the market structure rather than sunspot equilibria and the possibility of a self-fulfilling crisis. In other words, it places greater emphasis on market characteristics as a structural vulnerability and less on the notion of weaknesses in the policy architecture.

The second paper considers the drivers of imbalances and the idea that it was a policy failure to allow them to get so large. As has already been noted, although official institutions have taken a more optimistic view, an academic consensus has cast doubt on the feasibility of managing imbalances. The evidence base upon which this consensus is based is thin, however, primarily drawing on reviews of partial equilibrium analyses. The aim of the second paper is to strengthen the evidence base on this issue by explicitly considering the feasibility of managing macroeconomic imbalances with specific policy tools within a general equilibrium framework. In so doing, it seeks to provide a more rigorous answer to the question of whether, in a monetary union, macroeconomic imbalances can be managed by policymakers and, if so, which policy tools should be used. In this way, it is also able to provide a verdict as to whether the emergence of imbalances prior to the crisis was a policy failure, or largely unavoidable.

An applied macroeconomic methodology is used. It first articulates a simple structural economic model of financial imbalances in a monetary union using the Metzler diagram (Metzler 1960) and reviewing the post-crisis theories of imbalances. By assuming that agents hold false beliefs about the sustainability of

imbalances, they can persist indefinitely as a steady state outcome. This property of the structural economic model has been consciously adopted so that the economy can follow an unsustainable path that eventually leads to crisis, consistent with the literature on financial crises (Kindleberger 1978, Reinhart and Rogoff 2009) and the consensus view of the crisis (Baldwin and Giavazzi 2015). The model is recovered from data using the sign restricted Bayesian SVAR methodology commonly used in empirical macroeconomics. This approach has been applied successfully to the issue of global financial imbalances but, to the best of the author's knowledge, has never been applied to the issue of euro-area imbalances. Impulse response functions from the model are used to assess the drivers of imbalances and the efficacy of a range of policy options. These include fiscal policy, macro-prudential policy, product market structural reforms, and labour market structural reforms.

The results from the second paper suggest that while there is potential for fiscal policy and structural reforms to manage fiscal, output, and employment imbalances, only macro-prudential policy is a plausible candidate for managing current account and competitiveness imbalances. These findings cast doubt on the likely effectiveness of structural reforms, the preferred approach of the official institutions of the EU, in managing macroeconomic imbalances. The fact that the competitiveness and current account imbalances that are viewed as having been critical in contributing to the crisis can in principle be managed by macro-prudential policy is potentially significant. However, the paper concludes that, while further research is needed to provide a definitive answer, the likely scale of macro-prudential interventions required would undermine the concept of the euro area being a single currency with free capital movement. This suggests that the emergence of imbalances within the euro area should probably not be seen as a policy failure but as a fact of life in a diverse and financially integrated monetary union.

The third paper is focused on the political economy challenges of finding a robust political-economic settlement within the constraints identified in the previous two papers. The policy regime around the Maastricht compromise has proven unstable with monetary union having been in a constant process of reform since the crisis. There is potential for a profound change in the ongoing reform process, from an emphasis on national fiscal discipline and price stability to risk sharing and monetary-fiscal cooperation. But how can such a transition happen, especially in an environment of elevated public debt levels and markets reacting

strongly to any policy shift? This is not only a question of market constraints. Given the insight from political economy that any institutionalised consensus among multiple veto-players has stakeholders who try to block a move, how can a new political settlement emerge?

To answer these questions, the paper adopts the methodological approach of the trilemma and gives it a decidedly political-financial interpretation. The paper argues that financial integration, autonomous fiscal policy, and cheap public finance are an inconsistent trinity that the Maastricht compromise attempted to deliver. The adoption of the Stability and Growth Pact (SGP) was an early example of how policies were created to reconcile the three inconsistent policy goals, but the crisis revealed how fiscal rules cannot insure against contingent liabilities of the banking system led by private-sector credit booms. Since the crisis, the euro area has been circling the trilemma by resorting to a mix of some financial repression and some common debt management, but the market's verdict is that cheap public finance is not achievable, at least as far as the periphery economies are concerned. The paper uses a comparative analysis methodology between the euro area and U.S. bond markets to consider whether the transition to a stable policy could emulate the U.S. federation, with a particular emphasis on the market structure.

Paper 3 argues that finding a lasting solution to the euro area's political-financial trilemma need not rely on a pure solution in which two goals are pursued with one policy intervention that sacrifices a third goal. Instead, the new political settlement is likely to involve a new compromise to replace that of Maastricht through changing the weights attached to the goals. It is therefore crucial to consider intermediate solutions that can deliver a stable outcome. Steps towards common debt management, such as those pursued in the post-pandemic reforms, have the potential to reduce the cyclicity of the public finances and thereby improve the resilience of sovereign bond markets. However, a weakness of this conclusion is that it assumes, in doing so, that the bond market structure is unchanged. A comparison of the U.S. municipal bond markets and the euro-area government bond markets shows how moves to a federal structure of fiscal activity could prompt a profound change in the investor base, delivering a more stable outcome but one that does not deliver cheap public finance for national governments.

## 1.4 Thesis conclusions

Taken together, the three papers as a whole deliver on the ambition to provide an inter-disciplinary perspective to the crisis. While the approach is substantially economic the papers integrate important elements of finance and political economy into their structures, and their inclusion is critical to the conclusions and policy implications. The market structure of the euro area's sovereign bond markets is central to the arguments in Paper 1 and distinguishes it clearly from existing economic models of the intense phase of the euro-area crisis; the history of financial crises is essential context for the framework used to analyse macroeconomic imbalances and the potential for policies to manage them in Paper 2; and the political economy context of the Maastricht compromise, as well as a comparison of the structures of the U.S. and euro area bond markets, are shown to be crucial in understanding the challenges of reaching a lasting political-financial settlement in Paper 3. Only an inter-disciplinary approach could yield the conclusions that are reached.

The papers each have something substantive to say about the crisis of monetary union as well as contributing to the literature in their own spheres. The significance of the first paper rests on how it places emphasis on market characteristics as a structural vulnerability in a literature that has generally emphasised weaknesses in the policy architecture instead. For the second paper, while its focus is on assessing the drivers of imbalances and policies to address them its significance is in identifying that while it is no panacea to the euro area's problems, and the potential gains might not seem all that large, it could nonetheless contribute towards stability. In this sense, it endorses the need for a paradigm shift away from fiscal and monetary discipline and towards something multi-faceted. This idea is taken further forward in the third paper which places financial markets – and those for sovereign bonds – as the ultimate constraint and modifies the concept of the trilemma by deriving the policy goals from the original Maastricht compromise, super-imposing the financial and political constraints, and suggesting the need for a multi-faceted approach.

In providing a modified diagnosis of the problem and prescription for a solution the thesis also offers some conclusions on the consensus narrative of the crisis itself and the emphasis it places on policy failures. The thesis leans towards thinking that the role of policy failures in explaining the crisis has been exaggerated and that more attention should be placed on the intractability of the problem. Based on the Kantian principle that 'ought implies can' it is not at all obvious that there were egregious policy failures either in the lead

up to the crisis or during it. The lesson from Paper 1 is that once in a bad equilibrium then there is not much that national government policy can do to stabilise the situation and the lesson from Paper 2 is that imbalances are difficult to manage. An analytical theme across the three papers has been the challenges to investors and policymakers alike of living in a world of imperfect information and how learning more about the world occurs with the passage of time. As Paper 3 shows, the Maastricht compromise attempted to pursue three inconsistent policy goals – financial integration, autonomous fiscal policy, and cheap public finance – but this was not fully appreciated at the time. But it, too, was not necessarily a policy failure. A true policy failure would be to underestimate the intractability of the problem and shy away from designing appropriate reforms that address it today.

## Chapter 2

# A Market Structure-Policy Risk

## Model of the Euro Crisis

### 2.1 Introduction: The lender of last resort problem

Since late 2009, the sovereign bond markets in the euro area have experienced considerable volatility<sup>1</sup>. Spreads between the periphery economies and Germany began to widen in early 2009, but never exceeded more than 300bp. But in late 2009, following the release of revised Greek fiscal deficit figures, the Greek-German ten-year government bond spread widened sharply, reaching nearly 1000bp in early May 2010. Spreads on Irish ten-year government bonds were the next to widen sharply, in the autumn, closely followed by Portugal in early 2011. Italy and Spain were then dragged into the crisis in the second half of 2011. Measures of volatility increased sharply in all countries with the standard deviation of bond yields reaching as high as eight percentage points for Greece in 2012.

It is widely accepted that one of the causes of the excess volatility seen in euro-area sovereign bond markets has been the absence of a lender of last resort (LoLR)<sup>2</sup>. There are at least two dimensions to this. First, governments that have the legal right to use the printing press retain the capacity to repay bond

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<sup>1</sup>All bond yield data are from Bloomberg Finance LP.

<sup>2</sup>See, for example, Krugman (2013), Gros (2012a, 2015), De Grauwe (2011, 2015), Baldwin and Giavazzi (2015).



holders under all circumstances. They can simply force central banks to print the money to do so. They may not choose to do so for various reasons, such as its inflationary and reputational consequences, but the capacity to repay the debt is always there<sup>3</sup>. In the euro area, this is prohibited by Article 123 TFEU. The second dimension of the LoLR problem, and arguably the more important, is the difficulty in the euro area of the ECB targeting its interventions in secondary government bond markets towards individual member states<sup>4</sup>. This can be viewed as the Quantitative Easing equivalent of the “one size fits all” problem of monetary union. Explaining the volatility of euro-area sovereign bond markets entails understanding what the absence of these LoLR functions implies for risk premia.

The consensus view is that the absence of a LoLR introduces risk premia into sovereign bond yield spreads via the possibility of strategic default by the sovereign borrower and that this creates a vulnerability to falling into a “bad” equilibrium, where changes in investor beliefs can generate a self-fulfilling crisis<sup>5</sup>. This view rests on insights from models of previous debt and currency crises, especially the debt repudiation model of Calvo (1988). This class of model has been applied extensively to the euro-area case, notably by Gros (2012a), De Grauwe and Ji (2013), and Corsetti and Dedola (2016). All the models in these contributions are founded on the concept that the sovereign borrower will choose to stop honouring its debt obligations when debt service payments exceed a fixed cost of default. It is changing beliefs by investors about the level of interest rate at which the sovereign will make this choice that creates the possibility of a self-fulfilling crisis.<sup>6</sup>

Empirical research covering the crisis period has identified several features of the sovereign bond crisis that appear consistent with the strategic default theory. For example, numerous empirical studies suggest that sovereign bond yields experienced heightened sensitivity to economic fundamentals during the crisis (Gibson et al. 2011, Bernoth et al. 2012, Beirne and Fratzscher 2013, De Grauwe and Ji 2013). And

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<sup>3</sup>Part III of Reinhart and Rogoff (2009) shows that domestic defaults have been common throughout history. This illustrates that governments have often chosen default despite having access to a LoLR. The main point is that in the face of fiscal stress standalone countries have the option of fiscal consolidation, default or turning to their LoLR. Euro-area countries do not have the third option.

<sup>4</sup>See Buiter and Rahbari (2012) for a discussion of the mechanisms through which the ECB can act as a LoLR for sovereigns via secondary markets and indirectly via lending vehicles.

<sup>5</sup>In this paper the terms “beliefs” and “expectations” are used interchangeably. However, expectations are just one type of belief concerning the future. Beliefs about the present, such as the state of the economy or its structure, can also be important in determining investor behaviour.

<sup>6</sup>See the supplementary appendix for a comprehensive review of the theoretical models and empirical studies.

variables that might be thought to be heavily influenced by beliefs, such rating agency actions and the extent of contagion, seem to have played an important role (Constancio 2011, Afonso et al. 2011, De Santis 2012, Caporin et al. 2013). In other words, the volatility of bond yields was excessive and shifting beliefs seem to have been an important driver, just as the strategic default theory predicts.

The idea that the euro area fell into a bad equilibrium underpinned the announcement by the ECB of its Outright Monetary Transactions (OMT) policy. Proponents argued that, if shifting beliefs risk being self-fulfilling, then policy should be aimed at maintaining a “good” equilibrium in sovereign bond markets. In the press conference following the Governing Council’s decision to approve OMTs in September 2012 the President of the ECB, Mario Draghi, said, “The assessment of the Governing Council is that we are in a situation now where you have large parts of the euro area in what we call a bad equilibrium, namely an equilibrium where you may have self-fulfilling expectations that feed upon themselves and generate very adverse scenarios” (ECB 2012a: n.p.). The subsequent success of the ECB’s OMT policy in bringing the acute phase of the crisis to an end might also be considered as providing further evidence in support for the strategic default theory.

Despite its widespread acceptance and much of the available evidence being consistent with its predictions, there are some important problems with the strategic default theory. First, euro-area governments had a very strong incentive to avoid default. Not only were the increases in debt interest burdens minimal at the time liquidity crises occurred, but detailed analysis of the political economy of adjustment policies strongly favours governments choosing internal adjustment and financing over external adjustment and default (Walter et al. 2020). Second, as will be shown in the next section, market-implied probabilities of default at the time of the crisis were low. Not only is this consistent with investors being aware that governments had strong incentives to avoid default, but it suggests that imminent default was not the primary fear of investors at the point that liquidity crises took place. Finally, it is hard to reconcile the strategic default theory with other evidence from the crisis, such as that fiscal austerity was self-defeating (Holland and Portes, 2012, Gross and Maurer 2012, Attinasi and Metelli 2016). If government policy is viewed as ineffective at improving debt sustainability by investors then it is plainly contradictory to place investor expectations about government policy centre stage. All in all, while investor fears of default are the primary source of bond market risk

premia, it seems unlikely, given these problems, that strategic default risk was the primary driver of these premia in the euro-area case.

That there are problems in reconciling the strategic default theory with important features of the crisis should not be surprising. The strategic default theory was imported from models of emerging market foreign currency debt crises on the premise that, due to an absence of a LoLR, a euro-area sovereign is similarly vulnerable to a “sudden stop” (De Grauwe 2011, Gros 2012a). But the commonalities pretty much end there. The euro area is not an emerging market and, as such, the risk characteristics of the sovereign borrowers, as well as the structure of the market they issue into, are very different. The typical investor in emerging market foreign currency debt (seeking a high return in exchange for bearing high risk) could hardly be more different from the typical investor in euro-area sovereign bonds (seeking a safe asset and bearing low risk). The problems with the strategic default theory identified above, combined with the fact that the theory was transplanted from emerging market crises, suggests the need to delve deeper into the anatomy of the euro area’s sovereign bond crisis and place it much more firmly in a euro-area context, to understand what was really going on.

This paper proposes an alternative theory embedded in a more realistic characterisation of the economic, financial, and political architecture of the euro area. It has two key foundations. The first is a legacy bond market structure that depends on a traditional institutional investor base requiring government bonds to perform the role of a safe asset in their portfolios. For these investors, even a small increase in default risk can be enough to lead them to withdraw their participation from the primary bond market. This makes the bond market vulnerable to a liquidity crisis at low levels of interest rates and market-implied default probabilities. The second is a policy risk premium reflecting the complex mix of options available to the EU authorities in the event of a liquidity crisis. The most important of these policy risks concerns the possibility of private sector involvement, but when external financing requirements exceed the financial capacity at the EU’s disposal then redenomination risk can become relevant too.

A formal theoretical model is used to articulate how these two features alone can account for why the liquidity crises occurred at low levels of interest rates and market-implied default probabilities and why bond markets exhibited heightened sensitivity to fundamentals. Because fiscal policy is assumed to be self-

defeating in crisis conditions, the potential for self-fulfilling crises is explained not by strategic default risk but by investors' imperfect knowledge of fundamentals. In the model bond yields are driven by changes in investor beliefs about solvency, liquidity, and policy but investors also undergo a learning process in response to new information, especially regarding the policy risk premium. This leads to sunspot equilibria and the scope for self-fulfilling crises to diminish as influences on the sovereign bond markets over time.

This theory is tested empirically against an innovative data set comprising textual analysis of daily market reports from the Financial Times during the crisis period. Its main findings are aligned with the predictions of the theoretical model. The rise in bond yields is found to be driven consistently by solvency news with other factors fluctuating in their importance over time. Contrary to the prediction of the strategic default model, beliefs about fiscal policy account for only a small proportion of the increase in bond yields. This reinforces the conclusions from previous analysis of debt maturity structures that fluctuations in self-fulfilling rollover risk accounted for only a modest fraction of the increase in sovereign borrowing costs in Italy (Bocola and Dovis 2016). The results are also found to be consistent with investor learning behaviour. For example, while policy beliefs were the dominant drivers in the case of Ireland and Portugal when the ESM framework was being developed, they played a much smaller role by the time the crisis spread to Spain. The model predicts that the flip side of this investor learning should be a declining role for sunspot equilibria. Again, this is found to be the case, with solvency fundamentals becoming more important and solvency sunspots becoming less important over time.

The paper's finding that the source of volatility transitioned from one that was driven significantly by changes in policy and self-fulfilling beliefs to one predominantly driven by solvency fundamentals has significant policy implications. It suggests that the ongoing vulnerability of euro-area sovereign bond markets should be viewed as structural and not easily dealt with by attempts to coordinate beliefs on a good equilibrium, as the strategic default model implies (De Grauwe 2012, Corsetti and Dedola 2016). The underlying structural weakness – a fragile bond market structure – needs to be addressed directly or factored into thinking about alternative policy solutions. With its current bond market structure, the euro area can avoid falling into a bad equilibrium only by the underlying structure of the economy being far more resilient than other economies. It is not clear how feasible it is to achieve such a high level of resilience. The paper con-

cludes that the most direct way to meet that challenge is to issue tiered bonds and that there are only two alternatives: suppressing bond spreads and volatility through financial repression or adopting a framework of common debt management. This paper is organised as follows. Section 2.2 explains the problems with the strategic default theory in more detail. Section 2.3 sets out an alternative framework of analysis. Section 2.4 develops a formal model and Section 2.5 reports the results of an empirical application of the model. Finally, Section 2.6 makes some concluding observations, including implications for policy and future research.

## 2.2 Problems with the strategic default theory

The strategic default model of sovereign debt crises can trace its origins at least as far back as Guillermo Calvo's debt repudiation model of the 1980's (Calvo 1988). In this model a self-fulfilling crisis can arise when markets anticipate that the government will choose to default on its debt. Crucially, the government does so in preference to paying the prevailing interest rate at which it can borrow and because doing so maximizes its welfare. This model has been applied to the euro area without serious consideration of some of the problems in doing so. This section identifies three problems that simultaneously lay the foundations of an alternative framework of analysis.

### 2.2.1 Problem 1: Strong incentives to avoid default

Calvo's debt repudiation mechanism makes a lot of sense for emerging economies borrowing in foreign currency where, during crises, debt interest payments have increased significantly. Debt in these countries typically had a short maturity with considerable volumes being rolled over each week. For example, by December 1994 all of Mexico's outstanding Tesobonos were due in 1995 (Lustig 1995)<sup>7</sup> and interest rates increased by over 1000bp (Masson and Agènor 1999). In the case of the Argentina crisis in 2001 the maturity of the outstanding dollar bonds was about two years and the US dollar lending rate surged to over 20% (Daseking et al. 2004). The combination of a short maturity profile and large increases in interest rates means that debt interest payments increased sharply. This provided ample incentive to default.

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<sup>7</sup>The maturity structure reflected a government decision to convert all its short-term local currency debt into foreign current debt to bolster the credibility of its exchange rate regime.

The incentive for euro-area sovereigns to default are not nearly so strong. Previous studies, notably Walter et al. (2020), have shown how the vulnerability profiles of the euro-area crisis countries and interest groups pointed strongly to governments of both deficit and surplus countries favouring internal adjustment and financing rather than external adjustment and default as a response to the crisis. According to the authors, “Our analyses suggest that surplus-creditor country governments faced strong domestic incentives to push most of the adjustment burden onto deficit countries and to provide external financing in the form of bailout packages” (Walter et al. 2020: p.4) while “the puzzle of why deficit countries agreed to unprecedented austerity [as a condition of the bailout packages], which has taken such a heavy toll on their economies, becomes less puzzling, for example, if one considers that the alternatives available to them were Eurozone exit and/or unilateral debt default, both costly and highly undesirable outcomes” (Walter et al. 2020: p.23).

It is hard to argue with this political economy view from a cost benefit analysis perspective. If the government were to default, it is highly likely that interest rates for the rest of the economy would increase sharply and the banking system would experience huge losses on its holdings of government bonds, triggering a sharp tightening of credit conditions. The effect of higher interest rates and tighter credit conditions on the economy would likely be severe, pushing the economy into a deep recession and leading to a sharp deterioration in the primary budget balance and further increasing the contingent liabilities of the public-sector balance sheet. As has already been noted, a default might even entail a forced exit from the euro area given that the ECB would no longer be able to accept the country’s government bonds as collateral. This could lead to the collapse of the banking system.

It is hard to see how these economic costs do not vastly exceed the potential economic benefits of default. With the change in interest rates for the euro-area countries in government bond markets at the point of crisis having generally been only 300-400bp, for a country with a debt-to-GDP ratio of 75%, debt interest payments would eventually increase by about of 3% of GDP. However, the average maturity of government debt in the euro-area periphery countries prior to the crisis was about seven years (Eidam 2020: p.42). This means that, in the short term, say over five years, the increase in interest rates would amount to only about a third of that, or just 1% of GDP. Consequently, while an extended period of elevated interest rates might

eventually be expected to exert some pressures on governments to change policy it does not seem plausible that they did so in the short period, of just a few months, over which the euro area crisis took place. The political economy of adjustment policies therefore argues strongly against strategic default being a plausible fear for investors.

### **2.2.2 Problem 2: Low interest rates and market-implied default probabilities**

Apart from making the rise in interest burden small, the low level of interest rates at which a liquidity crisis took place also implies that investors assigned only a low probability to an imminent default. This follows from market-implied default probabilities being directly proportional to the level of interest rate spreads. For example, the Irish-German two-year bond spread peaked at 576bp on 11 November 2010 just before rumours circulated of it requesting an ESM<sup>8</sup> support package<sup>9</sup>. Even if all this spread is attributed to default risk, assuming a historical 50% loss given default rate, and making no allowance for investors being risk averse, it implies only a 23% two-year probability of default. Not only does this indicate that investors did not see a liquidity crisis as tantamount to a government choosing default, undermining the strategic default theory, it suggests that investors had high conviction that some form of external support would be forthcoming and that the conditions of that support would not entail a high risk of default either.

### **2.2.3 Problem 3: Self-defeating fiscal austerity**

In principle, governments should be able to prevent a crisis through fiscal adjustment. Fiscal austerity, by improving the budget balance, should reassure investors and allow market interest rates and debt interest burden to fall. On this view, if a liquidity crisis takes place, it reveals that the government prefers this outcome over the fiscal austerity needed to prevent it. In other words, even if the government seemingly has strong incentives to avoid default, and the crisis occurs at low interest rates and market-implied default probabilities, it still represents a strategic choice of the government to allow the crisis to happen. Investors

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<sup>8</sup>The ESM was created in September 2012 and was preceded by the EFSF and EFSM. Throughout this paper the term ESM is used to refer to all these support mechanisms.

<sup>9</sup>On November 11, 2010, the Irish 2-year bond closing yield was 669bp while the Germany 2-year closing yield was 95bp (Bloomberg Finance LP).

will therefore need to anticipate the government's choice and, hence, the strategic default dynamic of the Calvo model is still relevant.

Apart from being a tautological line of reasoning, it requires fiscal austerity to be effective at improving debt sustainability. But the available evidence suggests that it probably is not effective in times of crisis. In fact, there is a lot of evidence that fiscal austerity is self-defeating, or even counter-productive, in crisis conditions. Fiscal multipliers have been found to be large in the euro area due to monetary policy and exchange rate responses to changes in fiscal policy being damped at the country level. There is also evidence that the fiscal multiplier may become further strengthened in times of crisis (De Long and Summers 2012). This is because monetary policy may already have been exhausted as a source of support to growth and households and firms may be more liquidity constrained, meaning that they are unable to smooth their spending through the downturn. Moreover, to the extent that several countries were undertaking fiscal austerity simultaneously, there could be spill-over effects. Under certain conditions fiscal austerity may not only be self-defeating but have sizeable perverse effects (Holland and Portes 2012, Attinasi and Metelli 2016). All in all, even if fiscal austerity is not always completely self-defeating, it is likely to be a very weak tool with which to prevent a crisis.

Self-defeating austerity calls into question the notion that governments somehow preferred a liquidity crisis to implementing fiscal austerity. Typically, in the studies cited above, self-defeating austerity has been defined as occurring when budgetary measures have no impact on the debt-to-GDP ratio. This happens because the benefit from a lower budget deficit is wiped out by its knock-on effect to the level of GDP. While the debt-to-GDP ratio is not the same as debt sustainability, they are closely related. So, if fiscal policy has no impact on the debt-to-GDP ratio, and it can be debated whether it applies only in the short-term or also the long-term (Gros and Maurer 2012), it is hard to envisage how it can exert much of an influence on perceptions of debt sustainability and, by extension, the government bond yield either. In effect, the inability of fiscal austerity to improve debt sustainability renders the concept of strategic default null and void, because the government is unable to affect the interest rate no matter what it does. In effect, the government is reduced to playing the role of a powerless spectator of market conditions as investors respond to other factors determining the bond yield. Governments did not choose to have a crisis in preference to



fiscal austerity, they simply stepped away from a fight that they could not win.

## 2.3 The foundations of an alternative to strategic default

The problems with the strategic default theory suggest the need for an alternative explanation that can account not only for the increased sensitivity to fundamentals and presence of sunspot equilibria found in the literature but also for why the liquidity crises happened at such low levels of interest rates and market implied default probabilities. This section argues that the explanation can be found in (i) a legacy bond market structure and (ii) a complex policy risk premium.

### 2.3.1 A legacy bond market structure

The euro area's liquidity crises were marked by sovereigns losing the capacity to issue debt in the primary market and seeking external assistance. And one of the most important features is that this happened at relatively low interest rates<sup>10</sup>. Greece lost market access in early April 2010, ahead of sizeable financing needs (European Commission 2010: p.8). At that point 10-year yields were around 7%. When Greece formally requested external assistance on 23 April, its 10-year bonds yielded 8½% in the secondary market. Loss of market access was also central to the decisions of both Ireland and Portugal to seek external assistance. Although Ireland was already fully funded by the time of its financing programme, according to the IMF, “when the [Irish] banks faced renewed private funding outflows, the sovereign also lost access to market funding, necessitating official support” (IMF, 2012a: p.6). When the Irish started these discussions in early November its ten-year bond yields were less than 8%. As for Portugal, the IMF states that, “as in other euro area periphery countries sovereign yields rose sharply, quickly followed by the Portuguese government losing access to the bond market” (IMF, 2012b: p.15). When Portugal sought external assistance on 7 April 2011 the yields on its ten-year bonds were 8.6%.

These levels of interest rates are significantly lower than those seen in emerging market debt crises. The explanation for this is clear: markedly different market structures. Investors in emerging market bonds are

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<sup>10</sup>All bond yield data are from Bloomberg Finance LP.

typically mandated to invest in high-risk government bonds of which they are expert investors. They are skilled in assessing risks as they change and invest knowing that there are high risks associated with their exposures. When those risks materialise, they are well placed to make a judgement of the risk of default and what level of interest rate is needed to compensate for those risks. In euro-area countries, however, the investor base at the time of the crisis was predominantly looking to invest in a safe asset. This marked difference in perceived risk characteristics is illustrated not only by the differing interest rate levels at the point market access was lost but by the contrast between high investment grade ratings on sovereign bonds in the euro-area prior to the crisis (Table 2.1) and the mostly junk ratings of foreign currency long-term debt of Latin American sovereigns in the 1980's and 1990's (Table 2.2).

These differences meant that once the perceived risk of a euro-area sovereign bond reached a certain level, signalling an increased level of credit risk, a significant portion of the traditional investor base was no longer willing to participate in primary market bond issues. The loss of market access at low levels of interest rates and market-implied default probabilities was therefore related to the legacy market structure of the euro area. Small increases in default risk had an outsized impact on market functioning. In other words, euro-area sovereigns suffered from issuing into markets that are incomplete and cease to function when default risks rise by even modest amounts. This is a significant feature of the bond market because it introduces non-linear liquidity risks. As will be shown in the next section, it also explains why euro-area sovereign bonds, once in a bad equilibrium, exhibit heightened sensitivity to fundamentals.

Table 2.1: Sovereign ratings on local currency debt prior to the euro-area crisis

	<b>Ireland</b>	<b>Portugal</b>	<b>Italy</b>	<b>Spain</b>
<b>S&amp;P</b>	AAA (Jul '09)	AA- (Jan '09)	A+ (Feb '11)	AAA (Jan '09)
<b>Moody's</b>	Aaa (Jul '09)	Aa2 (Jul '10)	Aa2 (Oct '11)	Aaa (Sep '10)
<b>Fitch</b>	AAA (Mar '09)	AA (Mar '10)	AA- (Oct '11)	AAA (May '10)

\* The date when the rating was downgraded by at least one notch is in brackets. Prime or high-grade ratings are in blue.

Source: S&P, Moody's, Fitch

Table 2.2: Initial sovereign ratings for foreign currency long-term debt in Latin America

	<b>Brazil</b>	<b>Argentina</b>	<b>Mexico</b>	<b>Columbia</b>
<b>S&amp;P</b>	<b>B</b> ('94)	BBB- ('94)	<b>BB+</b> ('92)	BBB- ('93)
<b>Moody's</b>	<b>Ba1</b> ('86)	<b>Ba3</b> ('86)	<b>Ba2</b> ('91)	<b>Ba1</b> ('93)
<b>Fitch</b>	<b>B+</b> ('94)	<b>BB</b> ('97)	<b>BB</b> ('95)	<b>BB+</b> ('00)

\* The year the initial rating was published is in brackets.

Source: S&P, Moody's, Fitch

### 2.3.2 A complex policy risk premium

From the perspective of an investor, when a sovereign loses market access, it will crystallise a risk premium. The nature of the risk premium will depend on institutional arrangements. For sovereigns with their own currency the risk premium might relate more to inflation than default because the government might choose to turn to the central bank, it's LoLR, for its financing needs. For sovereigns in the euro area, because they have no LoLR, inflation risk would seem to be excluded. But it is not quite as simple as that. The risk premium that crystallises is certainly not a simple form of default risk. For example, if there was no prospect of external support, or a country refuses to accept it, then some form of default would occur as soon as the sovereign's financing needs exhaust any pre-funding of those financing needs – i.e., imminently in most cases. But, because, in the euro area, a default could rapidly introduce the possibility of banking sector collapse, and potentially even euro and EU exit, investors also must factor in the possibility of redenomination followed by devaluation. In other words, there is some inflation risk after all.

Even with external support, the risk premium is far from simple, for several reasons. One is because, unlike in the case of LoLR support from a central bank, the resources of the ESM are finite. This was a pertinent consideration in the cases of Italy and Spain, whose funding requirements were potentially so large as to risk overwhelming the ESM's finite lending capacity, increasing the risk of both PSI and eventual default, redenomination, and devaluation risk. And it is not just the constraint of the finite resources of the ESM being exhausted that introduces the risk of PSI. Politicians are incentivised to minimise risks to taxpayers and so policymakers may force bond holders to share in the adjustment burden through PSI before ESM resources are exhausted. These risks were enhanced by the terms of the ESM Treaty that place

its lending behind the IMF but ahead of private sector creditors (Eurogroup 2010, para. 6). This means that, as ESM lending replaces private sector lending, to achieve a given improvement in debt sustainability, remaining investors will be forced to take a larger haircut. This mechanism amplifies risks to investors for countries with large re-financing needs.

It is clear from the preceding discussion that in the euro area investors face a complex array of what might be termed “policy risks” once a sovereign loses market access. And, importantly, these policy risks will need to be reflected in bond yields before a sovereign loses market access. Forward-looking bond investors will form expectations about what will happen in the event of a loss of market access with a view to assessing the correct level of liquidity risk premium today. This means that beliefs about policy risks will have an important impact on bond yields before a liquidity crisis takes place. It is this mechanism that explains why the Deauville Summit declaration on 18 October 2010, which announced the possibility of PSI (Franco-German Declaration 2010, para. 9), had such a large effect on the bond yields of Ireland and other euro-area periphery economies. It also explains why the ECB’s OMT policy, which expanded the sustainability of ESM programmes with lending that was *pari passu* with private and other creditors (ECB 2012b), had such a powerful effect.

## 2.4 The Market Structure-Policy Risk (MSPR) Model

This section develops a simple two-period stochastic model that reflects the essentials of the framework of analysis developed in the previous section. It assumes a bond market structure that leads to a loss of market access at a low level of bond yields and a policy risk premium reflecting the absence of a LoLR. It starts by describing the macroeconomy and its relationship to a solvency risk premium and the equilibrium interest rate before incorporating a measure of the liquidity risk premium reflecting the risks from a loss of market access. Under a perfect knowledge assumption, and with fiscal austerity being self-defeating, the equilibrium interest rate is determinate and varies with the variance of the solvency shock, the threshold for a loss of market access, and a policy risk premium. However, under an imperfect knowledge assumption the equilibrium is indeterminate, creating a vulnerability to self-fulfilling liquidity crises.

### 2.4.1 The macroeconomy, solvency risk premium, and interest rate

We start with a simple linear macroeconomic model in which output relative to potential,  $(y - \bar{y})$ , is determined by the real exchange rate,  $(p - \bar{p})$ , the structural budget balance as a proportion of potential output,  $b$ , and the deviation of the economy's interest rate from its natural level  $(i - \bar{i})$ :

$$(y - \bar{y}) = \theta(p - \bar{p}) + \alpha b + \beta(i - \bar{i}) \quad (\theta, \alpha, \beta < 0) \quad (2.1)$$

It is assumed that the government bond market determines the economy's interest rate and so is modelled as an interest rate spread against the risk-free euro interest rate,  $i - i^{euro}$ , and reflects a solvency risk premium,  $srp$ :

$$(i - i^{euro}) = srp \quad (2.2)$$

The solvency risk premium itself is a function of the outstanding level of public debt as a proportion of potential output,  $d$ , and the overall budget balance as a proportion of potential output, which is modelled as the sum of its structural and cyclical components,  $(b + \delta(y - \bar{y}))$ :<sup>11</sup>

$$srp = \pi d + \rho(b + \delta(y - \bar{y})) \quad (\pi, \delta > 0; \rho < 0) \quad (2.3)$$

After normalising  $i^{euro} = \bar{y} = \bar{p} = \bar{i} = 0$  and assuming prices are fixed in the short term, the period 0 fundamental equilibrium interest rate can be expressed as:

$$i_0^F = \frac{\pi}{(1 - \rho\delta\beta)} d_0 + \frac{\rho(1 + \alpha\delta)}{(1 - \rho\delta\beta)} b_0 \quad (2.4)$$

In period 1 the solvency risk premium is subject to a zero-mean i.i.d. solvency shock,  $\epsilon_S$ . This is to capture, among other things, the impact of changes in the sovereign's contingent liabilities. After the solvency shock is realised,  $\epsilon_S = \hat{\epsilon}_S$ , the period 1 fundamental equilibrium interest rate is then:

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<sup>11</sup>Note that there is no role for the interest rate in determining the solvency risk premium. This assumption has been made primarily to simplify the presentation, but also serves to emphasise the importance of the long maturity structure of euro-area sovereign debt. Including a role for the interest rate in the solvency risk premium has no bearing on the results or conclusions of the paper.

$$i_1^F = \frac{\pi}{(1 - \rho\delta\beta)}d_0 + \frac{\rho(1 + \alpha\delta)}{(1 - \rho\delta\beta)}b_0 + \frac{1}{(1 - \rho\delta\beta)}\hat{\epsilon}_S \quad (2.5)$$

These equations represent the relationship between the fundamental equilibrium interest rate and solvency across the two periods.

### 2.4.2 Solvency shocks and the liquidity risk premium

The model set out above takes no account of possible non-linear effects from the solvency shock. However, as explained in the previous section, euro-area sovereigns are at risk of losing market access at a low level of interest rates. This means that, when a solvency shock hits, there is the potential for it to push the fundamental equilibrium interest rate in period 1 to the point where market access is lost,  $i_1^F \geq i_L$ . The interest rate in period 0 will therefore also reflect a liquidity risk premium  $lrp$  to take account of this:

$$i_0 = srp_0 + lrp_0 \quad (2.6)$$

Assuming investors are risk-neutral, and noting that  $i^{euro} = 0$  and  $E(\epsilon_S) = 0$ , the liquidity risk premium in period 0 will simply be the risk premium that investors expect in period 1:

$$lrp_0 = E_0(rp_1) \quad (2.7)$$

To derive the liquidity risk premium in period 0, it is necessary to model both the probability of a loss of market access and any non-linear effect this might have on the interest rate. This implies taking the probability-weighted average of the expected period 1 risk premium that would result from the solvency shock triggering a loss of market access and not triggering a loss of market access:

$$lrp_0 = pr(\epsilon_S > \epsilon_L) * E_0(rp_1|\epsilon_S > \epsilon_L) + pr(\epsilon_S < \epsilon_L) * E_0(rp_1|\epsilon_S < \epsilon_L) \quad (2.8)$$

Where  $pr$  is the probability operator,  $\epsilon_L$  is the size of the shock that triggers a loss of market access,  $rp$  is the risk premium,  $E_0$  denotes expectations, and the separator denotes conditionality.

Following Obstfeld (1994) it is assumed that the solvency shock is uniformly distributed between  $[-\bar{\epsilon}_S, \bar{\epsilon}_S]$ . This means that the probabilities of the solvency shock being above and below the trigger point for a loss of market access are:

$$pr(\epsilon_S > \epsilon_L) = \frac{(\bar{\epsilon}_S - \epsilon_L)}{2\bar{\epsilon}_S} \quad (2.9)$$

$$pr(\epsilon_S < \epsilon_L) = \frac{(\bar{\epsilon}_S + \epsilon_L)}{2\bar{\epsilon}_S} \quad (2.10)$$

If the solvency shock triggers a loss of market access,  $(\epsilon_S > \epsilon_L)$ , the risk premium becomes a policy risk premium,  $\bar{P}$ , which is defined as the losses that bond holders expect to be imposed on them by policymakers. Hence:

$$E_0(rp_1|\epsilon_S > \epsilon_L) = E_0(\bar{P}_1) \quad (2.11)$$

If the solvency shock does not trigger a loss of market access,  $(\epsilon_S < \epsilon_L)$ , the economy ceases to be in a bad equilibrium and there is no risk premium:

$$E_0(rp_1|\epsilon_S < \epsilon_L) = 0 \quad (2.12)$$

Substituting equations (2.9) – (2.12) into equation (2.8) shows that the period 0 liquidity risk premium is the product of the probability of a loss of market access and the policy risk premium:

$$lrp_0 = \frac{(\bar{\epsilon}_S - \epsilon_L)}{2\bar{\epsilon}_S} E_0(\bar{P}_1) \quad (2.13)$$

### 2.4.3 The equilibrium interest rate under perfect knowledge

Having obtained the liquidity risk premium, it is straightforward to derive the period 0 equilibrium interest rate by substituting equation 2.13 into equation 2.6 and solving:

$$i_0^* = \frac{\pi}{(1 - \rho\delta\beta)} d_0 + \frac{\rho(1 + \alpha\delta)}{(1 - \rho\delta\beta)} b_0 + \frac{(\bar{\epsilon}_S - \epsilon_L)}{2\bar{\epsilon}_S} \frac{E_0(\bar{P}_1)}{(1 - \rho\delta\beta)} \quad (2.14)$$

With the budget balance being a determinant of the interest rate, equation 2.14 suggests the possibility that investors should also factor in how the government responds to the solvency shock with fiscal policy. However, given strong evidence that fiscal austerity is self-defeating in crisis conditions, incorporating a fiscal policy reaction function would have no impact on the result. This is for the reason explained in the previous section. The period 0 equilibrium interest rate is therefore determined solely by period 0 debt and deficit levels, the probability of a liquidity crisis, and the expected policy risk premium. This result also suggests that the equilibrium interest rate is determinate with no role for self-fulfilling beliefs. The next section considers how imperfect knowledge could lead to an indeterminate period 0 equilibrium interest rate.

#### 2.4.4 Imperfect knowledge, investor beliefs, and sunspot equilibria

An assumption of perfect knowledge makes sense when there are relevant data or information in the public domain on the parameter or variable of interest. This is probably the case for the level of public debt and deficit and their impact on the solvency risk premium, given that public debt data are known with some confidence and investors understand its relationship to solvency risk from decades of research. However, the same cannot be said about some of the other determinants of the equilibrium interest rate. The probability distribution of solvency shocks and the policy risk premium are both unobserved variables. Even the structural parameters,  $\rho\delta\beta$ , might be subject to uncertainty initially given how the introduction of the euro might have affected the way economies adjust.

The liquidity risk premium is a complex concept, as can be seen by deriving its full expression. The policy risk premium component is a probability-weighted average of the expected loss if there is PSI as part of an ESM programme,  $E_0(L_1|PSI_1)$ , and the expected loss if there is no ESM programme,  $E_0(L_1|\sim ESM_1)$  which gives the following expression:



$$E_0(\bar{P}_1) = \{pr(ESM_1|\epsilon_S > \epsilon_L)*pr(PSI_1|ESM_1)*E_0(L_1|PSI_1)\} + \{[1-pr(ESM_1|\epsilon_S > \epsilon_L)]*E_0(L_1|\sim ESM_1)\} > 0 \quad (2.15)$$

But the expected loss if there is no ESM programme,  $E_0(L_0 \sim ESM_1)$ , is itself a probability-weighted average of the expected loss under redenomination,  $R$ , and no redenomination:

$$E_0(L_1|\sim ESM_1) = \{pr(R_1|\sim ESM_1) * E_0(L_1|R_1)\} + \{[1 - pr(R_1|\sim ESM_1)] * E_0(L_1|\sim R_1)\} \quad (2.16)$$

Finally, the expected loss under redenomination is determined by expectations of depreciation of the new currency,  $S$ , following redenomination:

$$E_0(L_1|R_1) = E_0(\Delta S_1|R_1) \quad (2.17)$$

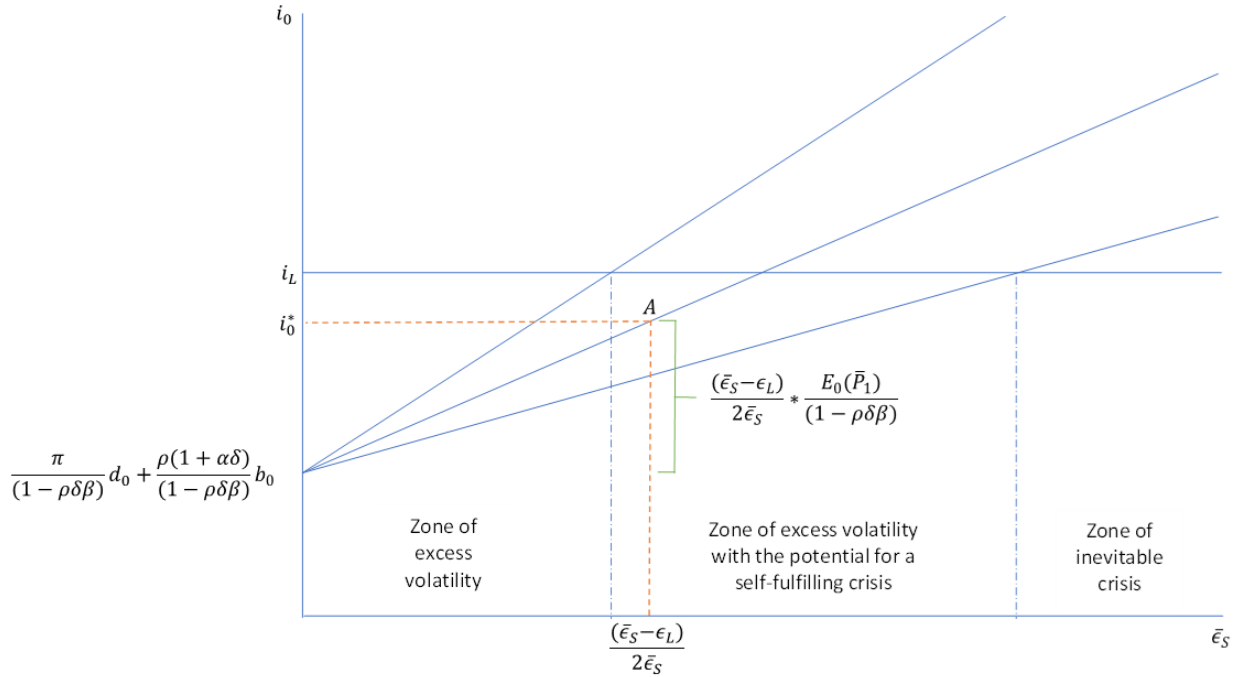
Bringing all these elements of the policy risk premium together with the probability of a loss of market access gives a full expression for the liquidity risk premium:

$$\begin{aligned} lrp_0 = \frac{(\bar{\epsilon}_S - \epsilon_L)}{2\bar{\epsilon}_S} * \{ \{ pr(ESM_1|\epsilon_S > \epsilon_L) * pr(PSI_1|ESM_1) * E_0(L_1|PSI_1) \} + [1 - pr(ESM_1|\epsilon_S > \epsilon_L)] \\ * \{ pr(R_1|\sim ESM_1) * E_0(\Delta S_1|R_1) \} + [1 - pr(R_1|\sim ESM_1)] * E_0(L_1|\sim R_1) \} \} \end{aligned} \quad (2.18)$$

There is no disputing that this is a complex variable. But more important than its complexity is that each of the elements require investors to form beliefs about probabilities and consequences. These beliefs cannot be anchored on reliable data or decades of research. Instead, they rely on professional judgements on issues where there might be a wide range of opinions, suggesting that the plausible range for the liquidity risk premium will also be wide. It is the imperfect knowledge of the liquidity risk premium that makes the sovereign bond market vulnerable to a self-fulfilling crisis in the MSPR model.

This is illustrated graphically in Figure 2.1. It shows the relationship between beliefs about the probability of a solvency shock being large enough to trigger a liquidity crisis and the period 0 interest rate. The perfect knowledge equilibrium is unique and shown at point A. However, because there is a plausible range for estimates of what size solvency shock is needed to trigger a liquidity crisis, as well as how the economy adjusts to shocks and the policy risk premium, there is a cone of ‘sunspot equilibria’<sup>12</sup>. When the true probability of a liquidity crisis is low there is a zone of excess volatility, but it is reasonably narrow with no scope for a self-fulfilling crisis; as the true probability of a liquidity crisis rises the scope for excess volatility is increased and a self-fulfilling crisis becomes possible; and, finally, there is a true probability of a liquidity crisis at which a crisis becomes inevitable.

Figure 2.1: The equilibrium interest rate under perfect and imperfect knowledge



The MSPR model provides important insights into the origins of the excess volatility of sovereign bond yields in the euro area. It suggests that there are two main components. The first component is volatility

<sup>12</sup>The term sunspot equilibria is used loosely to signify fragility in which trivial news can lead to large changes in bond yields. However, no extrinsic random variable, or sunspot, is identified in the model that can be used to determine the equilibrium.

induced by the presence of the liquidity risk premium. The root cause of this is the non-linearity introduced by the threshold for a liquidity crisis – i.e., the interest rate at which the sovereign loses market access. This causes the interest rate to exhibit heightened sensitivity to fundamentals once the market is in a bad equilibrium. The second component is volatility induced by the presence of sunspot equilibria. This is caused by investors' imperfect knowledge of the probability distribution of solvency shocks and the policy risk premium as well as uncertainty about how the euro might have affected the way economies adjust.

The MSPR model makes some important predictions. The first is that the increase in bond yields will most likely reflect a broad range of factors, driven by changes in investor beliefs about solvency, liquidity, and policy. While changes in investor beliefs about solvency are an essential component of the model the role of changes in investor beliefs about liquidity and policy should be considered as an empirical rather than theoretical issue. This contrasts with the strategic default theory which places investor beliefs about the fiscal policy of the government on a pedestal above all other causes. The second is that, starting with imperfect knowledge, investors are likely to undergo a learning process. This should happen in response to new information and is especially relevant for the policy risk premium given that the policy framework evolved throughout the crisis. It also implies that the cone of plausible beliefs, and hence the role of sunspot equilibria and the scope for self-fulfilling crises also, should narrow over time as knowledge is acquired.

## 2.5 Empirical model

The MSPR model suggests that sovereign bond yield spreads are determined by changes in investor beliefs about solvency, liquidity, and policy. This section estimates a simple empirical version of this model with a view to understanding which changes in beliefs mattered most, the relative importance of heightened sensitivity to fundamentals and the sunspot equilibria, and the extent to which the results are consistent with the MSPR and strategic default theories of the crisis.

### 2.5.1 Data sources and categorisation

One of the problems of conducting empirical analysis on the sovereign bond crisis is the complex nature of the variables entering the model. In some cases, although there are quantitative data available, an assessment of

its importance requires detailed analysis in each case. For example, in the case of government debt auctions there are many metrics that may matter, such as coverage ratios and the average yield. But the impact will depend on what was expected prior to the auction, data for which are unavailable. Even for the case of assessing solvency, while conventional measures such as monthly economic and fiscal data may matter there are several other factors that may matter more in a crisis, such as indicators concerning the health of the banking system and any contingent liabilities they may represent. This level of complexity is close to impossible to capture with quantitative data sources. To overcome these data problems some researchers have turned to using qualitative data (Beetsma et al. 2013; Mohl and Sondermann 2012; Gade et al. 2013; Ganem 2020). Political communication regarding the likelihood of PSI, for example, is qualitative in nature and subject to interpretation. But these studies have relied on analysis of thousands of news stories to determine an average effect. The problem with this approach is that most of the thousands of communications will have been of limited relevance.

This paper uses qualitative data in a restricted and targeted way that focuses on real-time beliefs about what caused large daily changes in bond yields. A daily survey of investors asking them to explain their asset allocation decisions during the crisis would be ideal but, to the best of the author's knowledge, no such survey exists. However, one data source comes close to this ideal: the daily Global Overview reports in the Companies and Markets section of the Financial Times. These reports reflect the Financial Times' market reporter's best assessment, based on discussions with contacts in financial markets, of what has driven changes in market prices each day. Consequently, these reports can provide an important insight into the changes in beliefs of investors that drove the largest changes in bond yields during the crisis. The Global Overview reports consist of about 650 words of commentary on the major developments in financial markets of the previous day. Typically, the commentary first describes these developments and then provides an interpretation of the reasons for these developments. In this way the reports help to identify not only the most significant changes in bond yields during the crisis but also provide an indication of the changes in beliefs associated with the most significant changes in bond yields. By categorising the changes in beliefs, these reports provide insight into the origins of the volatility in bond yields.

The text of the Global Overview reports was coded manually, and the taxonomy used to categorise

changes in beliefs reflects the structure of the MSPR model. There are therefore three broad categories of belief indices. The first encompasses beliefs about solvency risks and covers growth, fiscal data and policy, and banking system sub-types. The second covers beliefs about liquidity risks, including rating agency, auction, and margin requirement sub-types. The third is beliefs about policy risks, covering the ESM and PSI sub-types. When any of these beliefs were suggested as a reason for a change on bond yields, they were assigned a score of +1 if it led to a decrease in bond yields and a score of -1 if it led to an increase in bond yields. Further explanation of how the belief indices were constructed, the raw text extracted from the reports, and how it has been categorised is detailed in Appendix A.1 while the data used in estimation are shown in Appendix A.2.

### **2.5.2 Econometric model**

The MSPR model provides an explanation for bond yield spreads when the market is in a bad equilibrium. In the MSPR model a bad equilibrium is defined as beginning at the point where market concerns about loss of market access first arise and end either when a liquidity crisis occurs or when there is a definitive end to market concerns. Consequently, the phase is unique for each country. The point at which market concerns are deemed to start is necessarily a matter of judgement and data availability. In practice, the start has been identified based on a combination of (i) casual observation of when bond spreads with Germany began to increase in volatility after a period of stability and (ii) when movements in bond yields began to feature regularly in the Financial Times Global Overview reports.

Four countries are analysed: Ireland, Portugal, Italy, and Spain. Greece was excluded from the analysis because it is generally recognised as having been insolvent, even at low interest rates, and hence does not constitute an example of falling into a bad equilibrium. For Ireland the sample period selected was from 3 August 2010 to 26 November 2010; for Portugal it is from 16 December 2010 to 3 May 2011; for Italy it is from 30 June 2011 to 9 November 2011; and for Spain it runs from 21 March 2012 to 24 July 2012. In the case of Ireland and Portugal the endpoint in the sample is two days prior to the formal approval of an ESM programme; for Italy it is the local peak in yields; and for Spain it is two days before Mario Draghi's "whatever it takes" speech in London (which marked the beginning of the end of the acute phase of the

sovereign debt crisis).

The country-specific sample periods over which the model needs to be estimated means that the panel data approach typically used in the literature is not suitable. Unsurprisingly, given how the belief indices are constructed, pre-testing showed that the residuals from simultaneous equation time series methods were non-Gaussian<sup>13</sup>. However, Granger causality tests indicated that spread variables were Granger non-causal for the belief indices, suggesting that single-equation time series approaches are appropriate. With all variables found to be I(0) or I(1), and both the Johansen Trace and Maximum Eigenvalue tests indicating at most one co-integrating vector was present, the ARDL/Bounds Testing methodology of Pesaran and Shin (1999) and Pesaran et al (2001) was used.

The ARDL model took the following general form:

$$Y_t^i = \alpha + \beta Z_{t-1}^i + \gamma Y_{t-1}^i + \Gamma \Delta Z_t^i + \Pi D_t^i + \epsilon_t^i \quad (2.19)$$

Where  $Y_t^i$  is the ten-year bond yield spread to Germany at time t of country i;  $\beta$  is a column vector of coefficients;  $Z_{t-1}^i$  is a row vector of non-stationary composite beliefs indices at time t for country i;  $\Gamma$  is a column vector of coefficients;  $\Pi$  is a column vector of coefficients;  $D_t^i$  is a row vector of dummy variables; and  $\epsilon_t^i$  is a white noise error term.

The estimation process took the following structure. For the purposes of parsimony, and the avoidance of over-fitting given relatively small sample sizes of around 100 observations, competing models were selected using the Schwarz criterion. Where serial correlation was indicated, given the importance of serial independence of the errors for the Bounds-Testing approach, a strategy of increasing lags and using the Akaike criterion was employed until serial correlation was no longer indicated. The presence of a level relationship between the variables was judged against the I(1) F-Bounds Test critical values. The statistical significance of the coefficients was assessed using HAC standard errors as a precaution against the presence of heteroskedasticity often found in financial time series and any remaining serial correlation.

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<sup>13</sup>Full details of all pre-testing diagnostics are reported in Appendix A.3.

### 2.5.3 Benchmark (BMK) model results

The estimation results for both an initial and final benchmark (BMK) model are reported in Table 2.3. Owing to how the belief indices have been constructed the coefficients on all variables in the model are expected to be negative and this was found to be the case for all statistically significant variables, both in the initial and final benchmark models. All models exceed the 5% critical values for the I(1) F-Bounds Test, suggesting the presence of a level relationship, and also display strong error correction properties. There is no evidence of serial correlation in any of the models and the fit of the models is also generally good. Standard post-estimation checks (Appendix A.4) and tests for robustness and stability were conducted (Appendix A.5) along with some final checks against the possibility of endogeneity of the belief variables (Appendix A.6).

The testing down process between the initial and final models involved excluding statistically insignificant variables and including dummy variables for a small number of well-known events that might be expected to have an outsized impact. These included dummies for the Sarkozy-Merkel statement in Deauville on private-sector involvement and the decision by Clearnet to increase margin requirements in the Ireland model; and for the Italy model dummies for the Eurogroup meeting that signalled greater acceptance of private-sector involvement for Greece and an episode of unusually large-scale ECB intervention. For Portugal and Spain no dummy variables were included.

The final benchmark model results show a statistically significant level relationship between yield spreads and solvency beliefs at the 1% level in all four countries. The level relationship between yield spreads and liquidity beliefs is more varied with Ireland and Portugal exhibiting no relationship at all but Italy and Spain showing a strong relationship. This is consistent with the MSPR prediction that solvency beliefs are an essential component driving bond yields while the role of liquidity and policy beliefs will be more idiosyncratic. In Ireland and Portugal liquidity beliefs were predominantly driven by rating agency actions while in Italy and Spain the main drivers were central bank interventions and auctions.

The relationship between yield spreads and policy beliefs is also idiosyncratic but generally consistent with the real-time evolution of the policy framework for dealing with the crisis. Policy beliefs are statistically significant in Ireland and Italy only via the dummies used to capture the major milestones in the crisis regarding PSI policy. There is no role for PSI policy in Portugal and Spain because there is no instance

Table 2.3: Initial and final benchmark models (BMK)

	Ireland		Portugal		Italy		Spain	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
<b>Level Relationship</b>								
$SOL_{it}$	-2.309*** (0.800)	-0.958*** (0.348)	-0.209* (0.112)	-0.220*** (0.075)	-0.901*** (0.203)	-0.589*** (0.059)	-0.172*** (0.024)	-0.205*** (0.049)
$LIQ_{it}$	-0.013 (0.400)		0.000 (0.075)		-0.169 (0.126)	-0.227*** (0.063)	-0.115*** (0.043)	-0.183** (0.078)
$POI_{it}$	-1.372*** (0.477)		-0.536*** (0.130)	-0.529*** (0.130)	0.261 (0.263)		0.117 (0.083)	
$DUM\_PSI_{it}$		-1.823*** (0.444)				-1.229*** (0.224)		
<b>Error Correction Regression</b>								
$\sum \Delta Y_{t-j}$			-0.253** (0.107)	-0.244* (0.124)				
$\sum \Delta SOL_{t-j}$			-0.346*** (0.062)	-0.337*** (0.046)			-0.162*** (0.027)	-0.144*** (0.030)
$\sum \Delta LIQ_{t-j}$			-0.075*** (0.026)	-0.072*** (0.016)	-0.140*** (0.030)	-0.136*** (0.027)	-0.137*** (0.030)	-0.151*** (0.034)
$\sum \Delta POI_{t-j}$			-0.160*** (0.029)	-0.158*** (0.029)	-0.234*** (0.044)	-0.257*** (0.037)	-0.740*** (0.129)	-0.335*** (0.068)
$\Delta DUM\_LIQ_{it}$						-0.546*** (0.115)		
$ECM_{it-1}$			-0.119*** (0.027)	-0.121*** (0.030)	-0.163*** (0.024)	-0.252*** (0.031)	-0.268*** (0.042)	-0.142*** (0.035)
<b>Key Test Statistics</b>								
$R^2$	0.38	0.56	0.48	0.48	0.54	0.66	0.59	0.47
SE	0.17	0.14	0.09	0.09	0.13	0.11	0.12	0.13
LM $\chi^2$ test p-value	0.24	0.77	0.	0.72	0.61	0.56	0.08	0.94
F-Bounds Test I(1)	3.26	5.20***	4.47**	5.36**	8.93***	13.02***	7.87***	4.03**

\*Significant at the 10% level

\*\*Significant at the 5% level

\*\*\*Significant at the 1% level



during their crises when PSI policy enters their policy beliefs indices. But there is a statistically significant role for ESM policy beliefs in Portugal, consistent with this being a period when the ESM policy framework became more fully established. The absence of a statistically significant role for any policy beliefs in Spain, despite ESM policy beliefs contributing to the policy beliefs index, is perhaps a reflection that, ultimately, both Spain and Italy were viewed as too large to be supported via an ESM programme. This is consistent with the crisis in Spain precipitating Draghi's "whatever it takes" moment.

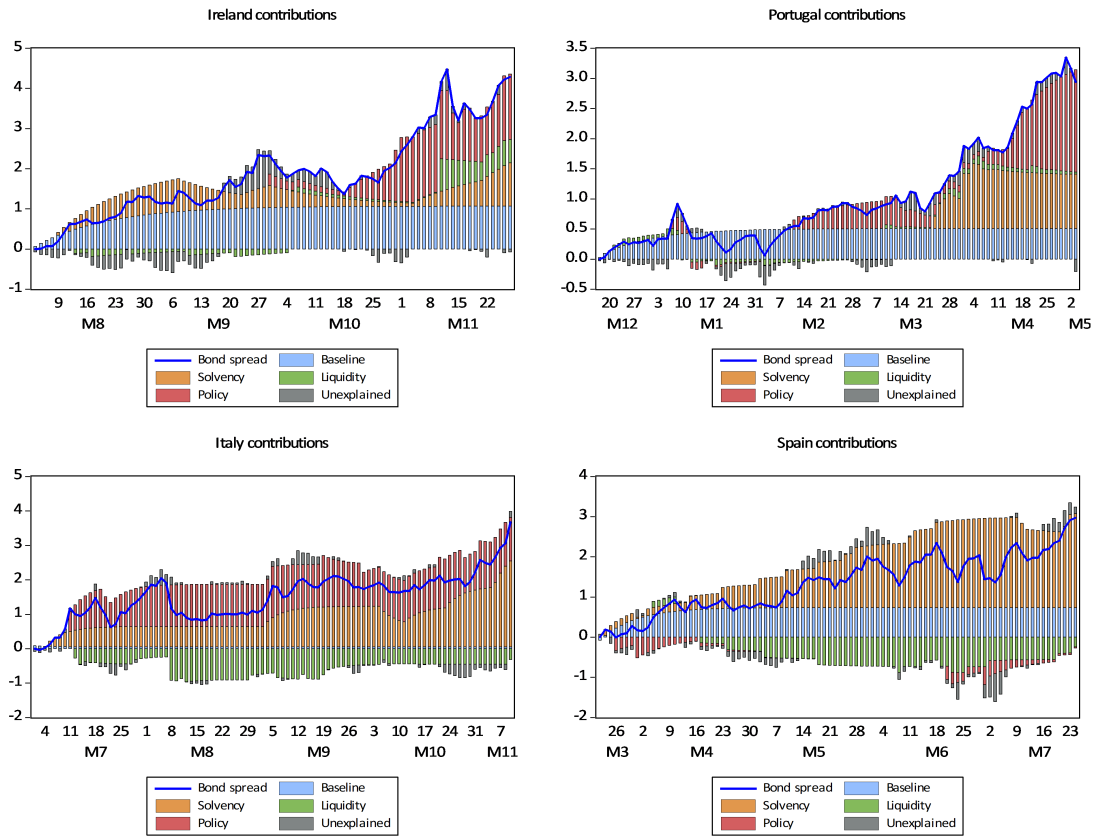
#### **2.5.4 BMK model decomposition analysis**

The estimation results provide an indication of which beliefs played a statistically significant role during the crisis in the four countries. However, the way the belief variables are constructed means that the estimated coefficients, except for the dummy variables, do not convey much information about how much each type of belief contributed to the changes in bond yields. To assess this requires a decomposition analysis through which the contributions of each type of belief is quantified. This is achieved through a simulation exercise in which a baseline scenario is constructed assuming no changes in the belief indices after which each belief index is introduced sequentially into the simulation. The contribution of each variable is obtained by comparing each simulation with the baseline scenario.

Figure 2.2 shows the decompositions using the final BMK model. In the case of Ireland there is a strikingly large role for policy beliefs in late October 2000. This followed the Deauville Summit on 19 October which announced the possibility of PSI for the first time. Despite subsequent efforts to damp concerns about PSI being partially successful they came too late to prevent a liquidity crisis given the unexpected announcement from LCH Clearnet to raise margin requirements. This triggered significant upward pressure on yields from the liquidity component. This suggests that investors were forced to revise their beliefs about the trigger point for a liquidity crisis once they learnt of the interaction between bond yield levels and margin requirements.

For Portugal, policy beliefs also played a significant role but only after solvency beliefs had already triggered a step up in yields in late March 2011. The contribution from solvency beliefs was related to the collapse of the Portuguese government and resignation of the Prime Minister, growing evidence that Portuguese banks were in trouble and hence increasing the contingent liabilities of the state, and news that

Figure 2.2: Decomposition analysis using the final BMK model



Portugal’s budget deficit had increased to 8.6% of GDP and some way above the government’s target of 7.3%. Policy beliefs drove the next leg higher in yields when Portugal requested financial assistance from the EU, but the advance of the Finnish Eurosceptic True Finns party threatened its ability to receive any, opening the way for a possible immediate default.

The decomposition of Italy’s increase in yields shows a different pattern from Ireland and Portugal. Policy beliefs played an important role in the initial move higher in yields when euro-area finance ministers first began to indicate that there was the possibility of default in Greece on 7 July 2011. Thereafter, however, the rise in yields was driven entirely by solvency beliefs related to the stability of the Italian government. Like Portugal, liquidity beliefs had a limited impact on yields and, if anything, acted to damp the increase. This was mainly a consequence of ECB intervention, but the model results indicate that the impact of such interventions was not substantial because its effects were transitory.

Finally, in Spain, the increase in yields was driven entirely by solvency beliefs with virtually no role

for liquidity or policy beliefs. It primarily reflected a steady stream of disappointing macroeconomic news and growing evidence that the banking system was in trouble. On the macroeconomic side it started with disappointing growth data but morphed into a full-blown recession with sharply rising unemployment. On the banking side it steadily became clear that one of Spain's largest banks, Bankia, was in serious trouble. It was then not long before the Spanish government sought rescue funds for its banks and the rating agencies downgraded a whole swathe of the Spanish banking system. The final nail in the coffin was when some of Spain's regional governments, starting with Valencia, fell into difficulties and requested assistance from Madrid.

The picture that emerges is one where solvency beliefs are found to be both statistically significant and quantitatively important in all four countries. The statistical significance and quantitative importance of other investor beliefs – liquidity and policy – are found to be more idiosyncratic. Other than for Ireland, where investors had underappreciated the aggravating effect of rising margin requirements as yields increased, the role of liquidity beliefs in driving bond yields is very limited. Auctions of sovereign debt, rating agency actions and interventions by the ECB all seem to have had only transitory, short-term, effects on the level of yields. Policy beliefs, by contrast, were both statistically significant and quantitatively important for the level of yields in Ireland, Portugal, and Italy but for Spain they had only transitory effects. This difference may reflect uncertainty about the policy framework having been largely eliminated by the time concerns had spread to Spain.

The results also show that, while fiscal policy had some role in driving yields, it was by no means dominant, as might be expected to be the case if strategic default was the principal concern of investors. Table 2.4 shows that, across the four countries, the contribution of solvency beliefs to the rise in yields ranged from 100% in Spain to 40% in Portugal. At the same time, the contribution of the fiscal policy beliefs to the solvency beliefs index ranges from just 10% in Spain to nearly 50% in Italy. Multiplying the two proportions gives an approximation of the contribution of fiscal policy beliefs to the rise in yields and in three of the four countries it accounts for 20% or less. Only in Italy is the contribution from fiscal policy beliefs larger and, even then, it accounts for less than half of the rise in bond yields. This suggests that, as the MSPR model predicts, investors were focused on a broad range of factors, with fiscal policy a secondary factor in most

Table 2.4: Contribution of the fiscal policy sub-type of belief to the rise in yields

<b>Contributions, %</b>	<b>Ireland</b>	<b>Portugal</b>	<b>Italy</b>	<b>Spain</b>
<b>Of solvency beliefs to the rise in yields</b>	49	40	68	100
<b>Of fiscal policy sub-type to solvency beliefs</b>	33	50	70	10
<b>Of fiscal policy sub-type to the rise in yields</b>	16	20	47	10

cases.

Finally, the results support the idea of investor learning embodied in the MSPR model. The first is the fact that only in Ireland, the first of our four countries to enter a bad equilibrium, was there a meaningful contribution from liquidity beliefs, notably from margin requirements. The Clearnet dummy for Ireland is estimated to have had an initial impact of nearly over 80bp, while for Portugal, Italy, and Spain the raising of margin requirements is estimated to have had an impact of no more than 15bp. The second feature consistent with a learning process is the diminishing role for policy beliefs as the crisis developed. This seems a natural consequence of the policy framework becoming more settled over time. Consequently, by the time the crisis had engulfed Spain the details of the ESM were already established and hence the focus was squarely on the risk of a liquidity crisis from changes in solvency beliefs, with little role for changes in liquidity or policy beliefs.

### 2.5.5 Fundamental and sunspots (FAS) model results

Although the BMK model identifies the role of different types of beliefs in the rise in bond yields there remains uncertainty over the extent to which the volatility reflected heightened sensitivity to fundamentals as opposed to the presence of sunspot equilibria. The MSPR model suggests that in a bad equilibrium there is a role for both, with changes in fundamentals eliciting larger-than-normal moves in yields but there also existing, for any given set of fundamentals, a cone of plausible beliefs within which trivial developments may fuel the emergence of sunspot equilibria. To address this issue the beliefs variables in the BMK model were decomposed into “fundamental” and “sunspot” indices. The fundamentals indices include only beliefs in which there is a clearly identifiable fact, such as economic data releases, a rating agency change, or an ECB

policy change. By contrast, the sunspots indices include only beliefs where there is no clearly identifiable fact and instead only commentary, fears, perceptions, rumours, or suchlike.

Table 2.5 reports the estimation results from both the initial and final “fundamentals and sunspots” (FAS) model. The initial FAS model included only fundamental and sunspot indices for those variables included in the final BMK model, after which the same testing down procedure for the BMK model was used to obtain the final FAS model. The first point to make is that the final model is consistent with the crises exhibiting both heightened sensitivity to fundamentals and sunspot equilibria: at least one of each were found to be statistically significant in the levels and dynamic relationships in all four countries. The most consistent findings are for statistically significant roles for solvency sunspots and policy fundamentals. The former is found in all four countries while the latter is found in all countries bar Spain. As has already been noted, the Spanish exception is consistent with the ESM policy framework having been fully articulated by the time its crisis had begun.

There are two other noteworthy findings. The first is that the coefficient on the solvency sunspots indices declines steadily through the crisis, falling from -1.424 in Ireland to -0.263 in Spain, while the role of solvency fundamentals, having been absent in Ireland and Portugal, was statistically significant in the case of Italy and Spain. This is another finding consistent with the prediction from the MSPR model of learning by investors, reducing the influence of solvency sunspots and increasing the role of solvency fundamentals over time. The second is that liquidity sunspots were found to be statistically significant in the case of Italy and Spain but not for Ireland or Portugal. The liquidity sunspot indices were driven primarily by perceived positive auction results in the case of Spain and repeated reports of ECB intervention in the case of Italy. This finding may therefore just reflect Spanish primary bond market demand having held up surprisingly well relative to the experiences of other countries and the ECB stepping up its Securities Market Programme purchases in the case of Italy.

### **2.5.6 FAS model decomposition analysis**

Figure 2.3 shows the contributions from the final FAS model to the rise in yields. Both fundamentals and sunspots are found to be important drivers in the case of Ireland and Portugal but only fundamentals

Table 2.5: Initial and final fundamentals and sunspots model (FAS)

	Ireland		Portugal		Italy		Spain	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final
<b>Levels Relationship</b>								
$SOL_{F_t}$	-0.511 (0.476)		0.220 (0.215)		-0.579*** (0.149)	-0.579*** (0.149)	-0.334*** (0.120)	-0.409*** (0.120)
$SOL_{S_t}$	-1.536*** (0.478)	-1.424*** (0.516)	-1.407*** (0.434)	-1.339*** (0.256)	-0.808*** (0.152)	-0.808*** (0.152)	-0.240** (0.111)	-0.263** (0.101)
$LIQ_{F_t}$					-0.210*** (0.062)	-0.210*** (0.062)	-0.128 (0.176)	
$LIQ_{S_t}$					-0.295*** (0.085)	-0.295*** (0.085)	-0.320** (0.123)	-0.379*** (0.125)
$POL_{F_t}$			-0.611*** (0.154)	-0.400*** (0.101)				
$POL_{S_t}$			-0.574 (0.353)	-0.387* (0.230)				
$DUM_{PSI_t}$	-1.691*** (0.499)	-1.805*** (0.525)			-1.376*** (0.260)	-1.376*** (0.260)		
<b>Error Correction Regression</b>								
$\sum \Delta Y_{t-i}$								
$\sum \Delta SOL_{F_{t-i}}$	-0.194*** (0.069)	-0.171** (0.071)						
$\sum \Delta SOL_{S_{t-i}}$							-0.181*** (0.050)	-0.182** (0.050)
$\sum \Delta LIQ_{F_{t-i}}$	-0.095* (0.057)	-0.128** (0.054)	-0.061 (0.040)				-0.230*** (0.053)	-0.217*** (0.054)
$\sum \Delta LIQ_{S_{t-i}}$	-0.142 (0.105)		-0.078 (0.053)	-0.106* (0.054)	-0.173*** (0.042)	-0.173*** (0.042)		
$\sum \Delta POL_{F_{t-i}}$	-0.368*** (0.070)	-0.375*** (0.071)	-0.173*** (0.034)	-0.143*** (0.038)	-0.232*** (0.080)	-0.232*** (0.080)	-0.311*** (0.104)	-0.296*** (0.104)
$\sum \Delta POL_{S_{t-i}}$	-0.166*** (0.073)	-0.147* (0.076)	-0.150*** (0.055)		-0.279*** (0.042)	-0.279*** (0.042)	-0.376*** (0.073)	-0.366*** (0.073)
$\Delta DUM_{LIQ_t}$	-0.810*** (0.139)	-0.828*** (0.141)			-0.551*** (0.119)	-0.551*** (0.119)		
$ECM_{t-1}$	-0.086*** (0.019)	-0.083*** (0.020)	-0.125*** (0.027)	-0.140*** (0.033)	-0.222*** (0.026)	-0.222*** (0.026)	-0.176*** (0.035)	-0.173*** (0.035)
<b>Key Test Statistics</b>								
$R^2$	0.61	0.59	0.48	0.30	0.67	0.67	0.45	0.45
SE	0.14	0.14	0.09	0.10	0.11	0.11	0.13	0.13
LM $\chi^2$ test p-value	0.46	0.53	0.75	0.14	0.55	0.55	0.98	0.97
F-Bounds Test I(1)	4.02**	4.20**	3.82**	4.39**	9.55***	9.55***	3.98**	4.64**

\*Significant at the 10% level

\*\*Significant at the 5% level

\*\*\*Significant at the 1% level

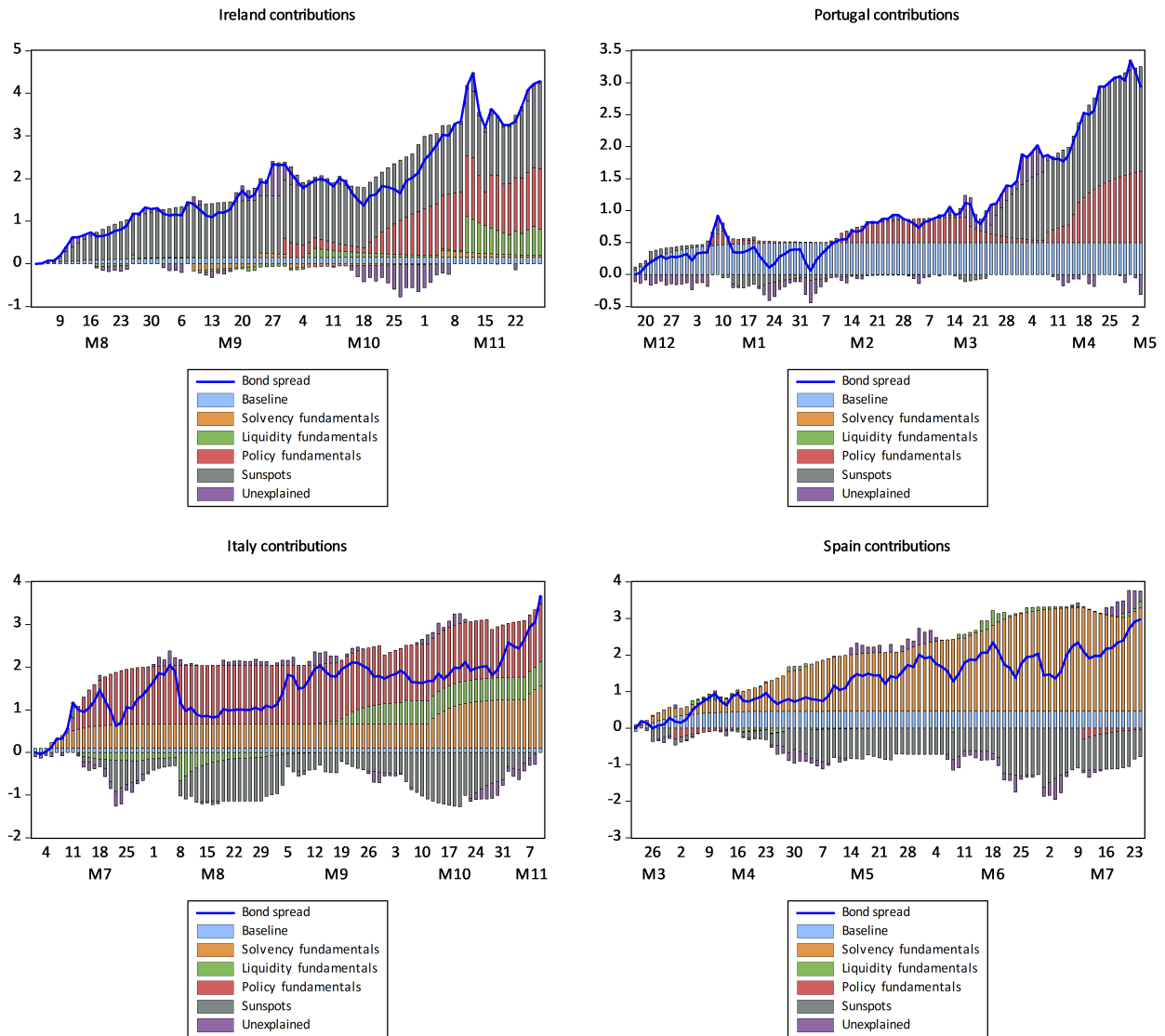
mattered in the case of Italy and Spain. The result for Italy is consistent with previous analysis of the behaviour of debt maturity structures that finds a small role for self-fulfilling rollover risk (Bocola and Dovis, 2016). And, for Spain, sunspots are found to have helped to contain the rise in bond yield spreads. But these overall results disguise a continuing role for solvency sunspots in the case of Italy and Spain that was offset by the effect of liquidity sunspots. As has already been noted, the latter reflected a succession of auction results in the case of Spain that were interpreted positively by investors as a sign of strong investor demand in the primary market while in the case of the latter it reflected successive reports of ECB intervention in the market. Once again, the results show that the role of policy fundamentals was significant in the case of Ireland, Portugal, and Italy but in the case of Spain they played no role.

A full decomposition is shown in Table 2.6, breaking down the contribution from fundamentals and sunspots to each of the solvency, liquidity, and policy categories across the four countries. Solvency sunspots were a substantial contributor to the rise in yields, exceeding 100bp, in all four cases but in Spain and Italy there is an even larger negative contribution from liquidity sunspots. Perhaps even more striking is the joint evolution of the contributions from solvency fundamentals and sunspots. While important in all countries, the contribution from solvency sunspots steadily declined from 192bp in Ireland to 100bp in Spain. At the same time, the contribution from solvency fundamentals increases substantially from essentially zero in the case of Ireland and Portugal to 146bp in the case of Italy and 282bp in the case of Spain. This pattern, in which the role of solvency sunspots declines, and solvency fundamentals increases, is consistent with an initial imperfect knowledge equilibrium followed by a process of investor learning as predicted by the MSPR model. It also implies that the cone of plausible beliefs, and hence the scope for a self-fulfilling crisis, was diminishing throughout the crisis.

## 2.6 Concluding discussion

Existing theoretical models of the crisis driven by self-fulfilling beliefs have been founded on the concept of strategic default. Once interest rates rise to a certain level the government chooses to default. It is not a question of capacity to pay, but willingness. Feedback from higher interest rates on the level of interest rate payments introduces multiple equilibria in which movements in bond yields become detached

Figure 2.3: Decomposition analysis using the final FAS model



from fundamentals and are instead driven by investor beliefs about the level of interest rates at which the government is expected to choose default. This paper has challenged the strategic default theory on three grounds (i) the strong incentives of euro-area governments to avoid default (ii) the low interest rates and market implied probabilities of default at the time of the liquidity crises and (iii) the clear evidence that fiscal austerity was self-defeating during the crisis. It has then articulated an alternative theory, presented a simple model based on the theory, and tested it empirically.

The foundations for the paper's alternative theory of the crisis are the euro area's legacy bond market structure and a complex policy risk premium. These were then incorporated into a simple stochastic Market



Table 2.6: Contributions from the FAS model

<i>Basis points (contributions &gt; 100bp (absolute) in red)</i>	<b>Ireland</b>	<b>Portugal</b>	<b>Italy</b>	<b>Spain</b>
<b>Contribution of solvency</b>	<b>196</b>	<b>132</b>	<b>275</b>	<b>382</b>
o/w fundamentals	4	0	146	282
o/w sunspots	192	132	129	100
<b>Contribution of liquidity</b>	<b>62</b>	<b>0</b>	<b>-76</b>	<b>-160</b>
o/w fundamentals	62	0	57	17
o/w sunspots	0	0	-133	-177
<b>Contribution of policy</b>	<b>149</b>	<b>143</b>	<b>142</b>	<b>0</b>
o/w fundamentals	141	111	135	-4
o/w sunspots	8	32	7	4

Structure-Policy Risk model. An empirical version of the model was tested against an innovative dataset with features that help to capture the most important changes in investor beliefs during the crisis. The empirical findings were found to be consistent with predictions of the MSPR model. The results also further challenged the strategic default theory: most significantly fiscal policy was found to be only one of a broad range of factors that account for the volatility in bond yields during the crisis. Solvency risks were found to be consistently important, but the role of liquidity and policy risks were found to fluctuate over time. There is clear evidence of investor learning. The role of solvency sunspots declined, and solvency fundamentals increased, suggesting that the scope for a self-fulfilling crisis diminished over time.

Importantly, the MSPR model can explain the perception that the volatility is due to self-fulfilling beliefs. The market structure creates a non-linearity that leads to bond markets exhibiting heightened sensitivity to changes in fundamentals. These fundamentals range across solvency, liquidity, and policy considerations but with the most important being solvency. As a result, while policy fumbling contributed to volatility when politicians were developing their response to the crisis, by the time Spain became embroiled it was solvency shocks linked to the collapse of its banking system that was the main driver. Moreover, the model suggests

that the OMT policy of the ECB did not work by coordinating investor beliefs around a good equilibrium but by directly reducing the policy risk premium that investors would be confronted with in the event of a liquidity crisis. It can also explain why the election of a populist government resistant to the ESM caused bond yield spreads to widen sharply after the OMT policy was introduced.

The MSPR model supports the idea that the euro-area bond market remains vulnerable to falling into a bad equilibrium. But, due to investor learning, especially concerning the policy risk premium, the continuing volatility now most likely reflects heightened sensitivity due to the presence of a non-linearity in the market structure rather than sunspot equilibria and the possibility of a self-fulfilling crisis. This has some important policy implications. First, as regards the bond market, it suggests a first-best policy is to address the market failure that creates the non-linearity in primary bond markets. Second, to the extent that the market failure cannot be eliminated either for economic or political reasons, one second-best option would be to improve resilience by reducing the policy risk premium as well as improving the ability of economies to adjust in the face of solvency shocks. Another second-best option, and arguably the dominant policy until the pandemic, is to use tools of financial repression to counter the effect of the market failure on borrowing spreads and volatility.

How can the market failure be addressed? When the solvency risk premium increases a group of investors favouring safe assets withdraws but is not replaced by other investors who favour risky assets. Consequently, the MSPR model suggests that previous calls for tiered sovereign bond issuance would be effective (De Grauwe and Moesen 2009, Weizsacker and Delpla 2010, European Commission 2011). The issuance of senior “blue” and junior “red” bonds that create segmented default risk would help to overcome the non-linearity. Red bond investors would likely continue participating in the primary market at higher levels of solvency risk while blue bond investors would only need worry about solvency risk in the face of much larger shocks that cannot be dealt after default on its red bonds. While tiered bond issuance would make the sovereign bond markets more stable it would undoubtedly increase the cost of issuance for some, possibly all, sovereigns and entails some level of cross-subsidy from the core to the periphery.

A second-best policy implies accepting the market failure and managing it. The MSPR model highlights two potential methods. The first is to reduce the magnitude of the shocks that hit the economy and thereby

lower the chance of entering a bad equilibrium in the first place. In principle, this can be done by managing macroeconomic imbalances, although this may be difficult to achieve in practice (Hume 2022c). And there will always be large-scale exogenous shocks to contend with. The pandemic has been a stark reminder of that. Consequently, this is not a sure-fire way of managing the problem. The second method is to damp feedback loops between the economy, solvency, and interest rates. This can be approached from several angles but all entail reducing the cyclicity of the public finances in some form or another. If it is assumed that euro-area governments are unwilling to reduce the level of insurance they provide citizens against the vagaries of the economic cycle, however, then that leaves only two viable options for a modern advanced economy such as the euro area: financial repression or common debt management.

Traditionally, financial repression has referred to the practice of directing investment to the sovereign through financial regulations, including such things as interest rate ceilings, margin requirements, and moral suasion. But, in more recent times, it can be thought of as capturing the effect of government bonds being “increasingly populated by nonmarket players, notably central banks” (Reinhart and Sbrancia 2015). There have been two components. The first is lending against sovereign bond collateral on attractive terms to the banking system with government bonds receiving a zero risk-weight in capital adequacy assessments. Note, however, that this serves to increase the underlying vulnerability by making the sovereign-bank nexus worse. The second component is large-scale purchases of sovereign debt in the secondary markets. This has undoubtedly helped to suppress spreads and volatility, but it is also state contingent in the sense that it is unlikely to persist if inflation increases and central banks adjust their main policy rates above the zero lower bound. It is therefore not a policy that can necessarily be relied on in the absence of a profound re-interpretation of the ECB’s mandate. A return to traditional forms of financial repression is always possible, however.

Common debt management breaks the cyclical link more fundamentally by divorcing the public debt from national economic conditions. In principle a debt union would address the problem more decisively, by making all national debts equivalent. However, debt unions come with other problems that cause them to be unsustainable (von Hagen 2014). Consequently, in practice, it will require some form of fiscal union that shifts some of the responsibility for macroeconomic stabilization away from national governments and

towards centralized and shared fiscal arrangements. The recent pandemic reforms have taken the EU along this path with unemployment re-insurance and grants funded at the EU level as part of the Covid recovery plan. The MSPR model suggests that this should have the effect of reducing the sensitivity on bond yields to shocks and lead to greater stability. But this assumes that the market structure for euro-area government bonds does not change. That is an assumption that is unlikely to hold in any transition away from national to common debt management.

## Chapter 3

# A Bayesian SVAR Model of Persistent Euro-Area Imbalances

### 3.1 Introduction: Uncertain origins and policy effectiveness

Over recent years, a consensus has emerged among economists concerning the causes of the euro-area crisis. More than seventy leading economists across academia, public sector institutions, the private sector and think tanks have subscribed to a consensus narrative suggesting that one of the causes of the crisis were “policy failures that allowed imbalances to get so large” (Baldwin and Giavazzi 2015: p49). Given this consensus view, it is thought to be essential that macroeconomic imbalances are managed more effectively in the future. This paper contributes to this policy imperative by assessing the drivers of intra-euro-area macroeconomic imbalances using a hitherto unused modelling framework and providing an assessment of the potential effectiveness of different macroeconomic and structural policies for managing them.

The European Commission defines imbalances as “*any trend giving rise to macroeconomic developments which are adversely affecting, or have the potential to adversely affect, the proper functioning of the economy of a Member State or of the Economic and Monetary Union, or of the Union as a whole*” (Regulation (EU) No 1176/2011, Article 2, para. 1). This definition is motivated by the macro-financial risks that such macroeconomic developments present and as such an important aspect is the accumulation of net financial

claims between economic sectors. Reflecting this, economic indicators that have historically been associated with the accumulation of these claims and generated macro-financial risks, such as current account balances, competitiveness, asset prices, and private-sector credit growth, are used by the European Commission to assess the existence of macroeconomic imbalances.

The pre-crisis policy for dealing with competitiveness and external imbalances in the euro area can best be described as one of benign neglect. There was a strong belief in the disciplining effects of membership of the single currency and how this would “lead to the further alignment of economic cycles” (Issing 2004: p.26). This is not to suggest that current account imbalances were not expected to arise from time to time. To the extent that financial integration was expected to spur greater income convergence among the members of the euro area and lead to the emergence of current account imbalances it was thought that they were structural, sustainable, and desirable (Blanchard and Giavazzi 2002). To the extent that asymmetric demand shocks hit national economies and led to current account imbalances it was thought that they would be cyclical, temporary, and self-correcting. In other words, it was thought that there were economic mechanisms in place to ensure that there was little need for policy to aid the adjustment process.

The pre-crisis policy for dealing with other macroeconomic imbalances was only slightly more developed and targeted mostly at delivering the broader objective of monetary and financial stability. It consisted of three principal mechanisms. First, monetary stability would be maintained at the euro-area level by the politically independent European Central Bank pursuing a two-pillar strategy oriented around monetary aggregates and consumer price inflation (Issing 2004). Second, financial stability would be achieved through micro-prudential supervision of financial institutions and infrastructure at the national level and “part of the Single Market Programme, institutionally separate from managing the common currency” (Schelke 2017: p.137). Third, to overcome the common pool problem created by monetary union the Stability and Growth Pact imposed constraints on national fiscal policies (Stark 2001, Costello 2001). It is now clear that this pre-crisis policy framework was flawed. While the ECB delivered monetary stability in terms of its inflation target, the Stability and Growth Pact was honoured mostly in the breach and micro-prudential supervision completely missed the emergence of major macro-prudential risks. The disciplining effects of euro membership proved less powerful than anticipated with changes in competitiveness and current account

imbalances more persistent than originally envisaged. The result was that structural and cyclical forces put economies on a path of external debt accumulation on a scale not seen in other advanced economies, and were left largely unmanaged, creating a dangerous vulnerability to a change in economic circumstances. The origins of these structural and cyclical forces remain hotly debated with several explanations advocated.

Most economists acknowledge that the introduction of a common interest rate was a factor explaining the emergence of macroeconomic imbalances (Baldwin and Giavazzi 2015). But it is generally thought to have run its course by the early-to-mid 2000s and mostly seen as being of secondary importance relative to other explanations for the credit booms (Lane 2015). For this reason, the Walters' critique (Walters 1990) is sometimes invoked to suggest that, even if the initial shock from monetary union may have played itself out after a few years, subsequent inflation divergence resulted in pro-cyclical movements in real interest rates that could have contributed to the persistence of macroeconomic imbalances over a longer period (Giavazzi and Spaventa 2011). However, even if the Walters' critique is relevant, it does not appear to be quantitatively very important (Stracca 2017). Finally, it has been suggested that financial integration and differing speeds of financial liberalisation may have led to divergence in bank interest rates and credit conditions also fuelling macroeconomic imbalances (Cesaroni and De Santis 2015).

Another credit-based explanation is that macroeconomic imbalances were driven by an optimistic growth story in which animal spirits drove a decline in savings and increase in investment in periphery countries. De Grauwe (2010, 2012a) has suggested that this led to self-fulfilling but ultimately unsustainable national credit cycles. There is certainly a clear empirical relationship between optimism about growth and macroeconomic imbalances. For example, Lane and Pels (2012) have shown a strong relationship between growth expectations and external imbalances in a panel regression framework. Crucially, the animal spirits view does not depend on either income convergence or financial integration taking place, although they may have initiated them or amplified them in some cases. Rather, at the heart of this view is the contention that euro-area countries will always be vulnerable to the possibility of national credit cycles driven by animal spirits and that these need to be managed with policy.

An alternative post-crisis view is that they were driven by fiscal policy. This view is associated with the German government but is rarely stated explicitly (Schäuble 2011). There is some evidence to suggest

that fiscal policy may have a larger impact on current accounts in a monetary union. Bluedorn and Leigh (2011) have shown that traditional estimates of the impact of fiscal policy on the current account is probably underestimated due to endogeneity problems, especially in the case of monetary unions. And Abbas et al. (2010) have shown that public sector debt affected the current accounts in euro-area countries. But this explanation is not typically seen as being quantitatively significant. Paul Krugman (2012a) probably speaks for many when he suggests that, even in the case of Greece where fiscal deficits were the largest, the fundamental cause of the imbalances lay elsewhere.

A supply-side explanation is that macroeconomic imbalances were driven by divergent labour market institutions (Hancké 2013; Johnston 2016). Hancké (2013) has argued that the roots of competitiveness divergences can be found in the different responses of public sector unions to the launch of the euro. Prior to the euro, national central banks had contained wage demands across countries. But following the launch of the euro this disciplining device was no longer operative. Consequently, public sector wages increased and put upward pressure on wages in the export-competing manufacturing sectors via a ‘reverse Balassa-Samuelson effect’. More generally, many observers have emphasised the role played by wage restraint of large German manufacturing unions in helping to improve the competitiveness of German firms and contributing to the large increase in the German current account surplus.

Despite the continuing uncertainty surrounding the origins of macroeconomic imbalances several governance reforms have still been agreed and implemented to improve their management. They aim at identifying macroeconomic imbalances at an early stage and enforcing policy actions to correct them in a timely manner. The most important reform in this regard is the Macroeconomic Imbalances Procedure (MIP)<sup>1</sup>. This applies to all EU Member States and includes an Annual Alert Mechanism (AAM) report that uses standardised metrics to detect imbalances in current accounts, competitiveness, house prices, and credit markets. For those countries where macroeconomic imbalances are identified an In-Depth Review (IDR) will be triggered. Based on that review there is the possibility of corrective measures, backed up with fines in the case of euro-area members.

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<sup>1</sup>Regulation (EU) No 1176/2011. Chapter II refers to the Detection of Imbalances (Articles 3-7) while Chapter III refers to Excessive Imbalance Procedure (Articles 8-12).



The MIP's task of identifying and correcting macroeconomic imbalances in real time is not easy. Previous studies have suggested that managing macroeconomic imbalances in a monetary union may not be possible. For some, this is because it rests on national governments attempting to manage capital flows using policies for which they are only loosely related. Capital controls, monetary, and exchange rate policies are simply not available to national governments whose economies are part of the euro area. The policies available include fiscal policy, micro-prudential and macro-prudential policies, and structural policies. Dabrowski (2015: p.19) reviews these policy instruments and concludes that there is "limited potential of national policies in regulating the BoP, current account imbalances, IIP and real exchange rate within a monetary union and single market with unrestricted capital movement". Even those who see some hope in these policies still question whether they will be sufficient. According to Kincaid and Watson (2015: p.14) "reliance cannot be placed solely on the timeliness and adequacy of national fiscal and macro-prudential measures, even when coordinated across borders, to prevent financial stress arising under EMU". But the empirical evidence base upon which these conclusions are based is thin.

Researchers based in official institutions have tended to take a more optimistic view on the whole issue and have emphasised the importance of structural reforms to enhance the flexibility of economies. If prices and wages adjusted more flexibly then, according to this view, through changes in the real exchange rate, demand shocks would be neutralised by real income and expenditure switching effects. For example, Kennedy and Slok (2005) show that external imbalances are more persistent when market rigidities are high. And, relatedly, Zemanek et al. (2010) and Biroli et al. (2010) find that higher price and wage rigidities are associated with slower adjustment in real exchange rates while Ju and Wei (2007) and Berger and Nitsch (2010) find that labour market rigidities are more important than product market rigidities. More recently, the ECB has lent its support to the view that structural reforms should be an important component in the process of managing imbalances (Kamps et al. 2014, Pierluigi and Sondermann 2018) but tangible evidence that such policies will be effective also remain thin on the ground.

Finally, there is the political economy issue of whether such policies could be effectively implemented. According to Alcidi and Gros (2013a: p.14), the country-specific recommendations that have been made since the European Semester has been in place have been "too vague to allow one to judge implementation.

The politically and financially strong countries tend to ignore them. The politically and financially weaker countries usually respond to recommendations on structural policies by taking many measures, but it is often difficult to say whether these measures will achieve the intended result”. Others have focused on the MIP’s asymmetric design. Nine of the eleven thresholds used in the MIPs scorecard for the AMR only signal excessive deficits with no threshold for an emerging excessive surplus and there are different thresholds used in the AMR depending on whether the country has an external surplus (+6% of GDP) or a deficit (-4%). This has long led to claims that the MIP could lead to a deflationary bias in euro-area macroeconomic policy (Bénassy-Quéré and Ragot 2015, Kincaid and Watson 2015, Ederer 2015). Summarising, a recent report for the European Parliament by Bénassy-Quéré and Wolff (2020: p.5) concludes that “Implementation of the country-specific recommendations is low; their consistency is sometimes missing; despite past reforms the MIP remains largely a country-by-country approach running the risk of aggravating the deflationary bias of the euro area”.

The principal contribution of this paper is to apply a Bayesian SVAR analysis to the issue of intra-euro-area imbalances for the first time. Crucially it does so in a way that permits for them to be persistent. This makes the model consistent with the consensus narrative of the crisis. It considers the impact of four structural shocks – fiscal, credit supply, productivity, and labour supply – on a wide range of macroeconomic imbalances as well as the plausibility of using four encompassed policy tools to manage them. Its findings support the claim by Lane (2015: pp.129-130) that “the 2003-2007 period can be characterised as a ‘credit supply’ shock”. But it is not possible to identify whether this reflected the pro-cyclical real interest rate mechanism of Walters (1990), the ‘animal spirits’ national financial cycles of De Grauwe (2010, 2012a), over-optimistic growth expectations of Lane and Pels (2013), or the divergent speeds of financial integration and liberalisation of Cesaroni and De Santis (2015). What the findings do not support, however, is a strong role for either the fiscal policy (Abbas et al. 2010) or the labour market institutions (Hancké 2013; Johnston 2016) as drivers for the critical competitiveness and external imbalances.

As for managing imbalances, the results tend to confirm the pessimistic conclusions of the studies cited above, in that managing imbalances is likely to be difficult. While the importance of credit supply shocks on a wide range of imbalances suggest that macro-prudential policies could be a plausible candidate for

managing competitiveness, there are practical reasons to doubt their effectiveness. Most importantly, the scale of interventions that would likely be needed would be so large as to be incompatible with the concept of the euro area as a single currency with free capital movement. Given the difficulties in implementing the existing MIP framework identified in the political economy literature, pushing macro-prudential policies to these outer limits is not a realistic policy proposal. In that sense, the emergence of large imbalances prior to the crisis should not be seen as a policy failure but as a fact of life in a diverse and financially integrated monetary union. Nonetheless, as part of a combination of policies to improve the resilience of the euro, the use of macro-prudential policies is still worthy of serious consideration.

The paper is organised as follows. Section 3.2 describes the theoretical framework and empirical strategy used to model macroeconomic imbalances. Section 3.3 presents the main results from the model. Section 3.4 provides some conclusions and policy implications.

## 3.2 Modelling macroeconomic imbalances

### 3.2.1 A theory of persistent macroeconomic imbalances

In the years following the launch of the euro, there was a large volume of work that sought to measure the extent to which euro-area financial integration had increased.<sup>2</sup> This showed substantial integration, in terms of both prices and quantities, especially in wholesale markets but also to a more limited extent in retail markets. For most, these trends were seen to be a consequence of monetary union, although the effects of financial liberalisation that took place not only in the euro area but across most advanced economies in the 1990s were also emphasised. Around the same time macroeconomic imbalances emerged in euro-area countries with relatively low per capita incomes, notably in Portugal and Greece where there were current account deficits of between 8%-10% of GDP and public and private sector deficits of roughly 4%-5% of GDP.

The seminal paper in the field of euro-area macroeconomic imbalances – a Brookings Paper by Blanchard and Giavazzi (2002) [hereafter ‘BG’] – was the first theoretically and empirically substantive explanation for

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<sup>2</sup>See, for example, Adam et al. (2002), Cabral et al. (2002), Galati and Tsatsaronis (2003), Santos and Tsatsaronis (2003), Baele et al. (2004), Pagano and von Thadden (2004), Lane and Milesi-Ferretti (2005) and Coueurdacier and Martin (2007).

the co-existence of rapid financial integration and macroeconomic imbalances in the low per capita income countries of the euro area. Eichengreen (2010: pp.1-2) provides a helpful summary and sets out some of its normative implications:

*“The authors focused on savings-investment differentials in the run-up and immediately after the transition to the euro. They showed that savings-investment correlations fell significantly even before but especially with the advent of the euro, which they interpreted in terms of increased financial integration that comes with the adoption of a single currency. They demonstrated that the current account balances of the member states increased with per capita income. This showed capital to be flowing “downhill” from more advanced, capital-abundant countries to their less advanced, capital-scarce euro-area partners.*

*This in turn reflected the scope that existed within the euro-area periphery for catch-up and convergence. This, then, was an example of a “good” imbalance of countries with attractive investment opportunities and outstanding growth prospects capitalising on the advent of the euro and the deeper financial integration it entailed to undertake additional investment, tapping foreign saving by running current account deficits while at the same time boosting their consumption to reflect the positive permanent income effect of faster growth and the positive wealth effect of lower interest rates.”*

The theory underpinning the BG hypothesis follows straightforwardly from the inter-temporal theory of the current account (Obstfeld and Rogoff 1996). This model suggests that agents’ decisions to borrow and lend across economies reflects the efficient allocation of capital towards the most profitable investment opportunities and to households wishing to smooth their consumption over time. BG argued that for Portugal and Greece it was the impact of integration on the scope for income convergence that had driven the fall in their current account balances and that the main channel through which this took place was consumption smoothing leading to lower saving.

An important feature of the inter-temporal model is the absence of an explicit role for competitiveness. This is not to say that competitiveness does not matter. But as BG acknowledge, separating out the roles of competitiveness on the trade account from those of consumption smoothing on the capital account “is far from straightforward, both conceptually and empirically” (Blanchard and Giavazzi 2002: p174). An

important breakthrough of the new open economy macroeconomics developed over the past two decades is that both these channels are incorporated into the analysis. Within this framework consumption-smoothing households determine demand, but they are also affected by changes in relative costs through effects on real incomes and competitiveness.

In these models, the relative importance of the real income and competitiveness channels will depend on how prices are set across economies<sup>3</sup>. If firms set traded goods prices according to levels prevailing in the foreign economy – known as Local Currency Pricing (LCP) – then there will be no competitiveness effects but there will be real income effects from changes in relative costs. If firms set prices according to the level of costs in the home economy – known as Producer Currency Pricing (PCP) – then there will be competitiveness effects but no real income effects from changes in relative costs. The consensus view has been that LCP is the predominant pricing strategy of firms suggesting a limited role for competitiveness effects. This puts the emphasis back on inter-temporal demand rather than changes in competitiveness as being the main determinant of current accounts.

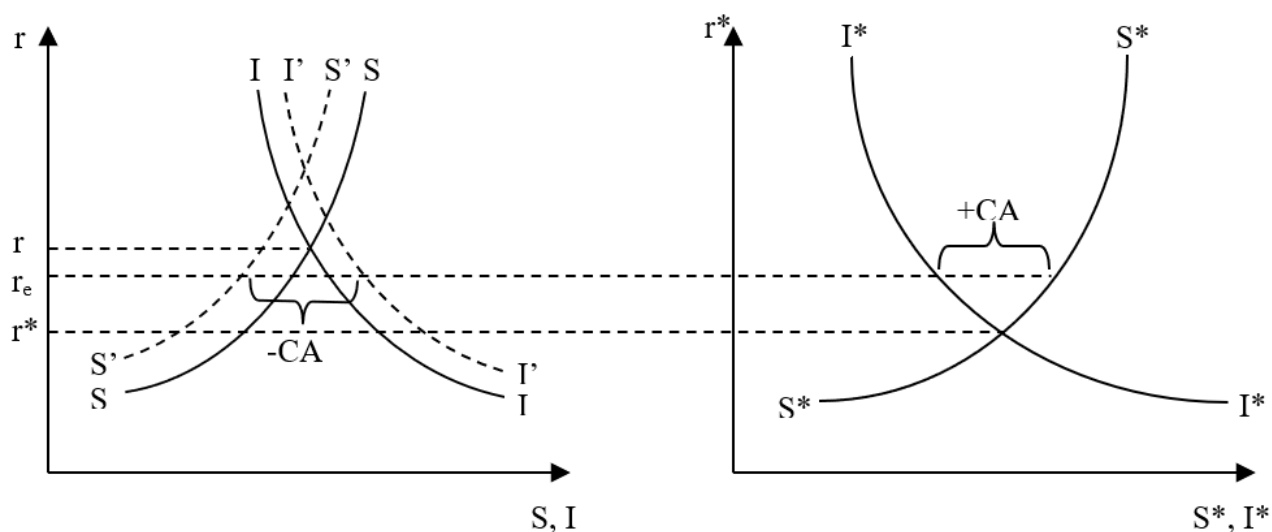
A simple graphical representation of the BG model is the Metzler diagram (Metzler (1960)) shown in Figure 3.1. The left-hand frame shows the relationship between interest rates and the saving and investment schedules of the periphery economy while the right-hand frame shows the same for the core economy. Euro membership leads to a common interest rate because of a single monetary policy and the elimination of exchange rate risk. Assuming pre-euro interest rates are higher in the periphery this interest rate convergence leads to excess investment in the periphery and excess saving in the core. In addition, if expected future productivity increases in the periphery because of broader economic integration, then the saving and investment schedules will undergo shifts that lead to further falls in the periphery current account balance. Taken together, the result is a current account deficit in the periphery and a current account surplus in the core.

After BG was published, the tendency for capital to flow “downhill” in this way was confirmed by several empirical studies. Abiad et al. (2009) shows that Europe has been unusual in seeing this “downhill” flow

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<sup>3</sup>A full review of the literature on LCP and PCP and their effects on the real income and competitiveness channels is beyond the scope of this paper. For an early paper that is relevant to the debate on monetary union, see Engel (2000). For a summary of the more recent literature in the context of its importance for monetary and fiscal policy debates see Chen et al (2021).

Figure 3.1: The Metzler Diagram



of capital, not only for euro-area economies but also those in emerging Europe that have been part of the European Union. These flows have been associated with a significant acceleration of income convergence. Ca'Zorzi and Rubaszek (2008) show how expectations of real income convergence and consumption smoothing explain the pattern of current account imbalances. Lane (2010) finds evidence for both differences in income levels and growth expectations. And Waysand et al. (2010) depart from the focus on current account imbalances and create a new database on bilateral external financial assets and liabilities. They note that creditor and debtor positions within the EU tended to increase between 2000 and 2008 with capital largely flowing from wealthier to catching-up economies. Schmitz and von Hagen (2011) find similar results.

The BG analysis suggested that, for the periphery economies, an initial period of strong consumption and current account deficits would be followed seamlessly by a period of strong production and current account surpluses. This was a consequence of a dynamic optimisation process in which households responded rationally to a combination of access to euro-area capital markets and expectations of stronger income growth in the years ahead. This implies that the subsequent crisis can be viewed as consistent with the BG analysis only if it was due to a large and unforeseeable shock that had nothing to do with the prior increase in macroeconomic imbalances.

Few economists today are willing to subscribe to such a view (Baldwin and Giavazzi 2015). And even

before the crisis there were some economists who expressed concern about the build-up of macroeconomic imbalances. For example, in direct response to the BG analysis, Pierre-Olivier Gourinchas raised the concern that although capital may be flowing “downhill”, it did not seem to be leading to income convergence, probably because of the tendency for saving to fall rather than for investment to rise. Presciently, he worried that “real overvaluation may happen relatively slowly in Portugal and Greece. But there are signs that it is coming. In time, this will require an adjustment in relative prices, which may prove painful” (Gourinchas 2002: p.206).

As explained in the introduction, since the crisis, a consensus narrative has emerged that highlights the major policy failure of ‘allowing’ imbalances to get so large. This is consistent with the idea that, in the absence of a stabilising policy framework, economic agents cannot be relied upon to ensure that the economy converges upon a stable adjustment path. The mainstream theory of current account determination may still be valid, but it needs to be adapted to allow for the possibility that shocks will come along and cause not only temporary disturbances but also put economies on an unsustainable path with imbalances being persistent. Both the consensus narrative and many other post-crisis explanations can be viewed as implicitly attributing this possibility to agents holding expectations that lead them to deviate from their inter-temporal budget constraint for an extended period before a day of reckoning is reached.

Reflecting this synthesis of the mainstream and post-crisis views this paper accepts the theoretical core of the BG model. As a result, it adapts an open economy New Keynesian model to a core-periphery framework where the euro area is assumed to be a large, closed, economy and macroeconomic imbalances are determined endogenously but without implications for general equilibrium. However, expectations are assumed to be formed in a way that allows for the possibility of imbalances being persistent and inconsistent with their true inter-temporal budget constraint. Overall, the theoretical model consists of six variables (output, prices, interest rates, fiscal balance, employment, and the current account balance) with four structural shocks (fiscal, credit supply, productivity, and labour demand) that encompass four policies (fiscal policy, macro-prudential policy, product market structural reforms, and labour market structural reforms). The model is set out formally in Appendix B.1.

### 3.2.2 Overcoming the endogeneity problem

Empirical modelling of macroeconomic imbalances is not straightforward. By their nature imbalances are determined simultaneously, leading to problems of endogeneity. This makes inference problematic in a field dominated by research that has relied to a large extent on cross-country analysis. For example, the absence of an empirical cross-country association between fiscal balances and current account balances prior to the crisis does not prove that fiscal policy had no role in causing macroeconomic imbalances. The truth is that it is impossible to say without controlling for the shocks that have affected both. A positive demand shock, for example, would tend to produce a negative correlation between the fiscal balance and the current account balance while a positive supply shock would tend to produce a positive correlation.

Another case in which correlations can be unstable concerns the role of competitiveness. To what extent does the empirical association between competitiveness measures and current account imbalances indicate that changes in relative prices have been the main driver of macroeconomic imbalances? Again, it is impossible to say without controlling for the shocks hitting the economy. Given the existence of a Phillips curve relationship between output and inflation, a positive demand shock that contributes to external imbalances primarily by boosting imports will nevertheless tend to produce a positive correlation between competitiveness and the current account balance. Yet, in this case, the change in prices may be of secondary importance. In other words, correlations can only take the analysis of macroeconomic imbalances so far.

Endogeneity problems of this sort are, of course, common in empirical macroeconomics and there are well-established methods for overcoming them. One approach is to use a DSGE model in which the economy is fully articulated and hence capable of decomposing past outturns into a full array of structural shocks. There have been some attempts to apply both DGSE and other structural economic modelling approaches to understanding the origins of macroeconomic imbalances within a monetary union (ECB 2012c, Badarau et al. 2013, Gomes et al. 2014, Siena 2021). But not only have these attempts produced conflicting results, indicating sensitivity to the precise structure of the economy being articulated, these models are incompatible with the consensus narrative and the many other post-crisis explanations about the origins of macroeconomic imbalances: these structural models all impose rational expectations and optimising behaviour by agents and hence are inconsistent with persistent macroeconomic imbalances.



A less rigid method that still overcomes the endogeneity problem is to estimate a Structural Vector Auto Regression (SVAR) in which the structure of the economy is reflected in the key properties of a small-scale model but is not as fully articulated as in a DSGE model. With this more limited economic structure a subset of the structural shocks that hit the economy can be identified and used to provide estimates of their impact. This method has the advantage of not presuming any knowledge of the decision rules followed by agents and so is compatible with a wide range of explanations for the emergence of imbalances, most of which eschew rational expectations. It has also been applied successfully to the related issue of global macroeconomic imbalances<sup>4</sup>. However, to the best of the author's knowledge, this is the first time this technique has been applied to the issue of euro-area macroeconomic imbalances.

### 3.2.3 The reduced-form BVAR model

The VAR is based on the theoretical model described in the previous section and is estimated using Bayesian methods. The derivation of the VAR representation of the model and method of estimation is set out formally in Appendix B.2. The reduced-form VAR is:

$$VAR = [\Delta y; \Delta p; \Delta g; \Delta r; \Delta n; \Delta x] \quad (3.1)$$

Where  $\Delta y$  is output growth;  $\Delta p$  is the inflation rate of the GDP deflator at market prices;  $\Delta g$  is change in the fiscal balance as a percentage of GDP;  $\Delta r$  is the change in the interest rate on bank loans;  $\Delta n$  is employment growth;  $\Delta x$  is the change in the current account balance as a percentage of GDP.

The raw data are shown in Figure 3.2 and consist of the differences between periphery and core aggregate variables. Output, prices, and employment are shown as log differences, interest rates as absolute differences, and fiscal and current account balances as % of GDP. The data are aggregated using GDP weights of national series of Eurostat data. The countries comprising the core aggregate are Germany and the Netherlands

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<sup>4</sup>There are two papers in the global imbalances literature that are relevant to this paper. The first considered the role of shocks to technology, monetary policy, and fiscal policy as a driver of US financial imbalances (Bems et al. 2007). The second identified shocks to real savings, real investment, and monetary policy as drivers of US and Asian current account balances in the late 1990s and 2000s (Bracke and Fidora 2008).

while the countries comprising the periphery are Spain, Portugal, Ireland, and Greece. These groupings were selected on the basis that they showed persistent widening of current account surpluses and deficits since the early 2000s until the financial crisis. The benchmark model was estimated over a sample period from 2000Q1 to 2015Q2 using four lags. The model was estimated in first differences to prevent the results being impacted by co-integrating relationships arising from the impact of the financial crisis.

### 3.2.4 Sign restrictions and the structural form

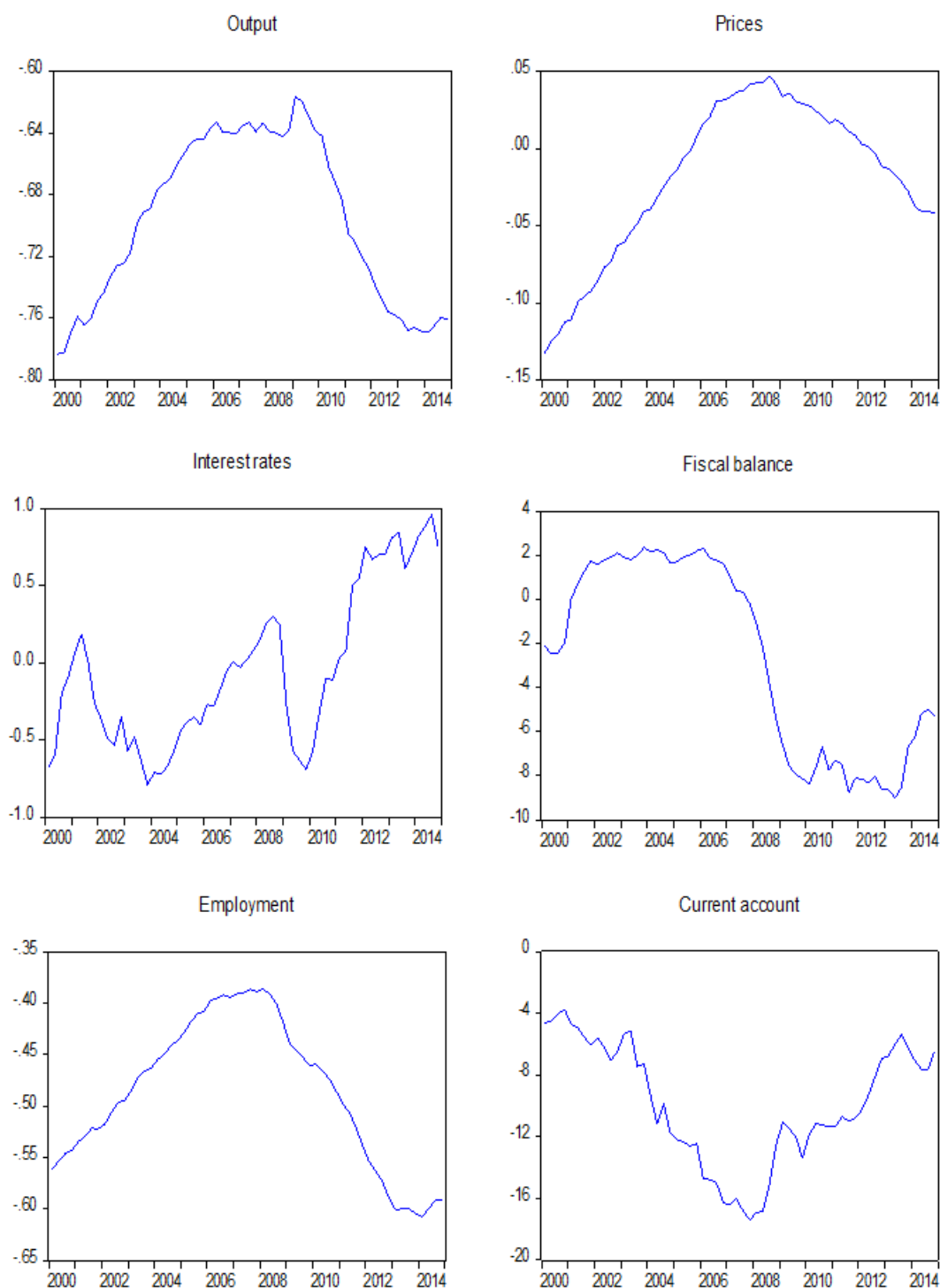
There are many methods for identifying the structural form of the VAR model. Appendix B.3 sets out the most common methods and their principal advantages and disadvantages. This paper adopts the method of sign restrictions in which economic theory is used to establish what the initial impact of shocks on the variables should be. Sign restrictions are set when they are compatible with candidate models that could be said to characterise the structure of the economy. Where there is uncertainty about the correct sign that a shock will have on a variable it can be left unrestricted. Canova and Paustian (2011) have shown that sign restrictions is a robust method of identification that has good properties, even in small samples, and even when the class of models is incorrectly specified. It requires no knowledge of either the data generation process or the decision rules of agents. These properties are particularly suited to the case of euro-area macroeconomic imbalances where, as explained in the introduction, there remains considerable uncertainty about the precise nature of the shocks that led to the emergence of persistent imbalances and about how expectations are formed.

Table 3.1 details the choices of sign restrictions used in this paper. First, a set of restrictions consistent with the properties of the macroeconomic imbalances model specified in Appendix B.1 were imposed. These are shown in red. The positive demand-side structural shocks lead to higher growth, higher inflation, and a lower current account balance. In addition, a positive fiscal shock – e.g., a government spending increase – leads to a decline in the fiscal balance<sup>5</sup> while a positive credit supply shock – e.g., an easing of credit

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<sup>5</sup>The identification of fiscal shocks using sign restrictions is not without controversy. For example, Leeper et al. (2012, 2013) have shown that anticipation effects complicate identification and that additional information is needed to avoid contamination issues. However, there is clear precedent for identifying fiscal shocks in a Structural VAR framework (e.g., Dalsgaard and de Serres 2001, Peersman and Straub 2009) and the estimates of the impact of fiscal shocks on output and current accounts found

Figure 3.2: Data Used In Estimation



\* The data shown are the differences between periphery and core variables weighted by GDP. Core countries are Germany and the Netherlands while Periphery countries are Spain, Portugal, Ireland, and Greece.

Table 3.1: Identifying sign restrictions for contemporaneous impact effect

Structural Shock		Encompassed Policy	$\Delta y$	$\Delta p$	$\Delta r$	$\Delta g$	$\Delta n$	$\Delta x$
Demand	Fiscal	Fiscal Policy	+	+		-		-
	Credit Supply	Macro-Prudential Policy	+	+	-	+		-
Supply	Productivity	Product Market Structural Reforms	+	-			-	+
	Labour Supply	Labour Market Structural Reforms	+	-			+	+

Red = Signs consistent with the macroeconomic imbalances model specified in Appendix B.1

Green = Signs required for unique identification

conditions – leads to a decline in the interest rate. Positive supply-side structural shocks lead to higher growth, lower inflation, and a higher current account balance. Additionally, a positive labour supply shock leads to an increase in employment. To ensure unique identification of the four structural shocks a further two ad hoc restrictions were imposed. These are shown in green. The first restriction is that a positive credit supply shock leads to an improvement in the fiscal balance. This can be justified by the positive sign restrictions on growth and inflation, which would be expected to lead to an improvement in the cyclical fiscal balance via an increase in the level of nominal output. The second restriction is that a positive productivity shock leads to a fall in employment. While there remains some controversy about the impact of productivity shocks on employment there is a considerable body of work to suggest a negative impact. It is thought to stem from the presence of sticky prices (Gali 1999).

The structural shocks identified are macroeconomic but, in each case, there is a clearly defined policy associated with it and is encompassed by the structural shock. These encompassed policy shocks are also shown in Table 3.1. For example, the policy shock encompassed in credit supply shocks is a macro-prudential policy shock because the latter has the macroeconomic effect of changing credit supply. And labour market structural reform shocks are the policy shock encompassed by labour supply shocks because the former has the macroeconomic effect of changing the labour supply. Similarly straightforward reasoning applies to fiscal policy and product market structural reforms and their association with fiscal and productivity shocks.

This encompassing implies that the structural shocks recovered from the VAR will reflect an average of shocks originating from both policy and non-policy sources. And because the model does not include directly

observable policy variables it is not possible to distinguish between them. For example, a fiscal shock from an exogenous change in the composition of the tax base cannot be distinguished from that of a policy change in tax rates; and a labour supply shock from an exogenous change in demographics cannot be distinguished from the impact of a labour market structural reform. Nevertheless, given that the focus of this paper is on the potential role of policy in managing imbalances the shocks are henceforth primarily referred to using the encompassed policy rather than the broader structural shock. In so doing the paper assumes that the response of the economy to non-policy and policy shocks are similar. For this reason, the results should be interpreted as providing only an approximate guide as to the actual macroeconomic impact that these policies could achieve and the issue of whether, in practice, such policies would have similar effects, and could be implemented on the scale required, will be discussed in the conclusion.

### 3.3 Results

This section provides analysis of the results both in terms of steady state impacts and the impulse response functions (IRFs). It also considers several robustness checks. The steady state shows the impact on the levels of the variables after a period of five years while the IRFs show the impact on the growth rates of the variables over a period of 20 quarters.

#### 3.3.1 Persistent imbalances in steady state

The steady state impacts of one standard deviation structural shocks are shown in Table 3.2 and how some of the model's key properties compare with the literature is shown in Table 3.3. Several features are consistent with findings in the literature regarding the behaviour of imbalances and the economy. First, as expected, there is a consistent negative relationship between competitiveness and external imbalances across the different shocks. Macro-prudential policy has a relatively larger impact on the external imbalances for a given change in competitiveness and fiscal policy a relatively smaller impact, but the differences are not large. Second the output gap-based Phillips curve relationship is stable across the two demand-based policies, at around 0.2. This is within the range of estimates of the Phillips curve slope found in the literature for the euro area (Eser et al. 2020). Third, the fiscal multiplier is around -0.9. The range of multipliers found in the

literature is very wide, but the estimate sits comfortably within it (ECB 2015). Finally, fiscal pass-through to external imbalances – the ‘twin deficits hypothesis’ – is just over 0.5. This is larger than the 0.1-0.3 estimate found in the literature based on cyclically adjusted primary balances but consistent with the estimate of 0.6 using action-based measures of fiscal policy (Bluedorn and Leigh 2011). These ‘as expected’ findings indicate that the model is generally well specified.

Table 3.2: Steady state impact of a 1 standard deviation shock

<b>Structural shock</b>	<b>Fiscal shock</b>	<b>Credit supply shock</b>	<b>Productivity shock</b>	<b>Labour supply shock</b>
<i>Encompassed Policy</i>	<i>Fiscal policy</i>	<i>Macro-prudential policy</i>	<i>Product market structural reforms</i>	<i>Labour market structural reforms</i>
<b>Output imbalances (y)</b>	0.36	0.99	0.26	0.89
<b>Competitiveness imbalances (p)</b>	0.27	0.78	-0.34	0.21
<b>Fiscal imbalances (g)</b>	-0.41	0.48	-0.16	0.11
<b>Monetary imbalances (r)</b>	-0.01	-0.06	-0.07	-0.07
<b>Employment imbalances (n)</b>	0.10	1.37	-0.38	1.15
<b>External imbalances (x)</b>	-0.23	-0.94	0.39	-0.23

There are two noteworthy features of the steady state results. The first is the generally strong response of imbalances to the macro-prudential policy shock. The one exception to this is the response of monetary imbalances, measured using the core-periphery interest rate spread on bank loans. The results imply a very powerful impact from changes in interest rates on the economy, approximately four times as large in terms of its impact on output and six times as large in terms of its impact on prices as is typically found

Table 3.3: Implied properties of the model

Property	Implied from model	Literature
Phillips curve slope	0.19 to 0.20 <sup>1</sup>	0.09 to 0.24 (Eser et al. 2020)
Fiscal multiplier	-0.88 <sup>2</sup>	-1.27 to 0.23 (ECB 2015)
Fiscal pass-through	0.56 <sup>3</sup>	0.1 to 0.6 (Bluedorn and Leigh 2011)

<sup>1</sup> Steady state change in competitiveness imbalance per annum divided by output imbalance (demand shocks only)

<sup>2</sup> Steady state change in output imbalance divided by fiscal imbalance (fiscal shock only)

<sup>3</sup> Steady state change in external imbalance divided by fiscal balance (fiscal shock only)

in the literature. If correct this could point to an important role for macro-prudential policy in managing macroeconomic imbalances. The second noteworthy finding is the counter-intuitive result that a labour market structural reform shock leads to deterioration in the external balance. This may be a consequence of strong output and employment responses leading to an increase in relative prices (this is despite the shock having been identified via a contemporaneous negative impact effect on relative prices). This raises important questions about the role of structural reforms to labour markets in addressing competitiveness and external imbalances.

### 3.3.2 Impulse response functions

The most striking feature of the impulse response functions is that the confidence bounds indicate a low level of statistical significance in many cases, as shown in Figures 3.3 to 3.6. This result applies to most of the IRFs from the fiscal policy, labour market structural reform, and product market structural reform shocks. This would seem to add weight to the consensus view that managing macroeconomic imbalances within the euro area using policy may not be possible. However, there are ten responses which display statistical significance beyond the contemporaneous impact, five of which show persistent statistical significance beyond two quarters (ranging from four to 20 quarters).

The responses that show statistical significance beyond the contemporaneous impact are the fiscal shock on fiscal imbalances; the macro-prudential policy shock on the output, competitiveness, fiscal, employment, and external imbalances; the product market structural reforms shock on output and employment imbalances;

and the labour market structural reforms shock on the output and employment imbalances. These results suggest that it is plausible to think that these macroeconomic policies could be used to manage a wide range of macroeconomic imbalances. Notably, however, the fiscal policy shock is only statistically significant for the fiscal balance itself and the structural reform shocks are only statistically significant for output and employment imbalances. As hinted at by the steady-state outcomes, only macro-prudential policy has a statistically significant impact on the critical competitiveness and external imbalances.

Of these ten responses, there are five that show statistical significance beyond the second quarter. The first is the impact of a labour market structural reform shock on employment imbalances. In this case the impact on employment imbalances is statistically significant for the first three years. So, we can say with some confidence that labour market structural reforms would have a positive effect on addressing employment imbalances in the euro area. However, it bears re-iterating that success in addressing employment imbalances does not translate into success in terms of other measures of macroeconomic imbalances. As noted in the steady state analysis, the impact on external imbalances could be perverse, though it should be stressed that there is no statistically significant impact for either this imbalance or any other imbalances, save those for output and employment.

The other four responses to show statistical significance beyond the second quarter all concern the impact of the macro-prudential policy shock. Like the structural reform shocks, macro-prudential policy has a statistically significant impact on the output and employment imbalances. It is also worth noting that the profile of the IRF for the macro-prudential policy shock is very similar to that of a standard monetary policy shock in terms of its effect on growth, with its peak impact occurring after one year, again suggesting the model is well specified. Most importantly, however, the macro-prudential shock has a statistically significant impact on the critical competitiveness and external imbalances, in the former case for the entire five-year period. Recognising also that these results are derived from identifying a credit supply shock, their quantitative and statistical significance supports the idea that intra-euro area imbalances were significantly driven by credit supply shocks, consistent with the explanations for imbalances offered by De Grauwe (2010, 2012a), Lane and Pels (2012), and Cesoroni and De Santis (2015). However, it is not possible to distinguish the extent to which this reflects a one-off effect of financial integration or a structural feature that is at risk



of being repeated.

### 3.3.3 Robustness checks

Several robustness checks were conducted. First, the IRFs from nine alternative models with different lag lengths and sample periods were estimated. The lag lengths ranged from one to six quarters and sample periods were truncated by two years at the start and the end of the sample period in the benchmark model. The results from these nine alternative models are shown in Figure 3.7 with the IRFs from these models represented by a light blue swathe. These swathes are generally narrow and closely aligned with the IRF from the benchmark model, which is shown as a dark blue line, indicating that the results are robust to alternative sample periods and lag lengths. The steady state results were also found to be robust to these different sample periods and lag lengths.

A second robustness check was to use alternative sign restrictions to identify the product market and labour market reform shocks. In the benchmark model these shocks are distinguished from each other by the employment response. However, it is possible that the initial impact of some type of labour market reforms – such as those making it easier to dismiss employees – could be to reduce employment rather than increase it, as required in the benchmark model. To check this an alternative model in which the employment variable is replaced by a real wage variable was estimated. Product market structural reforms were identified by a rise in the real wage and labour market structural reforms were identified by a fall in the real wage. This alternative specification was not found to alter the main results either.

A third robustness check was to use data from different countries in the macroeconomic imbalances model. In principle, the model results should be the same for any two countries or two groups of countries which, together, can be considered as a large, closed, economy and where there are macroeconomic imbalances present. Consistent with this principle an alternative ‘large two-country’ macroeconomic imbalances model between Germany and Spain was estimated. This alternative specification was also not found to alter the main results.

Figure 3.3: Demand - Fiscal Policy Shock IRFs

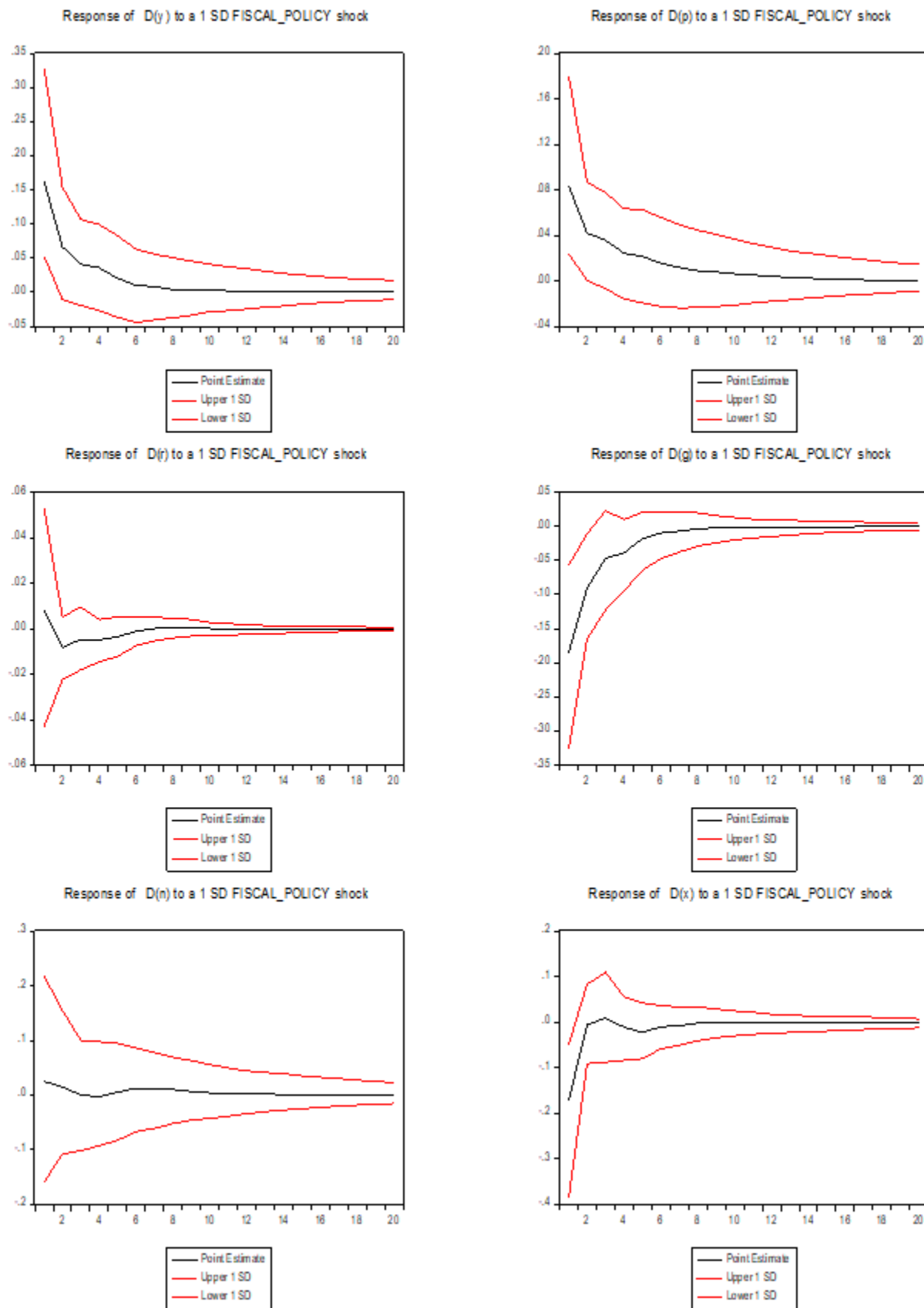


Figure 3.4: Demand – Macro-Prudential Policy Shock IRFs

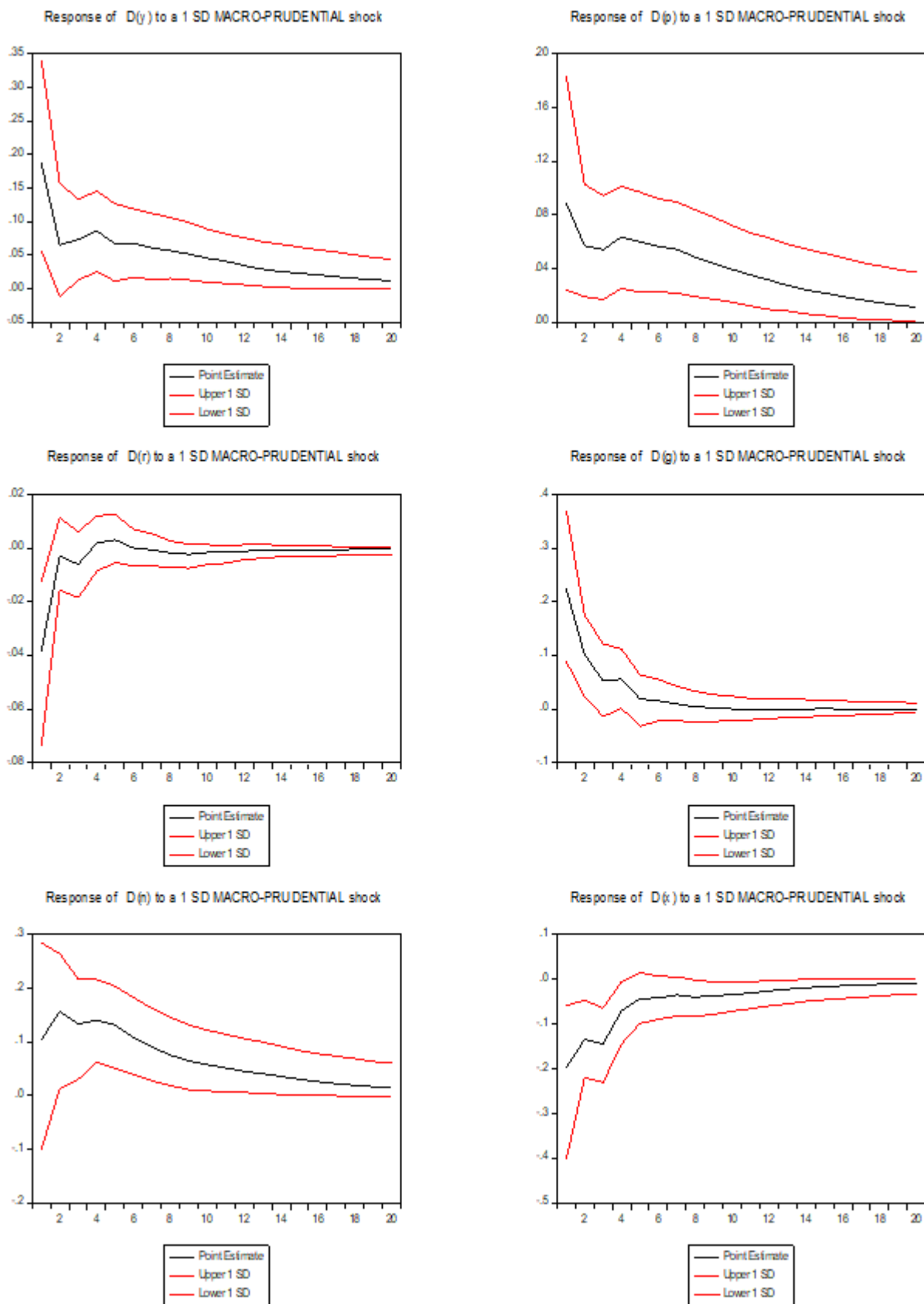
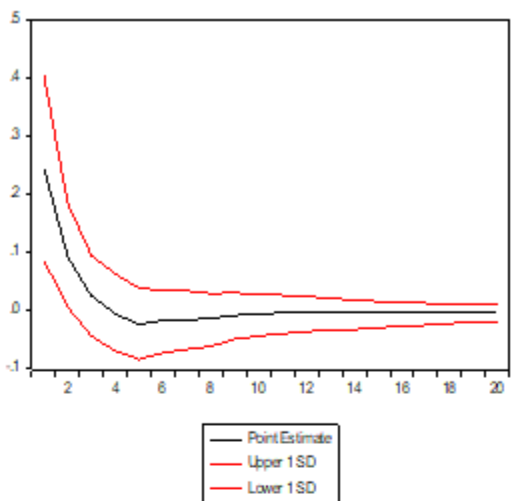
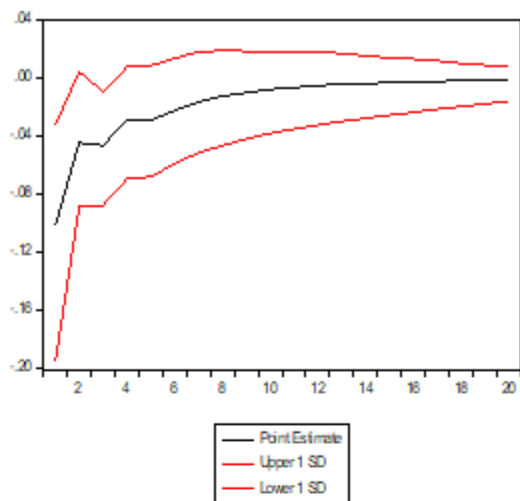


Figure 3.5: Supply – Product Market Structural Reform Shock IRFs

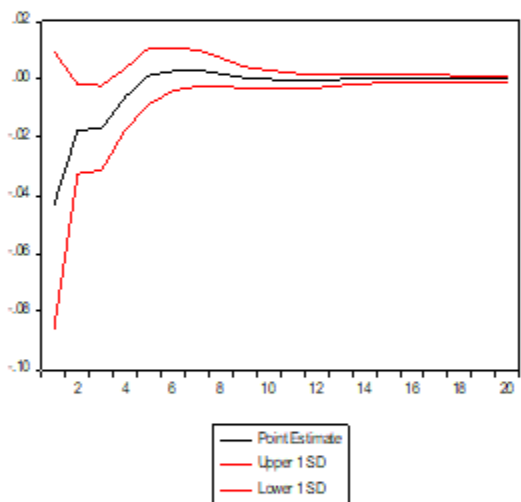
Response of  $D(y)$  to a 1 SD PRODUCT\_MARKET\_REFORMS shock



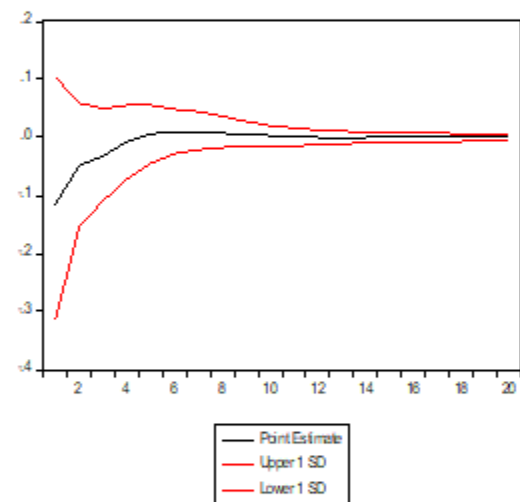
Response of  $D(p)$  to a 1 SD PRODUCT\_MARKET\_REFORMS shock



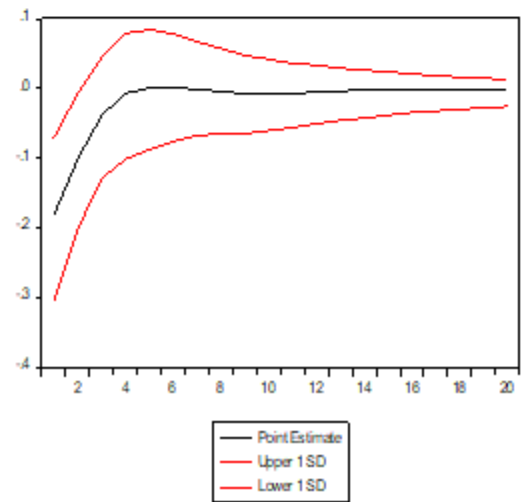
Response of  $D(r)$  to a 1 SD PRODUCT\_MARKET\_REFORMS shock



Response of  $D(g)$  to a 1 SD PRODUCT\_MARKET\_REFORMS shock



Response of  $D(h)$  to a 1 SD PRODUCT\_MARKET\_REFORMS shock



Response of  $D(x)$  to a 1 SD PRODUCT\_MARKET\_REFORMS shock

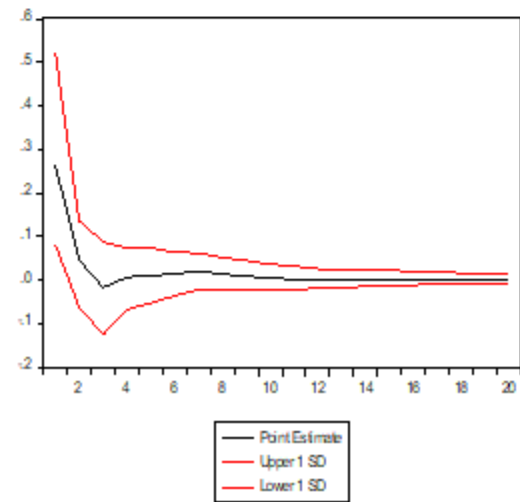


Figure 3.6: Supply – Labour Market Structural Reform Shock IRFs

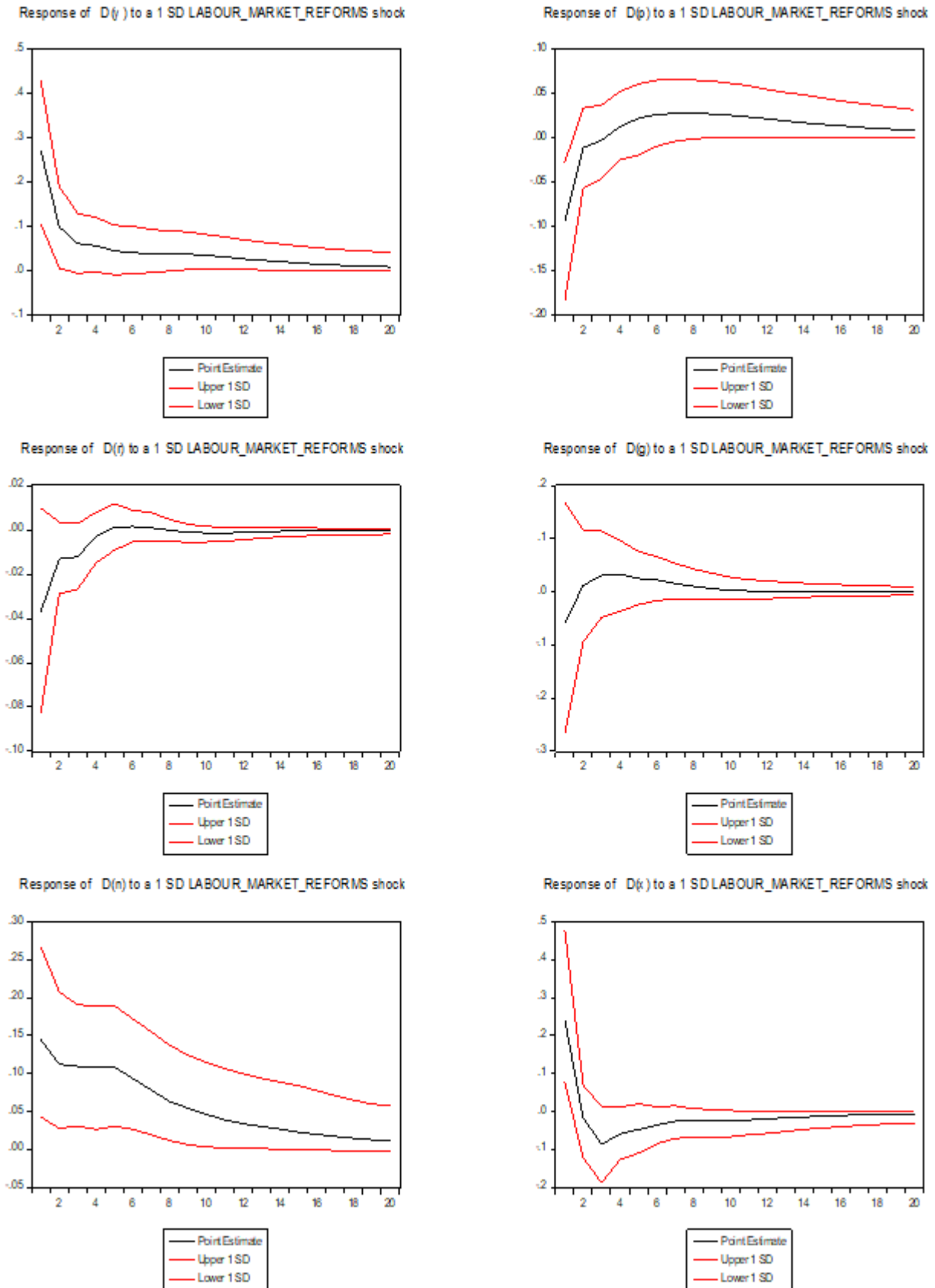
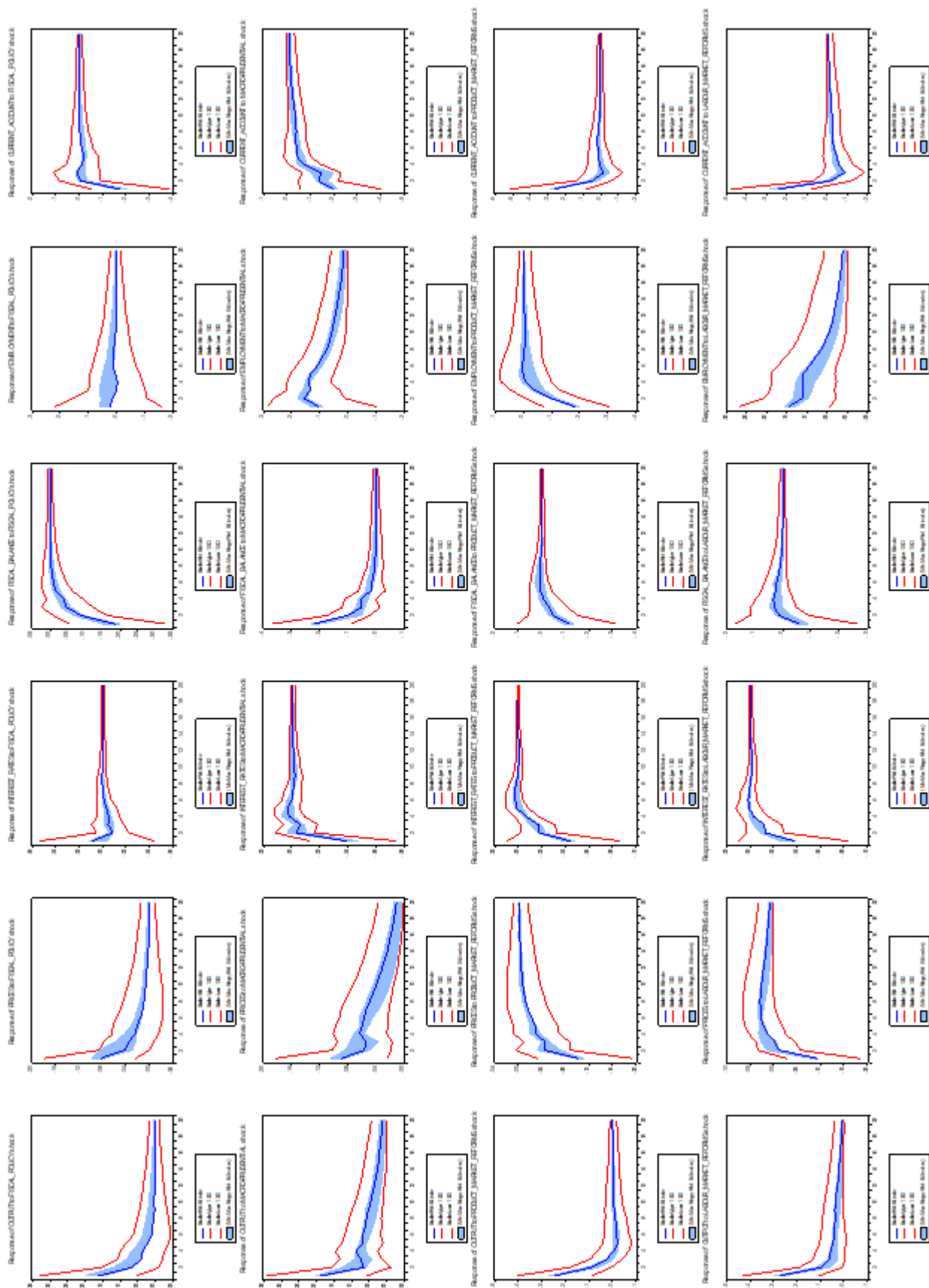


Figure 3.7: Robustness – impulse responses



### 3.4 Concluding discussion

The theoretical and empirical strategy used to analyse macroeconomic imbalances in this paper is founded on the consensus narrative of the euro area crisis in which one of the root causes of the crisis was “policy failures that allowed imbalances to get so large”. This interpretation of the crisis is uncontroversial in the sense that it is consistent with the mainstream macroeconomic model in which modern capitalist economies are not automatically self-correcting but require policy interventions for macroeconomic stability to be achieved. In the standard New Keynesian macroeconomic model, for example, adherence to a monetary policy rule is necessary to ensure that outcomes are determinate. Consequently, it is not difficult to see how monetary union, by sacrificing monetary policy independence of its members, risked setting in train unsustainable processes that would lead to macroeconomic and financial instability.

The architects of monetary union thought the enhancing effect of the elimination of exchange rate volatility on trade integration and price transparency would prevent such instability (Issing 2014). Pro-cyclical changes in prices in one country were expected to generate strong counter-cyclical movements in the affected country’s net exports and price setting behaviour and hence keep its economy on a sustainable path. In practice, these counter-cyclical mechanisms seem to have been overwhelmed by pro-cyclical mechanisms that flowed, in part, from the increased financial integration that monetary union introduced. And because financial integration primarily took the form of increased inter-bank flows between national institutions it created financial fragilities that would be painfully exposed when the unsustainable processes eventually came to an end. In this sense, the crisis of monetary union is little different from other financial crises (Kindleberger 1978, Reinhart and Rogoff 2009).

In the case of the euro-area crisis, pro-cyclical mechanisms originated from the weakened feedback mechanism between national economic conditions and the domestic nominal interest rate. Perhaps the best known of these mechanisms is the Walters’ critique, which postulates that a common interest rate will result in pro-cyclical shifts in the real interest rate (Walters 1990). In other words, the well-known “one size fits all” monetary policy problem of monetary union probably has implications for macroeconomic imbalances as well as growth and inflation. But other mechanisms appear to have been more important, notably the establishment of over-optimistic growth expectations in some economies at the outset of monetary union. As

predicted by international macroeconomic theory, with the introduction of a common interest rate, capital flowed from those economies that previously had relatively low interest rates to those economies that previously had high interest rates. But these capital flows were supporting lower savings more than they were supporting higher investment, leading not to strength in future output so much as an unsustainable rise in the stock of foreign debt.

The theoretical and empirical model developed in this paper captures both the pro-cyclical and counter-cyclical effects described in the literature. For example, while the model can capture the impact of the pro-cyclical Walters' critique mechanisms described above via inclusion of relative bank interest rates it also allows for counter-cyclical mechanisms in which changes in relative prices affect net exports and price setting. Whether current account imbalances prove to be explosive, persistent, or self-correcting in this model will depend on the relative strength of these, and other, mechanisms. It is not something that can be established a priori and must draw on empirical evidence. With the benefit of hindsight, it is now clear that imbalances were persistent with no tendency to be self-correcting or explosive. This persistence, while ultimately unsustainable, created the semblance of stability and contributed to the conditions for a long period of detachment between expectations and underlying economic reality. It was in some sense an equilibrium while it lasted, but it was still inevitable that it would eventually come to an end.

The structural economic model developed in Appendix B.1, and the Bayesian Structural VAR used in the paper, are both designed to allow for the possibility of imbalances being persistent. They do so by implicitly allowing agents to hold false beliefs about their inter-temporal budget constraint, meaning that there is no tendency in the model to return to a sustainable equilibrium. Expectations are model-consistent but the model itself does not enforce the inter-temporal budget constraint. In this way the paper allows for an investigation of how structural shocks can lead to persistent intra euro-area macroeconomic imbalances. It considers two demand-side shocks (fiscal and credit supply) and two supply-side shocks (productivity and labour supply). Its findings of a strong and statistically significant impact from credit supply shocks on competitiveness and external imbalances supports those who have argued that they were primarily driven by credit cycles. The 'animal spirits' national financial cycles of De Grauwe (2010, 2012a), over-optimistic growth expectations of Lane and Pels (2012), and the divergent speeds of financial integration



and liberalisation of Cesoroni and De Santis (2015) are all compatible with imbalances being driven by credit supply shocks. But the lack of any statistically significant role for fiscal, productivity, or labour supply shocks on competitiveness and external imbalances cast doubt on those who argue for strong roles from either fiscal policy (Abbas et al. 2010) or labour market institutions (Hancké 2013; Johnston 2016).

On the assumption that the best that associated policies could hope to achieve is to mimic the structural shocks that encompass them, the results also support the previous studies that have argued that managing macroeconomic imbalances in the euro area is likely to be difficult (Dabrowski 2015, Kincaid and Watson 2015). While the results suggest there is potential for fiscal policy and structural reforms to manage fiscal, output, and employment imbalances, they do not appear to be plausible candidate policies for managing competitiveness or external imbalances. These findings therefore cast doubt on the likely effectiveness of structural reforms, the preferred approach of the official institutions of the EU, as a policy for managing macroeconomic imbalances. At the same time, the fact that credit supply shocks were found to have a persistent and statistically significant effect on a wide range of macroeconomic imbalances, including the critical competitiveness and current account imbalances that are seen as one of the root causes of the crisis, offers some encouragement. If macro-prudential policies can be deployed at a national level with sufficient force, they may well be able to attenuate the impact of credit supply shocks on imbalances. But is it plausible that credit supply shocks have such a large effect, and can macro-prudential policies mimic their effects?

The credit supply shock appears to be well identified in the model, given that the profiles of the impulse response functions are found to be consistent with that of a monetary policy shock for both output and prices and the implied Phillips curve slope sits within the range of estimates found in the literature. And a strong impact from credit supply shocks is undoubtedly consistent with the consensus view that intra euro-area capital flows having been an important driver of imbalances prior to the crisis. However, the magnitude of the responses for a given change in interest rates is several times larger than is typically found in the literature on monetary policy shocks. There are reasons to think that in a monetary union credit supply shocks could have relatively small impacts on bank interest rates and hence seemingly very outsized effects on economies. For example, owing to the common interest rate in money markets, an easing in credit supply within the banking system is more likely to manifest itself in terms of easier credit conditions available to

households and firms than lower interest rates. This could take the form of lower fees and less stringent credit checks. As a result, the easing of credit supply may show up more strongly in terms of credit and money growth than in changes in interest rates. Certainly, credit and money growth were markedly higher in the periphery than the core during the period of widening macroeconomic imbalances. In other words, monetary imbalances might be better illustrated by divergences in money and credit growth than interest rates in a monetary union.

Could macro-prudential policy be used to offset the effect of credit supply shocks and other sources of imbalances? Even if some of the political economy difficulties of applying and enforcing the MIP (Bénassy-Quéré and Wolff 2020, Bénassy-Quéré and Ragot 2015, Alcidi and Gros 2013a, 2013b) can be overcome, the evidence in favour of such a policy being effective is limited. Some calibrated DSGE models have suggested that macro-prudential policies could have an impact on macroeconomic variables, including on imbalances in a monetary union (Brzoza-Brzezina et al. 2015, Quint and Rabanal 2014). And the ECB has found that raising bank capital ratios by 1pp could have a similar impact on output to a 25bp change in the policy rate (ECB 2020a). But the ECB's estimates are roughly twice that found by others, and it is likely that there would be significant 'leakage' if capital ratio spreads across the euro area were to be more than the current 2.5% limit (ECB 2020b). The evidence for macroeconomic effects from other macro-prudential tools, such as loan-to-value ratios, is even weaker (Richter et al. 2018). It is for these reasons that the policy frameworks of central banks are currently based on the assumption that macro-prudential policies build resilience of the financial system without interfering in monetary policy objectives. Consequently, while further research is undoubtedly required on the macroeconomic effects of macro-prudential policies, it seems reasonable to conclude that the scale of interventions required to correct the large imbalances that existed prior to the crisis would have been incompatible with the concept of the euro area as a single currency with free capital movement. In this sense, the emergence of imbalances within the euro area prior to the crisis was not a policy failure but the inevitable consequence of a living in a diverse and financially integrated monetary union. But could such policies provide at least some contribution, alongside a wide range of other policies, towards stabilising the monetary union? That seems almost certain.

## Chapter 4

# Navigating Monetary Union's Political-Financial Trilemma

### 4.1 Introduction: The search for a new political settlement

The European monetary union is in a constant process of reform. The policy regime around the Maastricht consensus has proven unstable. We share the economic diagnosis that this was largely due to the destabilising role of financial markets (Brunnermeier and Reis 2019, De Grauwe 2011, Hume 2022b), but the original policy architecture of the euro area was singularly ill-suited to prevent or manage this instability. The strict separation of monetary, financial, and fiscal policies did not allow for effective responses to evolving financial cycles and concomitant macroeconomic imbalances (Hume 2022c)<sup>1</sup>. Early responses to the euro-area crisis since 2009-10 sought partial remedies, such as bailout loans in return for intrusive prescriptions for national adjustment. This proved to be politically extremely divisive.

Many observers, including us (Schelkle 2021), see a potential for a profound change in the ongoing reform process, from an emphasis on national fiscal discipline and price stability to risk sharing and monetary-fiscal cooperation. But how can such a transition happen, especially in an environment of elevated public debt

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<sup>1</sup>This includes the strict curb on monetary financing by the European Central Bank (ECB), devolved budgetary policies and fragmented financial supervision (Schelkle 2017: pp.79-86).

levels and markets reacting strongly to any policy shift? Reforms in the wake of the euro-area crisis and the Covid-19 pandemic show that policymakers are ready to move to a new political settlement. We explore the advantages and disadvantages of conceivable moves, with particular attention to the constraints from government bond markets.

To address these issues, we employ the analytics of a trilemma and give it a decidedly political-financial interpretation. Trilemmas provide a simplified set of three viable policy settings that cannot be sustained simultaneously. They are not full theories but useful analytical shortcuts for a political economy problem (Bordo and James 2015). They capture that policy choices can change quite considerably, albeit by preserving elements of the old. In contrast to simple trade-offs between two desirable goals, trilemmas allow for more agency and diversity of choices, which gives a greater role to politics, while economic-systemic constraints establish what constitutes an equilibrium and the opportunity costs of a particular choice. To accept these constraints, policymakers must share the mental model of the economic system in mind. This cannot be taken for granted. Hence, a trilemma inherently implies that the neglect of the third policy choice comes at a political cost.

However, the 'edges' of a trilemma may also be unduly sharp. In a very diverse union, members may always want to aim for all three policy choices. And while this has a destabilising potential, we explore, for the policy architecture of the euro-area, how combinations of three less purist policy choices can be achieved and what risk the transitions between policy choices entail. They may have unintended consequences that stem from the reaction of actors not explicitly considered, notably market actors. We are not aware of a literature that has problematised these transitions; it treats the choice between stable solutions only in comparative-static fashion.

The Mundell-Fleming trilemma was often invoked to characterise the policy consensus around the time of the Maastricht Treaty: stable exchange rates with free capital flows, giving up autonomy in monetary policy terms. Architects of the euro area referred to this 'Unholy Trinity' in explicit contrast to the theory of Optimum Currency Areas that the report of One Market, One Money rejected as a foundation for the single currency (European Commission 1990: p.31, p.46). Yet, this Trilemma was a brainchild of the era of financial repression and fiscal pump-priming that characterised the North American reading and practice of Keynesian

macroeconomics. It was meant to explain the consistent choices of an exchange rate regime (European Commission 1990: p.43). By the time the Commission report adopted this lens, financial integration had come to be seen as a way of allocating capital optimally inside the union (European Commission 1990: p.161).

The versions of a trilemma on which we build, by Schoenmaker (2011) and Pisani-Ferry (2012), consider financial integration and stability explicitly. These conceptualisations of a trilemma put cross-border capital flows centre stage. The political-financial trilemma developed in this paper takes into account how the policy regime has developed from the Maastricht compromise during the long decade of financial crises. We focus on the markets for government debt because this is where the fiscal conflicts and the systemic constraints on policy choices in the euro area have proven to become virulent. It is also no coincidence that many observers, in particular U.S. scholars, see the only way out of the euro area's fragility in the creation of a central EU budget and joint public debt management (Frankel 2015, Krugman 2013b, McNamara 2015). But what they propose is part of at least two possible and consistent policy choices in our formulation of a trilemma, not just one. Moreover, it is not enough to emulate the U.S. policy architecture. This solution also depends on a particular bond market structure, as we will show by comparing the markets for euro-denominated bonds in Europe with the markets for municipal bonds in the U.S.

The paper proceeds as follows: the next section motivates our trilemma by building on the work of Schoenmaker (2011) and Pisani-Ferry (2012). Then we analyse the Maastricht compromise in terms of this political-financial trilemma, arguing that the policy architecture tried to attain all three policy choices; bond market instability was the symptom. The following section discusses the political obstacles and market constraints of settling on a stable configuration by comparing the euro-denominated bond markets with municipal bond markets in the U.S. A short, penultimate, section gauges how significant the reforms over the long crisis decade of 2010-21 are, notably whether they manage an incremental transition to another stable policy choice. The conclusions summarise our contribution.

## 4.2 The concept of a political-financial trilemma

Reflecting the ongoing instability of the euro area, economists and political economists have proposed a series of trilemmas. Increasingly, they have taken account of the importance of cross-border capital flows and the experience of the financial crises since 2008 (Bordo and James 2015). Two of them are of relevance for us.

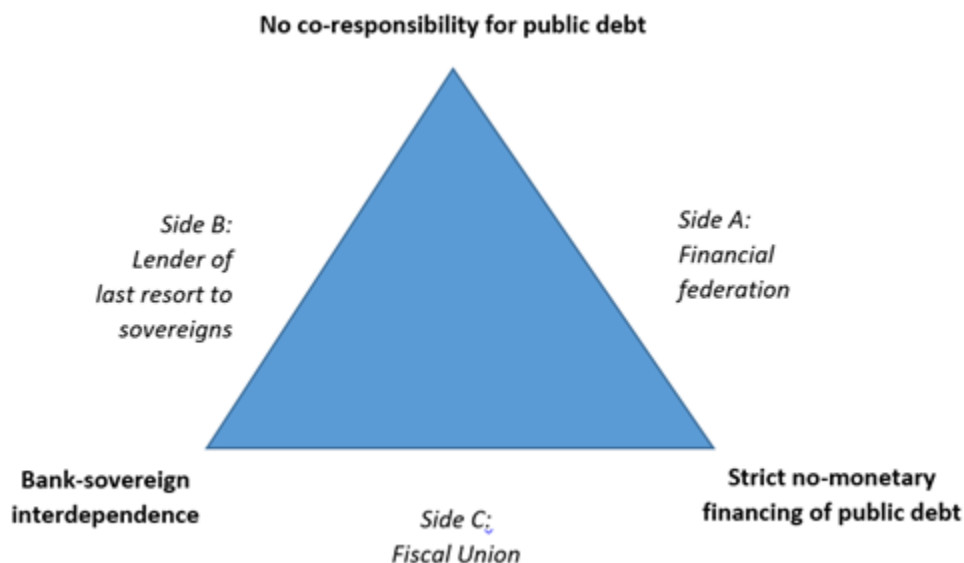
Early on, Dirk Schoenmaker (2011) formulated ‘a financial trilemma [which] states that financial stability, financial integration, and national financial policies are incompatible.’ It is a variant of Rodrik’s (2000) trilemma of democracy (financial stability), hyper-globalisation (financial integration) and sovereignty (national financial policies). Historically, financial repression combined the democratic preference for stability with national autonomy. When growth rates fell and unemployment rose in the 1970s, political economies liberalised, and their financial systems integrated (Abdelal 2007). Accordingly, either financial instability had to be accepted, with intensifying financial contagion and the risk of systemic crises, or national policies towards domestic banks could no longer pursue goals of their own. Precautionary regulation had to be geared towards making financial integration and financial stability compatible, with a backstop from the state of sufficient refunding of banks in a crisis. The Financial Services Action Plan of the EU created the legal basis for the latter choice between 1999 and 2004. But governments pursuing national goals, incompatible with the collective choice for integration and stability, had the potential for upsetting the equilibrium; Ireland with its high-risk strategy for financialized growth is a prime example for this uncooperative behaviour of governments (Regan 2016).

As path-breaking as the Schoenmaker model was, it takes a somewhat narrow financial sector point of view while his trilemma is meant to capture a systemic problem. The vertex of ‘National financial policies’, especially, downplays the role of government. It does not consider that fiscal policy is available to maintain a viable policy choice with either financial stability or financial integration. But fiscal policy may also be overwhelmed by the task of rescuing national banks and subsidiaries of foreign banks. This consideration would bring in the central bank as lender of last resort, to both banks but also sovereigns in a systemic crisis that has negative feedback loops on the solvency of the fiscal authority<sup>2</sup>. The financial

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<sup>2</sup>This was not only an issue in the euro area (Mabbett and Schelkle 2019).

Figure 4.1: Pisani-Ferry's impossible trinity



Source: Pisani-Ferry (2012)

trilemma of Pisani-Ferry (2012), shown in figure 4.1, captures that the trilemma grasps instability as much as equilibrium choices: “the core of euro-area vulnerability is an impossible trinity” of, first, strict no-monetary financing of public debt, national bank-sovereign interdependence, and no co-responsibility of member states for public debt. This trilemma encapsulates stylized features of the euro area’s architecture that create its vulnerability to negative feedback loops between weak bank balance sheets and weak public finances. The ECB is not allowed to buy bonds directly from a member state government whose solvency is doubted by bond investors. Devolved fiscal policy responsibilities, including national responsibility for bank rescues, imply that this government may be shut out of bond markets and its issues downgraded. The home bias in the EU banks’ sovereign bond holdings also weakens those banks’ solvency, even of the ones that did not require a rescue initially.

To get out of Pisani-Ferry’s impossible trinity, further financial integration could be promoted. A banking federation and regulation to reduce the home bias in bond holdings, would make fiscal devolution and the restriction on the ECB compatible. However, Pisani-Ferry notes that this solution would require a long, drawn-out process of transition. In particular, the level of public debt on banks’ balance sheets and giving the EU taxing power for a backstop to deposit insurance are non-trivial hurdles. Alternatively, the ECB

could be given the mandate to buy sovereign bonds in primary markets, which would allow devolved fiscal policy to be combined with bank-sovereign interdependence. Pisani-Ferry (2012) considered this solution least likely. Finally, a fiscal union would make the limited mandate of the ECB compatible with home bias in banks' sovereign bond holdings. This is what Pisani-Ferry (2012) viewed as the preferable solution, but he saw obstacles in terms of unevenly distributed benefits for member states and the momentous change in political integration that would be required to issue Eurobonds for a union of democratic Member States.

Pisani-Ferry's trilemma formulates concisely the two policy decisions and a structural feature (bank-sovereign interdependence) of European political economies to capture the instability of the euro area's policy choices. Euro-area reforms and innovation by the central bank over the past decade have gone some way to move off the sharp edges of the Schoemaker and Pisani-Ferry trilemmas. The steps towards banking union have significantly constrained national financial policies and moved towards a financial federation. Recapitalisation of banking systems remains a national fiscal responsibility but has undoubtedly been helped by the ECB stepping in to help through its asset purchases and the promise to "do whatever it takes". More recently, the European Stability Mechanism (ESM) has been made a backstop for bank resolution (ESM 2021).

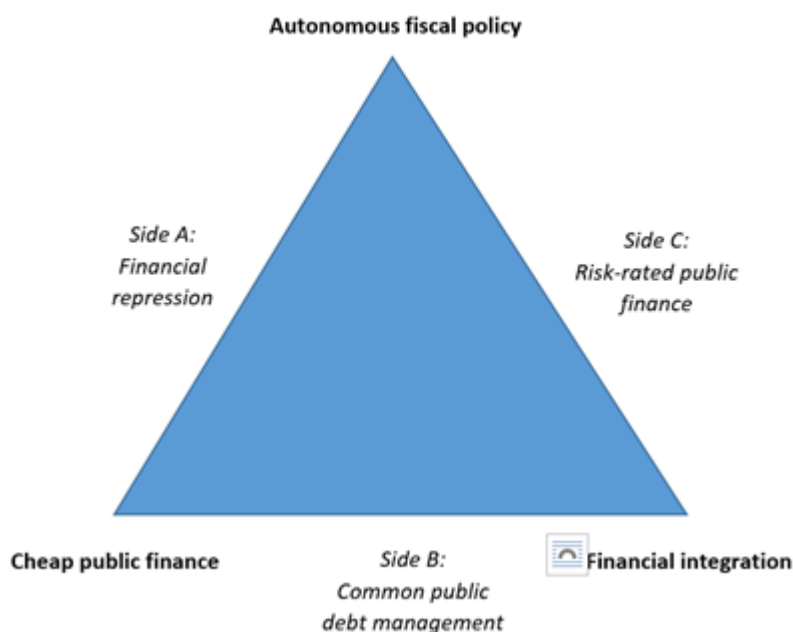
However, all reforms avoid making open-ended, jointly backed commitments. For instance, the "whatever it takes" promise is conditioned on an ESM programme and the ESM backstop for the resolution fund is limited to €60 billion. The new Recovery and Resilience Facility (RRF) is a temporary grant and loan fund. Such limitations have been justified, explicitly by then German Finance Minister Schäuble, with concerns about moral hazard of financial institutions and governments<sup>3</sup>. Hence, the decade-long crisis in the euro area has continued with episodic surges in sovereign bond yield spreads. A stark example was the upheaval created in the Italian bond market in March 2020, when ECB President Lagarde (2020) insisted that the central bank was "not here to close spreads" between members' borrowing costs. Italian bond rates climbed for five days, interpreting this as a lack of ECB commitment to Italy under new leadership (Jones 2020), even though she said this in a context of urging fiscal authorities to do more to stabilise the economy and

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<sup>3</sup>"Every step we take in the direction of risk-sharing diminishes risk reduction. Hence, risk reduction must have priority." (Schäuble 2015, our translation)



Figure 4.2: The political-financial trilemma



followed up with an immediate clarification.

To understand this fragility, despite massive reforms, our trilemma goes back to the original Maastricht consensus and traces how the policy consensus incrementally changed without settling on a purist policy choice of only two options. We do this by simultaneously generalising and combining the Schoenmaker and the Pisani-Ferry trilemmas and incorporating the bond market constraints identified by Hume (2022b). The Maastricht consensus – or better compromise, as will become clear in the next section – was arguably characterised by combining nationally autonomous fiscal policy with cheap public finance, both the reward for observing fiscal rules and respecting the independence of the central bank. Part of the Maastricht compromise was also financial liberalisation and integration, but this was a compartmentalised pursuit of the Single Market Programme. This constitutes a political-financial trilemma: political decisions, to keep fiscal policies of member states autonomous and institutionalise cheap public finance in particular ways, combined with dynamics of integrated financial markets that are not entirely under the control of policymakers.

Our formulation, shown in figure 4.2, takes the government bond markets as the theatre in which the trilemma plays itself out. Why does it make for drama? Combining autonomous fiscal policy, cheap public finance, and financial integration in a diverse monetary union is incompatible with how financial markets

create and manage risks. Capital flows across financially integrated and diverse economies led to the emergence of unsustainable financial imbalances followed by a sudden stop and recessions in the OECD world (De Grauwe 2013, Obstfeld 2013). It turned into a euro-area sovereign debt crisis when the sovereign-bank nexus of autonomous fiscal policy created a diabolic loop and the ECB's independence precluded lending of last resort to sovereigns. The Maastricht goal of cheap public finance could not be sustained for all members as bond market investors priced in sovereign credit risks that could not be smoothly handled by the euro area's legacy bond market structure (Hume 2022b). In its pure form, the political-financial trilemma states that any solution to these dynamics must entail giving up one of the policy positions that lies at its vertices.

We will argue below that the Maastricht compromise can be understood as moving away from trying to choose all three pure solutions, the edges of the trilemma, which would be inconsistent. Nonetheless, the compromise made the currency union fragile. Fragility in a general sense means crisis-prone but also resilient (Ferrera et al. 2022) and is compatible with the more specific sense of fragility that De Grauwe (2013) uses: an indeterminate state of market expectations that, in a market panic, can lead to a good or bad equilibrium.

To take side A first: to counter the effects of financial integration some form of financial repression is required. As an institutional policy choice, it would entail adding the control of capital flows through macroprudential interventions to strict enforcement of fiscal rules to manage macroeconomic imbalances (Hume 2022c). As a crisis management tool, however, repression means overriding integrated financial markets by directing capital to indebted members and thus suppress diverging spreads, mostly via the actions of the central bank through discounted liquidity operations and secondary market asset purchases. In other words, the initial Maastricht compromise as regards the euro architecture, at certain times at least, requires financial repression, not in terms of the means but in terms of the goal of cheap public finance, or 'debt liquidation', for indebted members with autonomous fiscal policies.<sup>4</sup>

To come to side B: common public debt management was the one institutional policy choice that was explicitly excluded by the Maastricht compromise. It is most often proposed as fiscal union but only requires

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<sup>4</sup>Reinhart and Sbrancia (2015) study the historical parallels of debt liquidation after the Great Recession and the early post-war decades. The means employed then included interest rate regulation and the creation of captive audiences that had to hold government bonds at low interest rates.

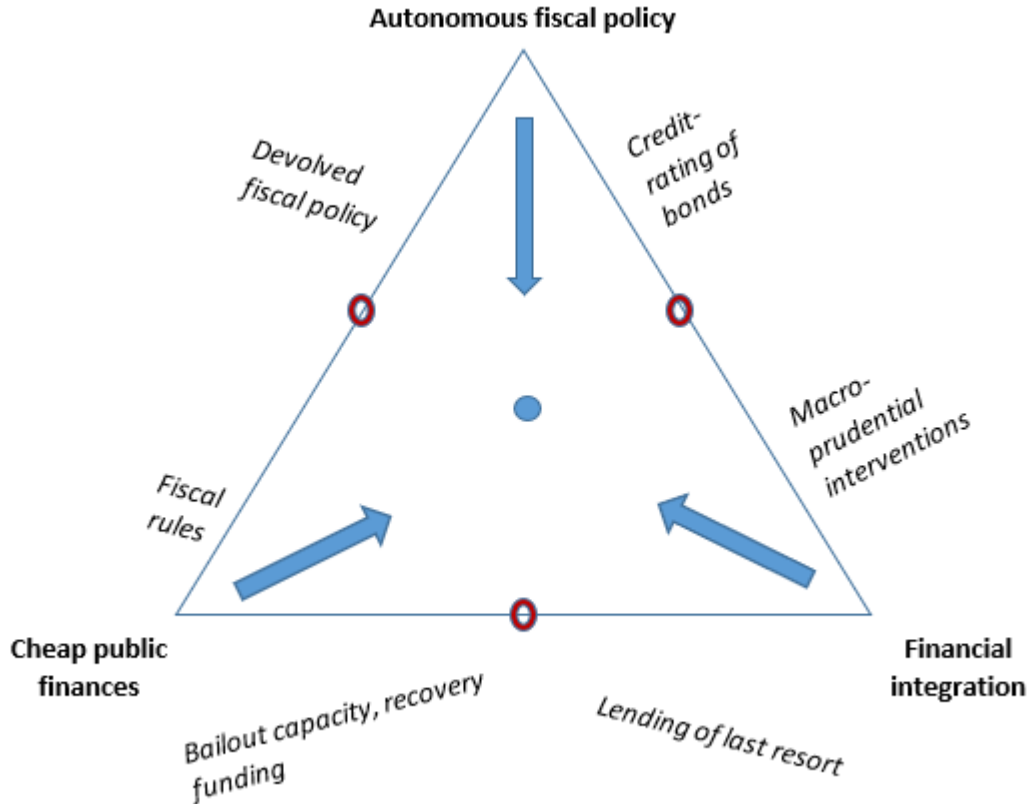
joined-up authority over public debt management that includes, in emergencies, a way for the central bank to act as a lender of last resort to this fiscal authority. As a crisis management tool, common debt management encompasses the emergency lending measures taken by the EU during the crisis, notably the European Stability Mechanism (ESM) and its forerunners, but these finite funds are too partial to amount to an institutional policy choice. Many observers have the U.S. in mind when they propose fiscal union as the solution for the euro area. We will show below, however, that this is not the policy choice that the U.S. federal system has institutionalised, which corresponds more closely to side C.

Side C depicts the alternative to cheap public finance for all by accepting risk-rated public finance. As an institutional choice, this would entail the issuance of tiered government bonds and has been proposed in several forms, most notably the Eurobonds of De Grauwe and Moesen (2009), Bruegel's "Red and Blue bond" proposal (Delpla and Weizsäcker 2010) and the Barroso Commission's "Stability Bonds" (European Commission 2011). Tiered bond issuance elevates stability over cheapness by hard-wiring risk-rated borrowing spreads in exchange for allowing more straightforward debt restructuring. U.S. municipal bond markets have this feature. Risk-rated public finance cannot be framed as crisis management policy but instead is the outcome bond markets impose in a crisis when alternative policies of repression and common debt management are not deployed or are insufficient. This has evidently been the case much of the time since the euro-area crisis began, with periphery debt consistently exhibiting higher spreads and volatility than core debt.

Our reference to the Maastricht compromise raises the question of whether all choices that are not halfway between the vertices of two goals are incompatible with stability. This is often the reading of trilemmas, and it stops there. But our political-economic formulation suggests that the corners are pure solutions that hardly exist: all are matters of degree. How autonomous is a devolved fiscal policy arrangement? Does the introduction of macro-prudential regulation weaken financial integration? How cheap is cheap public finance? Compromises between the members mean that instead of giving one goal a zero weight, a combination of all three goals are pursued, albeit constrained by the underlying economics and policy capabilities. The policy choices then become more complex, but they can, and arguably must, move inside the triangle. We formulate the circling and compromising under the constraints of a trilemma more analytically in Appendix C.1. The

graphic representation in Figure 4.3 illustrates the argument: the red circles mark pure choices while the positions inside the triangle mark a choice of all three goals that need more than one policy intervention or institution to shift. The dot in the middle illustrates the point where all three goals have equal weight.<sup>5</sup>

Figure 4.3: Compromises in the political-financial trilemma



Constructed in this way, our political-financial trilemma allows us to address three broader issues than the two predecessors: the political agreement underpinning the initial choice, the tensions in this choice as well as the compromising over alternative policy choices, and finally the difficulties of transition from one choice to another. We address each of these three issues in the following sections.

<sup>5</sup>Intermediate choices cannot be accurately positioned on a two-dimensional triangle but, for illustrative purposes, Figure 4.3 shows some choices that can be portrayed intuitively. For a full analysis of the solutions to a policy trilemma and a three-dimensional representation, please see Appendix C.1

### 4.3 The fragile Maastricht compromise and its demise

The political-financial trilemma is an analytical and conceptual device to understand why the euro area is fragile, crisis-prone, but also resilient. While the analytics of a trilemma are only useful if they speak to the contested issues in the negotiations of the Maastricht policy architecture, we do not claim that policymakers had our trilemma in mind. For our account of what they had in mind, we rely largely on Moravcsik (1998: pp.379-471). In contrast to the other classical study of the Maastricht negotiations by Dyson and Featherstone (1999), Moravcsik focuses on policy issues as the unit of analysis. His intention is to prove that Germany largely got its way in determining key features of the policy architecture, thanks to its veto-player position with the smallest win-set. Our intention is to see whether compromises between different positions led to policy choices that can be captured analytically as a circling of the trilemma and the fragility of the euro-area.

What made governments agree on a common currency in the first place? The launch of the euro was meant to find a viable policy choice post-Bretton Woods. The choice of giving up independent monetary policy seems to be surprising to 'realist' political economists. But in the international monetary order post-Bretton Woods, many European countries found that their monetary policy was not sovereign but could choose only between a rock and a hard place, i.e., between the expansionary but destabilising U.S. Fed policy and the stable but growth-constraining stance of the German Bundesbank. If proof was needed, the 1992/93 ERM crisis provided it, humiliating a proud secondary reserve currency like the British Pound and a sovereignty-conscious member state, France, with its much better macroeconomic indicators than post-unification Germany (Bayoumi and Eichengreen 1993). Giving up 'independent' monetary policy did not seem to be much of a sacrifice for most member states (De Grauwe 1988, Schelkle 2017: pp.126-135). If small currency areas could no longer be played off against each other, elites in Treasuries and central banks hoped that a stable supply of finance would facilitate private and public investment to revive the lacklustre growth after the dismal 1970s and early 1980s (Abdelal 2007: ch.4). They were thus ready to actively integrate financial markets.

### 4.3.1 The different positions in the Maastricht compromise

In line with Moravcsik (1998), we investigate the national positions of Germany, France, and the UK (Table 4.1). They cover the spectrum of disagreements and represent other vocal member states: the Dutch and Belgian positions were largely aligned with Germany's, Italy's with those of France, and the Danish with UK opposition. The Commission under President Delors was often close to the French position, but the latter is much more flexible than that of the supranational body.

Six important negotiation issues can explain how the euro area ended up with an architecture that we grasp with our trilemma. The first two issues are concerned with the controversies on how countries could adopt the single currency and whether they had to first qualify through fiscal convergence. Positions revealed very different political views of what the future common currency area ought to be: a club of select members with a pertinent stability culture, which was the German government's position, or the aspiration of an inclusive European Union, which characterised France's view.<sup>6</sup> The British view was closer to the German, above all because convergence on a low inflation regime prior to adopting a single currency would take a very long time. Britain's main goal was not to be left out of proceedings (Moravcsik 1998: p.426). The Delors Commission was close to the French position, arguably for different reasons: if countries would have to converge beforehand, they may lose interest in monetary integration once they have reached that stage. The positions on these two criteria meant that Germany supported a longer qualification process while France and the Commission considered the political will to adopt a hard currency as the decisive criterion.

It is worth noting that no member state wanted a monetary union that accepted high inflation. Elites in soft currency countries such as Italy could see that there would be little gain in adopting such a currency, while losing discretion over the national interest rate policy. They hoped for a hard currency, guaranteed by a pragmatic supranational central bank, which would reward national adaptation with low interest rates. This prospect made French and British business associations support the common currency (Moravcsik 1998: pp.408-9, p.420). Even the German government under Chancellor Kohl hoped for a more accommodating

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<sup>6</sup>The (conservative) German position on monetary integration is sometimes dubbed 'economist', the French 'monetarist', which is easily confused with almost the opposite stance of these countries on monetary policy at the time. In this context, it refers to the sequencing of economic and monetary integration.

Table 4.1: Negotiation positions relevant to the political-financial trilemma

	Germany	France	United Kingdom	Commission
<b>1. Membership in European Monetary Union</b>	Prefers EMU with no opt-out but parliamentary vote to opt-in	Prefers EMU with no opt-out	Opposes EMU, every country must opt-in but none can be excluded	Prefers EMU with no opt-out
<b>2. Strict convergence</b>	Prefers prior but flexible macro-economic convergence; national central bank independence as pre-condition	No pre-conditions	Unclear	No pre-conditions
<b>3. ECB autonomy and mandate</b>	Prefers strong autonomy except for multilateral exchange rate policy; anti-inflationary mandate; simple majority decision-making	Prefers political control, especially for multilateral exchange rate policy; balanced mandate; simple majority decision-making	Opposes EMU but apparently in favour of autonomous ECB with anti-inflationary mandate	Prefers political control with a role for the Commission; balanced mandate; simple majority decision-making
<b>4. Budgetary controls of member states</b>	In favour, with sanctions decided by simple majority	Opposes controls	Opposes controls	Opposes controls
<b>5. Budgetary support</b>	No bail-outs, no transfers	No transfers	No transfers	Fiscal federalism with permanent transfers
<b>6. Free capital movement</b>	Full capital liberalization as pre-condition	Capital liberalization in return for EMU	Capital liberalization for autonomous reasons	EMU as complement of capital liberalization

Source: adapted from Moravcsik (1998: pp.382-383 and passim for free capital movement)

stance of the ECB compared to the Bundesbank (Moravcsik 1998: p.394). Low inflation and low interest rates for public and private borrowers were seen as two sides of the same coin (European Commission 1990: p.11).

Against this background, it is easier to see the positions on the other four issues. First, Germany fought hard for the institutionalisation of the ECB because there was this tried and tested example of the Bundesbank, even though it had become an admittedly over-eager guarantor of stability even for German Chancellors. France wanted the ECB to embody a more symmetric mandate and be subject to a modicum of political control, although it was not entirely clear how this oversight could be exercised without a government. The German position prevailed. Second and third, from a German point of view, budgetary surveillance and sanctions had to make sure that the original compact was also heeded in future, while France and even the Commission saw such budgetary controls as conditional on reciprocity in terms of central budgetary transfers. The fiscal rules of the Stability and Growth Pact were added only later, accompanied

by considerable additional transfers in the guise of Cohesion Funds. Finally, capital liberalization was for Germany and the UK a crucial element of the Single Market. In the case of Germany, it was also a possible instrument of market discipline for profligate governments. The UK had abandoned capital controls already in 1977-79, in the hope of weakening an overvalued Pound that would help industrial exports. It was a beggar-thy-neighbour policy that, under Margaret Thatcher, was dressed up as liberalization to mollify markets (Copley 2019). For the French position, capital market liberalization had to be a consequence of monetary integration that would eliminate speculative currency attacks between members. Similarly, the European Commission (1990: 161) stated that capital liberalization and elimination of exchange rates had to go together to reap the full benefits of the free movement of capital.

For Moravcsik (1998), these views are ultimately anchored in the structural economic interests of member states. But he also admits for each that the political positions of the governing heads of state did make a difference. Kohl was a convinced federalist and was therefore willing to compromise even if it required outmanoeuvring the Bundesbank (Moravcsik 1998: p.403). Mitterand had a complex position but was ultimately a Gaullist in the sense that he supported European integration generally as a counterweight to the U.S. and monetary integration specifically as a way of reining in German dominance (Moravcsik 1998: pp.405-407). Margaret Thatcher's sovereigntist world view was sometimes directly opposed to Britain's business interests while John Major was more pragmatic, mindful of the commercial interests of the financial sector (Moravcsik 1998: p.426).

The outcome of all this was a compromise. This included very different understandings of what the vertices mean. For those aligned with the German position, fiscal policies should not be entirely autonomous but devolved and following the discipline of fiscal rules; for those aligned with the French position, fiscal policies had to do the heavy lifting of national macroeconomic stabilisation and should therefore either be autonomous or preferably supported by collective capacities. Financial integration meant for Germany and its allies primarily freedom of capital movements, for France and its allies in this context the elimination of exchange rates. Cheap public borrowing was welcome to all Finance Ministers, but while the German world view saw this as the reward for low inflation, the French world view was inclined to see low interest as the outcome of creating a deep and liquid capital market. None of these interpretations is wrong but we will see



that this implies different stakes in the policy choices of the trilemma and not fastening on any of them as an outcome.

### 4.3.2 Tensions within the Maastricht compromise

The euro-area crisis more than two decades later exposed significant fragilities in the institutional arrangements of the single currency. Financial instability was not unique to the monetary union. But the crisis in Europe's sovereign bond markets and the institutional and political crisis associated with it was not evident in other advanced economies on anything like the same scale. National financial cycles had fed on the process of financial integration catalysed by the launch of the euro and eventually bled into the public sector balance sheet via bank loans going sour. While a case can be made that in some cases, such as Greece, the financial stability originated in excess public debt issuance, a much stronger case can be made that several other countries, notably Ireland and Spain, experienced extreme financial instability despite easily meeting their commitments on fiscal discipline (De Grauwe and Ji 2013). Sustainable fiscal policy on its own is not enough if financial systems are so interconnected that national capacities are easily overwhelmed. In turn, if national fiscal capacities are already overstretched, as in Italy, nationally autonomous public finances become a source of vulnerability even if the national financial system is traditional and not very large. We see the Maastricht compromise as having been undermined by three related sources of tension which can be thought of as emerging in an almost chronological sequence.

The first source of tension came from financial integration, arguably the somewhat neglected vertex of the euro-area construction (side A). Financial flows tend to be pro-cyclical, i.e., they promote and follow regional growth and abandon depressed areas.<sup>7</sup> Contrary to neoclassical economics, the equilibrating price adjustments, such as appreciating real exchange rates in the booming regions and real depreciation in the depressed regions, cannot outweigh the attraction of rising employment, incomes and real estate values that feed on each other. The ensuing current account deficits can easily be financed and alleviate emerging

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<sup>7</sup>We share with many authors that managing imbalances in a financially integrated currency union of diverse members is difficult (Giavazzi and Baldwin 2015, Frieden and Walter 2017, Johnston and Regan 2016). But our causal analysis is different: for them, vulnerability predominantly reflects the twin deficit of government and current account imbalances while for us, vulnerability also reflects gross financial flows.

bottlenecks in a high-growth region with deteriorating price competitiveness. But they tend to be driven by unrealistic expectations of future income growth and when the bubble bursts, banks holding these claims bear a good share of the losses and have the potential to create systemic risks in the absence of stabilizing policy interventions. Transnational policy interventions are therefore necessary to manage private-sector as well as public-sector imbalances.

The second source of tension came from autonomous public finances when national governments were forced to step in as the ultimate backstop. Public-sector refinancing of failing banks is a conventional macroeconomic stabilization tool to prevent systemic risks spiralling out of control. But an additional problem facing euro-area countries was the absence of other policy tools to help them. With no central bank or currency of their own, almost all macroeconomic stabilization responsibility falls on fiscal policy. Monetary policy might be eased, and the euro exchange rate might fall, but only in proportion to the significance of the affected economy for the euro area as whole. And while the ECB was able to provide ample liquidity, this is a weak tool in the face of recession and systemic banking sector risks. The extra burden on the public sector balance sheet of the banking crises was therefore amplified, leading to questions of debt sustainability of the sovereign.

The third source of tension emerged when doubts about debt sustainability translated much faster into higher government borrowing costs than historical relationships would suggest, challenging the goal of cheap public finance. Fundamentally, this reflects the absence of a lender of last resort, linked to Article 21 of the ECB's statute that prohibits the monetisation of public debt (De Grauwe 2013). It states that the central bank cannot directly buy bonds from government entities or extend overdraft facilities to them.<sup>8</sup> In addition, there are institutional features of European sovereign bond markets that make them prone to liquidity crises at low levels of default risk and interest rates. Hume (2022b) explains how this is a

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<sup>8</sup>It is important to note that the eight EU member states that are not members of the euro are also bound by the prohibition on direct monetary financing contained in Article 123 TFEU and the provision of direct monetary finance to governments by major central banks is rare. What sets the euro area apart is not only that the ECB is restricted in direct monetary finance, but also in terms of purchasing sovereign bonds on the secondary market. In standalone countries, when the sovereign bond market becomes stressed, the central bank can straightforwardly motivate large-scale purchases in the secondary market using either its monetary policy or financial stability mandates. But concerns about the distributive consequences of targeted bond purchases made the European System of Central Banks stipulate that member state bonds must be bought according to a key determined by their share in the paid-in capital of the ECB. This 'one size-fits-all' restraint on Quantitative Easing (QE) created market uncertainty about the ECB's capacity to intervene when sovereign bond markets became stressed.

consequence of a legacy market structure for developed economy sovereign bonds interacting with a complex policy risk premium. It relies on a traditional investor base, such as pension funds and insurers as well as banks, that requires government bonds to perform the role of a safe asset. For these investors, even a small increase in default risk is enough to lead them to withdraw their participation from the market. This implies that sovereigns can quickly lose market access when perceptions of credit risk increase.

The lesson is that, for the euro area, where there is an absence of a lender of last resort and a market structure that leads to instability, adverse shocks can very quickly tip markets towards a liquidity crisis. This institutional feature also explains why, long after the intense phase of the crisis had passed, and despite all the reforms to euro-area governance over the past decade, the monetary union remains surprisingly vulnerable to a fresh crisis, as the March 2020 tantrum shows (Hume 2022b).

### 4.3.3 Circling the trilemma

One way of looking at the travails of the euro area over the long decade of crises since 2008 is that the euro area has been circling around the institutional policy choices that make bond markets fragile. We can grasp this analytically as the attempt to move inside the trilemma with policy interventions along all vertices (Figure 4.3 and Appendix C.1). Whether this represents a transition and leads to a different pure choice of two goals remains to be seen, but we are sceptical: the monetary union is diverse and traditional national stances show little sign of convergence. However, compromises that broke new ground were brokered and regularly prevented the escalation of policy crises into a deeper political crisis (Schelkle 2021, Truchlewski and Schelkle 2022).

The lowest common denominator of the Maastricht consensus unravelled even before the euro was introduced. Fiscal policies were not autonomous but devolved, with considerable interdependence as the crisis of the Exchange Rate Mechanism in 1992-93 demonstrated, when member state governments could not agree on a strategy of responding to extremely asynchronous business cycles after German unification. This left the Bundesbank to decide; the high interest rates and the recession they inflicted were costly even for the German economy (Eichengreen and Wyplosz 1993, Dornbusch 1993). By the mid-1990s, the German Finance Minister proposed fiscal rules that eventually became enshrined in the Stability and Growth Pact.

The interdependence of devolved fiscal policies and the ever more elaborate fiscal rules acknowledged that fiscal policy could not be entirely autonomous and that those who violate the rules must incur penalties. In Figure 4.3, this acknowledgement is represented by a move inside the triangle from both corners.

Through the qualifying Maastricht process, all future members had to prove that they could live with the rigours of a stability-oriented monetary policy. The convergence on lower inflation rates was sweetened by converging nominal interest rates that provided some previous high inflation countries with very low real interest rates that stimulated credit markets and growth. In 2008-10, there was a rude awakening to the fact that financial integration was spurred on by monetary integration. While no member state was ever penalised under the fiscal rules, the goal of cheap public finance was thwarted by widening bond spreads. Up until the pandemic in 2020, the main response of the EU to financial instability in integrated markets has been bailout funding through the ESM and ECB lending of last resort on an unimaginable scale before the crisis, directly to banks and indirectly to governments. With the Banking Union since 2014, the ECB became the Single Supervisor and can, through stress testing and macroprudential measures, manage financial integration to the point where they can segment regional credit markets. This is represented by another move inside the triangle in Figure 4.3.

While the ESM falls under the umbrella of common public debt management – it issues jointly guaranteed debt instruments to facilitate lending to national governments – it is too partial and limited in scope to represent an institutional policy choice and is best viewed as a crisis management tool. The lending is intended to replace market-based funding at lower interest rates. It does not reduce the liabilities of national governments, only the form they take. ESM lending has several features that limited its effectiveness. Being senior to other creditors, it introduced the risk that, in the event of default, a larger proportion of the overall loss falls on private lenders. This increased risk premia in countries that might need ESM lending in the future, especially once it became clear that the EU was contemplating using private sector involvement to put public finances on a sustainable path. It also suffered from finite resources. This introduced redenomination risks once governments with larger debt burdens, such as Italy and Spain, became at risk of losing market access. Hence, the ECB was forced to step in more forcefully. ECB President Mario Draghi's 'whatever it takes' speech was a prelude to the central bank's subsequent announcement

of Outright Monetary Transactions (OMT). This policy addressed the problem of finite ESM resources and took the central bank as close to being a lender of last resort for sovereigns as the Maastricht Treaty permits. Crucially, however, OMT support can be provided only in the context of an ESM financing programme that imposes strict conditionality. Given that such programmes are put in place after a liquidity crisis has taken place, the policy does not preclude the possibility of a crisis. It makes a liquidity crisis less likely, by lowering the probability of redenomination due to the sovereign's financing needs exceeding the capacity of the ESM. But as a policy that enhances the power of the ESM, it should still be viewed as a crisis management tool rather than an institutional policy choice towards common public debt management.

This restriction forced the ECB to step in repeatedly. Since 2010, the central bank has massively extended its capacity to stabilise government bond markets (Hume 2022a). Most significant has been the channelling of funds to sovereigns via discounted liquidity provisions to the banking system. These liquidity operations with long maturities – the LTROs, TLTROs, and PELTROs – amounted to almost 15% of GDP at the end of 2021 (Hume 2022a). These are large sums, but as a crisis management tool they suffer from making the bank-sovereign nexus worse as they cause banks to buy more government bonds. Of more unambiguous benefit have been the ECB's total asset purchases through both the APP and the PEPP, which at the end of 2021 stood at over 30% of GDP. As a proportion of GDP, these purchases are on a similar scale to other G7 central banks, such as the U.S. Federal Reserve and the Bank of England. Yet, as the March 2020 tantrum illustrated when Italy's bond spreads rose because the new ECB President misspoke, cheap public finance for all remains elusive.

The recent pandemic reforms, especially the RRF within the NGEU agenda, are the most significant attempts to date to move the single currency towards a new settlement of the political-financial trilemma (Schelkle 2021). But before we consider the nature of these reforms, and the extent to which they should be viewed as an institutional policy choice as opposed to just another crisis management tool, we look at the U.S. arrangements for public finance as an example of an institutional policy choice that highlights how unlikely it is that the euro area can end its fragility in this way.

## 4.4 Managing fragile bond markets in monetary unions

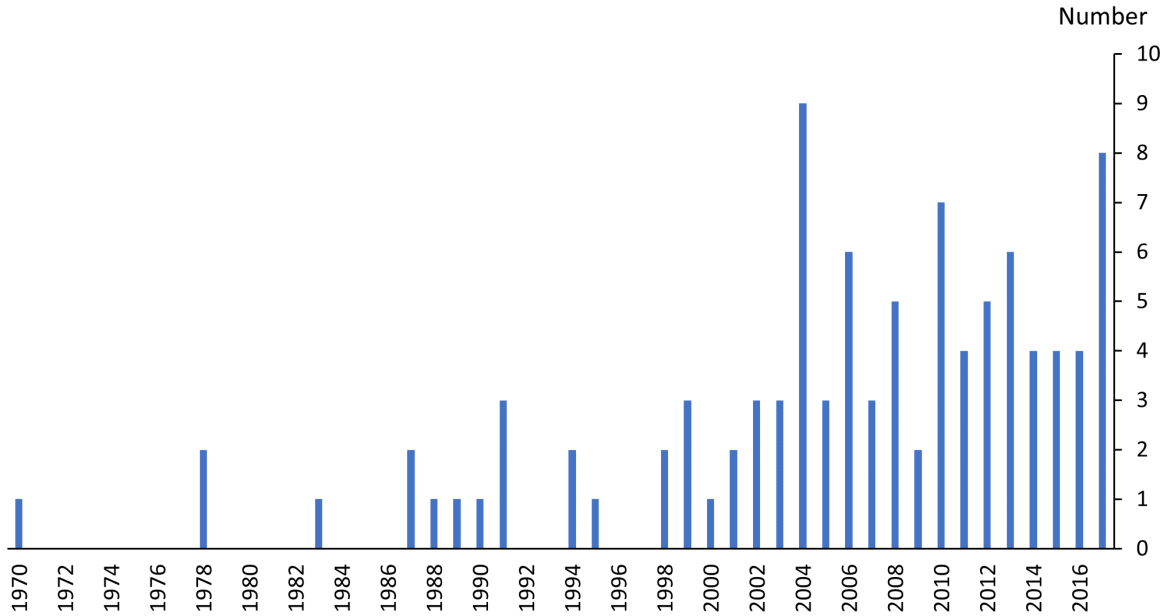
The political-financial trilemma need not be viewed as unique to the euro area but can be applied to any monetary union with financial integration and some degree of fiscal policy autonomy. So, it is worth considering the experiences of federal states. Taking the trilemma with sharp edges, one could argue that in federal states market investors see a reliable choice: in crisis times, Side C of the trilemma can replace autonomous fiscal policy with mutual support in a fiscal federation. Federations are therefore able to live with deep financial integration among the states within the federation and replace markets in a crisis that could jeopardise states' public finances.

Except that they typically do not live like that. Central governments are not inclined to give member states a guarantee of full-scale intervention. Fiscal federations do not have a great record of macroeconomic stability (Rodden and Wibbels 2002, Wibbels 2003). This is the price they pay for devolved fiscal policy with sizeable fiscal capacities at the centre. Hence, members retain a modicum of fiscal and financial policy autonomy in normal times, while having incentives to freeride on the centre's fiscal policy. The degree to which the federal government replaces bond markets is therefore a matter of circumstances, such as political alignments between central and state governments and strains at the central level from veto-players and overstretch of its capacities. No-bailout rules may prevent the extent to which a state in a fiscal federation can get support (Henning and Kessler 2012). All this makes fiscal federalism potentially an intermediary resolution of the trilemma (Figure 4.2), transient between the Eastern side B in normal times and Southern side C when crisis hits. So, what, exactly, are the key features of the stable outcome if they can achieve it? To answer this, we take a closer look at the arrangements in the U.S.

Municipal bonds in the U.S. are far from risk-free assets and do not offer state governments access to cheap finance. They have no special creditor status and do not benefit from a lender of last resort, since they are not usable for getting guaranteed access to central bank money. In fact, there is a presumption that municipal bond holders will not be bailed out by the Federal government. Consequently, defaults on municipal bonds have become a regular event over the past two decades (Figure 4.4).

Reflecting this, municipal bonds exhibit many characteristics of the periphery government bond markets

Figure 4.4: History of defaults on U.S. municipal debt



Source: Fidelity, Moody's Investor Services

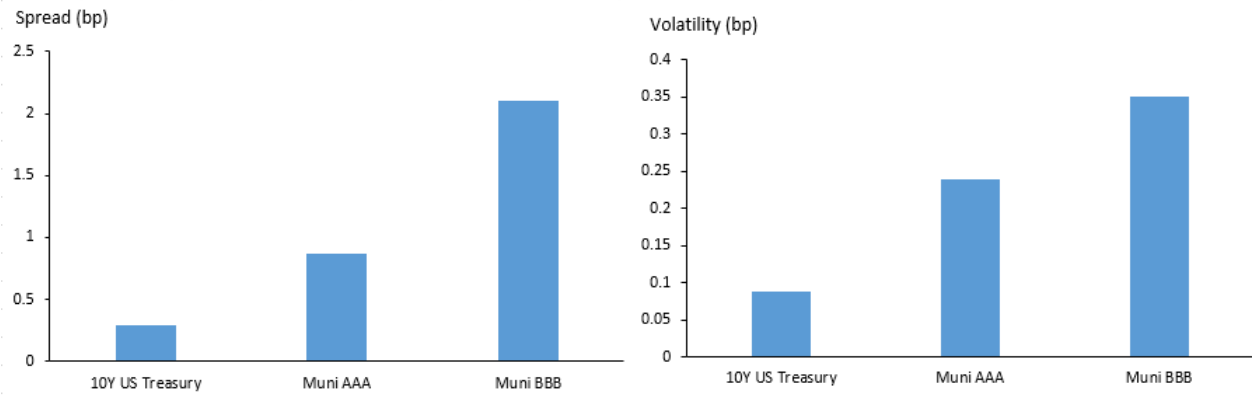
of the euro area. Spreads to risk-free Overnight Indexed Swap (OIS)<sup>9</sup> rates are higher than for federal debt and they experience greater levels of volatility, whether for similar-rated AAA issues or lower-rated BBB issues (Figure 4.5).

So, even though they operate within a federal system, many of the key features observed in periphery euro area government bond markets apply to the U.S. municipal bond markets. In other words, fiscal union does not necessarily act against higher risk premia and volatility at the sub-federal level. This is an important observation given that steps to fiscal union in the euro area are generally presumed to reduce risk premia and volatility in national government bond markets.

Comparing euro-area government bond markets directly with U.S. municipal bond markets reveals an apparent contradiction. While borrowing spreads in the U.S. municipal markets are higher than in the euro area, the lower-rated issues nonetheless tend to exhibit lower volatility (Figure 4.6). One reason for this

<sup>9</sup>OIS rates are based on expectations for the central bank's policy rate and are regarded as almost risk free as no exchange of principal is involved. The spread of other borrowing rates over them, such as LIBOR or government bond yields, is an indicator of risk premia specific to these markets.

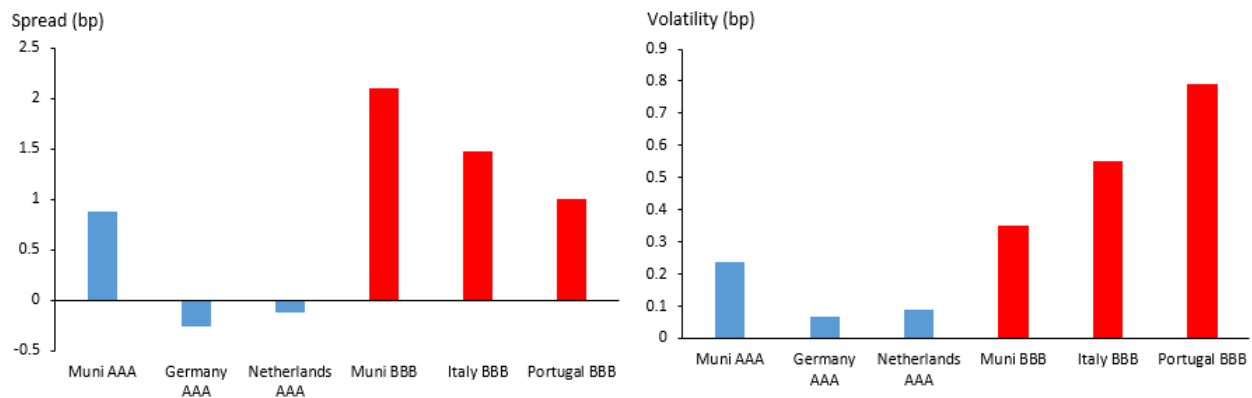
Figure 4.5: Spreads and volatility in the U.S. public debt markets since 2016



Source: Bloomberg Finance LP, authors' calculations

is that contagion in the U.S. municipal bond market appears to be restricted to some limited information signalling about specific risks rather than concerns about exposures within the financial system. For example, Gospodinov et al. (2014) examine the case of the 2013 Detroit Chapter 9 bankruptcy filing. They find that “[t]he evidence of spill-over from Detroit’s bankruptcy to abnormal yield changes for other municipalities is relatively limited; only states with heavy pension/financial obligations (Illinois and Puerto Rico) and a few speculative grade securities experienced statistically significant downward re-pricing”. Another observation is that bouts of volatility can often be addressed by relatively limited policy interventions, unlike in the euro area. Sanchez and Wilkinson (2020) show how distress in the municipal bond markets during the pandemic were eased sharply once the Federal Reserve began, exceptionally, to accept municipal bonds as collateral in their repo operations.

Figure 4.6: Spreads and volatility in U.S. municipal and euro-area sovereign markets since 2016



Source: Bloomberg Finance LP, authors' calculations



At a deeper level these relative properties of the U.S. municipal bond and euro-area sovereign bond markets can be traced to different market structures. In contrast to the euro area, the municipal bond market is dominated by buy-and-hold retail investors investing either directly or through investment funds (Table 4.2). This difference in investor base is crucial for ensuring a more stable market for lower-rated credits. While market liquidity may become impaired in times of stress, it is generally able to adapt to changes in perceptions of credit risk. At the same time, the reduced role of monetary and financial institutions among investors keeps systemic risks contained, which also helps to limit contagion effects. However, this dependence on buy-and-hold retail investors, while conferring advantages in terms of stability, comes at the cost of higher borrowing spreads. In other words, consistent with the political-financial trilemma, the U.S. federal structure achieves stability through the institutional choice of public finances being risk-rated.

Table 4.2: Ownership by investor type of the public debt (2021 Q4)

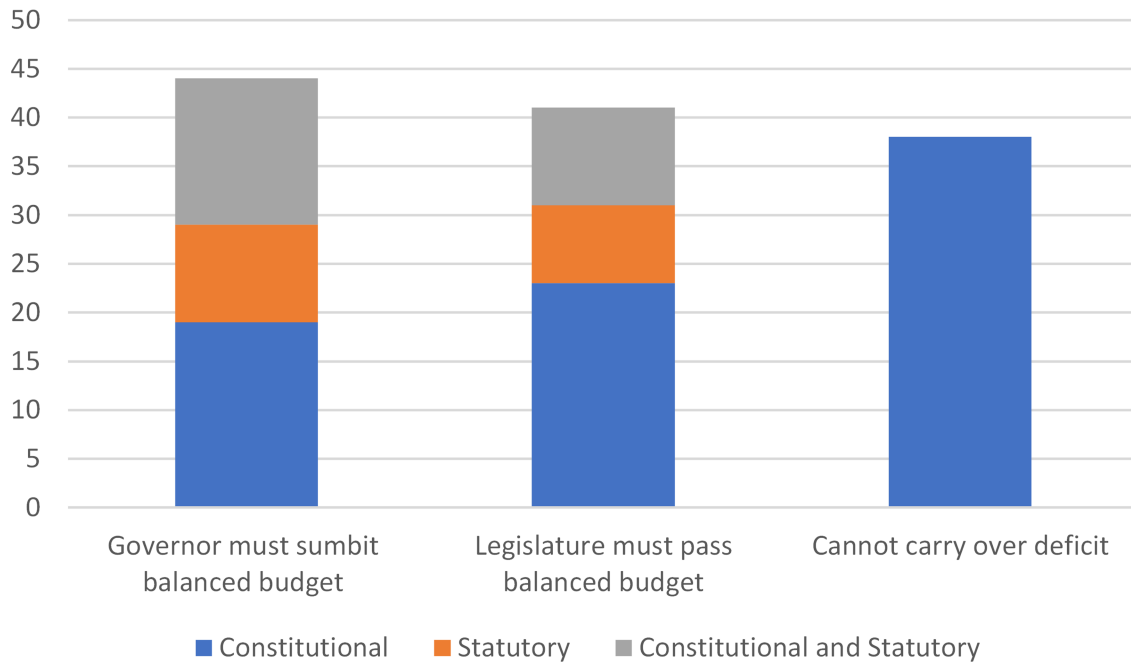
Shares of total, %	United States		Euro Area			
	Federal	Municipal	Germany	France	Italy	Spain
<b>Households and NFCs</b>	3	43	1	1	9	1
<b>Investment Funds</b>	15	29	28	17	16	15
<b>Pension and Insurance</b>	37	12	32	59	31	39
<b>MFI</b>	8	12	30	21	38	42
<b>Other</b>	37	4	9	2	6	4

Source: U.S. Federal Reserve Flow of Funds Z1 tables, European Central Bank Securities Holdings Statistics, authors' calculations

This risk-rated choice with devolved, not autonomous, state fiscal policy is supported by some other features and reinforcing mechanisms in U.S. public finance arrangements. Fiscal activity at the sub-federal level, while still substantial, is much smaller than in the euro area (see Appendix C.2 for details). This, too, limits the systemic importance of state finances. The fact that the state governments do not represent a source of broader instability also serves to reinforce the credibility of the fiscal no-bailout presumption. If a bailout happens, it is generally for political rather than financial stability reasons. All of this serves to encourage prudent public finances. Most states have balanced budget amendments out of choice and engage

in pro-cyclical spending policies (Figure 4.7; Dolls et al. 2010). This justifies the generally high credit ratings of the state governments but, as indicated by the trilemma, the bonds are still risk-rated in that they have higher credit spreads and volatility than U.S. Treasury bonds. That is the price of the U.S. solution to the trilemma: the issuance of risk-rated sub-federal bonds that can adapt to changing perceptions of risk. In short, while both U.S. municipal and euro-area government bonds have no lender of last resort, the former has traded away low borrowing spreads for the advantage of more stable financing arrangements while the latter has been reluctant to let risk-rating of bonds happen. The result has been fragility of bond markets that has repeatedly forced the ECB's hands (Mabbett and Schelkle 2019).

Figure 4.7: Number and types of balanced budget amendments in U.S. states



Source: National Association of State Budget Officers.

Our finding that the U.S. public finance system does not support the presumption that fiscal union reduces risk premia and volatility at the sub-federal level challenges the idea of fiscal union ending financial fragility in the euro-area. Even common public debt management comes at a price unless the federal level accepts any level of fiscal risk-taking by member states. To us, this suggests that how the market structure adapts is likely to have an important bearing on the impact of incremental moves towards fiscal union on the stability and cheapness of public debt at the national level. The next section turns to this issue by

considering the nature of recent reforms and the impact they may have on the market structure.

## 4.5 Pandemic reforms in the political-financial trilemma

A move closer to a new policy choice has become conceivable. The pandemic reforms seem to abandon devolved fiscal policy, for the first time not so much through fiscal and no-bailout rules, but by creating fiscal and lending capacity at the EU level that tries to enshrine cheap public finance for all member states, at least during the recovery in the medium term. The bonds to finance the RRF create a new tier of asset for investors that is potentially safer than many government bonds issued by member states, adding to those already in issue by the ESM and another new instrument, SURE (see below). Risk-rating of bonds may be the result. The political-financial trilemma, and the experience of the U.S. municipal bond market, tells us that how the market structure adapts is likely to be important in determining the overall effect on national government bond markets. We now look at the reforms, considering how they may impact the market structure, and what this implies for policy choices and the fragility of euro-area bond markets.

The use of the ESM as a backstop for governments that encounter bond market difficulties during recovery was rejected by a strong member state coalition early on. Nine heads of state signed a letter in March 2020 that demanded a joint debt instrument, soon referred to as ‘Coronabonds’, instead (Wilmès et al. 2020). This, and a categorical opposition by the Italian government against ESM conditionality, triggered a debate about alternatives. But the ESM was available and could fill a gap that even the ECB could not easily fill: buying up bonds from governments directly if they were not eligible for any of the QE programmes. For instance, even under the PEPP, the ECB must not buy bonds with a residual maturity of less than 70 days. This is where the new Pandemic Crisis Support by the ESM would come in, a new contingent credit line that became available on 15th May 2020. The ESM-PCS is available until the end of 2022 to every ESM member (so far, but not necessarily, synonymous with euro-area members) to the tune of 2% of national 2019 GDP, with a volume of about €240bn. Funding is available for direct and indirect health care costs, which is the only stipulation; there is no policy conditionality attached (European Commission 2020). The thrust of the new ESM credit facility is to remove the potentially destabilising stigma that had motivated

the opposition of the Italian government.<sup>10</sup>

SURE, the EU's re-insurance programme for national job-retention schemes, is a relatively large labour market stabiliser, to the tune of close to 1% of EU GDP in 2020. It encouraged member states to introduce such schemes and thus maintain employment, substituting for unemployment benefits as automatic stabilisers. Job retention schemes subsidise labour hoarding in existing businesses instead of down-sizing businesses through unemployment, presumably with less negative confidence effects on aggregate demand. Moreover, SURE could be used for schemes to support the self-employed, who are typically not entitled to unemployment benefits. Loans under SURE operate like an overdraft for national expenditure on job (and business) maintenance. There is no conditionality attached, beyond the member state providing evidence of costs of job retention incurred. The Commission must report back to the Council every six months on how loans have been used (Regulation 2020/672, Article 14). The programme is financed out of the EU budget but secured by explicit guarantees from member states, given that it exceeds the margin ('headroom') for excess demand on budget resources (Garicano 2020). It was disbursed quickly and although it is a temporary support mechanism, SURE avoided the process by which market panic forces governments to switch off an automatic stabiliser that directly affects households.

The flagship Recovery and Resilience Facility (RRF) recognises that a preventive fiscal capacity is required to shield and support the euro area's most vulnerable members. This is in stark contrast to the ESM, which handed out cheap rescue loans only once a government was shut out of bond markets. The RRF provides grants of up to €312.5bn and loans of up to €360bn, both in 2018 prices. It entered into force in February 2021 and will finance programmes until the end of 2026. The grant element of the RRF has affinity with a gigantic cohesion programme. Grants are allocated such that they help poorer member states more but also those that were harder hit economically by the pandemic, i.e. the allocation combines redistribution with insurance. The Council authorised the Commission 'to borrow on behalf of the Union in capital markets' (European Council 2020: A.3). The long-term bonds are secured by the budget itself, skilfully avoiding the dead-end of the Eurobonds discussion. The RRF is procedurally tied to the European Semester (Regulation

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<sup>10</sup>In November 2020, the member states decided to make the ESM a common backstop to the industry-financed Single Resolution Fund, i.e. the ESM would provide revolving loans to this EU institution, rather than to governments (Mascher et al. 2020). This ESM backstop came into effect in early 2022.

2021/241: Preamble para. 17), for the first time providing financial incentives for compliance with this process of coordinating economic policies. Conditionality is minimal (and the term is avoided): payments can be suspended if recommendations to correct an excessive deficit have not been followed twice (Regulation 2021/241: Article 10). This is a minimal condition because the RRF itself should make it easier to meet the fiscal rules. Over half of the requested finance must be spent on climate change and digital transition. The Commission assists in drawing up these plans to a presentable standard and the Council signs them off on a case-by-case basis.

The RRF is a novel support mechanism that gives fiscal powers to the EU level that it did not have before. The Commission was allowed to ‘mortgage’ the EU budget to resist both Coronabonds and ever more contingent liabilities (guarantees) for overstretched national budgets (Garicano 2020). Providing grants on a macroeconomic scale is an element of fiscal federalism. Finally, member states now have an incentive to give the Commission the power to tax, a power which is likely to be exercised via digital tax and environmental levies, which are sources that nation-states find hard to target. These are big steps and yet incremental insofar as they are reversible. The RRF is a temporary measure, and it applies to the EU as a whole; the link to the common currency is absent if not all EU members adopt the euro. Since repayment of RRF bonds continues until 2050, this can be considered as a test-run of a permanent fiscal capacity to take countries temporarily off bond markets when recovery from a shock is predictably fraught with downside risks.

There can be no doubt that the pandemic reforms, although born out of a crisis just as much as previous reforms had been, are not just another crisis management tool. The reforms to the ESM and the introduction of SURE create lending facilities that remove the stigma of earlier versions and provides a source of stable and cheap finance for sovereigns in a crisis. But the RRF is the most important innovation as it has the ingredients of being an institutional policy choice that moves the euro area further away from side A of our trilemma. The lesser burden on national member governments needs to be weighed against the consequences for the structure of the euro area’s bond markets. The issuance of NGEU, SURE, and ESM bonds will undoubtedly provide EU investors with an alternative safe asset to national government bonds. Under current plans, for NGEU alone, EU issuance will total nearly €800bn by 2026. This issuance will likely compete with national debt for those most in need of safe assets, such as banks, pension funds, and insurance

Table 4.3: Investor type in syndicated issues of NGEU, SURE, and ESM bonds since 2020

	NGEU		SURE		ESM		Total	
	€bn	%	€bn	%	€bn	%	€bn	%
<b>Fund Managers</b>	19.7	33	36.0	40	5.3	32	55.7	37
<b>Banks</b>	15.1	26	25.3	28	6.2	37	40.3	27
<b>Central Banks</b>	15.8	27	18.1	20	4.8	29	33.9	23
<b>Pension and Insurance</b>	7.5	13	8.2	9	0.3	2	15.7	11
<b>Hedge Funds</b>	1.0	2	2.0	2	0.0	0	3.0	2
<b>Total</b>	<b>59.0</b>	<b>100</b>	<b>89.6</b>	<b>100</b>	<b>16.5</b>	<b>100</b>	<b>148.6</b>	<b>100</b>

Source: European Commission, ESM, authors' calculations

companies.

It is early days, but the first issues of these bonds would seem to confirm this, having attracted a similar set of investors to those who traditionally invest in the euro area's largest national sovereign bond markets (tables 4.3 and 4.4). As the scale of issuance increases with the pandemic programmes, allocations by these investors to these EU bonds will inevitably increase and become a steadily larger portion of their portfolios. The essence of the political-financial trilemma tells us that a potential unintended consequence of bond-financed support at the EU level could be to recategorize national government bonds, particularly those of the periphery, more firmly as risk-rated public finance assets, much like U.S. municipal bonds. In other words, it will result in tiered issuance through the back door.

Whether this is a stable or at least less fragile outcome will depend on several factors. The experience of the U.S. public finance architecture can provide only clues given that key differences between the two systems remain, notably that a far larger share of fiscal activity will remain at the national level in the euro area. But it is reasonable to think that if risk-rated public finance becomes entrenched, then the euro area will begin to take on elements of side B of the political-financial trilemma. Moreover, there is no doubt that the recent reforms, as well as potentially entrenching risk-rated public finance, also provide an element of common public debt management. This is straightforwardly the case when it comes to the ESM and SURE

Table 4.4: Investor type in syndicated issues of European Government Bonds since 2020

	Germany		France		Italy		Spain	
	€bn	%	€bn	%	€bn	%	€bn	%
<b>Fund Managers</b>	15.2	43	11.8	35	109.5	45	37.7	37
<b>Banks</b>	7.8	22	8.0	2.4	69.4	28	30.6	31
<b>Central Banks</b>	3.8	11	9.8	29	28.9	12	20.0	20
<b>Pension and Insurance</b>	4.2	12	2.1	6	18.1	7	4.7	5
<b>Hedge Funds</b>	4.4	12	2.4	7	20.1	8	9.9	10
<b>Total</b>	<b>35.5</b>	<b>100</b>	<b>34.0</b>	<b>100</b>	<b>246.0</b>	<b>100</b>	<b>103.0</b>	<b>100</b>

Source: JP Morgan, authors' calculations

lending facilities while the RRF instead acts to alter the balance between EU and national fiscal activity. A key issue will be the role of the ECB in managing the transition to a new intermediate choice and whether EU issued bonds can truly take on the role as a safe asset for the euro area.

## 4.6 Concluding discussion

The article contributes to the trilemma literature by providing an explicit political-financial version that builds on the policy trilemmas of Schoenmaker (2011) and Pisani-Ferry (2012). Our formulation combines financial market constraints with political agreements that members of a currency union may strike. In a diverse monetary union like the euro area, it is quite unlikely that any of the pure solutions, combining two desirable goals at the cost of another, will ever stick. Unlike the previous literature we traced how the original Maastricht compromise was reflected in the trilemma's corners and how it dissolved. The Maastricht compromise wanted to preserve autonomous fiscal policy but achieve or preserve cheap debt finance. Monetary-financial integration was either seen as a benign process of goods and services market integration or as instrumental for creating the liquid capital markets that would make debt issuance all too easy; hence the no-bailout clause and fiscal rules.

Our second conceptual contribution to the trilemma literature is to emphasise the possibility of interme-

mediate outcomes that reside inside the triangle. Trilemmas tend to contemplate quite a narrow set of policy choices by allowing policymakers to deploy only one policy to deal with the neglected goal. The reforms that followed the financial crisis in 2008-9 that morphed into a sovereign debt crisis in the euro area by 2010 can be interpreted in our framework as moving inside the trilemma and giving weight to all three goals. The policy interventions that make for a solution need then to become more complex. We argue that one could allow for more policies to achieve a modicum of all three policy goals. Once inside the triangle, the trilemma still makes itself felt in that this circling has the potential of instability, for instance the present situation in the euro area can easily lead to bond market selloffs in peripheral markets for euro-denominated public debt. This vulnerability stems from a financial constraint that we incorporated into our trilemma: that bond markets in the euro area are dominated by institutional investors who react very sensitively to rising credit risks, rather than retail customers who buy bonds to hold them to maturity.

We show the importance of different bond market structures with reference to U.S. municipal bond markets that correspond to national bond markets in the euro area. We find that state governments in the US must pay higher (if less volatile) borrowing spreads, despite being rated similarly by credit rating agencies. This is compatible with a policy choice that prioritises devolved fiscal policy with financial integration that requires risk-rated public finance. We can thus see the political in our political-financial trilemma. Members of a monetary union with some capacity for fiscal policy and debt issuance will rarely agree on one pure solution. In fact, democracies with shifting partisan governments in power will not always opt for the same weighting of policy goals. There is no a priori reason why these political preferences cannot be accommodated by a more complex mix of interventions than economists' favoured trilemmas allow. But the challenge is to find a position within the triangle that satisfies both political and financial constraints.

The policy implication of our argument puts a fiscal union into perspective. If our political-financial trilemma has some traction, steps towards a fiscal union are unlikely to end the debate and the need for complex interventions. Member states will not agree to a unitary fiscal state and the bond market structure may adjust in ways that frustrate the achievement of a lasting settlement at intermediate positions. Hence, the question of what must give arises. European bond markets might be less crisis-prone if the member states placed a lower weight on the goal of financial integration, which scales up the potential for financial markets



to be de-stabilising. Alternatively, member states could accept some hard-wiring of risk-rated finance. Or they could change the mandate of the ECB so it can more effectively step in to manage financial stability risks that come from national bond markets. Perhaps the biggest gain of all from steps towards fiscal union is that it would make such monetary-fiscal cooperation easier.

## Chapter 5

# Conclusion: To be a bee or a bumblebee, that is the question

*The euro is like a bumblebee. This is a mystery of nature because it shouldn't fly but instead it does. So the euro was a bumblebee that flew very well for several years. And now – and I think people ask “how come?” – probably there was something in the atmosphere, in the air, that made the bumblebee fly. Now something must have changed in the air, and we know what after the financial crisis. The bumblebee would have to graduate to a real bee. And that's what it's doing.*

- Mario Draghi, 26 July 2012

### 5.1 Contribution of the thesis

The stated motivation for this thesis, made in the introduction, was to contribute to understanding why the euro area is still crisis-prone following more than a decade of substantial reforms. Episodic bouts of instability, while less intense than during 2010-12, have persisted and precipitated ever-more policy reforms. The thesis began by asking whether this might be because there are some problems with the diagnosis of the consensus narrative rather than because the reforms have not been pursued vigorously enough. Its answer is

that, while of course reforms could have bolder, there is a strong case for a modified diagnosis also. If there is to be a stable outcome or, in the words of Mario Draghi, the euro area is to “graduate to a real bee”, it is essential to get the diagnosis right. In fact, the thesis would indicate that, with the right diagnosis, it might not be necessary for the euro area to graduate to a real bee at all. With some flexibility and imagination, it may be able to revert to being a bumblebee that, somewhat miraculously, flies again.

The papers in this thesis have emphasised economic, financial, and political economy interactions in explaining the euro area’s continued vulnerabilities. The first paper, which proposes and empirically tests a new MSPR model of the crisis, argues for a different source of vulnerability to the one contained in existing crisis theories. It focuses on the market structure of sovereign bond markets interacting with a complex policy risk premium. It concludes that the vulnerabilities of euro-area sovereign bond markets are now largely structural and only partially amendable to policymaker attempts to coordinate investor beliefs on a good equilibrium. The market failure is that the euro area’s sovereign bond markets are incomplete, unable to adapt to changing perceptions of sovereign credit risk. A market failure such as this can only be fully remedied by addressing it directly or at least factoring it into policy frameworks; other policies will act more like sticking plasters. This, at heart, is the thesis’ explanation for the continued vulnerability of the euro area to crisis despite extensive reforms.

With the modified diagnosis at hand, the rest of the thesis looks at ways in which a more lasting solution might be found. Paper 2 focuses on the drivers of macroeconomic imbalances and the policy tools that could be used to manage them. If imbalances could be managed then, while the vulnerability in sovereign bond markets would remain, it might never be exposed. Unfortunately, the paper finds that policies to manage the key competitiveness and external imbalances are likely to be met with limited success. Fiscal policy and product and labour market reforms are found to impact only output and employment imbalances, not competitiveness and external imbalances. Macroprudential policies are found to be effective, but the paper concludes that the scale of policy changes that would be needed to fully offset the impact of credit supply shocks would likely be so large as to undermine the concept of the euro area as a single currency with free capital movement.

All is not lost, however, because as Paper 3 emphasises there is no need to find a lasting solution using

one policy instrument only. If macroprudential policy can be used to attenuate some of the solvency risks of sovereigns, then they will make a difference. Every little helps. But this is not to suggest that some fundamental choices do not need to be made. The political-financial trilemma set out in Paper 3 imports the viable policy options identified in Paper 1 and maps them onto the three policy goals that embody the Maastricht compromise. It rejects the traditional view of trilemmas that imply that one policy goal must be fully scrutinised and instead looks at how an intermediate outcome can be achieved. That is just as well, because members of a monetary union with some capacity for fiscal policy and debt issuance are unlikely to agree on one pure solution. Inevitably, given the conclusions of Paper 1, an important factor in whether an intermediate solution will offer a pathway to stability will be how the bond markets adapt to the choices that are made and whether this has the effect of producing a solution that is different from that intended by politicians. The overarching conclusion is that the interaction between political and financial dynamics must be fully accounted for in any proposed solutions.

In providing a modified diagnosis of the problem and prescription for a solution the thesis also has some things to say regarding the consensus narrative of the crisis itself and the emphasis it places on policy failures. The thesis leans towards thinking that the role of policy failures in explaining the crisis has been exaggerated and that more attention should be placed on the intractability of the problem. Based on the Kantian principle that ‘ought implies can’ it is not at all obvious that there were egregious policy failures either in the lead up to the crisis or during it. The lesson from Paper 1 is that once in a bad equilibrium then there is not much that policy can do to stabilise the situation and the lesson from Paper 2 is that imbalances are difficult to manage. An analytical theme across the three papers has been the challenges to investors and policymakers alike of living in a world of imperfect knowledge and how learning more about the world occurs with the passage of time. As Paper 3 shows, the Maastricht compromise attempted to pursue three inconsistent policy goals, but this was not appreciated at the time. But it, too, was not necessarily a policy failure. A true policy failure would be to underestimate the intractability of the problem and shy away from designing appropriate reforms that address it today.

The rest of this concluding chapter sets out the contributions of the papers individually, summarises some of their limitations along with opportunities for future research, and sets out the overall policy implications.

## 5.2 Contribution of the papers

The papers each have something substantive to say about the crisis of monetary union as well as contributing to the literature in their own spheres. The significance of the first paper rests on how it places emphasis on market characteristics as a structural vulnerability rather than one in which the policy architecture is blamed instead. For the second paper, while its focus is on assessing the drivers of imbalances and policies to address them its significance is in identifying that, while it is no panacea to the euro area's problems, and the potential gains might not seem all that large, it could nonetheless contribute towards stability. In this sense, it endorses the need for a paradigm shift away from fiscal and monetary discipline and towards something multi-faceted. This idea is taken further forward in the third paper which places financial markets – and those for sovereign bonds – as the ultimate constraint and modifies the concept of the trilemma by deriving the policy goals from the original Maastricht compromise, super-imposing the financial and political constraints, and suggesting the need for a multi-faceted approach.

In terms of its own sphere, Paper 1 makes an important contribution to both the theoretical and empirical literature on the crisis, explaining bond volatility using a new theory and taking a new approach to the application of qualitative 'news' analysis through the creation of a bespoke dataset. Theoretical models of the euro-area crisis have built upon the debt repudiation model of Calvo (1988), most notably Gros (2012), De Grauwe (2013), Corsetti and Dedola (2016). This set up creates scope for multiple equilibria due to a strategic default incentive. The paper contributes to the literature by taking a completely different approach, arguing that the euro area's vulnerability is structural, related to an essential feature of the functioning of financial markets, and is not amendable to policymakers simply coordinating beliefs on a 'good' equilibrium. It explains not only the empirical features explained by the strategic default models but also some features that they cannot, such as the strong incentives of governments not to default (Walter et al. 2020) and why the defaults occurred at such low interest rates and market-implied default probabilities, as well as being reconcilable with evidence that austerity is self-defeating in crisis conditions (Holland and Portes 2012, Gros and Maurer 2012, Attinasi and Metelli 2016).

On the empirical side, existing studies in the literature have tended to either utilise traditional data on fundamentals (Gibson et al. 2011, Bernoth et al. 2012, De Grauwe and Ji 2013) or large news-based

datasets (Beetsma et al. 2013, Mohl and Sondermann 2012, Gade et al. 2013, Ganem 2020). The paper in this thesis contributes to the literature by rejecting both approaches and focusing instead on a small news-based dataset. The purpose of this is to precisely identify the news that mattered most during the intense phase of the crisis when yields increased by 300-400bp in the space of just a few of months. The results confirm that a relatively few pieces of important news had outsized effects on yields, notably the Deauville summit statement and Eurogroup meeting on Greece that signalled greater acceptance of private sector involvement.

The paper is also relevant to the literature on modelling financial crises more generally. The recent literature on financial crisis models has been heavily focused on the incentives of policymakers. As already noted, this is true of existing euro-area models but is also true of second-generation models used to explain the Exchange Rate Mechanism crisis. They have similarly placed the policymaker centre stage with the result that they too create scope for multiple equilibria that set the scene for a speculative attack (Obstfeld 1994, Krugman 1998). Paper 1 switches the focus away from the policymaker which, owing to self-defeating austerity, is largely powerless to influence events. Instead, the crisis is brought about by investors learning about the size of the shock hitting the economy interacting with incomplete markets, creating a non-linearity. While sunspot equilibria are possible owing to imperfect knowledge, even with perfect knowledge, the market failure causes heightened sensitivity to fundamentals. In this way, the paper is also related to the literature on imperfect knowledge (Frydman and Goldberg 2007) and learning and expectations (Evans and Honkapohja 2001). It contributes to the literature on theories of the euro-area crisis by bringing these dynamics into the analysis.

The second paper's primary contribution is towards the literature on managing macroeconomic imbalances in the euro area. The evidence base on this issue is surprisingly sparse given the importance of the topic. The findings of the paper support the views of those who have argued that managing imbalances in a monetary union is likely to be either difficult for economic reasons (Dabrowski 2015; Kincaid and Watson 2015) or ineffective for political economy reasons (Alcidi and Gros 2013a, 2013b; Bénassy-Quéré and Ragot 2015, Bénassy-Quéré and Wolff 2020). At the same time, by virtue of the MIP not focusing on the one policy that is found to be potentially effectively in the paper, macro-prudential policies, it also pushes against those

who fear that the current design of the MIP may impart a deflationary bias on the euro area (Bénassy-Quéré and Ragot 2015; Kincaid and Watson 2015; Ederer 2015). Instead, it suggests that the centrality of product and labour market structural reforms in the MIP will most likely only have consequences for output and employment imbalances, most likely through its long-term impact on potential GDP and the NAIRU, with few consequences for other imbalances.

The paper also has something to say about the causes of intra-euro area imbalances. Its findings strongly supports those who have argued that competitiveness and external imbalances were primarily driven by credit cycles. The quantitative and statistical significance of credit supply shocks on competitiveness and external imbalances contrasts sharply with those of the other structural shocks. What the model cannot do is intervene strongly in the debate about the potential causes of these credit cycles. The pro-cyclical real interest rate mechanism of Walters (1990), the ‘animal spirits’ national financial cycles of De Grauwe (2010, 2012a), over-optimistic growth expectations of Lane and Pels (2012), and the divergent speeds of financial integration and liberalisation of Cesoroni and De Santis (2015) are all compatible with imbalances being driven by credit supply shocks. However, the IRFs of the credit supply shock do corroborate the consensus view that factors other than the effect of interest rate convergence on imbalances were probably more important (Lane 2015). What the findings do not support, however, is a strong role for either the fiscal policy (Abbas et al 2010) or labour market institutions (Hancké 2013; Johnston 2016) as drivers of imbalances. They were found to be relevant only for fiscal, output and employment imbalances but not the critical competitiveness and external imbalances.

The second paper also contributes to the broader literature on global imbalances. It adds to the findings from Structural VAR models of global imbalances that have found a strong role for financial over real channels (Fratzscher et al 2010; Bracke and Fidora 2008). But, perhaps more importantly, the findings also reinforce the importance of exchange rate policies for driving credit-driven imbalances. The mainstream views on the large global imbalances that emerged in the late 1990s and early 2000s has centred around the ‘savings glut’ and ‘shortage of financial assets’ hypotheses (Bernanke 2005; Caballero 2006; Caballero et al 2006). These theories suggest that excess savings in East Asian and oil exporting economies were intermediated, via managed exchange rate policies, to advanced economy financial markets (Astley et al 2009: p.180).

The findings of the second paper are consistent with the notion of exchange rate policies, in this case the permanency of the euro, being crucial for intermediating credit across economies that create competitiveness and external imbalances on a large scale.

Finally, the second paper is of relevance to the developing literature on macroeconomics which deviates from the DSGE paradigm. Recently, the development of Behavioural Macroeconomics has emphasised the importance of irrational expectations (De Grauwe 2012b; De Grauwe and Ji 2019; Jump and Levine 2019). The second paper is similar but constructed on a slightly different basis by instead incorporating ‘persistently wrong’ expectations instead. It deviates from the DGSE paradigm primarily by rejecting the idea that agents can accurately judge the inter-temporal budget constraint they face. It accepts that agents attempt to form expectations rationally and dynamically optimise against their perceived inter-temporal budget constraint but asserts that they are prone to significant errors of judgement due to imperfect knowledge and the plausibility of what, with the benefit of hindsight, turn out to be unsustainable outcomes. Modelling imbalances in this way was a deliberate choice to reflect the widely accepted view of the crisis that the imbalances were fundamentally unsustainable and that they could only persist through ongoing divergence between expectations and underlying reality. But it also acknowledges that the mainstream view prior to the crisis was that these were ‘good’ imbalances with capital flowing ‘downhill’ (Eichengreen 2010). The expectations in the estimated model are therefore taken to be model-consistent but with the model itself generating persistent imbalances in steady state that, with the benefit of hindsight, were unsustainable. The paper therefore also contributes to the literature by illustrating how a standard tool of empirical macroeconomics – the Bayesian structural VAR – can be estimated in a way that deviates from the DSGE paradigm in a carefully defined manner.

The third paper contributes to the trilemma literature in two ways. The first conceptual contribution was to provide an explicit political-financial version that builds on the policy trilemmas of Schoenmaker (2011) and Pisani-Ferry (2012). The formulation used in the paper combines financial market constraints with political agreements that members of a currency union may strike. And, unlike the previous literature, we traced how the original Maastricht compromise was reflected in the trilemma’s corners and how it dissolved. A second conceptual contribution the second paper makes to the trilemma literature is to emphasise the



possibility of intermediate outcomes that reside inside the triangle. Trilemmas tend to contemplate quite a narrow set of policy choices by allowing policymakers to deploy only one policy to deal with the neglected goal. The reforms that followed the financial crisis in 2008-9 that morphed into a sovereign debt crisis in the euro area by 2010 can be interpreted in our framework as moving inside the trilemma and giving weight to all three goals. Once inside the triangle, the trilemma makes itself felt in that this circling has the potential for creating instability in the sovereign bond markets. This vulnerability stems from the financial constraint identified in the first paper that was incorporated into our trilemma.

The other main contribution of the third paper is to show the importance of different bond market structures with reference to U.S. municipal bond markets that correspond to national bond markets in the euro area. We find that state governments in the U.S. must pay higher (if less volatile) borrowing spreads, despite being rated similarly by credit rating agencies. This is compatible with a policy choice that prioritises devolved fiscal policy with financial integration that requires risk-rated public finance. This is the political in our political-financial trilemma. Members of a monetary union with some capacity for fiscal policy and debt issuance will rarely agree on one pure solution. In fact, democracies with shifting partisan governments in power will not always opt for the same weighting of policy goals. There is no a priori reason why these political preferences cannot be accommodated by a more complex mix of interventions than economists' favoured trilemmas allow. But the challenge is to find a position within the triangle that satisfies both political and financial constraints.

### **5.3 Limitations and opportunities for further research**

The first paper proposes an entirely new theory of the crisis and provides motivation for the second and third papers. The paper set out the key foundations for the theory and developed a formal model, but more analysis is needed to properly understand what drives the loss of market access and how national debt agencies determine that they have lost access. In Greece's case there were unsuccessful auctions but there were no unsuccessful auctions for Ireland, which had pre-funded itself. The model's simple two-period formulation is helpful for expositional purposes but a useful extension would be to develop a calibrated dynamic model that could produce simulations to assess the reasons for fragility and resilience. Self-defeating austerity

conveniently assumes away the strategic default problem fully in the paper. That was a deliberate choice, supported by the empirical evidence, but the paper's own empirical results showed some, albeit modest, sensitivity to fiscal policy. This suggests that a revised version of the theoretical model, extended to include weak, but nonetheless beneficial, impacts from fiscal austerity on bond yields, could provide further insights.

The empirical version of the model relies on qualitative data but the relatively small data set, comprising less than 100 observations for each model, at least means that the categorization is fully transparent. The full data used in estimation is provided as an appendix including the raw text that the coding applied to. One objection to this empirical strategy is the possibility that the news reports were endogenous with market participants and the journalist who spoke with them creating a narrative to fit the price action. The paper took important precautions to check that this was not the case with post-estimation tests but further work, perhaps in the form of more detailed qualitative and network analysis, would be helpful to confirm that this is not an issue. A useful extension to the model would be to try to replicate the results on a larger dataset. The intense phase of the crisis took place over a relatively short period of time but a specialist financial market news source, such as Bloomberg, might provide sufficient commentary over a wider range of dates to increase the sample size.

The most important limitation of paper 2 is that it does not differentiate between the structural shocks and the policy shocks that they encompass. This does mean that the results can only be used as an approximate guide to the likely effectiveness of these policies, and that further analysis is required to assess what the quantitative effect of a policy change of a given size would be on macroeconomic imbalances. But in the case of macro-prudential policies the results were shown to have both quantitatively and statistically significant effects on the critical competitiveness and external imbalances. Now that macro-prudential policies are being used during the post-crisis period it might not be long before directly observed policy changes could be included into the model and help to identify their quantitative impact more precisely. In the meantime, the model provides a guide as to the structural shocks that impact these imbalances and hence the plausibility of alternative policies to manage them.

In assessing the drivers of imbalances, the model leaves open the contributions from different sources of credit supply shocks in driving the competitiveness and external imbalances and so this could provide an

avenue for further work. An important issue is whether the credit supply shocks were a one-off or in danger of being repeated. If it was a one-off effect of monetary union and financial integration that led to interest rate convergence and access to deeper capital markets, then these imbalances are unlikely ever to return on such a large scale. But if the credit supply shocks driving imbalances reflected expectations of future growth becoming detached from reality then, while the launch of the euro may have made a contribution, the lesson from the history of financial crises is that there is always the potential for alternative narratives to cause a wedge between expectations and underlying reality. In this sense, there will always be the risk of national financial cycles driving credit flows and imbalances. It would therefore be valuable to extend the model to explicitly include surveyed expectations of growth as a way of identifying growth expectations structural shocks from other sources of credit supply shocks, although achieving a unique identification might be challenging.

Another area that warrants further investigation is whether the structural policies might impact how the economy adjusts to shocks. The results from the model in the paper suggest that the structural policies themselves do not have any impact on the critical competitiveness and external imbalances, even though they do affect output and employment imbalances. But structural policies might alter how the economy adjusts, both in response to the credit supply shocks that drive the critical imbalances and in the event of a crisis that requires rapid economic adjustment. The EU's official institutions have placed emphasis on the role that structural reforms can play in managing imbalances through exactly this mechanism, i.e., improving the ability of economies to adjust to shocks. A useful extension could be to see whether the parameters of the model are stable over time using time-varying parameter estimation techniques to see whether there is evidence to support these claims.

The third paper on navigating the monetary union's political-financial trilemma suffers in some respects from the usual problem of trilemmas being a gross simplification of reality. The usual problem with a trilemma is that it insists that one policy is required to uphold the two other goals that are chosen. That is something that democracies can rarely ever settle upon; these choices are always subject to debate and change. The whole point of democracy is to offer periodically a change in policy choices. Some trilemmas can be presented in this way and seem close enough to reality but with something as complex as monetary union

it clearly cannot hold, where there is a union of democracies with diverse histories, cultures, preferences and policy orthodoxies and frameworks. The paper attempts to overcome this by considering what an intermediate solution might look like and how a transition can be achieved. It focused on the important role of how bond market structures might adapt but further work is undoubtedly needed to assess what the mix of policy goals could be, given the likely interaction and feedback with financial markets.

The other issue to consider is that changes in policy can sometimes be incremental and at other times more abrupt. One of the traditional strengths of the trilemma approach is how it explains why, occasionally, these policies can change abruptly. For example, within the Mundell-Fleming trilemma the abrupt switch from a fixed to a floating exchange rate or free capital mobility to strict capital controls. Our paper, in proposing the need for an intermediate solution to the euro area's political-financial trilemma, has not engaged with whether the reform process at this point will, or should be, incremental or abrupt. The incremental approach may help to ascertain more information on the likely response of financial markets to a shift to common debt management but, then again, a faster move, while recognising the implications for market segmentation between EU safe assets and risk-rated national government debt, might be preferable. These are issues that the political-financial trilemma helps to frame as opportunities for further research.

## 5.4 Policy Implications

While the thesis provides fertile opportunities for further research it can already provide considerable insight in terms of policy implications. These implications are probably best framed using the analysis from Paper 1, which analyses the sources of vulnerability to bond markets. If it is accepted that once the market is in a bad equilibrium it is hard for policymakers to exert much influence on the outcome, then the policy challenge is to (i) reduce the probability of falling into a bad equilibrium in the first place and (ii) reduce the sensitivity of interest rates to fundamentals once in a bad equilibrium. The period 1 fundamental equilibrium interest rate in the MSPR model can be manipulated to show the threshold condition for falling into a bad equilibrium:

$$\bar{e}_S \geq i_L(1 - \rho\delta\beta) - \pi d_0 - \rho(1 + \alpha\delta)b_0 \quad (5.1)$$

This facilitates a decomposition of the policies that could be used to reduce the likelihood of entering a bad equilibrium. Anything that increases the term of the right-hand side will make the bond market more resilient, and vice versa for the left-hand side.

Starting with policies that could increase the right-hand side<sup>1</sup>:

- **There is a need to raise the threshold interest rate level for a liquidity crisis,  $i_L$ .** As noted in Paper 1, this could be achieved by issuing tiered bonds. But given this has been repeatedly rejected as a policy, it is worth considering alternatives such as providing risk-tolerant buy-and-hold retail investors with tax incentives to hold sovereign debt through co-mingled investment vehicles.
- **More realistically, the multiplier,  $(1 - \rho\gamma\beta)$ , could be increased.** This could be achieved through policies that reduce the structural sensitivity of output to interest rates,  $\beta$ , and of the budget balance to output,  $\delta$ . Policies under the control of national policymakers that could help with this include encouraging issuance of longer-maturity public and private debt, possibly through tax incentives, and by reducing automatic stabilizers and the use of counter-cyclical fiscal policy. If the latter is deemed unacceptable, as seems likely, the only alternative policy is to centralise macroeconomic stabilisation responsibilities at the EU level instead. This is how the pandemic reforms that provide unemployment re-insurance (SURE) and recovery grants and loans (RRF) have helped to stabilise bond markets.
- **Lower debt,  $d_0$ , and budget deficits,  $b_0$ , also make a bad equilibrium less likely.** This, of course, supports the need for fiscal rules to constrain and reduce public debt and deficits, but the same effect could similarly be achieved through a debt union, even if this is politically unlikely to be acceptable or even democratically feasible.

Moving to the left-hand side of the inequality:

- **There is a need to reduce the variance of negative solvency shocks,  $\bar{\epsilon}_S$ .** Not much can be done when it comes to purely exogenous shocks, such as a global pandemic. But there are also euro-area

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<sup>1</sup>This sentence assumes that the sensitivity of interest rates to the public finances,  $\pi$  and  $\rho$ , and the fiscal multiplier,  $\alpha$ , are ‘deep parameters’ that are not amenable to change by policy.

specific solvency risks that could be managed. These include addressing the sovereign-bank nexus, which can be a source of non-linearity in the macro-financial system. Policies to help achieve this could be to attach risk weights to concentrated own-country holdings of sovereign bonds. This would help to lessen home bias while not reducing bank holdings of sovereign debt overall. Another important source of solvency risk comes from intra-euro-area imbalances. However, the results from Paper 2 that examined whether they could be managed are not especially encouraging. It finds that the critical competitiveness and external imbalances are predominantly driven by credit supply shocks and that fiscal policy and structural reforms are unlikely to be effective in countering them. This suggests that the only plausible option for managing imbalances is macro-prudential policies. However, while the literature on the impact of macro-prudential policies on financial cycles remains in its infancy, the available evidence suggests that even quite large policy changes in terms of bank capital ratios and loan-to-value ratios will most likely have only modest effects.

The above formulation shows what can be done to reduce the risk of falling into a bad equilibrium. What about making the bad equilibrium less bad once a country has fallen into it? This can be achieved by reducing the sensitivity of the bond yield to fundamentals. Formally, this is illustrated by taking the first partial derivative of the period 0 equilibrium interest rate with respect to the probability of a liquidity crisis:

$$\frac{\partial i_0^*}{\partial \frac{(\bar{\epsilon}_S - \epsilon_L)}{2\bar{\epsilon}_S}} = \frac{E_0(\bar{P}_1)}{(1 - \rho\delta\beta)} \quad (5.2)$$

So, this suggests one final policy implication:<sup>2</sup>:

- **Hold down expectations for the policy risk premium,  $E_0(\bar{P}_1)$ .** As noted in Paper 1, the policy risk premium is a complex variable of several probabilities and expected impacts. But several of its components can be influenced by policy. The first option is to increase confidence that there will be an ESM programme of sufficient size in the event of a liquidity crisis. This was a key strength of the ECB's OMT intervention because it effectively removed rollover risk, given the ECB's commitment to

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<sup>2</sup>It also shows that an additional benefit of raising the multiplier,  $(1 - \rho\delta\beta)$ , is that it will reduce the sensitivity of bond yields to fundamentals in a bad equilibrium.

buy unlimited quantities of short maturity debt in the secondary market. But the Italian experience of 2018, when Italian bond yield spreads widened sharply on the election of a populist government, shows that there can be political obstacles to achieving this. The second option for compressing the policy risk premium would be to specify, in advance, limits on private-sector involvement. Under current rules, PSI is set as needed to achieve debt sustainability for a programme country, given that ESM debt ranks above private-sector debt in the capital structure (Eurogroup 2010). Such rankings destabilise markets, especially when they are absolute. While changing this would increase the potential cost to other Member States in a crisis, by reducing the policy risk premium, it would reduce the chance of a crisis in the first place. For this reason, it is not self-evident that there would be a positive expected cost from introducing such a policy. This would structure the ESM like an insurance policy where private-sector investors are expected to pay an excess before their insurance kicks in. The current arrangements instead are like the ESM having 100% insurance with no excess up to the level of private sector holdings of the debt.

Nevertheless, as Paper 3 demonstrates, finding a lasting solution to the euro area's political-financial trilemma need not rely on a pure solution in which two goals are pursued with one policy intervention that sacrifices a third goal. Instead, the new political settlement is likely to involve a new compromise to replace that of the Maastricht compromise through changing the weights attached to the goals. It is therefore crucial to consider intermediate solutions that can deliver a stable outcome. Macro-prudential policies as a tool for managing macroeconomic imbalances should therefore not be ignored if they can attenuate solvency risks even slightly because this may help reduce the probability of the euro-area sovereign bond markets falling into a bad equilibrium. In combination with other policies, including those identified above from analysis of the MSPR model, there is hope for a lasting political settlement that can deliver a stable, or at least more stable, outcome.

The third paper also has important policy implications for managing the transition away from the Maastricht compromise of financial integration, autonomous fiscal policy, and cheap public finance. The MSPR model identifies that steps towards common debt management, such as those pursued in the post-pandemic reforms, have the potential to reduce the cyclicity of the public finances and thereby improve the resilience

of sovereign bond markets. However, a weakness of this conclusion is that it assumes, in doing so, that the bond market structure is unchanged – i.e., that the threshold for a liquidity crisis is not affected. However, a transition towards common debt management by its very nature is likely to have a profound impact on the euro area sovereign bond markets. In other words, the euro area’s bond market structure cannot be assumed to be invariant to the policy change. Paper 3 has highlighted, through a comparison of the U.S. municipal bond markets and the euro-area government bond markets, how moves to a federal structure of fiscal activity could prompt a profound change in the investor base, delivering a more stable outcome but one that does not deliver cheap public finance for national governments. This is most likely to happen because of expanded central fiscal activity massively increasing the provision of safe assets that compete with those issued by national governments and increase market segmentation. In the absence of policies to encourage risk-tolerant buy-and-hold retail investors there is a danger that the prediction of the MSPR, that steps to common debt management should improve the resilience of sovereign bond markets, might not be realised.

Finally, Paper 3 highlights the role of the ECB as a tool of financial repression since the crisis, suppressing spreads and volatility through both liquidity provision to the banking system and secondary market purchases through its APP and PEPP policies. The ability of the ECB to engage in financial repression is state contingent in the sense that the financial repression has not been the goal, but the means, by which its price stability mandate has been pursued. This is a divine coincidence but one that might not survive the return of inflation, which is something that has only just recently emerged as a potential threat following the pandemic and how it has impacted global supply chains and the supply of labour, especially in advanced economies. One of the features of our political-financial trilemma is that risk-rated public finance, along with sovereign bond volatility, is the default outcome of not choosing a stable institutional solution or deploying a convincing crisis management tool. The ECB played the role of handmaiden during the pandemic, greasing the wheels towards the first substantial form of common debt management. But the ECB’s state contingent support means that its role as handmaiden is not assured. It therefore leaves open the question of whether alternative justifications for the ECB to play such a role will need to be constructed, if the euro area is to transition to a lasting political-economic settlement.



# Appendix A

## Appendices to chapter 2

### A.1 Textual analysis of the Global Overview reports

Any text referring to euro-area government bond markets was highlighted. For each euro-area jurisdiction a two-stage process governing eligibility and categorisation was then followed.

#### **Stage A: Eligibility**

The diagram below sets out the eligibility of different types of news. Market rumours were considered eligible as they mostly relate to either leaks of subsequent news events or reports of ECB market operations by traders.

#### **Stage B: Categorisation**

Eligible news events were separated according to the three broad categories of news shown below. These news categories were then divided into several further sub-types.

Figure A.1: Stage A: Eligibility

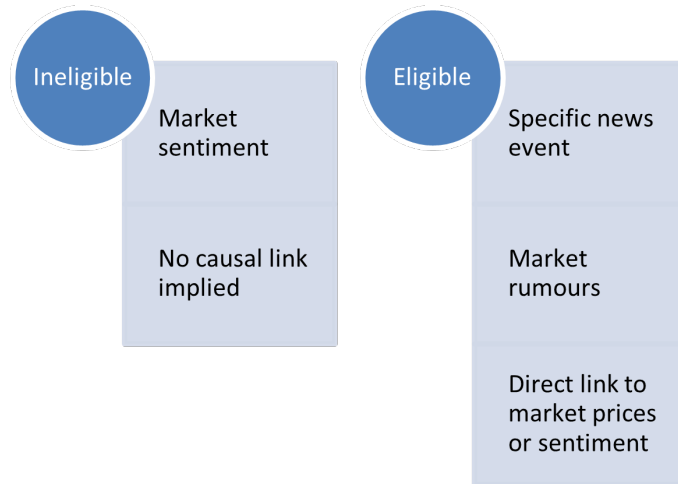


Figure A.2: Stage B: Categorisation

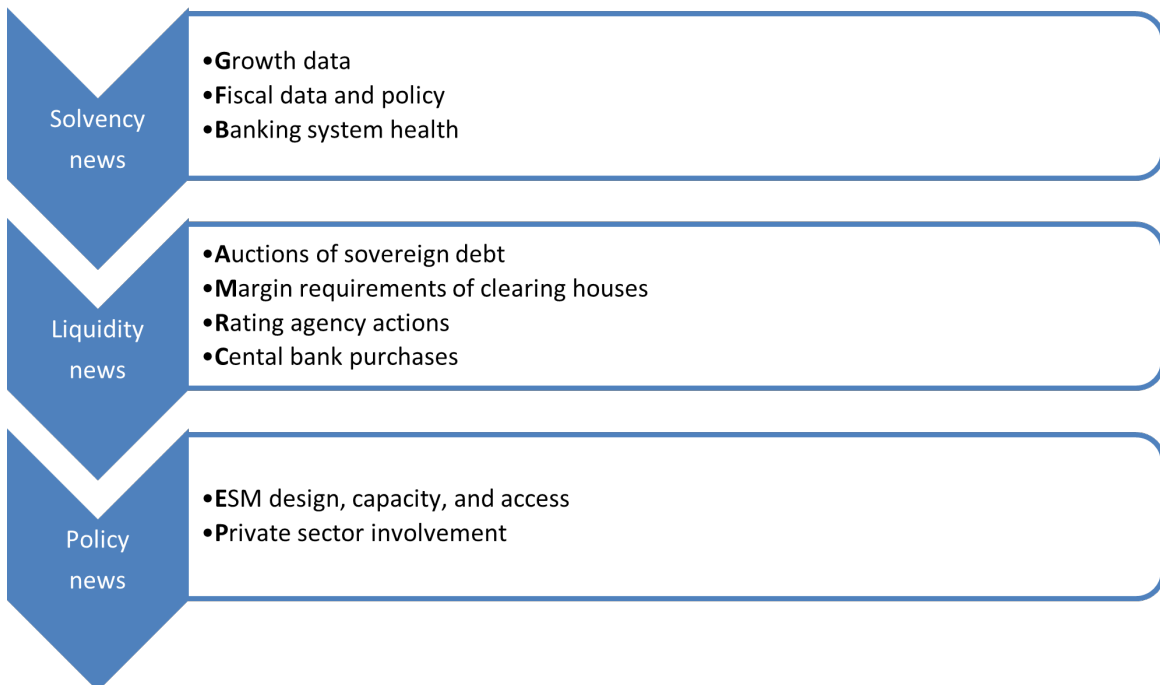


Figure A.3: Flow chart determining eligibility of different news

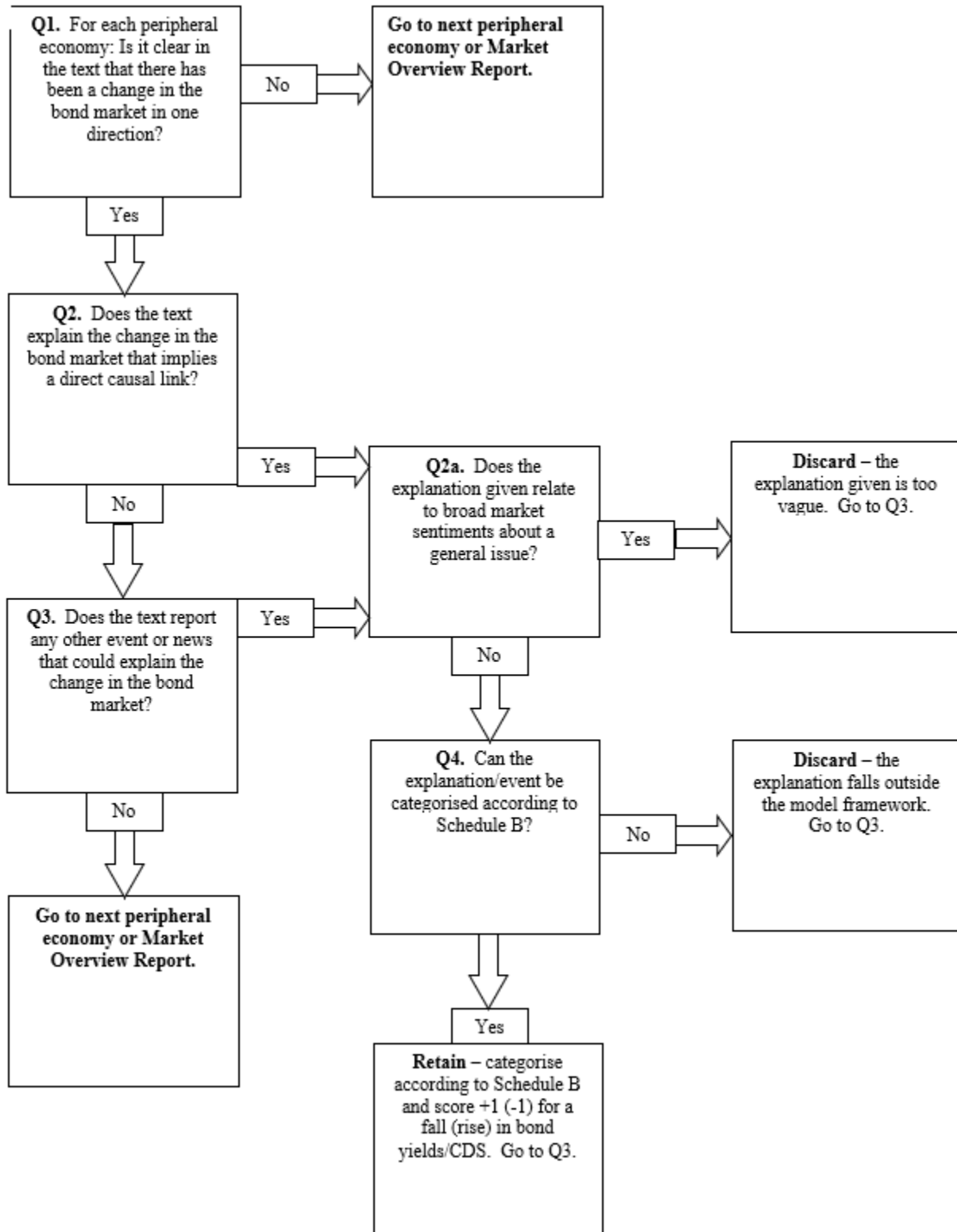


Figure A.4: Ireland – categorisation of eligible news

Date	Chronology and <i>Financial Times</i> comments	News	Sub-type
8/3/10	START OF ESTIMATION SAMPLE		
8/9/10	“Fears about spiralling costs of bailing out Anglo Irish Bank had driven the spread about 75bp wider over the past week”	S(-1,-1)	B(-1,-1)
8/12/10	“the spread of Irish 10-year government bonds over their German counterparts narrowed 1bp to 296bp ... amid reports that European central banks had been buying Irish debt”	L(+1,+1)	C(+1,+1)
8/17/10	“the focus was on Ireland as it sold €1.5bn of 4 and 10 year bonds ... After the auctions, yields on Irish debt rallied”	L(+1,+2)	A(+1,+1)
8/25/10	“Yield spreads ... widened as a downgrade of Ireland’s sovereign credit rating offered a reminder of difficulties ...”	L(-1,+1)	R(-1,-1)
8/26/10	“The [Irish] spread ... held steady ... after a well received auction”	L(+1,+2)	A(+1,+2)
9/8/10	“The mood was also helped by Ireland’s announcement that Anglo Irish Bank would be split into a funding bank and an asset recovery bank to wind down its assets”	S(+1,0)	B(+1,0)
9/9/10	“The spread ... narrowed as a smooth sale of Irish short-term Treasury bills helped soothe sovereign debt concerns”	L(+1,+3)	A(+1,+3)
9/21/10	“the focus was on ... a batch of well received peripheral Eurozone government bond auctions ... and most importantly Ireland successfully auctioned €1.5bn of 4 and 8 year notes”	L(+1,+4)	A(+1,+4)
9/23/10	“Sentiment was further dented by news that Ireland’s economy had shrunk 1.2% in the second quarter confounding expectations for growth of about 0.5%”	S(-1,-1)	G(-1,-1)
9/29/10	“Angela Merkel added to her criticism of the €440bn European stabilisation fund”	P(-1,-1)	E(-1,-1)
9/30/10	“Ireland, as anticipated, struck a deal to inject an additional €10bn into three financial institutions, including Anglo Irish Bank ... the move calmed markets in the short term”	S(+1,0)	B(+1,+1)
10/5/10	“Moody’s Investor Service put Irish debt on review for possible downgrade”	L(-1,+3)	R(-1,-2)
10/6/10	“Fitch cut Ireland’s credit rating”	L(-1,+2)	R(-1,-3)
10/29/10	“Peripheral eurozone bond yields have risen across the board ... amid uncertainty about German proposals for new debt crisis management procedures. These would involve debt restructuring with losses for private holders”	P(-1,-2)	P(-1,-1)
11/1/10	“Government bond yields in Greece soared after comments ... on debt restructuring. He [said] that ‘debts exist to be restructured’”	P(-1,-3)	P(-1,-2)
11/4/10	“The gap between Irish and German 10-year bond yields widened ... as Dublin provided details of its 2011 budget”	S(-1,-1)	F(-1,-1)
11/10/10	“The Irish-German 10-year spread widened ... as LCH.Clearnet, the clearing house, raised its margin requirement facts for trading Irish debt”	CLEARNET DUMMY	
11/12/10	“a wave of rumours spread through the markets that Dublin was in talks about receiving emergency funding from the European Union.”	P(+1,-2)	E(+1,0)
	“EU ministers, speaking from Seoul, attempted to soothe matters by reiterating that any new sovereign debt restructuring mechanism would only apply after mid-2013”	P(+1,-1)	P(0,-1)
11/15/10	“speculation remained rife that Ireland was on the point of requesting financial help from the European Union”	P(+1,0)	E(+1,+1)
11/16/10	“Doubts that an agreement would be reached sent Irish government bonds lower”	P(-1,-1)	E(-1,0)
11/18/10	“The governor of Ireland’s central bank said that Dublin was highly likely to ask for a loan of “tens of billions” of euros from the European Union and the IMF”	P(+1,0)	E(+1,+1)
11/22/10	“The sense of crisis in Dublin was heightened by growing political division and uncertainty. Two independent members of parliament warned they would vote against next month’s crucial budget”	S(-1,-2)	F(-1,-2)
	“Moody’s Investors Service further dented sentiment in the markets as it said it could lower Ireland’s credit rating”	L(-1,+1)	R(-1,-4)
11/24/10	“Standard and Poor’s cut Ireland’s sovereign rating”	L(-1,0)	R(-1,-5)
11/25/10	“Angela Merkel and Axel Weber were again stressing the importance of enshrining private sector involvement in the permanent bailout mechanism”	P(-1,-1)	P(-1,-2)
	“LCH.Clearnet announced it would be raising its margin requirement on Irish bonds from 30% to 45%”	L(-1,-1)	M(-1,-1)
11/26/10	END OF ESTIMATION SAMPLE		
11/28/10	ESM SUPPORT PACKAGE AGREED		

Figure A.5: Portugal – categorisation of eligible news

Date	Financial Times Global Overview comments	News	Sub-type
12/16/10	START OF ESTIMATION SAMPLE		
12/21/10	"Moody's Investors Service warned that it may downgrade Portugal's credit rating by one or two notches"	L(-1,-1)	R(-1,-1)
12/23/10	"Late in the session, Fitch announced that it had cut Portugal's debt rating"	L(-1,-2)	R(-1,-2)
1/5/11	"Portuguese bond prices declined after a sale of six-month debt by Lisbon"	L(-1,-3)	A(-1,-1)
1/10/11	"Portuguese government bonds reversed sharp early falls amid reports of buying by the European Central Bank"	L(+1,-2)	C(+1,+1)
1/11/11	"A pledge by Japan to buy more than 20% of a forthcoming bond issuance from the EFSF helped soothe the latest eruption of Eurozone concerns"	P(+1,+1)	E(+1,+1)
1/12/11	"Lisbon sold €599m of bonds due in 2020 at a yield of 6.716% ... below the 7% widely viewed as the point at which the country might be forced to seek assistance"	L(+1,-1)	A(+1,0)
	"Meanwhile, analysts pointed to comments by Olli Rehn, the EU commissioner for economic and monetary affairs, raising the proposition that the region's bail-out facility be enlarged and revamped to allow it more flexibility"	P(+1,+2)	E(+1,+2)
1/17/11	"The focus turned to concern over more political wrangling among European finance ministers with Germany said to be reluctant to support an expansion of the EFSF"	P(-1,+1)	E(-1,+1)
1/19/11	"The yield on Portuguese 10-year government bonds eased back after the country successfully auctioned €750m of short-term debt"	L(+1,0)	A(+1,+1)
2/2/11	"Portugal's [ten-year] yields dropped by 8bp after a sale of €1.2bn of T-bills with lower borrowing costs than recent auctions"	L(+1,+1)	A(+1,+2)
3/9/11	"Portugal took centre stage ... as Lisbon auctioned €1.2bn of two-year debt. Although the amount was the maximum of the announced range the sale's bid-to-cover ratio of 1.6 was disappointing and the average yield was nearly 6%"	L(-1,0)	A(-1,+1)
3/14/11	"In the Eurozone, the debt of peripheral member states rallied following a deal at the weekend between Europe's leaders to try to resolve the region's debt crisis. Leaders committed to increasing the lending capacity ... from about €250bn to its full, headline, level of €440bn"	P(+1,+2)	E(+1,+2)
3/23/11	"Meanwhile, political crisis paralysed Portugal as the government fought to gain parliamentary approval for a new round of austerity measures. The crisis sent Portugal's CDS ... to two-month highs"	S(-1,-1)	F(-1,-1)
3/24/11	"The resilience of investors was illustrated in the wake of Jose Socrates resigning as prime minister. While yields on Portugal's short-term government bonds rose ... the collapse of the government is seen ultimately as leading to a bailout package for the debt-laden country."	S(-1,-2)	F(-1,-2)
3/25/11	"Standard and Poor's, the rating agency, downgraded Portugal two notches to triple B with a negative outlook, while Fitch downgraded it two notches to A minus, with a negative watch"	L(-1,-1)	R(-1,-3)
3/29/11	"Standard and Poor's had cut its sovereign credit rating on Portugal for the second time in less than a week, putting its rating just above junk status"	L(-1,-2)	R(-1,-4)
3/31/11	"Portuguese bond yields reached fresh euro-era highs ... after news that Standard and Poor's had downgraded four of Lisbon's leading banks"	S(-1,-3)	B(-1,-1)
	"Portugal's budget deficit also reached 8.6% of GDP last year, well above the government's target of 7.3%"	S(-1,-4)	F(-1,-3)
4/5/11	"Portugal's government bond yields hit record highs after Moody's Investors Service cut Portugal's sovereign debt by one notch"	L(-1,-3)	R(-1,-5)
4/7/11	"Portugal ended months of speculation by following Greece and Ireland in requesting financial assistance from the EU ... Portuguese yields edged higher"	P(-1,+1)	E(-1,+1)
4/18/11	"The electoral advance of a Finnish eurosceptic party [is] threatening Portugal's bailout deal"	P(-1,0)	E(-1,0)
4/20/11	"LCH Clearnet, the clearing house, announced an increase to its margin requirement for Portuguese debt"	L(-1,-4)	M(-1,-1)
5/3/11	END OF ESTIMATION SAMPLE		
5/5/11	ESM SUPPORT PACKAGE AGREED		

Figure A.6: Italy – categorisation of eligible news

Date	Financial Times Global Overview comments	News	Sub-type
6/30/11	START OF ESTIMATION SAMPLE		
7/5/11	"Italian CDS put in an even worse showing after a presentation of the government's austerity plans were cancelled"	S(-1,-1)	F(-1,-1)
7/11/11	"Italy's 10-year bond spread over Bunds climbed to euro-era highs on Monday as eurozone finance ministers met to address the latest market pressures on the country and work out details of a new bail-out plan for Greece. Investors were rattled by signs of an increasing acceptance on the part of policymakers that Greece might have to default on part of its debt"	P(-1,-1)	P(-1,-1)
7/12/11	"However, the mood turned as an auction of Italian Treasury Bills went off relatively successfully and unconfirmed rumours of European Central Bank bond buying began to swirl through markets"	L(+1,+1) L(+1,+2)	A(+1,+1) C(+1,+1)
7/13/11	"Italian and Spanish debt received respite after a recent sell-off. Fitch said that Italy would be able to keep its credit rating if it stuck to its fiscal targets"	L(+1,+3)	R(+1,+1)
7/14/11	"Italian government bonds remained under pressure as yields at an auction of nearly €5bn of the country's debt rose sharply"	L(-1,+2)	A(-1,0)
7/20/11	"There were reports that the talks would focus on increasing the scope of the European Financial Stability Facility"	P(+1,0)	E(+1,+1)
7/21/11	"According to draft proposals ... the EFSF would be given far greater flexibility to help Greece"	P(+1,+1)	E(+1,+2)
7/28/11	"Italian government bond yields rose on the secondary market after yields at an auction of 10-year debt climbed to an 11-year high"	L(-1,+1)	A(-1,-1)
8/8/11	"Italian and Spanish government debt rallied after the European Central Bank stepped into markets to buy both countries' bonds, dealers said"	L(+1,+2)	C(+1,+2)
8/9/11	"Spanish and Italian debt continued to rise as traders reported further buying by the European Central Bank"	L(+1,+3)	C(+1,+3)
8/11/11	"the Spanish 10-year yield fell ... and its Italian counterpart shed 8bp ... as traders reported further buying of both countries' bonds by the European Central Bank"	L(+1,+4)	C(+1,+4)
8/30/11	"the yield on Italian 10-year government bonds crept up to the highest for three weeks after a relatively disappointing auction"	L(-1,+3)	A(-1,-2)
9/2/11	"sentiment towards Italy was further hurt as the government's commitment to fiscal sustainability was called into question"	S(-1,-2)	F(-1,-2)
9/6/11	"Italy's 10-year yield had finally eased back ... amid reports of heavy intervention by the European Central Bank"	L(+1,+4)	C(+1,+5)
9/13/11	"benchmark Italian bond yields spiked 13bp ... after lukewarm support for a €3.9bn debt auction"	L(-1,+3)	A(-1,-3)
9/14/11	"Italian debt rose for the first time in five days after reports of buying by the European Central Bank"	L(+1,+4)	C(+1,+6)
9/19/11	"Italy's 10-year yields rose 8bp to 5.59 per cent in the wake of Moody's extending its review of the country's sovereign rating"	L(-1,+3)	R(-1,0)
	"Markets were left unimpressed by the lack of any resolution from a weekend meeting of European finance ministers where US Treasury secretary Tim Geithner received little support for his call to beef up Europe's bailout fund"	P(-1,0)	E(-1,+1)
9/20/11	Italian government bond yields rose after S&P downgraded the country's sovereign credit rating, citing weakening growth prospects and the difficulty of the 'fragile governing coalition'"	L(-1,+2)	R(-1,-1)
9/29/11	"The early focus for the markets was on Germany as the country's parliament voted overwhelmingly to back enhancements to the European financial stability facility"	P(+1,+1)	E(+1,+2)
10/5/11	"Italy's 10-year yield rose 3bp to 5.53 per cent after Moody's Investors Service cut the country's credit rating by three notches"	L(-1,+1)	R(-1,-2)
	"comments on Tuesday from Olli Rehn, commissioner for economic affairs, [suggested] that EU finance ministers were examining ways of coordinating recapitalisations of financial institutions"	S(+1,-1)	B(+1,+1)
10/6/11	"Jean-Claude Trichet concluded his presidency by announcing a raft of additional refinancing facilities aimed at boosting liquidity in the region's financial system"	L(+1,+2)	C(+1,+7)
10/12/11	"Italy reappeared in investors' radar screens amid fresh concerns about a forthcoming vote of confidence ... and ... uncertainty surrounding the political stability of the government and the commitment to implement the crucial austerity package"	S(-1,-2)	F(-1,-3)

10/20/11	"Negotiations over [the EFSF] appeared to have stalled"	P(-1,0)	E(-1,+1)
10/24/11	"evidence that the eurozone could be heading towards recession, which would only accelerate concerns about struggling economies"	S(-1,-3)	G(-1,-1)
10/27/11	"A summit of European leaders that concluded ... that the €440bn European financial stability facility would provide 'risk insurance' to struggling sovereign debt issuers"	P(+1,+1)	E(+1,+2)
11/1/11	"the prospect of a Greek referendum to approve the latest bailout agreement severely dented recent optimism"	P(-1,0)	E(-1,+1)
11/4/11	"there was increasing focus on Italy as concerns grew over whether Rome could deliver credible fiscal reforms"	S(-1,-4)	F(-1,-4)
11/7/11	"Italian government bond yields reached critical levels after Mr Berlusconi suffered further defections from his ruling party ahead of a crucial budget vote on Tuesday"	S(-1,-5)	F(-1,-5)
11/9/11	"News that LCH.Clearnet SA, the clearing house, was raising the margin required to trade Italy's debt served to amplify concerns"	L(-1,+1)	M(-1,-1)
11/9/11	END OF ESTIMATION SAMPLE		



Figure A.7: Spain – categorisation of eligible news

Date	Financial Times Global Overview comments	News	Sub-type
3/21/12	START OF ESTIMATION SAMPLE		
3/22/12	“Spanish and Italian bond yields rose as disappointing manufacturing and service sector data rekindled concerns about the outlook for growth in the region”	S(-1,-1)	G(-1,-1)
3/26/12	“the pressure on Spanish sovereign yields eased as hopes of an increased firewall helped offset disappointing election results”	P(+1,+1)	E(+1,+1)
3/30/12	“an increase to the region’s bailout fund was agreed and Spain unveiled tough spending cuts and tax increases worth an estimated €27bn a day”	P(+1,+2) S(+1,0)	E(+1,+2) F(+1,+1)
4/3/12	“Spanish benchmark yields rose as investors reacted to higher jobless figures in Spain”	S(-1,-1)	G(-1,-2)
4/4/12	“A further concern for eurozone finance ministers came from news that Spain managed to sell just €2.6bn of debt, at the lower end of its targeted range”	L(-1,-1)	A(-1,-1)
4/11/12	“a member of the ECB’s executive board signalled the bank could resume purchases of sovereign debt”	L(+1,0)	C(+1,+1)
4/13/12	“The European Central Bank announced that Spanish banks had borrowed €227.6bn in March, a huge jump from €152.4bn in February”	S(-1,-2)	B(-1,-1)
4/17/12	“Spain’s 10-year government bond yield fell back below 6 per cent as worries about the country’s ability to fund itself were soothed by encouraging demand at a bill auction in Madrid”	L(+1,1)	A(+1,0)
4/23/12	“The eurozone gloom intensified as the Bank of Spain confirmed that the -5country had fallen into recession”	S(-1,-3)	G(-1,-3)
4/24/12	“r-5relatively successful sovereign bond auctions in Italy, Spain and – and perhaps most importantly, the Netherlands – helped soothe the latest bout of eurozone debt nerves”	L(+1,+2)	A(+1,+1)
4/27/12	“News that Spain had fallen into recession was followed up by deeply worrying unemployment data from the country and a two-notch downgrade to its sovereign credit rating from Standard & Poor’s”	S(-1,-4) L(-1,1)	G(-1,-4) R(-1,-1)
4/30/12	“analysts noted the drop in the official GDP data had been less than that predicted by the Bank of Spain last week”	S(+1,-3)	G(+1,-3)
5/2/12	“manufacturing data from both countries proved especially worrying. Italy’s purchasing managers’ index tumbled to 43.8 in April from 47.9 while that of Spain slipped to 43.5”	S(-1,-4)	G(-1,-4)
5/3/12	“The yield on Spain’s 10-year government bond eased back after a well-received debt auction in Madrid helped calm market nerves ahead of weekend elections in France and Greece”	L(+1,+2)	A(+1,+2)
5/9/12	“growing concerns about the Spanish banking sector added a further dimension to recent worries”	S(-1,-5)	B(-1,-2)
5/17/12	“The mood was not helped by reports that Moody’s was preparing imminent downgrades to Spanish banks’ ratings.”	S(-1,-6)	B(-1,-3)
	“slightly more positive news came from a relatively well received sale of Spanish three- and four-year debt”	L(+1,+3)	A(+1,+3)
5/24/12	“Sovereign yields in Spain spent much of the week drifting lower, before jumping sharply yesterday on fresh worries about Bankia, the country’s second biggest domestic lender”	S(-1,-7)	B(-1,-4)
5/28/12	“Spain’s 10-year government bond yield briefly edged above 6.5 per cent as Madrid’s emergency €19bn injection into Bankia heightened worries about the country’s lenders”	S(-1,-8)	B(-1,-5)
6/7/12	“The extra yield demanded by investors to own Spanish rather than German government bonds fell after a debt auction in Madrid attracted healthy demand”	L(+1,+4)	A(+1,+4)
6/8/12	“The grim outlook for Spain was further highlighted by a three-notch credit rating downgrade on the country from Fitch on Thursday”	L(-1,+3)	R(-1,-2)
6/11/12	“The burst of euphoria with which markets initially greeted Spain’s decision to seek rescue funds for its banks proved short-lived, as doubts quickly surfaced about details of the deal”	S(-1,-9)	B(-1,-6)
6/12/12	“Rating agency Fitch downgraded 18 Spanish banks”	S(-1,-10)	B(-1,-7)
6/14/12	“Spain’s 10-year sovereign yield briefly nosed above 7% ... after Moody’s Investors Service lowered the country’s credit rating by three notches”	L(-1,+2)	R(-1,-3)
6/18/12	“The problems facing the country’s banking sector were highlighted by data showing bad loans as a percentage of total lending by Spanish banks had reached an 18-year high in April”	S(-1,-11)	B(-1,-8)
6/19/12	“Madrid managed to raise slightly more than €3bn in a sale of short-dated debt, at the upper end of the target range”	L(+1,+3)	A(+1,+5)



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6/20/12	“observers attributed the improved tone of peripheral debt to reports that policy makers were preparing to allow eurozone rescue funds to buy Spanish and Italian bonds”	P(+1,+3)	E(+1,+3)
6/21/12	“Spain’s 10-year government bond yield fell further below 7 per cent on the secondary market after Madrid sold €2.2bn of debt”	L(+1,+4)	A(+1,+6)
6/26/12	“short-term debt auctions in Spain and Italy saw borrowing costs for both nations rise sharply”	L(-1,+3)	A(-1,+5)
6/29/12	“Analysts noted that the euphoric mood in markets was created by relief among investors at what appeared to be a concerted attempt by policy makers to weaken the link between the banking sector and sovereign risk”	P(+1,+4)	E(+1,+4)
7/5/12	“Spain’s 10-year government bond yield raced higher as doubts set in that the ECB would initiate further non-standard policy measures”	L(-1,+2)	C(-1,0)
7/10/12	Spain’s 10-year yield slid below 7 per cent after eurozone finance ministers allowed the country extra time to meet deficit targets and set parameters on an aid package for its banks”	P(+1,+5)	E(+1,+5)
7/11/12	“Mariono Rajoy, Spanish prime minister, unveiled a further €65bn of public spending cuts and tax increases over the next two and a half years”	S(+1,-10)	F(+1,+2)
7/19/12	Spain’s 10-year government bond yield ... broke back above 7 per cent following a disappointing debt auction in Madrid”	L(-1,+1)	A(-1,+4)
7/20/12	“Valencia said it would request financial aid from Madrid”	S(-1,-11)	F(-1,+1)
7/23/12	“reports at the weekend suggested that more of the country’s regional governments would follow Valencia in seeking financial assistance from Madrid”	S(-1,-12)	F(-1,0)
	“A gloomy forecast for second-quarter GDP growth from the Bank of Spain ... eroded investor confidence”	S(-1,-13)	G(-1,-5)
7/24/12	“The debt-laden country [Spain] was forced to pay more to borrow in a €3bn auction of short-term debt”	L(-1,0)	A(-1,+3)
7/24/12	END OF ESTIMATION SAMPLE		
7/26/12	DRAGHI’S WHATEVER IT TAKES SPEECH		

## A.2 Data used in estimation

Figure A.8: Ireland Raw Data (2010)

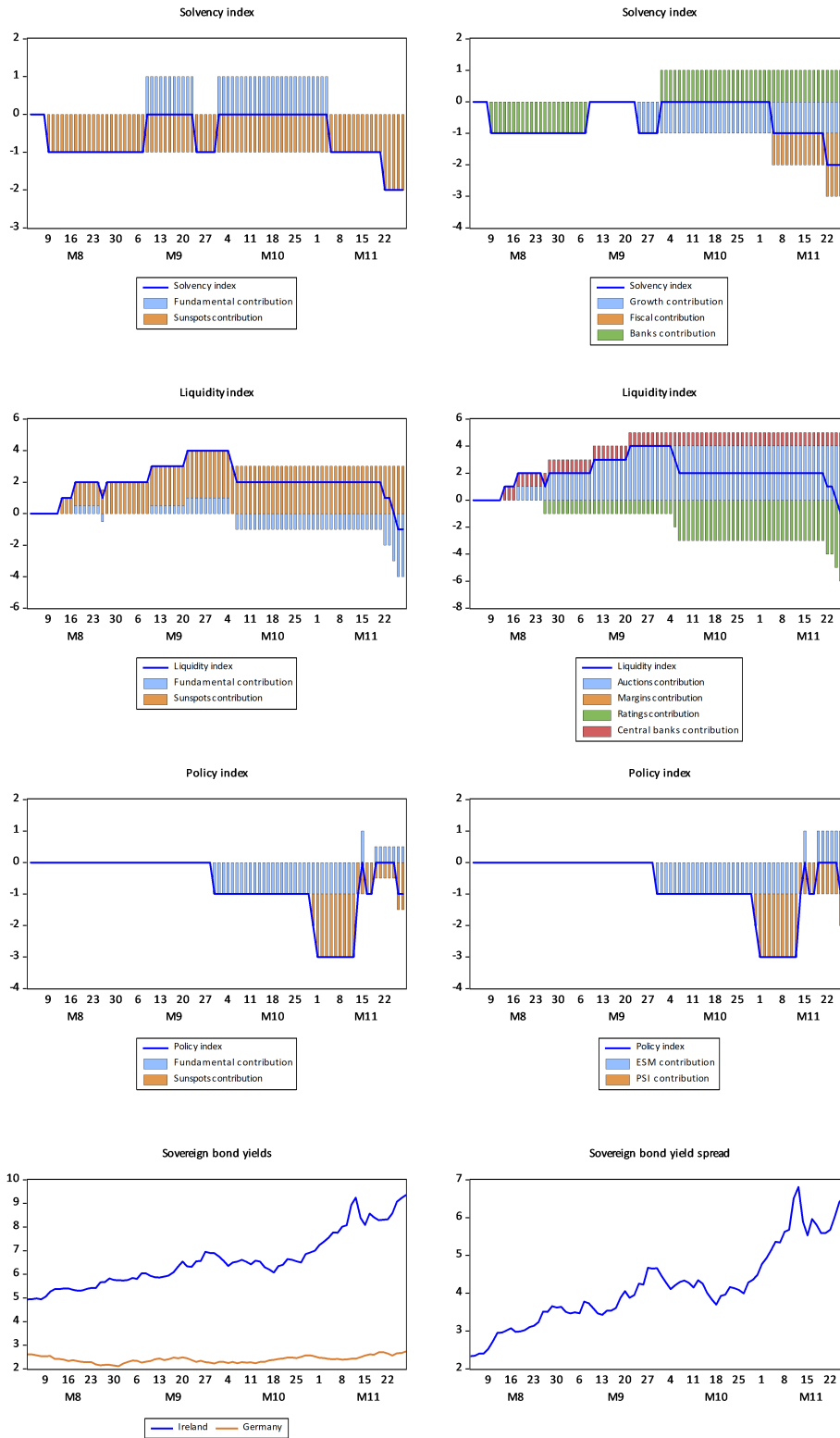


Figure A.9: Portugal Raw Data (2010-11)

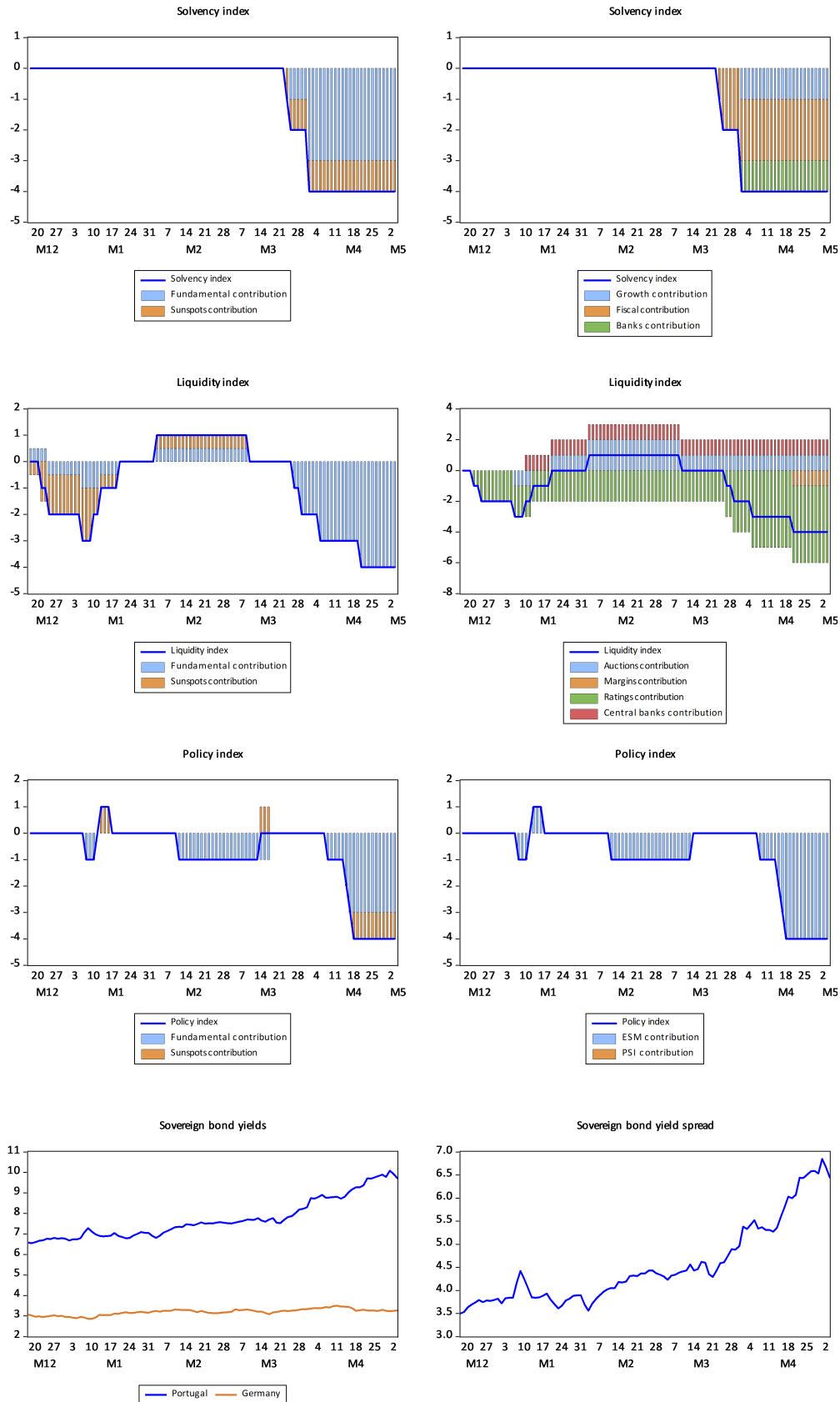


Figure A.10: Italy Raw Data (2011)

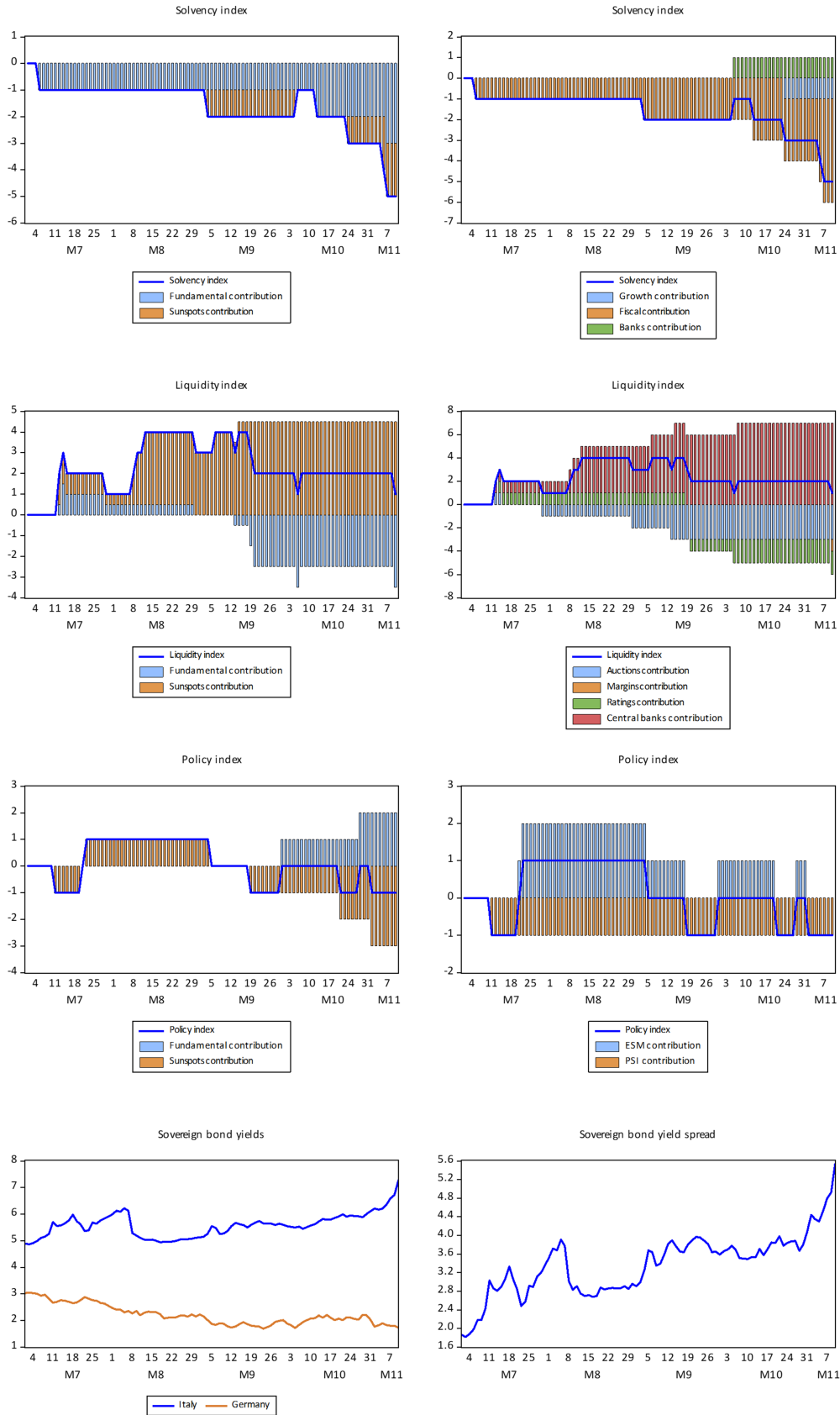
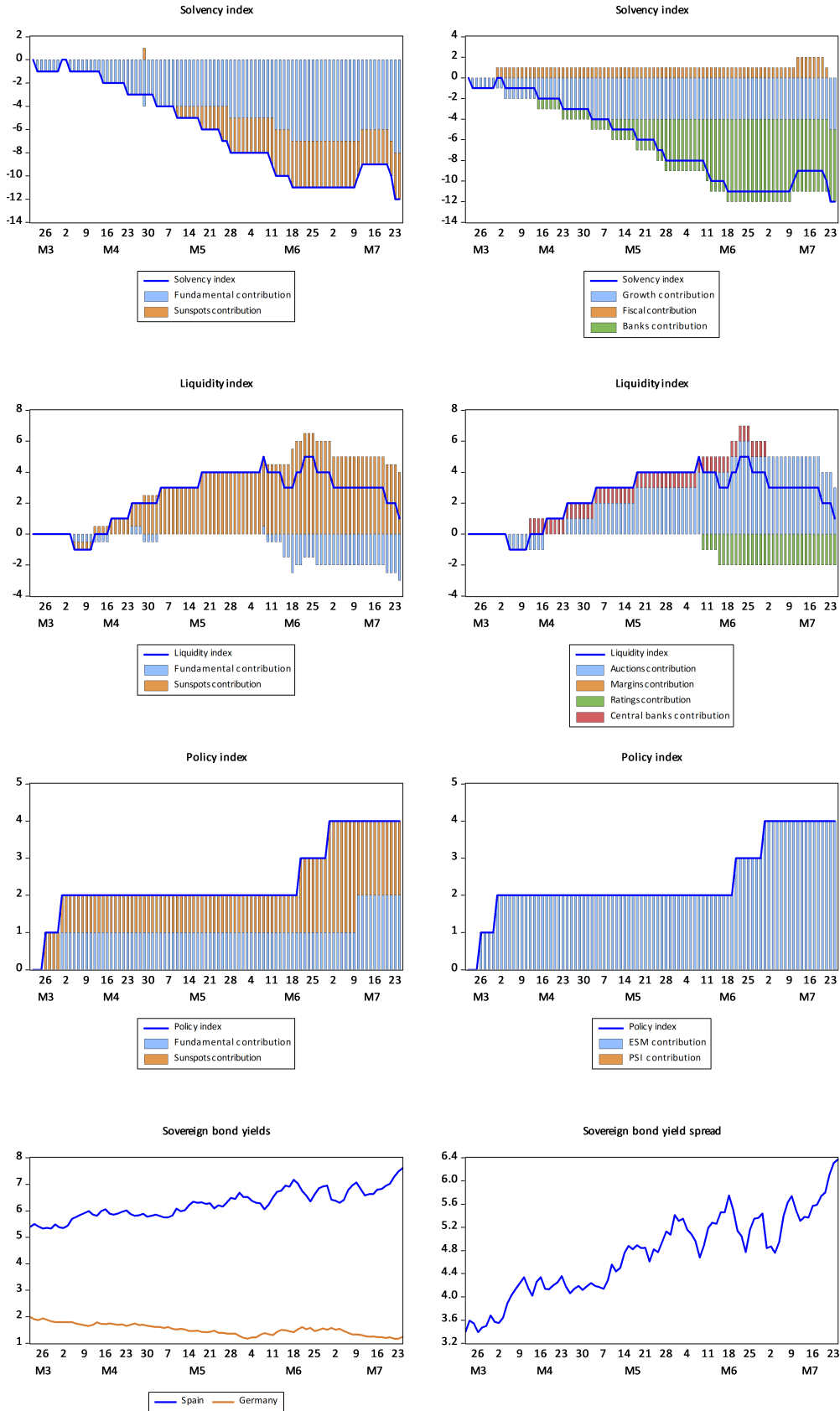


Figure A.11: Spain Raw Data (2012)



### A.3 Pre-estimation diagnostic tests

Table A.1: Residual tests on a VAR(5) model

	<b>Ireland</b>	<b>Portugal</b>	<b>Italy</b>	<b>Spain</b>
<b>Null = no serial correlation</b>	0.32 (lag=1)	0.46 (lag=1)	0.08 (lag=3)	0.25 (lag=4)
<b>Null = multivariate normality</b>	0.00	0.00	0.00	0.00
<b>Null = no heteroskedasticity</b>	0.09	0.00	0.73	0.13

*\*p-values < 0.05 consistent with rejection of null hypothesis*

Table A.2: Granger causality tests (lags=2)

	<b>Ireland</b>	<b>Portugal</b>	<b>Italy</b>	<b>Spain</b>
<b>N=</b>	71	96	106	83
<b>Spread DOES NOT GRANGER CAUSE Solvency</b>	0.78	0.56	0.86	0.07
<b>Spread DOES NOT GRANGER CAUSE Liquidity</b>	0.26	0.32	0.96	0.90
<b>Spread DOES NOT GRANGER CAUSE Policy</b>	0.94	0.08	0.10	0.24

*\*p-values < 0.05 consistent with rejection of null hypothesis*

Table A.3: Johansen Trace and maximum eigenvalue tests for reduced rank

	<b>Ireland</b>	<b>Portugal</b>	<b>Italy</b>	<b>Spain</b>
<b>Trace test</b>	At most 1	None	None	None
<b>Maximum Eigenvalue Test</b>	At most 1	None	None	None

Figure A.12: ADF stationarity test using MacKinnon one-sided p-values

*Ireland*

	No intercept/No trend**		Intercept/No trend		Intercept/Trend	
	Level	Difference	Level	Difference	Level	Difference
<b>Spread</b>			0.944	0.000	0.417	0.000
<b>Solvency</b>	0.417	0.000				
<b>Liquidity</b>	0.416	0.000				
<b>Policy</b>	0.574	0.000				

*Portugal*

	No intercept/No trend**		Intercept/No trend		Intercept/Trend	
	Level	Difference	Level	Difference	Level	Difference
<b>Spread</b>			0.972	0.000	0.092	0.000
<b>Solvency</b>	0.926	0.000				
<b>Liquidity</b>	0.777	0.000				
<b>Policy</b>	0.285	0.000				

*Italy*

	No intercept/No trend**		Intercept/No trend		Intercept/Trend	
	Level	Difference	Level	Difference	Level	Difference
<b>Spread</b>			0.908	0.000	0.469	0.000
<b>Solvency</b>	0.986	0.000				
<b>Liquidity</b>	0.361	0.000				
<b>Policy</b>	0.081	0.000				

*Spain*

	No intercept/No trend**		Intercept/No trend		Intercept/Trend	
	Level	Difference	Level	Difference	Level	Difference
<b>Spread</b>			0.974	0.000	0.001	0.000
<b>Solvency</b>	0.991	0.000				
<b>Liquidity</b>	0.428	0.000				
<b>Policy</b>	0.950	0.000				

\*p-values < 0.05 consistent with rejection of null hypothesis of a unit root

\*\*applied when the d.g.p. is known to have an initial value of zero

## A.4 Post-estimation diagnostic tests

Table A.4: Pesaran and Smith ARDL Bounds Test of Co-integration: Final BMK Model

Null hypothesis: No Co-integration	Ireland	Portugal	Italy	Spain
N=	84	99	95	90
k=	2	2	3	2
F-statistic	5.20**	5.36**	13.02***	4.03**

*\*significant at the 10% level for I(1) levels relationships*

*\*\*significant at the 5% level for I(1) levels relationships*

*\*\*\*significant at the 1% level for I(1) levels relationships*

Table A.5: Pesaran and Shin ARDL Bounds Test of Co-integration: Final FAS Model

Null hypothesis: No Co-integration	Ireland	Portugal	Italy	Spain
N=	84	99	95	90
k=	2	3	5	3
F-statistic	4.20***	4.39**	9.55***	4.64**

*\*significant at the 10% level for I(1) levels relationships*

*\*\*significant at the 5% level for I(1) levels relationships*

*\*\*\*significant at the 1% level for I(1) levels relationships*

Table A.6: Tests for Gaussian residuals

p-values	Model	Ireland	Portugal	Italy	Spain
<i>Breusch-Godfrey LM <math>\chi^2</math> test for serial correlation</i>	BMK	0.77	0.72	0.56	0.94
	FAS	0.53	0.14	0.55	0.97
<i>Jarque-Bera LM <math>\chi^2</math> test for non-normality</i>	BMK	0.13	0.06	0.38	0.48
	FAS	0.01	0.00	0.26	0.70
<i>Breusch-Pagan-Godfrey F-test for heteroskedasticity</i>	BMK	0.04	0.03	0.56	0.00
	FAS	0.23	0.08	0.08	0.13

*\*p-values < 0.05 consistent with rejection of null hypothesis*



## A.5 Post-estimation robustness and stability tests

The BMK model was tested to check for robustness against changes in the dependent variable and sample, as well as dynamic and structural stability. Robustness checks included re-estimating the model using the level of yields as the dependent variable rather than the yield spread and by shortening the sample period by one month. Neither change altered the statistical significance of the coefficients. Dynamic stability was confirmed by the inverse roots of the characteristic equation all being inside the unit circle. Structural stability was indicated by the CUSUM stability test showing that the recursive forecast errors were comfortably within the 5% significance bands over the available sample period.

Figure A.13: CUSUM Structural Stability Test

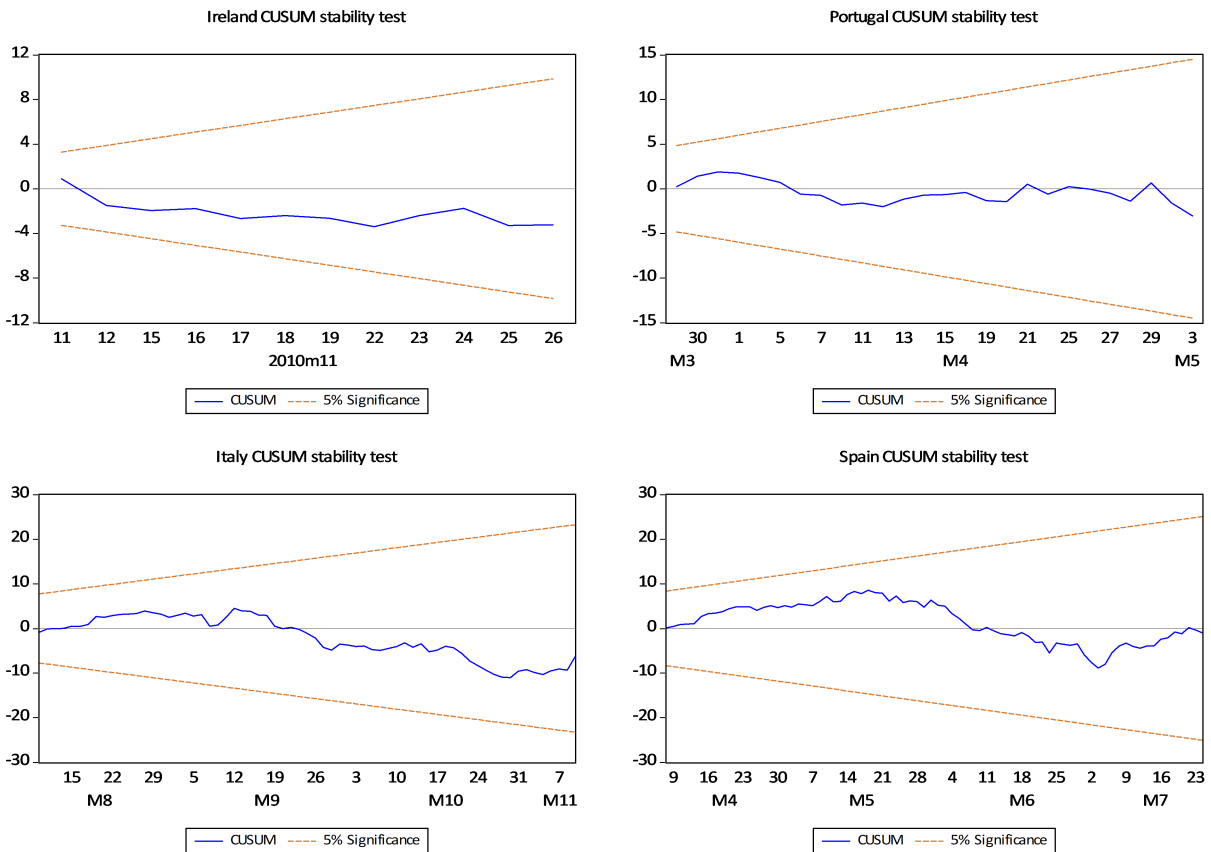


Table A.7: Robustness against dependent variable and sample variation

	Ireland			Portugal			Italy			Spain			
	Final BMK	10-year yield	Shorter sample	Final BMK Model	10-year yield	Shorter sample	Final BMK Model	10-year yield	Shorter sample	Final BMK Model	10-year yield	Shorter sample	
				<b>Level Relationship</b>									
$SOL_{it}$	-0.958*** (0.348)	-1.072 (0.768)	-0.796*** (0.205)	-0.220*** (0.075)	-0.305*** (0.081)	-0.250*** (0.074)	0.589*** (0.059)	-0.429*** (0.137)	-0.684*** (0.100)	-0.205*** (0.049)	-0.161*** (0.024)	-0.211*** (0.037)	
$LIQ_{it}$							-0.227*** (0.063)	-0.374*** (0.074)	-0.239*** (0.066)	-0.183*** (0.078)	-0.137*** (0.041)	-0.173 (0.114)	
$POL_{it}$				-0.529*** (0.130)	-0.516*** (0.156)	-0.478*** (0.139)							
$DUM_{P}S_{it}$	-1.823*** (0.444)	-1.576*** (0.443)	-0.780*** (0.186)				-1.229*** (0.224)	-0.971*** (0.231)	-1.219*** (0.239)				
				<b>Error Correction Regression</b>									
$\sum \Delta Y_{t-j}$				-0.244* (0.124)	-0.309** (0.138)	-0.206 (0.150)						0.178** (0.077)	
$\sum \Delta SOL_{t-j}$				-0.337*** (0.046)	-0.329*** (0.041)	-0.310*** (0.041)				-0.144*** (0.030)	-0.131*** (0.024)	-0.170*** (0.035)	
$\sum \Delta LIQ_{t-j}$	-0.106** (0.043)	-0.103** (0.044)	-0.098 (0.060)	-0.072*** (0.016)	-0.073*** (0.026)	-0.090** (0.038)	-0.136*** (0.027)	-0.112*** (0.022)	-0.120*** (0.028)	-0.151*** (0.034)	-0.134*** (0.027)	-0.138*** (0.040)	
$\sum \Delta POL_{t-j}$	-0.280*** (0.044)	0.243*** (0.044)	-0.221*** (0.051)	-0.158*** (0.029)	-0.112*** (0.029)	-0.132*** (0.038)	-0.257*** (0.037)	-0.134*** (0.030)	-0.258*** (0.045)	-0.335*** (0.068)	-0.246*** (0.054)	-0.515*** (0.098)	
$\Delta DUM_{L}IQ_{it}$	-0.788*** (0.143)	-0.758*** (0.147)	-0.726*** (0.158)				-0.546*** (0.115)	-0.709*** (0.092)	-0.563*** (0.114)				
$ECM_{it-1}$	-0.076*** (0.016)	-0.044*** (0.012)	-0.167*** (0.039)	-0.121*** (0.030)	-0.079*** (0.026)	-0.129*** (0.037)	-0.252*** (0.031)	-0.167*** (0.026)	-0.258*** (0.040)	-0.142*** (0.035)	-0.209*** (0.050)	-0.153*** (0.051)	

Table A.8: Dynamic Stability Tests

	<b>Ireland</b>	<b>Portugal</b>	<b>Italy</b>	<b>Spain</b>
<b>Roots</b>	0.922	0.907 0.023 – 0.593i 0.023 + 0.592i	0.748	0.858
<b>Moduli</b>	0.922	0.907 0.593 0.593	0.748	0.858
<b>Result</b>	No root lies outside the unit circle: ARDL model satisfies the dynamic stability condition	No root lies outside the unit circle: ARDL model satisfies the dynamic stability condition	No root lies outside the unit circle: ARDL model satisfies the dynamic stability condition	No root lies outside the unit circle: ARDL model satisfies the dynamic stability condition

## A.6 Post-estimation tests for endogeneity

The models were also stress-tested for evidence of endogeneity of the belief variables given the possibility that the changes in beliefs reported by market participants could represent ex-post rationalisations for the observed daily changes in market prices. Granger causality tests had already confirmed that belief variables were weakly exogenous in pre-testing. This implies that the ex-post rationalisation hypothesis can be correct only if endogeneity is contemporaneous. Further tests suggested this was unlikely. First, while changes in bond yield spreads were found to be autocorrelated the changes in the belief variables were not found to be autocorrelated in three of the four countries (A.6). A difference in autocorrelation structure would not be expected if there was a robust contemporaneous causal relationship from changes in yield spreads to changes in beliefs. Second, post-estimation Wald tests showed that there are statistically significant differences between the estimated coefficients on the contemporaneous impact of changes in belief variables in three of the four models (A.7). Given that the ex-post rationalisation hypothesis assumes a common, random, data generating process across the belief variables such differences would not generally be expected to be statistically significant.

Table A.9: Autocorrelation of bond yield spreads and associated Granger causality tests

	<b>Ireland</b>	<b>Portugal</b>	<b>Italy</b>	<b>Spain</b>
Lag selection	2	No AC present	1	4
Autocorrelation	-0.224		0.226	-0.297
Q-stat	6.21		5.13	16.17
p value*	0.045		0.012	0.003
Spread DOES NOT GRANGER CAUSE Solvency	0.78		0.97	0.06
Spread DOES NOT GRANGER CAUSE Liquidity	0.26		0.83	0.99
Spread DOES NOT GRANGER CAUSE Policy	0.94		0.26	0.38

\*p-values < 0.05 consistent with rejection of null hypothesis of no autocorrelation

Table A.10: Wald tests of common coefficients on the contemporaneous impact of news variables

	<b>Ireland</b>	<b>Portugal</b>	<b>Italy</b>	<b>Spain</b>
F-statistic	0.00	0.00	0.00	0.20
Chi-square	0.00	0.00	0.00	0.19

*\*p-values < 0.05 consistent with rejection of null hypothesis of common coefficients*

## A.7 Supplementary Appendix: Literature Review of Theoretical Models and Empirical Studies

Theories of crises in the euro area have emerged in two waves. The first wave took place in the lead-up to monetary union in 1999 when several economists expressed concerns about the vulnerabilities of what, even at the time, was viewed as a primarily political project. The second wave took place in response to the sovereign debt crisis that began in late 2009 and has generally incorporated relatively minor amendments to previous theoretical models of debt crises, notably those related to emerging economies. This section reviews the literature that emerged in both waves.

There was a small group of papers prior to the euro's launch that examined the vulnerabilities of EMU when both domestic and euro currency were circulating. Eltis (1997) focused upon the effects on European money supply of speculation about a withdrawal. For example, the prospect of an Italian withdrawal would lead people to exchange their euro-liras for euro-DMs in preference to any other sub-unit. This would result in a huge increase in German money supply, generate opposition to EMU in Germany, and lead to legal actions to halt it. Dooley (1997) considered a similar mechanism through the banking system. If doubts about membership are raised this will increase the exchange risk premium and depress the market value of the banks' long-term domestic currency assets relative to its short-term liabilities. This could reduce confidence in the banking system and causes bank runs that require large-scale money creation to stop. This could then, as in Eltis (1997), incentivise Germany to exit.

More presciently, Goodhart (1997) focused on the long-term threat to EMU from the sovereign bond markets. He argued that not having the right to use the printing press, or what is often termed an absence of a lender of last resort (LoLR) for sovereigns, implied deterioration in sovereign credit ratings and higher

interest rates. It also raised the spectre of self-reinforcing runs in bond markets should a budgetary crisis emerge. According to Goodhart “One of the objectives of EMU is to get away from crises and runs on foreign exchange markets. Are the founders of EMU going to discover that they have merely shifted the locus of such crises from the foreign exchange markets to the bond markets?” Hume (1997) presents a formal model based on the insights of Goodhart to show that a budgetary crisis shock could interact with expectations of EMU exit to generate a self-fulfilling sovereign bond market crisis.

Recent attempts to model the sovereign debt crisis have incorporated Goodhart’s concerns about the absence of a LoLR for sovereigns by using “second generation” crisis models in which the focus is on the incentives of policymakers. The key distinction between these and other crisis models is that the policymaker makes a rational choice to make a regime change rather than being forced out by resource or credit constraints. These models emphasise the importance of changes in private agents’ expectations about government policy and how this can affect current economic conditions, market prices and, by extension, the policymaker’s welfare. If expectations change sufficiently then this can induce, by reducing welfare beyond a threshold point, a change in policy. Under special circumstances these shifts in expectations can be self-fulfilling.

One such model is that of Corsetti and Dedola (2016) which applies a Calvo (1988) debt repudiation model in which fundamental factors regarding tax capacity and the state of confidence both drive risk premia <sup>1</sup>. The main departure from the Calvo formulation is that output and spending are allowed to vary stochastically across two states of the world, a high output state and a low output state. It is shown that there is an equilibrium in which default occurs only in the low output state and another equilibrium in which default occurs in both states of the world. The latter equilibrium reflects the possibility that a self-fulfilling attack on the public debt may require the government to raise taxes to capacity owing to increases in debt interest payments. The authors find that an easy way to ensure that the good equilibrium is chosen by markets is for the central bank to impose an interest rate ceiling which is below the rate at which default occurs in the high output state.

Gros (2012) presents a model in a similar vein in which the policymaker must choose whether to undertake

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<sup>1</sup>The authors make it clear that the tax capacity of the government should not be interpreted as a technical limit but as the ex-post choice of taxes that maximises private consumption, which is assumed to be the policymaker’s objective.

a strategic default based on maximisation of a social loss function. This is based on the idea that the costs of austerity needed to avoid default may exceed the level of default costs. The paper's main insight is that, somewhat counter-intuitively, the introduction of uncertainty may make multiple equilibria less likely. Within a perfect foresight setting the model generates multiple equilibria over a wide range of debt levels. But when there is uncertainty about the circumstances in which the government would undertake default, while multiple equilibria still exist, they are locally stable and would require large shocks to bring about a shift from one equilibrium outcome to another.

Other models have also tended to emphasise the possibility of multiple equilibria. Arghyrou and Tsoukalas (2011) adapt the models in Obstfeld (1994, 1996) that were used to explain the crisis in the European Exchange Rate mechanism in 1991-2. In this model the main driver of risk premia is not default risk but the risk of EMU exit. In line with the findings of Hume (1997), they find that expectations of euro exit could, in principle, be self-fulfilling. De Grauwe (2013) adapts the Obstfeld (1994, 1996) models within a more general framework. Rather than focusing on the risk of EMU exit this model emphasises the overall costs and benefits of avoiding default in the context of changes in interest rates affecting the level of output and debt interest payments. Again, the model generates multiple equilibria and supports the case for central bank intervention to maintain a good equilibrium.

The empirical literature that considers the factors driving euro-area bond yields during the crisis has grown rapidly over recent years. The papers tend to consider increased sensitivity either to fundamentals or to other factors, such as contagion, rating agency actions, and policy news. This section considers these two strands of the literature.

There is a consensus view that bond yields became more sensitive to economic fundamentals during the crisis. Gibson et al (2011) examine the behaviour of Greek long-term government bond spreads over Germany, using monthly data from 2000 to 2010. They estimate a co-integrating relationship between spreads and fundamentals, such as fiscal space, competitiveness, economic activity, and oil prices. They find that Greek spreads were significantly below what would be predicted by fundamentals from end-2004 up to the middle of 2005 but that since May 2010 spreads have exceeded predicted spreads by some 400bp. Using a unique euro-area data set on issue spreads Bernoth et al (2012) conclude that "with the financial crisis, the cost of

loose fiscal policy has increased considerably”.

Ghosh et al (2013) use a measure of fiscal space to consider the observed behaviour of euro-area bond yields and CDS. The paper estimates a cubic relationship between primary balance adjustment and debt levels and combines this with estimates of long-term interest and growth rates to establish debt limits across different economies. Using this framework, the authors find empirical evidence to support the idea that once it became clear during the crisis phase that bailouts from stronger euro-area economies would not be immediately forthcoming the euro-area periphery was punished with higher interest rates owing to a perceived reduction in debt sustainability owing to monetary union constraints on policy.

Finally, De Grauwe and Ji (2013) conduct an empirical test of the multiple equilibria crisis models in which euro-area government bond markets are more susceptible to self-fulfilling liquidity crises than standalone countries. It is found that a significant part of the surge in periphery interest rate spreads in 2010-11 was disconnected from underlying increases in the debt-to-GDP ratios and fiscal space variables. It is argued that this is the result of negative self-fulfilling market sentiments that became very strong since the end of 2010. However, there may be other explanations for this disconnect between fundamentals and bond yields.

There is substantial evidence of contagion across the euro-area sovereign bond markets. Constancio (2011) defines contagion as “a situation whereby instability in a specific market or institution is transmitted to one or several other markets or institutions”.<sup>2</sup> A number of studies have found clear evidence of such an effect. Beirne and Fratzscher (2012) find that a combination of fundamentals, fundamentals contagion, and herding contagion can explain the evolution of sovereign bond yields not just in the euro area but a group of 31 advanced and emerging economies<sup>3</sup>. Boeckx and Dewachter (2012) use an entirely statistical approach that decomposes changes in bond yields into a euro-area factor and a country-specific factor and detects a change in the co-movement between markets. They find that the impact of country-specific changes in bond yields in Greece, Spain, and Italy on bond yields in Belgium, France and Germany increased after 2007.

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<sup>2</sup>Constancio goes on to suggest that “There are two ideas underlying this definition. First, the wider spreading of instability would usually not happen without the initial shock. Second, the transmission of the initial instability goes beyond what could be expected from the normal relationships between markets or intermediaries, for example in terms of its speed, strength or scope”.

<sup>3</sup>The authors define fundamentals contagion as “a sharp rise in the sensitivity of financial markets to fundamentals” and herding contagion as “sharp, simultaneous increases in sovereign yields across countries”.



There is also evidence that rating agency actions have also affected sovereign bond yields. The rationale for expecting an effect is that many institutional investors, such as pension funds and insurers, are required by law to only hold bonds with a minimum rating. Changes in ratings can therefore generate portfolio shifts leading to changes in bond yields. But, as De Grauwe and Ji (2013) point out, there is a risk the rating agency actions are endogenous and so “can simply be seen as a reaction to the development of the crisis”. Some studies do attempt to control for this, however, and still find an effect. For example, De Santis (2012) uses a Structural VECM and finds that sovereign spreads are strongly affected by unexpected developments in ratings. And Afonso et al (2011) use Granger causality tests in a panel framework and find two-way causality between sovereign credit ratings and government bond yields.

There has also been some examination of the impact of “news” on sovereign bond yields. Beetsma et al (2013) investigate how news has affected domestic interest spreads vis-a-vis Germany and how it propagated to other countries during the recent period. It uses Eurointelligence newsflash releases to create variables based on the amount of news that is released on a country on a given date. According to their results more news on average raises the domestic interest rate spread of the periphery countries since September 2009. The magnitude of the news in one periphery country also has an impact on the interest rate spreads in other periphery countries, with the magnitude of the effect related to cross-border bank holdings.

Relatedly, empirical studies have demonstrated impacts from statements both specifically about restructuring, bailout, and the involvement of the ESM (Mohl and Sondermann (2012)) as well as more general political communication (Gade et al (2013)). These results back up anecdotal claims that certain policy announcements have played a pivotal role at key moments of the crisis. For example, the Deauville Summit between Chancellor Merkel and President Sarkozy on 19 October 2010, which declared the need for private sector involvement in debt restructurings, is generally thought to have been important in triggering the rapid rise in Irish bond yields that led to the country requesting a bailout on 22 November 2010.

# Appendix B

## Appendices to chapter 3

### B.1 Theoretical model

We start with a simple open economy New Keynesian (NK) model comprising a production function, an open economy dynamic IS equation, an open economy New Keynesian Phillips Curve, and an equation relating the trade balance to competitiveness (reflecting the impact of relative price changes on both consumption in the Euler equation and expenditure switching effects). The equations replicate the canonical form of small open economy of Gali and Monacelli (2005: pp.715-719) but with two modifications. First, there is a direct role for fiscal policy,  $g$ , in the IS equation; second there is a role for the ‘disciplining effects’ of increased price transparency from being a member of a monetary union (Issing 2014: p.26), captured by the intra-euro-area price level gap,  $q$ , both in IS equation and the New Keynesian Phillips curve:

$$\bar{y}_t = a_t + n_t \tag{B.1}$$

$$y_t = E_t(y_{t+1}) - \rho(r_t - E_t(\Delta p_{t+1}) - \bar{r}r_t) + \theta g_t - \vartheta q_t \tag{B.2}$$

$$\Delta p_t = E_t(\Delta p_{t+1}) + \lambda(y_t - \bar{y}_t) - \delta q_{t-1} \tag{B.3}$$

$$x_t = -\theta q_t \tag{B.4}$$

$\bar{y}$  is potential output,  $a$  is technology,  $n$  is employment,  $y$  is output,  $r$  is the effective interest rate,  $p$  is prices,  $\bar{r}$  is the neutral interest rate,  $g$  is the fiscal balance,  $q$  is intra-euro-area price level gap,  $x$  is the trade balance, and  $s$  is the real exchange rate.

To adapt the NK model for the analysis of intra-euro-area macroeconomic imbalances we need to make only two simplifying assumptions: (i) the euro area is a large, closed, economy (ii) members of the euro area are share identical economic structures. This enables the model to be re-written solely in terms of imbalances in output, prices, and trade where the subscript  $i$  denotes a variable expressed in differences across two sets of euro area members:

$$\bar{y}_{it} = a_{it} + n_{it} \tag{B.5}$$

$$y_{it} = E_t(y_{it+1} - \rho(r_{it} - E_t(\Delta p_{it+1}))) + \theta g_{it} - \vartheta p_{it} \tag{B.6}$$

$$p_{it} = (1 - \delta)p_{it-1} + E_t(\Delta p_{it+1}) + \lambda(y_{it} - \bar{y}_{it}) \tag{B.7}$$

$$x_{it} = -\phi p_{it} \tag{B.8}$$

We then close the model by identifying four structural shocks:

$$g_{it} = g_{it-1} + u_{it}^f: \text{fiscal shock} \tag{B.9}$$

$$r_{it} = r_{it-1} + u_{it}^c: \text{credit supply shock} \tag{B.10}$$

$$a_{it} = a_{it-1} + u_{it}^p: \textit{productivity shock} \quad (\text{B.11})$$

$$n_{it} = n_{it-1} + u_{it}^w: \textit{labour supply shock} \quad (\text{B.12})$$

These equations constitute the equilibrium dynamics. The steady state solution, in which imbalances are persistent, is found by setting all variables to their steady state levels.

## B.2 VAR representation and method of estimation

The model is estimated in first differences and represented in matrix form by:

$$B_0 \begin{bmatrix} \Delta y_t \\ \Delta p_t \\ \Delta g_t \\ \Delta r_t \\ \Delta n_t \\ \Delta x_t \end{bmatrix} = B_1 \tilde{E}_{t-1} \begin{bmatrix} \Delta y_{t+1} \\ \Delta p_{t+1} \\ \Delta g_{t+1} \\ \Delta r_{t+1} \\ \Delta n_{t+1} \\ \Delta x_{t+1} \end{bmatrix} + B_2 \begin{bmatrix} \Delta y_{t-1} \\ \Delta p_{t-1} \\ \Delta g_{t-1} \\ \Delta r_{t-1} \\ \Delta n_{t-1} \\ \Delta x_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \\ u_{5t} \\ u_{6t} \end{bmatrix} \quad (\text{B.13})$$

Or more compactly:

$$B_0 Z_t = B_1 \tilde{E}_{t-1} Z_{t+1} + B_2 Z_{t-1} + u_t \quad (\text{B.14})$$

$Z_t$  is a vector of potentially endogenous variables; and  $u_t$  is a vector of white noise disturbances.  $\tilde{E}_t$  is an expectations operator where the tilde denotes that these are expectations that are not formed rationally, as required by the consensus narrative of the crisis.

There are several ways in which expectations might be formed non-rationally. De Grauwe (2012b) proposes a behavioural formulation in which agents use heuristics to form their expectations. Such heuristics include fundamentalist and extrapolative rules that are weighted according to performance into a single “market forecast”. But it might be that they are formed in many other ways, such as assuming a random walk for each of the variables or with some proportion of agents forming their expectations rationally while

others form them adaptively. In estimation we simply model them in a model-consistent way:

$$\tilde{E}_{t-1}Z_{t+1} = C_1Z_{t-1} \quad (\text{B.15})$$

With this simple formulation, the structural equation above can now be re-written as:

$$A_0^{-1}Z_t = A_1Z_{t-1} + u_t \quad (\text{B.16})$$

Where  $A_0^{-1} = B_0$  and  $[B_1C_1 + B_2]$ . Pre-multiplying by  $A_0$  then gives:

$$Z_t = A_0A_1Z_{t-1} + A_0u_t \quad (\text{B.17})$$

Or:

$$Z_t = \Gamma_0Z_{t-1} + v_t \quad (\text{B.18})$$

Where  $\Gamma_0 = A_0A_1$  and  $v_t = A_0u_t$ . This final equation gives the reduced-form VAR representation of the model that is estimated.

To improve precision of the estimates, given the relatively small sample size, this paper utilises Bayesian methods to obtain the reduced-form VAR. The Bayesian reduced-form VAR (the “posterior VAR”) is a weighted average of a VAR estimated by Maximum Likelihood (the “sample VAR”) and a VAR assumed to follow a particular form and statistical distribution (the “prior VAR”) <sup>1</sup>. The prior VAR is that the vector of variables,  $X_t$ , is modelled as an AR(1) prior mean for the  $B$  matrix <sup>2</sup> :

$$X_t = BX_{t-1} \quad (\text{B.19})$$

The Bayesian reduced-form VAR therefore takes the same form as a standard Maximum Likelihood VAR in which a vector of variables,  $Z_t$ , are a function of their own lags,  $B(L)Z_{(t-1)}$ , with the reduced-form errors,

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<sup>1</sup>The weighting procedure was implemented in this paper using the dummy variables approach with hyper-parameters  $\tau = 1$  (prior tightness on own lag) and  $c = 10$  (prior tightness on constant).

<sup>2</sup>The coefficient matrix is assumed to follow a Normal-Inverse Wishart distribution

$v_t$ , having a covariance structure of  $\Sigma$ :

$$Z_t = B(L)Z_{t-1} + v_t, \quad \text{VAR}(v) = \Sigma \quad (\text{B.20})$$

### B.3 Alternative methods of structural identification

A VAR includes only a constant and lags of the vector of variables included in estimation. Consequently, a structural (i.e., economic) shock will lead to residuals in the reduced-form error vector,  $v_t$ . The errors will not be random but reflect the structure of the economy and how it responds contemporaneously to the structural shocks hitting the economy. By making assumptions about the structure of the economy the reduced-form errors can be used to recover the structural shocks that have hit the economy and what their impact on the variables in the VAR has been.

Formally, this is done by decomposing the reduced-form errors,  $v_t$ , into a  $N \times N$  contemporaneous impact matrix,  $A_0$ , and a  $N \times 1$  structural shock vector,  $u_t$ :

$$v_t = A_0 u_t, \quad \text{VAR}(u_t) = I \quad (\text{B.21})$$

In effect, the  $A_0$  matrix summarises the structure of the economy assumed by the econometrician. Note that the condition  $\text{VAR}(u_t) = I$  means that the structural shocks are assumed to be orthogonal to each other, i.e. there is no relationship between them and they occur independently of each other and are normalised to have unit variance.

There are several ways of imposing an economic structure on the  $A_0$  matrix. The challenge is to ensure that the imposed structure, when combined with the recovered structural shocks, results in the same covariance structure as seen in the reduced-form residuals, i.e.  $\text{VAR}(A_0 u) = \text{VAR}(v) = \Sigma$ . Because the structural shocks are normalised to have unit variance this condition amounts to finding a matrix that satisfies  $A_0 A_0' = \Sigma$ . The most basic solution to this problem is to use a Cholesky decomposition of the reduced-form errors. Its lower triangular structure means it automatically satisfies the  $\text{VAR}(A_0 u) = \text{VAR}(v) = \Sigma$  condition. But it requires there to be a unique causal chain that runs through the variables with at least one

variable being invariant to structural shocks in the other variables. It is doubtful whether the structure of the economy can ever be characterised in this way and consequently the results of such an interpretation are usually economically meaningless.

Alternative approaches include imposing restrictions on some combination of the short-run and long-run impact of specific structural shocks. This can be motivated by economic theory, e.g. that the effect of a monetary shock on real variables is neutral in the long-run (i.e. zero). However, in order to meet the condition  $VAR(A_0u) = VAR(v) = \Sigma$  an arbitrary number of restrictions is still required to identify the contemporaneous impact matrix. This may require imposing restrictions that are hard to justify on economic grounds purely for the purposes of identification. Experience has also shown that the results from these approaches are very sensitive to the model's specification, such as lag length.

Owing to the inherent weaknesses of these approaches, a method of identification that has become popular in recent years is the sign restrictions approach (Faust 1998, Canova and De Nicro 2002, Uhlig 2005). This method is much more flexible and requires only that each shock has a unique sign pattern of effects on the variables in the VAR. The basic idea is that the econometrician should establish from economic theory what the effect of the shocks on the variables should be. Numerical techniques are then used to find all the decompositions that are compatible with the imposed sign restrictions<sup>3</sup>.

A disadvantage of this approach relative to the Cholesky, short-run and long-run restrictions approaches is that a whole distribution of decompositions is obtained. To simplify analysis, however, the decomposition that produces impulse response functions (IRFs) that are closest to the mean response is the one that is used to summarise the model. The IRFs that this decomposition generates is referred to as the Fry-Pagan (2011) median. An indication of the uncertainty can be given by reporting intervals from the distribution of IRFs (usually one standard deviation either side of the median).

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<sup>3</sup>This is implemented using the Rubio-Ramirez et al. (2010) algorithm. First an  $N \times N$  matrix,  $K$ , is drawn from the standard normal distribution and the matrix  $Q$  is calculated from the  $QR$  decomposition of  $K$ . The Cholesky decomposition of the current draw of  $\Sigma = \tilde{A}_0' \tilde{A}_0$  is then found. The  $A_0$  matrix is obtained as  $A_0 = Q \tilde{A}_0$ . Note that the  $QR$  decomposition implies  $Q'Q = I$  and, therefore, that  $\Sigma = A_0' A_0$ . In other words, the new  $A_0$  matrix is a random rotation of the old  $\tilde{A}_0$  matrix that also satisfies the requirement that  $\Sigma = A_0' A_0$ . The signs of this new  $A_0$  matrix is checked to ensure that the contemporaneous impacts are in accordance with the sign restrictions derived from economic theory. If they are, the draw is kept. If they are not, the draw is discarded. This process is repeated until a distribution of the  $A_0$  matrices that is compatible with the economic theory underlying the model is obtained.

# Appendix C

## Appendices to chapter 4

### C.1 Intermediate solutions to the trilemma problem

This appendix presents mathematical proofs of the solutions to a trilemma in which three policy goals cannot be achieved simultaneously. In the literature, trilemmas have tended to focus on ‘pure’ solutions only – i.e., sacrificing one goal entirely to achieve full attainment of two other goals. Members of a monetary union should not be expected to agree on one solution; in fact, democracies with shifting partisan governments in power will change the weights they place on different policy goals. So, a more realistic solution is an intermediate one with some weight on all three goals. This appendix presents all the potential solutions to a trilemma and provides a three-dimensional representation of an intermediate solution with a known functional form. The difficulty is knowing how to achieve a lasting settlement in which both a political and financial equilibrium is achieved.

#### *Setting up the problem*

The trilemma is optimised as a non-linear programming problem. The policymaker maximises its welfare function subject to a series of inequality constraints. We first solve for a general problem in which the policymaker’s preferences are assumed to be strictly concave. The policymaker maximises the following welfare function:



The policymaker maximises the following welfare function:

$$W = f(x_1, x_2, x_3) \quad f'(x_1) > 0, \quad f''(x_1) < 0 \quad \forall x \quad (\text{C.1})$$

subject to:

$$x_1 + x_2 + x_3 \leq 2 \quad (\text{C.2})$$

and

$$x_1, x_2, x_3 \geq 0 \quad (\text{C.3})$$

The Lagrangian function is:

$$Z = f(x_1, x_2, x_3) + \lambda_1[2 - x_1 - x_2 - x_3] + \lambda_2[1 - x_1] + \lambda_4[1 - x_3] \quad (\text{C.4})$$

This yields the following Kuhn Tucker conditions:

$$Z_{x_1} = f'(x_1) - \lambda_1 - \lambda_2 \leq 0 \quad \text{and} \quad x_1 \geq 0 \quad \text{and} \quad x_1 Z_{x_1} = 0 \quad (\text{C.5})$$

$$Z_{x_2} = f'(x_2) - \lambda_1 - \lambda_3 \leq 0 \quad \text{and} \quad x_2 \geq 0 \quad \text{and} \quad x_2 Z_{x_2} = 0 \quad (\text{C.6})$$

$$Z_{x_3} = f'(x_3) - \lambda_1 - \lambda_4 \leq 0 \quad \text{and} \quad x_3 \geq 0 \quad \text{and} \quad x_3 Z_{x_3} = 0 \quad (\text{C.7})$$

$$Z_{\lambda_1} = [2 - x_1 - x_2 - x_3] \geq 0 \quad \text{and} \quad \lambda_1 \geq 0 \quad \text{and} \quad \lambda_1 Z_{\lambda_1} = 0 \quad (\text{C.8})$$

$$Z_{\lambda_2} = [1 - x_1] \geq 0 \quad \text{and} \quad \lambda_2 \geq 0 \quad \text{and} \quad \lambda_2 Z_{\lambda_2} = 0 \quad (\text{C.9})$$

$$Z_{\lambda_3} = [1 - x_2] \geq 0 \text{ and } \lambda_3 \geq 0 \text{ and } \lambda_3 Z_{\lambda_3} = 0 \quad (\text{C.10})$$

$$Z_{\lambda_4} = [1 - x_3] \geq 0 \text{ and } \lambda_4 \geq 0 \text{ and } \lambda_4 Z_{\lambda_4} = 0 \quad (\text{C.11})$$

### The conventional solution to the trilemma

We define the conventional solution to the trilemma as placing a zero weight on one goal and full weight on the other two goals:

$$x_1^* = 0 \text{ and } x_2^* = x_3^* = 1 \quad (\text{C.12})$$

The Kuhn-Tucker conditions directly imply:

$$Z_{\lambda_2} = 1 \text{ and } Z_{\lambda_3} = Z_{\lambda_4} = 0 \quad (\text{C.13})$$

While strict concavity and complementary slackness further imply:

$$Z_{x_2} = Z_{x_3} = Z_{\lambda_1} = \lambda_2^* = 0 \text{ and } \lambda_1^* > 0 \quad (\text{C.14})$$

Taken together this gives the following solution of a simultaneous equation system with three equations and three unknowns:

$$\lambda_1^* \geq f'(x_1^*) \quad (\text{C.15})$$

$$\lambda_1^* + \lambda_3^* = f'(x_2^*) \quad (\text{C.16})$$

$$\lambda_1^* + \lambda_4^* = f'(x_3^*) \quad (\text{C.17})$$

### Partial intermediate solution

A partial intermediate solution is:

$$x_1^* = 1 \text{ and } 0 < x_2^*, x_3^* < 1 \quad (\text{C.18})$$

This implies:

$$Z\lambda_2 = 0 \text{ and } Z\lambda_3, Z\lambda_4 > 0 \quad (\text{C.19})$$

Strict concavity and complementary slackness imply:

$$Z_{x_1} = Z_{x_2} = Z_{x_3} = Z_{\lambda_1} = \lambda_3 = \lambda_4 = 0 \text{ and } \lambda_2 \geq 0 \text{ and } \lambda_1 > 0 \quad (\text{C.20})$$

This gives the following solution:

$$\lambda_1^* + \lambda_2^* = f'(x_1^*) \quad (\text{C.21})$$

$$f'(x_2^*) - \lambda_1^* = 0 \quad (\text{C.22})$$

$$f'(x_3^*) - \lambda_1^* = 0 \quad (\text{C.23})$$

$$x_2^* + x_3^* = 1 \quad (\text{C.24})$$

### Fully intermediate solution

The fully intermediate solution is:

$$0 < x_1^*, x_2^*, x_3^* < 1 \quad (\text{C.25})$$

This implies:

$$Z\lambda_2 = Z\lambda_3 = Z\lambda_4 > 0 \quad (\text{C.26})$$

Strict concavity and complementary slackness imply:

$$Z_{x_1} = Z_{x_2} = Z_{x_3} = \lambda_2 = \lambda_3 = \lambda_4 = 0 \text{ and } \lambda_1 > 0 \quad (\text{C.27})$$

This gives the following solutions:

$$f'(x_1^*) - \lambda_1^* = 0 \tag{C.28}$$

$$f'(x_2^*) - \lambda_1^* = 0 \tag{C.29}$$

$$f'(x_3^*) - \lambda_1^* = 0 \tag{C.30}$$

$$x_1^* + x_2^* + x_3^* = 2 \tag{C.31}$$

**A fully intermediate solution for a known functional form:** The previous solutions were general for any strictly concave welfare function. Now we propose an arbitrary and simple functional form to illustrate the fully intermediate solution. The policymaker welfare function takes the following form:

$$W = x_1^{0.5} + x_2^{0.5} + x_3^{0.5} \tag{C.32}$$

From the general solution we can write:

$$0.5x_1^{-0.5} - \lambda_1^* = 0 \tag{C.33}$$

$$0.5x_2^{-0.5} - \lambda_1^* = 0 \tag{C.34}$$

$$0.5x_3^{-0.5} - \lambda_1^* = 0 \tag{C.35}$$

$$x_1^* + x_2^* + x_3^* = 2 \tag{C.36}$$

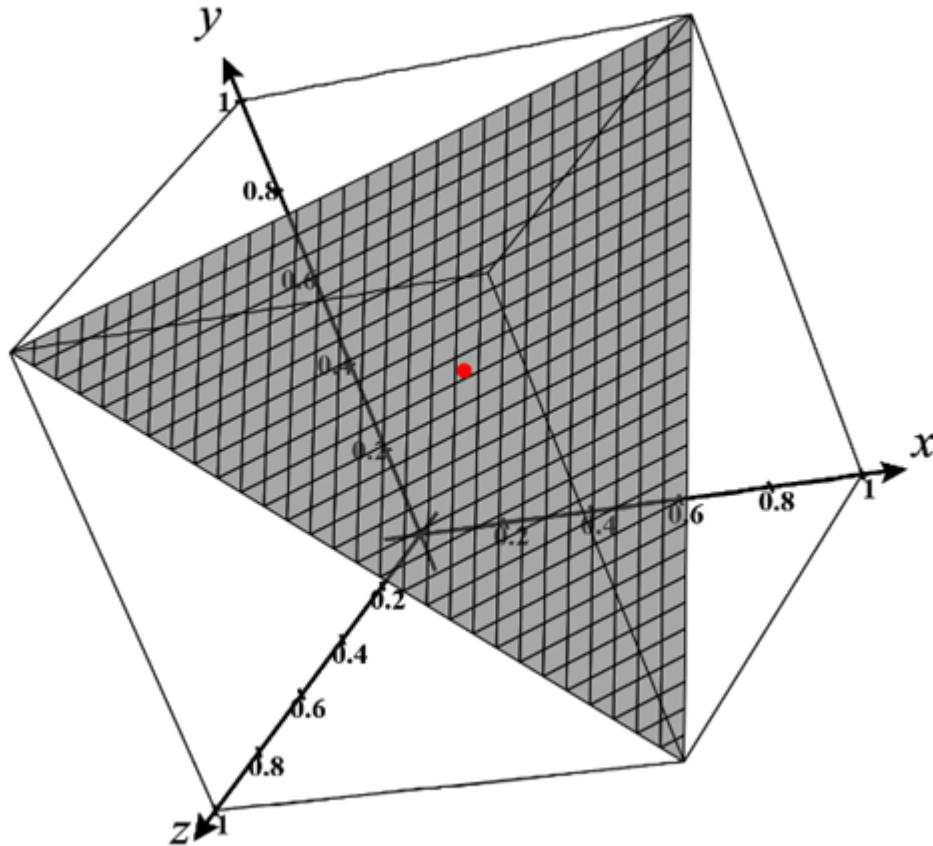
The solution is therefore:

$$x_1^* = x_2^* = x_3^* = 0.67 \quad (\text{C.37})$$

$$\lambda_1^* = 0.61 \quad (\text{C.38})$$

And this can be represented graphically, with the grey net representing the constraint and the red dot the optimal solution:

Figure C.1: Intermediate solution to the trilemma



## C.2 Fiscal Activity Charts

Figure C.2: Fiscal Activity: Debt

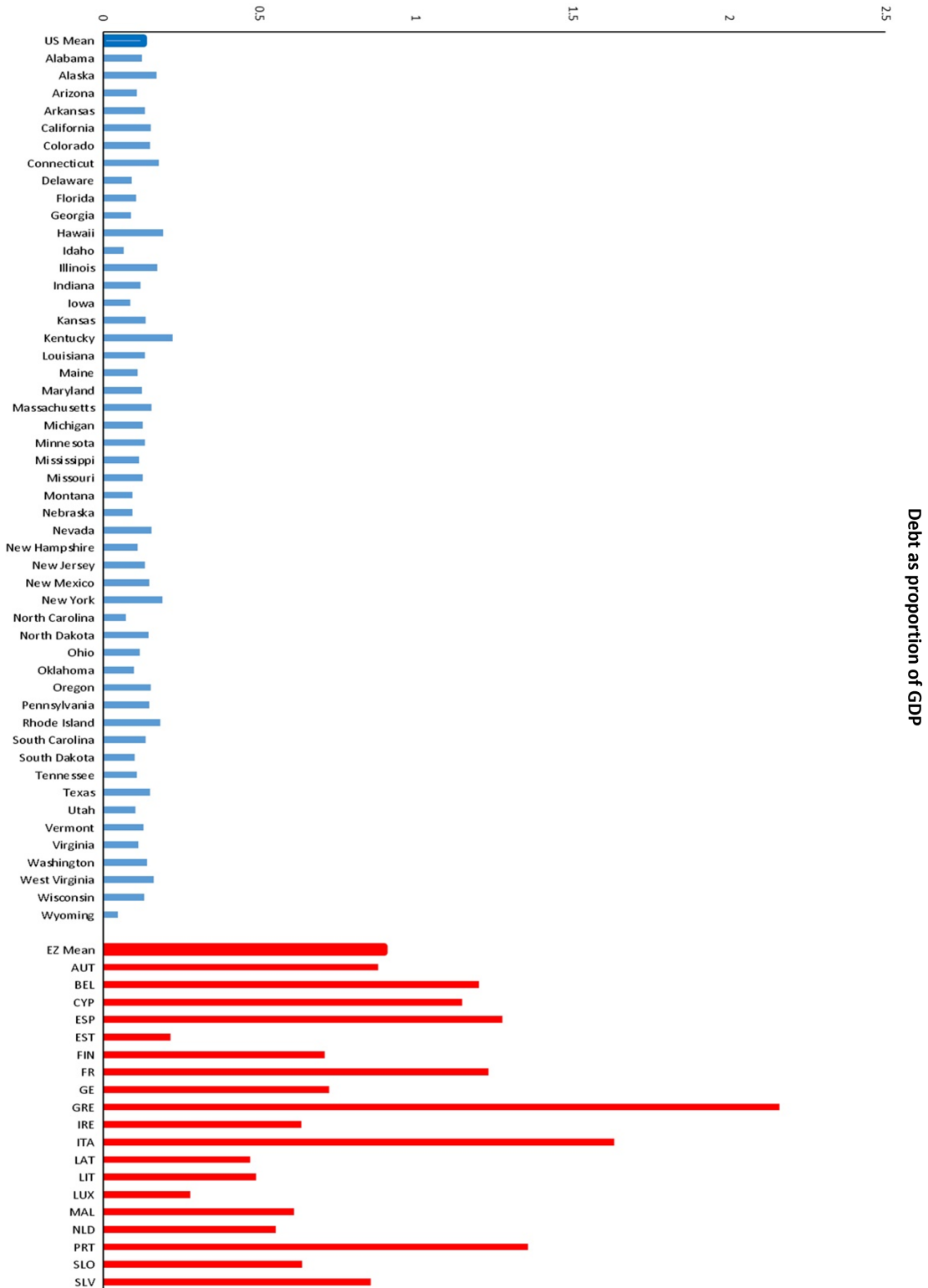


Figure C.3: Fiscal Activity: Expenditure

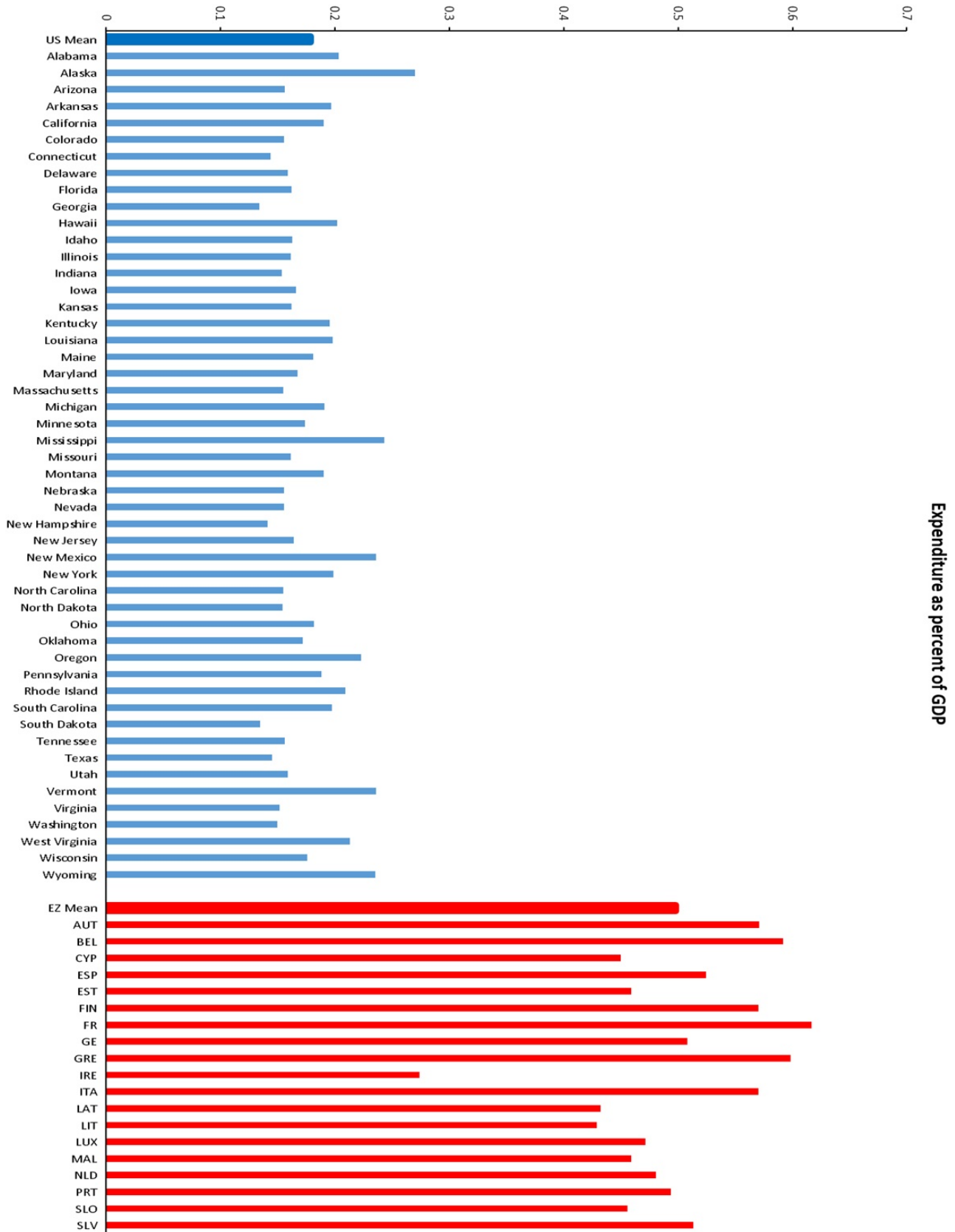
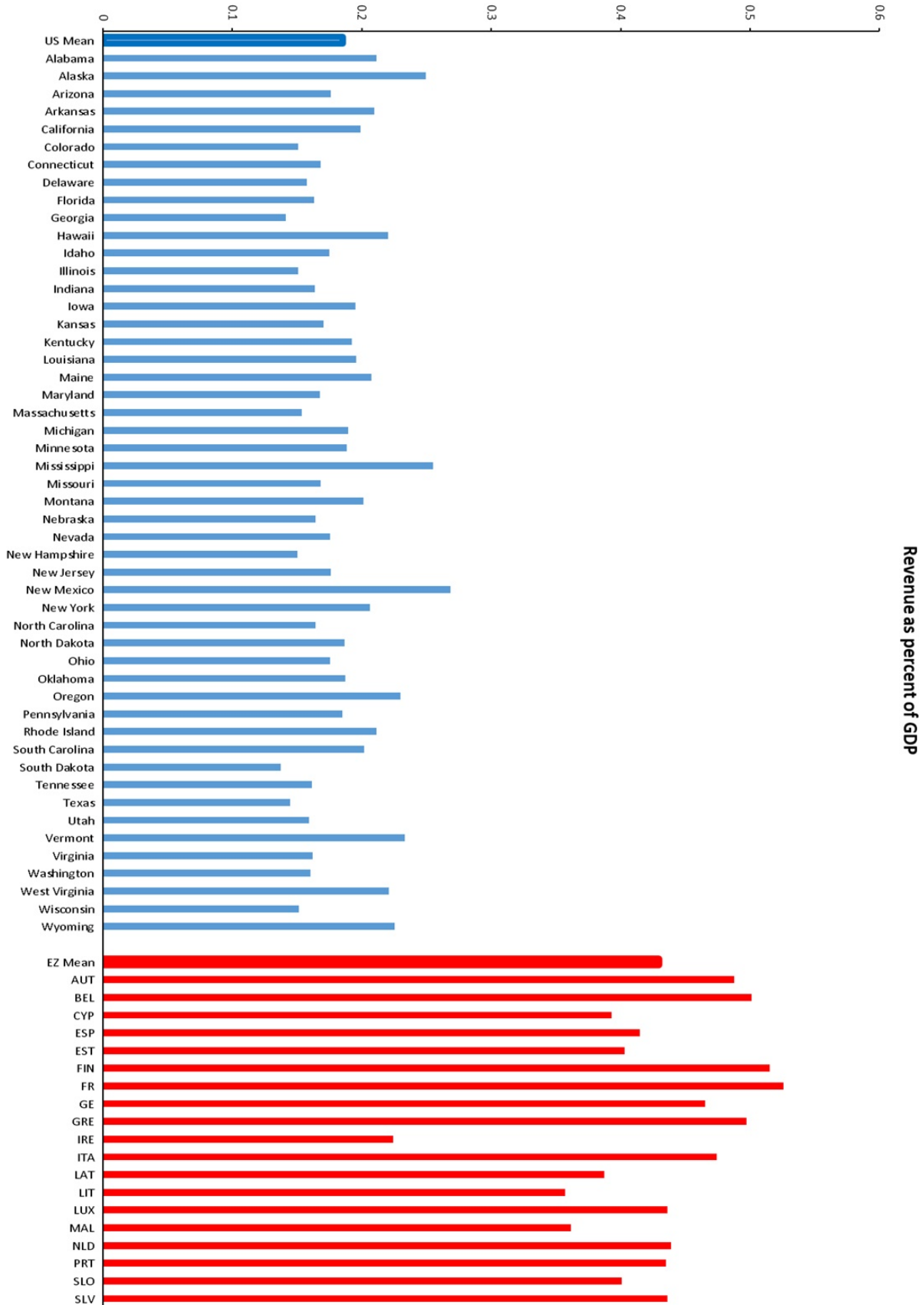


Figure C.4: Fiscal Activity: Revenue





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