MANAGING MACROECONOMIC IMBALANCES

A Bayesian SVAR Analysis

Michael Hume

London School of Economics and Political Science
European Institute

ABSTRACT

Over recent years a consensus has emerged that "policy failures that allowed imbalances to get so large" were probably the main root cause of the Euro-area crisis (Baldwin and Giavazzi (2015)). Reflecting this, the new Euro-area governance arrangements include a Macroeconomic Imbalances Procedure (MIP) that seeks to identify and take corrective action against emerging imbalances. This paper uses a Bayesian Structural VAR analysis to assess the strategies that are most likely to be effective in managing macroeconomic imbalances. In doing so it takes a political economic approach in which all policies incur a political cost. It finds that managing macroeconomics imbalances is likely to be most feasible if product market structural reforms are combined with macro-prudential policies and applied symmetrically in current account deficit and surplus countries.

1. Introduction

Over recent years, a consensus has emerged among economists concerning the root 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 the causes of the crisis were "imbalances and a lack of crisis management" (Baldwin and Giavazzi (2015)). In particular, it highlights the contribution of "policy failures that allowed imbalances to get so large". Given this consensus view, it would appear essential that macroeconomic imbalances are managed more effectively in the future. This paper contributes to this policy imperative by providing an assessment of the effectiveness of different macroeconomic and structural strategies for managing macroeconomic imbalances.

The European Commission defines a macroeconomic imbalance 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*". 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 phenomena that have historically been associated with the accumulation of these claims and generated macro-financial risks, such as current account deficits, competitiveness, asset price surges, and private-sector credit expansions, are viewed as evidence of macroeconomic imbalances.

This approach contrasts somewhat with the academic literature which has focused almost exclusively on external imbalances. As Gros (2012) notes, "within the euro area, macroeconomic imbalances refer to the existence of disequilibria in the external position". This interpretation reflects two characteristics of internal imbalances that should make them less important from a policy perspective.[1] First, in the accumulation phase, without a coexisting external imbalance, internal imbalances are unlikely to reflect processes that are a consequence of monetary union. Second, in the

[1] Pure internal imbalances are those between the public and private sectors or between components of the private sector, such as the financial, corporate or household sectors. These imbalances may be associated with large increases in credit and house prices without any corresponding external or competitiveness imbalance.

adjustment phase, an internal imbalance does not present as much of a challenge to euro members as an external imbalance.

The pre-crisis policy for dealing with external imbalances in the euro area can be described as one of benign neglect, driven by a belief in the disciplining effects of membership of the single currency on wage and price setters in national economies. This is not to suggest that external 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 imbalances it was thought that they were structural, sustainable, and desirable. To the extent that asymmetric shocks hit national economies and led to imbalances it was thought that they would be cyclical, temporary, and a price worth paying for establishing the euro. In other words, it was thought that economic mechanisms were in place to ensure that external imbalances would smoothly self-correct and that there was little need for policy to assist the 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. Second, financial stability would be achieved through micro-prudential supervision of financial institutions and infrastructure at the national level. Third, to overcome the common pool problem created by monetary union and prevent "fiscal laxity" undermining the euro the Stability and Growth Pact limited the public debt of euro members to 60% of GDP and public borrowing to 3% of GDP.

It is now clear that this pre-crisis policy framework was deeply 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 also proved far less powerful than anticipated with changes in competitiveness and external imbalances proving much more persistent

than originally envisaged. The end result was that structural shocks and cyclical forces put economies on a path of external debt accumulation that were left largely unmanaged, creating a dangerous vulnerability to a change in economic circumstances.

To ensure that national authorities do not neglect the emergence of macroeconomic imbalances in the future a number of governance reforms have been agreed and implemented. 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). This applies to all EU members and includes an Annual Alert Mechanism (AAM) report that will use standardised metrics to detect imbalances in current accounts, competitiveness, housing, and credit markets. For those countries with apparent macroeconomic imbalances 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.

The MIP's task of identifying and correcting macroeconomic imbalances in real time will not be easy. An emerging consensus[2] is that the effectiveness of the MIP will be constrained by two things:

- *Managing macroeconomic imbalances in a monetary union is not 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 not available to national governments. Potential policies include fiscal policy, micro-prudential and macro-prudential policies, and structural policies. Daborwski (2015) reviews these policy instruments and concludes that there is "limited potential of national policies in regulating [current account imbalances] 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) "reliance

[2] Some analysts are optimistic that the MIP would have made a difference in the 2000s. For example, Kamps et. al. (2014) has argued that, had the MIP framework been in place before the crisis it would "most certainly have facilitated an earlier identification of macroeconomic and budgetary imbalances. Euro area countries thus would have been obliged to take preventative and corrective action at an earlier stage, provided that the stricter rules had been effectively implemented".

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". Others focus on the impracticality of the process with Benassy-Quere and Ragot (2015) arguing that the European Semester has "ended up in a complicated, bureaucratic process rather than a fully-fledged coordination of macroeconomic policies".

- *The MIP has an asymmetric design.* A large number of concerns focus on asymmetry in the design of the MIP in terms of its treatment of deficit and surplus countries and how this could lead to a deflationary bias in euro-area macroeconomic policy (Benassy-Quere and Ragot (2015), Kincaid and Watson (2015), Ederer (2015)). 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%). Another aspect of asymmetry concerns the MIP's implementation. According to Alcidi and Gros (2013), the country-specific recommendations that have been made since the MIP has 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".

But the analysis upon which these concerns about the MIP are based is far from fully developed and so the main aim of this paper is to contribute to the developing literature by providing a more rigorous analysis of the feasibility of managing macroeconomic imbalances in the euro area. As part of that assessment the impact of the MIP's asymmetry on its effectiveness is also considered.

The rest of the paper is organised as follows. Section 2 considers explanations for the emergence of euro-area macroeconomic imbalances to provide context and support for the approach adopted in the rest of the paper. Section 3 sets out the SVAR model used for estimating and identifying the impact

of macroeconomic and structural shocks on euro-area macroeconomic imbalances. Section 4 presents the main results from the model and examines their stability and robustness. Section 5 considers how macroeconomic and structural policies could be used to manage euro-area macroeconomic imbalances. Section 6 offers some conclusions and ideas for future research.

2. The determinants of macroeconomic imbalances

This section provides some context for the empirical strategy of the paper by considering the main determinants of macroeconomic imbalances that have been proposed. It first reviews the pre-crisis mainstream explanation before characterising the most prominent post-crisis explanations.

2.1 The mainstream pre-crisis explanation

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.[3] This showed substantial integration, in terms of both prices and quantities, and especially in wholesale markets but also to a more limited extent in retail markets. For most, these trends were seen as a consequence of monetary union, although the effects of financial deregulation 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 the co-existence of rapid financial integration and macroeconomic imbalances in the low per capita income countries of the euro area. Eichengreen (2010) provides a helpful summary and sets out some of its normative implications:

[3] See, for example, Adam *et al* (2002), Cabral, Diereck and Vesala (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 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.*

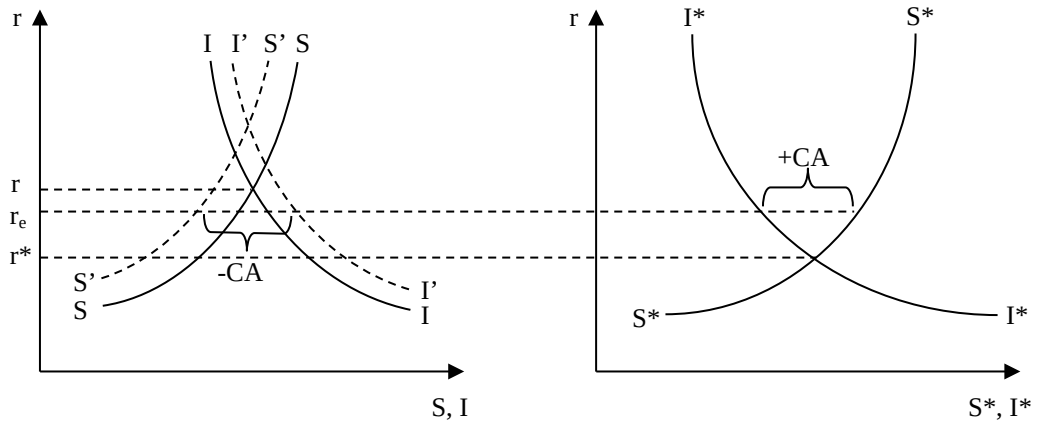
This in turn reflected the scope that existed within the euro-area periphery for catch-up and convergence. This, then, was an example of a "good" imbalance of countries with attractive investment opportunities and outstanding growth prospects capitalising on the advent of the euro and the deeper financial 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 Blanchard and Giavazzi (2002) 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". An important breakthrough of the new open economy macroeconomics developed over the past decade 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. 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.

Figure 2.1: The Metzler diagram



A simple graphical representation of the BG model is the Metzler diagram shown in Figure 2.1. 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 as a consequence 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 as a consequence 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 end 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 a number of empirical studies. Abiad *et al* (2007) shows that Europe has been unusual in seeing this "downhill" flow of capital, not only with regard to euro-area economies but also those in emerging Europe that have been part of the European Union. These flows have also been associated with a significant acceleration of income convergence. Ca'Zorzi and Rubaszek (2008) show 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 external imbalances and create a new database on bilateral external financial assets and liabilities. They note that creditor and debtor positions within the EU have 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 output growth 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. But subsequent events can be viewed as consistent with the BG analysis only if the crisis is seen as a consequence of a very large and unforeseeable shock to national balance sheets that had nothing at all to do with the accumulation of the imbalances themselves. As set out in the next section, few economists today are willing to subscribe to such a view.

2.2 Post-crisis explanations

There were economists that did express concern about the build-up of macroeconomic imbalances prior to the crisis. For example, in direct response to the BG analysis, Pierre-Olivier Gourinchas (2002) raised the concern that although capital may be flowing "downhill" it did not seem to be leading to income convergence and this reflected 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".

Not surprisingly, since the crisis, there have been a large number of post-crisis explanations that have been proposed emphasising that the origins of macroeconomic imbalances lay somewhere other than dynamically optimising households. Indeed, the consensus narrative highlights the major policy failure of 'allowing' imbalances to get so large betraying the fact that, in the absence of a stabilising policy framework, economic agents cannot be relied upon to ensure that the economy converges upon a stable equilibrium path. On this view it is inevitable that shocks will come along and cause not only temporary disturbances but also risk putting some economies on a path of unsustainable debt accumulation. The post-crisis explanations all take such a possibility as a given and asks instead exactly what it was that led some economies down such a path. It is here where disagreement remains. Although each of these post-crisis explanations has its own particular form, they can be grouped under the broad headings of demand and supply. This taxonomy is used both to make sense of what has become a vast literature and help provide the foundations for the structure of the SVAR model developed in Section 3.

2.2.1 Demand

One of the more controversial explanations 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, 2012) 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, this view does not depend on either income convergence or financial integration, 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**. There is certainly evidence to suggest that fiscal policy has a large impact on current accounts in a monetary union. In particular, Bluedorn and Leigh (2011) have shown that traditional estimates of the impact of fiscal policy and the current account is probably underestimated due to endogeneity problems in the existing literature and that this effect is even larger in monetary unions. In addition, Abbas *et al* (2010) have shown that public sector debt affected the current account in euro-area countries. But this explanation is not typically seen as being a quantitatively significant explanation. Paul Krugman probably speaks for many, for example, when he argues that the only country for which fiscal policy was an important contributor to macroeconomic imbalances was Greece. Nevertheless, it is often cited by the German government as an important factor contributing to the sovereign debt crisis and as a result continues to feature prominently in discussions concerning the management of macroeconomic imbalances.

Most economists acknowledge that the introduction of a common **monetary policy** was also a factor explaining the emergence of macroeconomics imbalances in some countries along the lines suggested by the Metzler diagram. But it is mostly seen as being of secondary importance relative to other demand-side explanations and is generally thought to have run its course by the early-to-mid 2000s. There is some disagreement about how persistent the effect of interest rate convergence might have been, however. The IMF, for example, refers to the role from interest rate convergence as leading to "booms" in domestic demand, housing and credit in the periphery throughout the 2000s. German economists of the Freiberg school have also tended to place considerable weight on the role of interest rate convergence in driving imbalances.

An alternative story on the interest rate side is that macroeconomic imbalances were driven by increased **credit supply** that led to a reduction in interest rates on bank lending. This reflects a combination of two forces: financial integration spurred by the elimination of exchange rate premia

and the financial liberalisation observed in a large number of euro-area (and other advanced) economies during the 1990s. The combination of these two things led to easier borrowing conditions in some countries and it is this change that is seen as having supported the growth of macroeconomic imbalances.

2.2.2 Supply[4]

The main post-crisis supply-side explanation of macroeconomic imbalances continues to be that they were driven by increases in **productivity** in the periphery as part of an income convergence process. This can be thought of as akin to the BG hypothesis but without the assumption that the process of adjustment would be smooth. Explanations for why the income convergence process culminated in a crisis vary. Some focus on the over-optimistic expectations for long-term income growth; some focus on related adjustments in asset markets; and still others emphasise the broader financial vulnerabilities that it created as part of the process of financial integration. A variant on the productivity explanation is that, following an initial rise, productivity declined leading to a fall in competitiveness. This highlights that the impact of supply shocks on imbalances is potentially ambiguous as their overall effect depends on whether the impact on income expectations (and hence domestic absorption) or competitiveness (and hence expenditure switching) dominates.

An alternative supply-side explanation is that imbalances were driven by **wage bargaining** developments as a result of divergent labour market institutions (Soskice and Iversen (2000), Hancké and Soskice (2003)). In recent contributions, Hancké (2013) has argued that the roots of competiveness 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. As a consequence, public sector wages increased and also put upward pressure on wages in the export-

[4] There is a third supply side view, advanced primarily by the European Commission, which suggests that the persistence of imbalances may have been exacerbated by slow nominal adjustment and the prevalence of structural rigidities in the euro area. The argument here is that if prices and wages adjusted more flexibly then, through changes in the real exchange rate, demand shocks would be neutralised by real income and expenditure switching effects. In particular, Kennedy and Slok (2005) show that external imbalances are more persistent when market rigidities are high. 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.

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.

3. Modelling macroeconomic imbalances

Modelling macroeconomic imbalances is not straightforward and not just because there is little agreement regarding what caused them. By their nature imbalances and their possible drivers are likely to be determined simultaneously leading to problems of endogeneity in empirical analysis. This makes inference problematic in a field dominated by research that has relied to a great extent on cross-country analysis. Consider, for example, the debate concerning the role of fiscal policy as a contributor to macroeconomic imbalances. Does the absence of an empirical cross-country association between fiscal balances and external balances prior to the crisis demonstrate that fiscal policy has not contributed to 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, will tend to produce a negative correlation between the fiscal balance and the external balance. This will even be the case if the fiscal authorities were to take advantage of the positive effect the demand shock has on the public finances by raising government expenditures, boosting imports and contributing to external imbalances.

Another case in which correlations shed more heat than light concerns the role of competitiveness, which may be amendable to being influenced through structural policies. To what extent does the empirical association between competitiveness measures and external 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 demand and prices, a positive demand shock that contributes to external imbalances primarily by boosting imports will nevertheless tend to produce a positive correlation between prices and the external 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 method is to use a DSGE model in which the structure of the economy is fully articulated and hence capable of decomposing past outturns into a full array of shocks to the deep parameters that comprise the model. There have been some attempts in recent years to apply this approach to understanding the origins of macroeconomic imbalances within a monetary union. 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 of the crisis and post-crisis explanations about the origins of macroeconomic imbalances, which reject the idea that they were the result of optimising behaviour by agents.

An alternative and less rigid method for overcoming the endogeneity problem is to estimate a Structural Vector Auto Regression (SVAR) in which the structure of the economy is not fully articulated but reflected in the key properties of a small-scale 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 the consensus narrative of the crisis and post-crisis explanations. This econometric tool has been applied extensively to a wide range of important macroeconomic issues, including the related issue of global macroeconomic imbalances.

Two papers in the global imbalances literature have used SVARs specifically to consider the determination of current accounts. The first paper considered the role of shocks to technology, monetary policy, and fiscal policy as a driver of US financial imbalances (Bems, Dedola and Smets (2007)). The second paper 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)). Somewhat surprisingly, however, the approach used in these papers has not been used to either analyse euro-area macroeconomic imbalances or consider the role of macroeconomic and structural policies in managing them. So, by applying the SVAR approach to these issues this paper not only provides a more rigorous evidence base for assessing policies for managing euro-area macroeconomic imbalances but also fills a methodological gap.

3.1 Reduced-form VAR

3.1.1 Model and choice of variables

The baseline reduced-form VAR is designed around (1) a theoretical macroeconomic model that has wide acceptance and (2) the post-crisis explanations for macroeconomic imbalances. Although the design of the model can be motivated in quite general terms, a specific version is set out in detail in Appendix A. It adapts an open economy New Keynesian model to a core-periphery framework where the euro-area as a whole is assumed to be a large closed economy and macroeconomic imbalances are determined endogenously but have no implications for the general equilibrium. Overall, the theoretical model consists of six variables (output, prices, interest rates, fiscal balance, employment, and the current account balance) and five structural shocks that correspond to the post-crisis explanations for macroeconomic imbalances (animal spirits, fiscal policy, credit supply, productivity, and wage bargaining). A VAR representation is derived directly from the theoretical model.

The VAR used in estimation is:

$$VAR = [\Delta \boldsymbol{y};\ \Delta \boldsymbol{p};\ \Delta \boldsymbol{g};\Delta \boldsymbol{r};\Delta \boldsymbol{n};\ \Delta \boldsymbol{x}]$$

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

3.1.2 Bayesian estimation

In order 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").[5] The prior VAR is that the vector of variables, Z_t, is modelled as an *AR*(1) prior mean for the B matrix[6]:

$$Z_t = C + BZ_{t-1}$$

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 a constant, c, and their own lags, $B(L)Z_{t-1}$, with the reduced-form errors, v_t, having a covariance structure of Σ:

$$Z_t = c + B(L)Z_{t-1} + v_t, \qquad VAR(v) = \Sigma$$

3.2 Structural decomposition

3.2.1 Method of 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 an assumption 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* x *N* contemporaneous impact matrix, A_0, and a *N* x *1* structural shock vector, u_t:

[5] The weighting procedure was implemented using the dummy variables approach with hyper-parameters $\tau = 1$ (prior tightness on own lag) and $c = 10$ (prior tightness on constant).
[6] The coefficient matrix B was assumed to follow a Normal-Inverse Wishart distribution.

$$v_t = A_0 u_t, \qquad VAR(u_t) = I$$

In effect, the A_0 matrix summarises the structure of the economy assumed by the econometrician. Note that the condition $VAR(u_t) = I$ 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. $VAR(A_0 u) = VAR(v) = \Sigma$. 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 $VAR(A_0 u) = VAR(v) = \Sigma$ 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 as a consequence 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 $VAR(A_0 u) = VAR(v) = \Sigma$ 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 Nicolo (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. For example, in a three-variable model of demand, supply and interest rates a wide class of models would suggest that a positive demand shock would raise all three and that a negative interest rate shock would raise demand and prices but lower interest rates. This signing pattern meets the condition of being unique in the sense that they have the same signed impact on demand and inflation but a different signed impact on interest rates.

Numerical techniques are then used to find all the decompositions that are compatible with the imposed sign restrictions.[7] 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 median (Fry and Pagan (2011)). 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).

3.2.2 Choice of sign restrictions

Sign restrictions are typically chosen to match the same model that has informed the variables entering the VAR. But Canova and Paustian (2011) have proposed an alternative method to evaluate cyclical models that does not require knowledge of either the data generation process or the decision rules of agents. This is suited to the case of euro-area macroeconomic imbalances where, as has been

[7] The sign restrictions approach is implemented using the Rubio-Ramirez, Waggoner and Zha (2010) algorithm. First an *N* x *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 are 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.

shown, there is uncertainty about the correct model. This method requires setting only those sign restrictions that are compatible with the wide class of candidate models that could be said to characterise the structure of the economy. Where models disagree about the correct sign that a shock will have on a variable it is left unrestricted. Such an approach has found to have good properties, even in small samples, and when the class of models is incorrectly specified (Canova and Paustian (2011)).

Figure 4.1: Identifying sign restrictions for contemporaneous impact effect

Shock\Variable		Δy	Δp	Δg	Δr	Δn	Δx
Demand	Animal Spirits	+	+	+	+		–
	Fiscal Policy	+	+		–		–
	Credit Supply	+	+	–	+		–
Supply	Productivity	+	–			+	+
	Wage Bargaining	+	–			–	+

Signs consistent with the standard macroeconomic model

Signs required for unique identification of structural shocks

Signs consistent with post-crisis explanations of macroeconomic imbalances

Figure 1 illustrates the choice of sign restrictions. The first set of restrictions shown in pink are consistent with a standard macroeconomic analysis whereby demand shocks lead to higher growth and inflation while supply shocks lead to higher growth and lower inflation. The second set of

restrictions is those needed to uniquely identify the structural shocks.[8] The third set of restrictions is consistent with the post-crisis explanations of macroeconomic imbalances of section 2.2. All of these restrictions are consistent with the theoretical model developed in Appendix A, but should also have wide acceptance among a large number of alternative models.

The data used in estimation are shown in Appendix B and consist of quarterly changes in log differences between core and periphery aggregate variables. Core countries are Germany and the Netherlands while the periphery countries are Spain, Portugal, Ireland, and Greece. The benchmark model was estimated over a sample period from 2000Q1 to 2015Q4 with three lags. The results were found to be robust to different sample periods and lag structures.

4. Results

This section reports and provides analysis of the impulse response functions. The charts show the impact of the five structural shocks on growth, inflation, interest rates, fiscal balance, employment, and the current account. The IRFs cover a period of 20 quarters.

4.1 Impulse response functions

The impulse response functions generally show persistent effects on output growth and inflation from the five structural shocks. In some cases the economy has not returned to its steady state as long as five years later. Changes in the current account are found to be persistent even as growth and inflation start to return to baseline levels. This is consistent with both the consensus narrative of the crisis and post-crisis explanations for imbalances which highlight how the economy deviated persistently from a sustainable long-term equilibrium.

---

[8] 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 serious contamination issues. However, there is clear precedent for identifying fiscal shocks in a Structural VAR framework (e.g., Dalsgaard and de Serres (2001), Straub and Peersman (2009)) and the estimates of the impact of fiscal policy shocks were found to be within the range found in the literature.

4.1.1 Demand shocks

The animal spirits shock shows a high degree of persistence in its effects on growth and inflation. However, other variables quickly converge towards their new equilibrium level. Fiscal policy shocks are found to have a much less persistent effect on growth and inflation while the impact on the current account is more or less immediate. The credit supply shock is found to have a profile that is similar to a monetary policy shock with the impact on growth peaking after a year and the impact on inflation peaking after 6-8 quarters. The current account takes considerably longer to reach its new equilibrium level following a credit supply shock than is the case with the other two demand shocks.

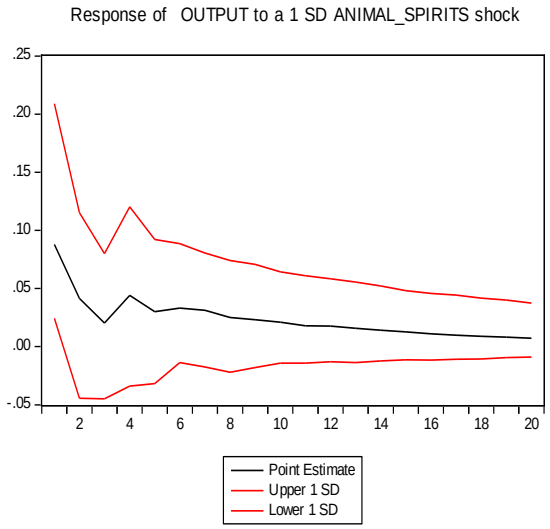
4.1.2 Supply shocks

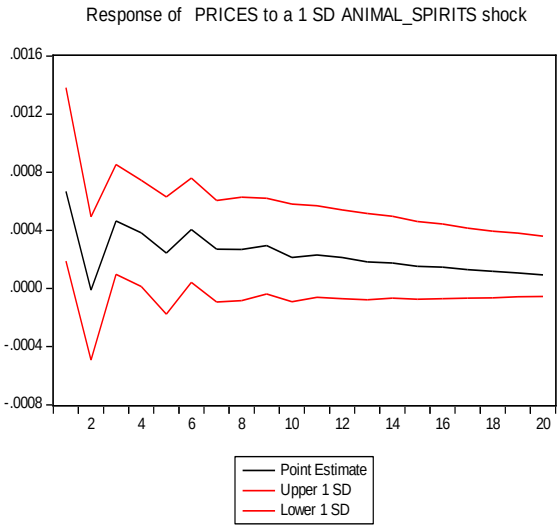
The productivity shock has only a short-lived positive effect on output growth but a more persistent negative effect on inflation. The wage bargaining shock, by contrast, has a more persistent impact on output growth and short-lived negative effect on inflation. This may reflect the difference in employment responses which is short-lived and negative in the case of a productivity shock but positive and persistent in the case of the wage bargaining shock. These differences also carry over to the impacts on the current account where the productivity shock has a short-lived effect but the effect of the wage bargaining starts to unwind after one quarter. In both cases interest rates experience downward pressure which may reflect the impact the positive impact of the supply shocks on income.

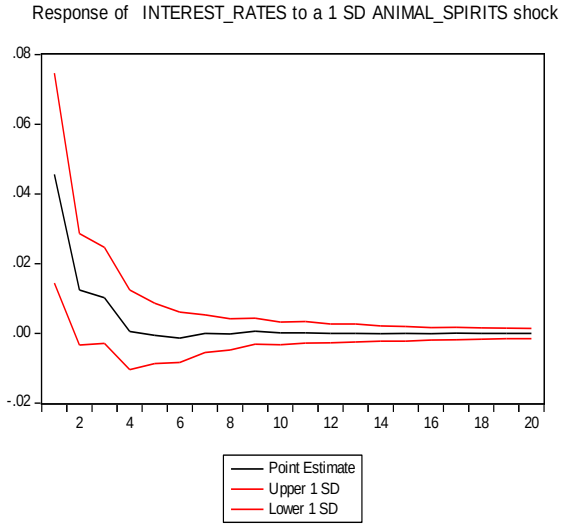
4.1.3 Robustness

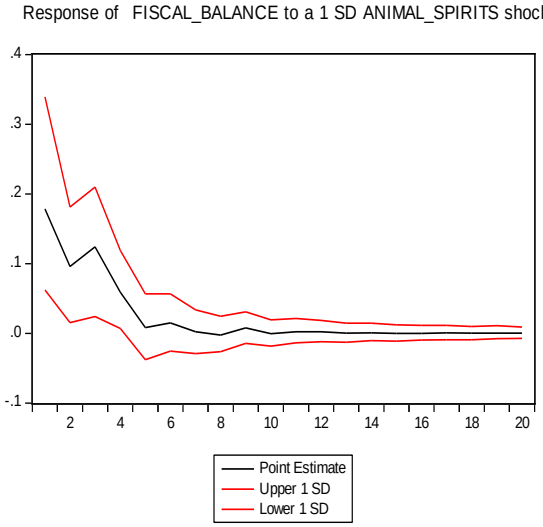
IRFs from eight alternative models with a combination of shorter and longer lag lengths as well different sample periods were estimated in order to check whether the impulse response functions were robust. Figure 4.1F shows the IRFs from these models as a light blue swathe. These swathes are generally narrow and closely aligned with the IRF from the benchmark model which is shown as dark blue line. This suggests that the use of Bayesian estimation methods and coherent economic structure of the model had ensured robust estimated results.

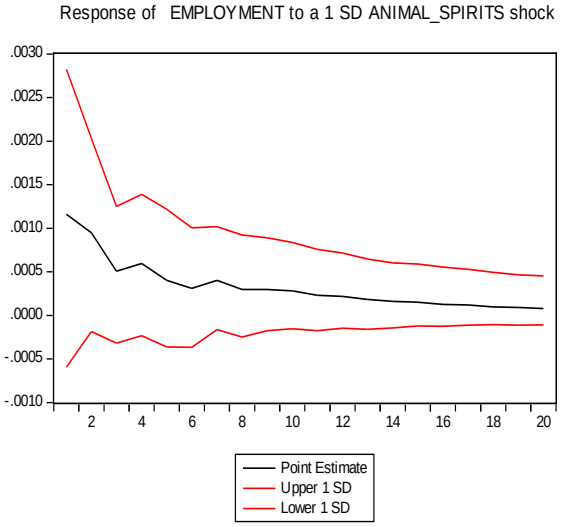
Figure 4.1A: Demand – Animal Spirits Shock IRFs











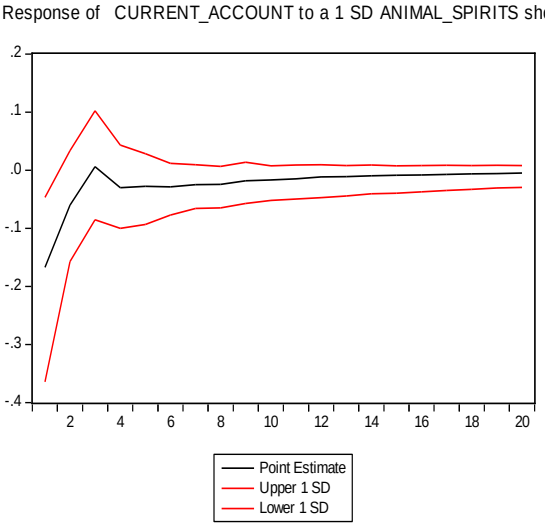
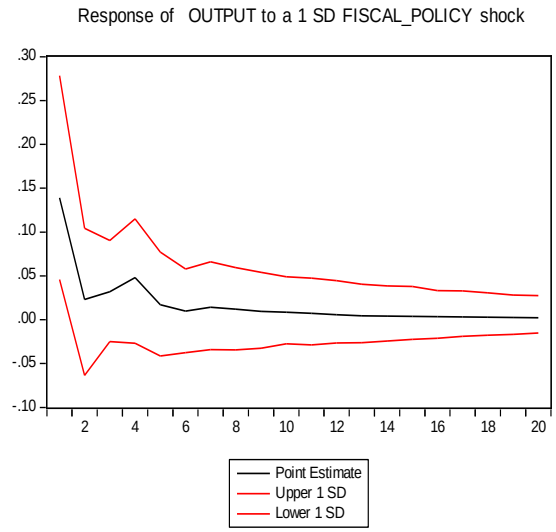
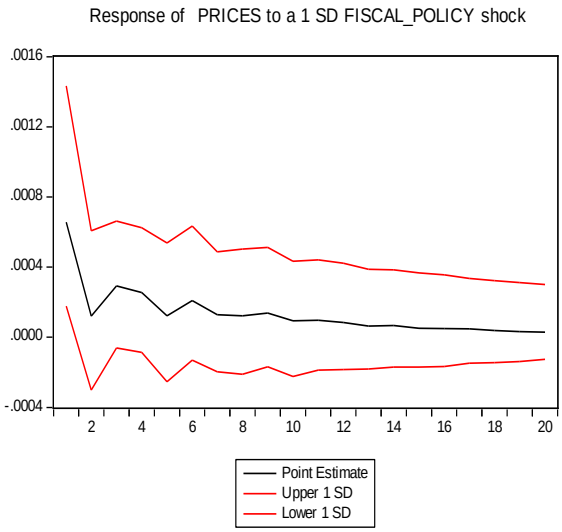
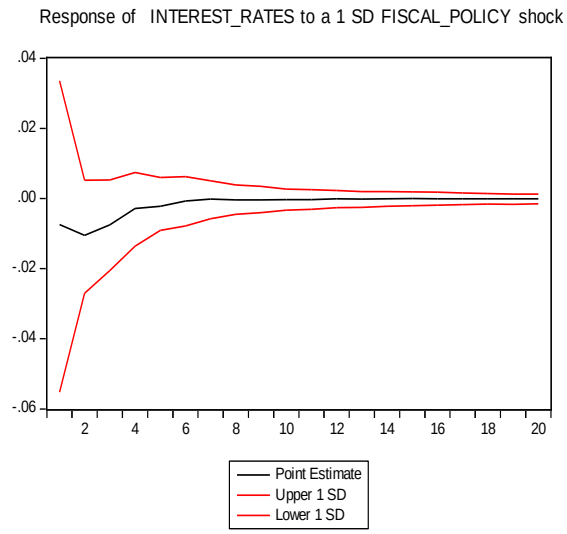
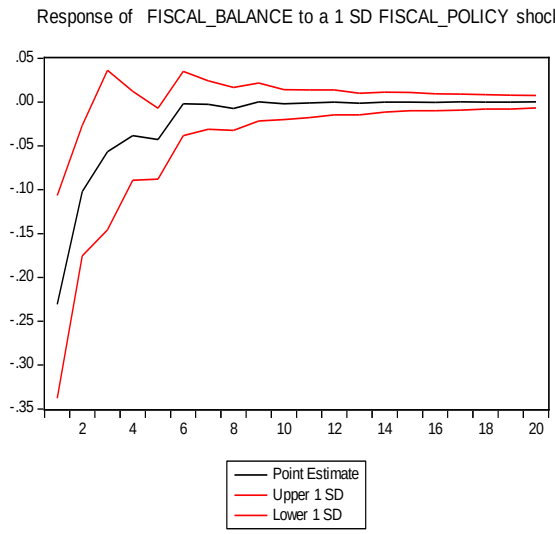


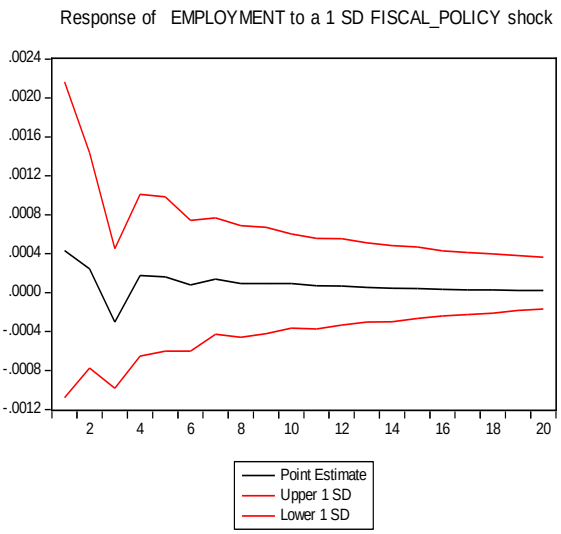
Figure 4.1B: Demand – Fiscal Policy Shock IRFs











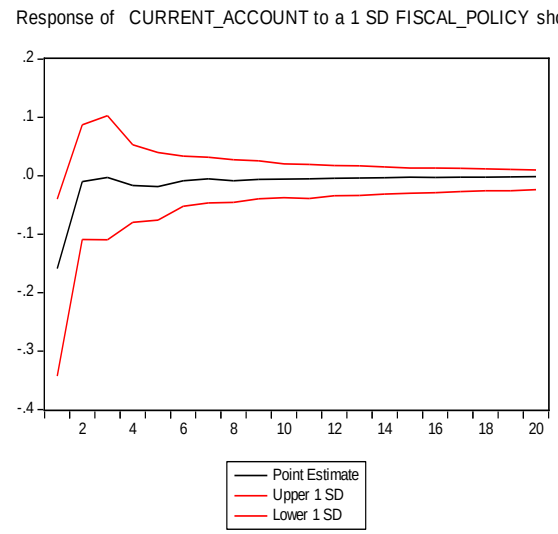
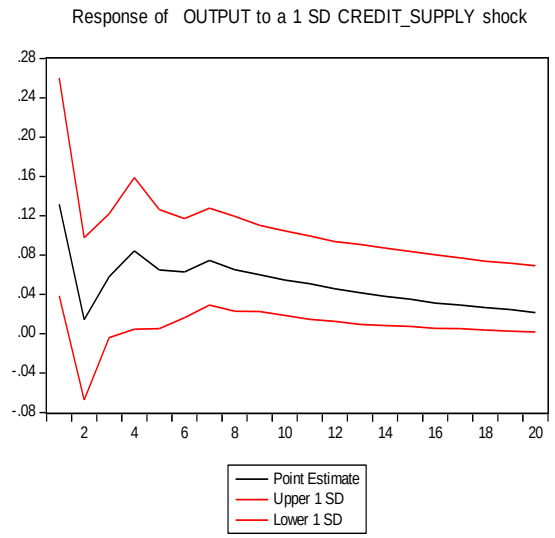
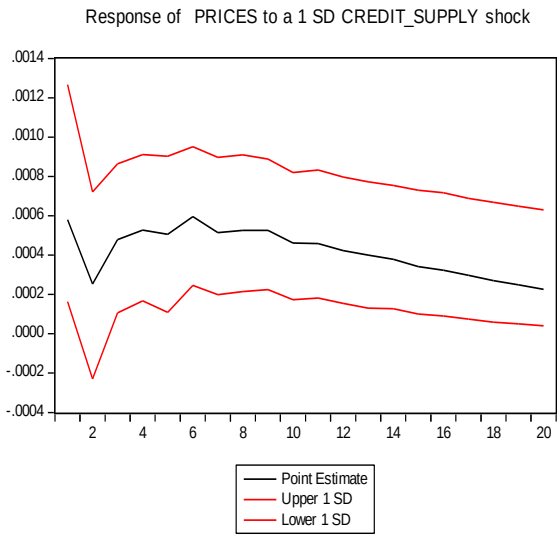
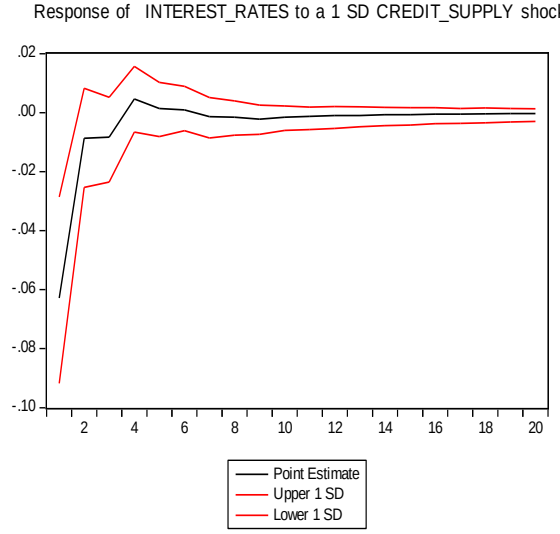
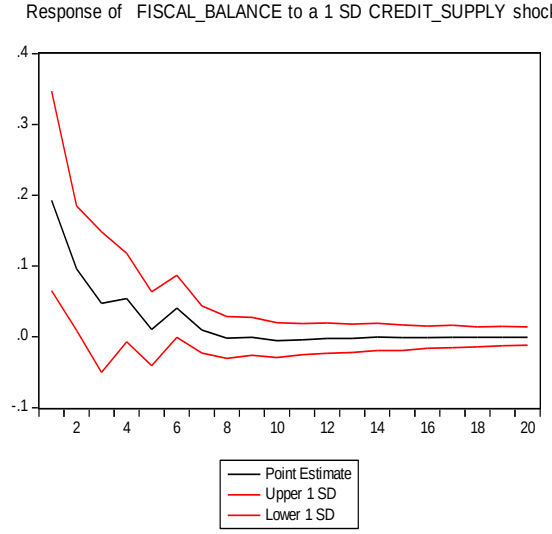


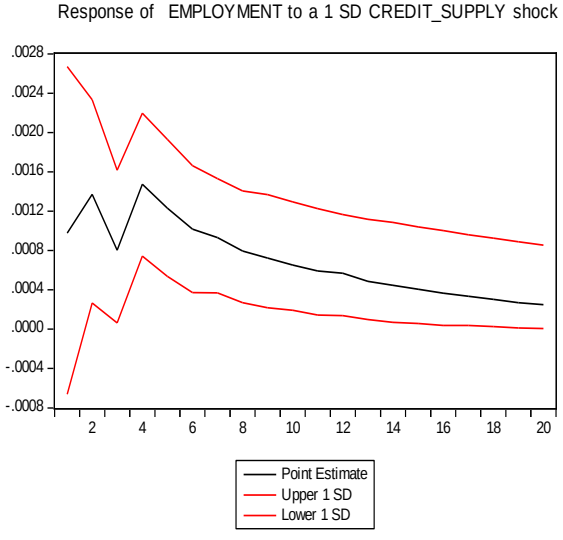
Figure 4.1C: Demand – Credit Supply Shock IRFs











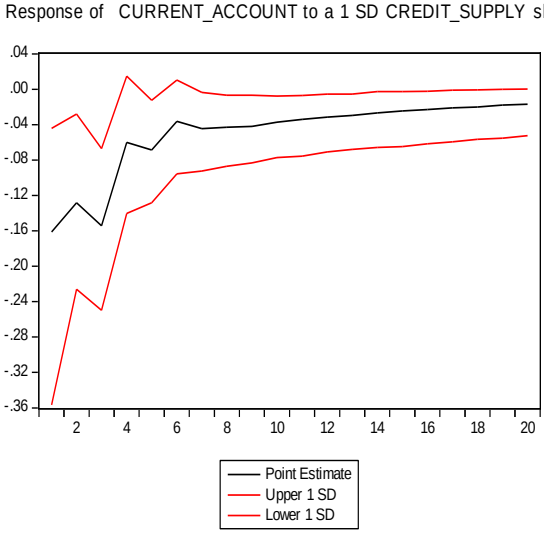
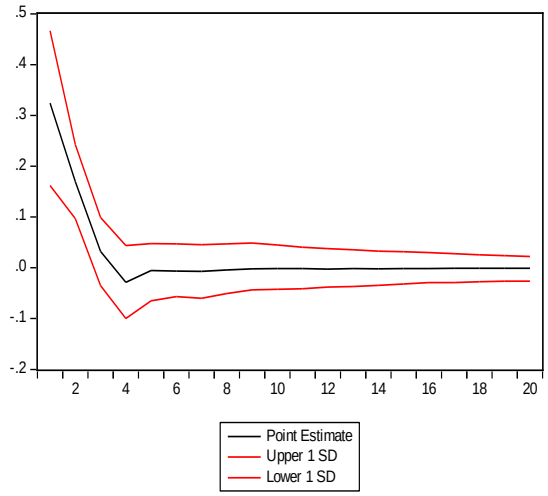
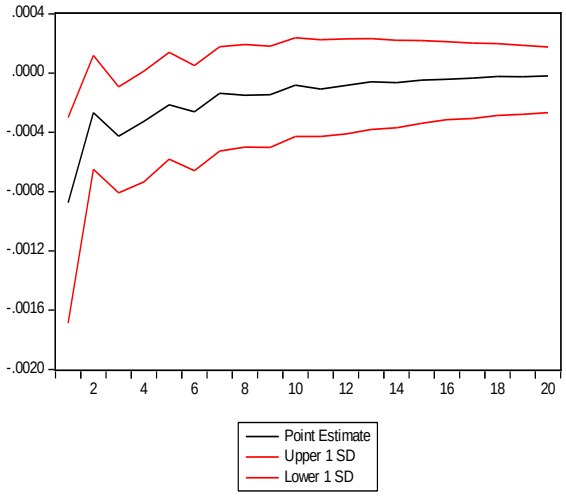


Figure 4.1D: Supply – Productivity Shock IRFs

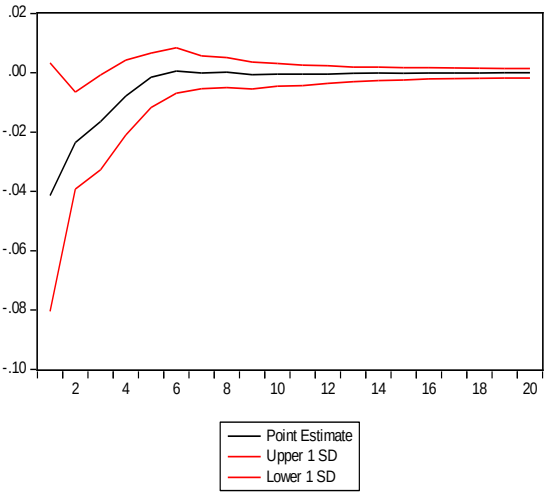
Response of OUTPUT to a 1 SD PRODUCTIVITY shock



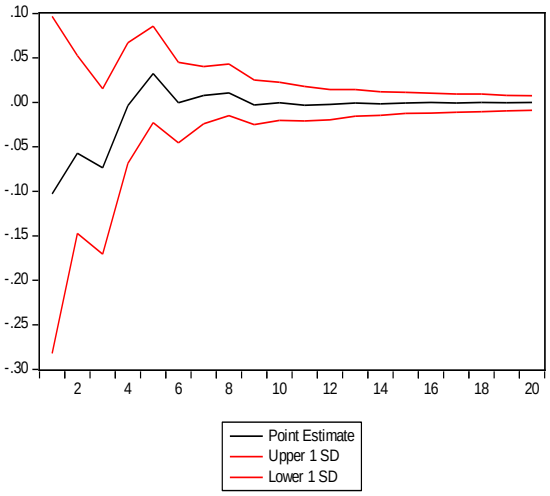
Response of PRICES to a 1 SD PRODUCTIVITY shock



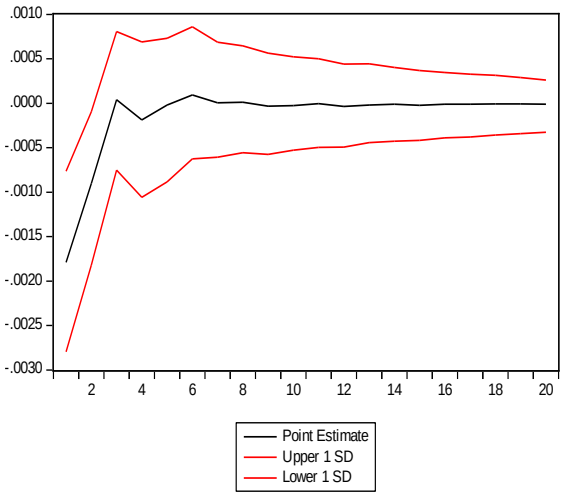
Response of INTEREST_RATES to a 1 SD PRODUCTIVITY shock



Response of FISCAL_BALANCE to a 1 SD PRODUCTIVITY shock



Response of EMPLOYMENT to a 1 SD PRODUCTIVITY shock



Response of CURRENT_ACCOUNT to a 1 SD PRODUCTIVITY shock

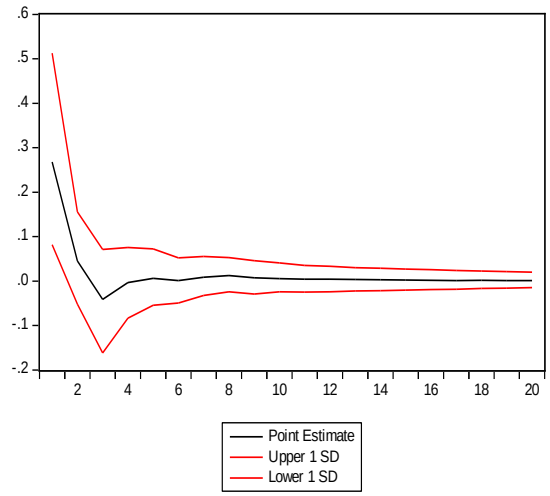
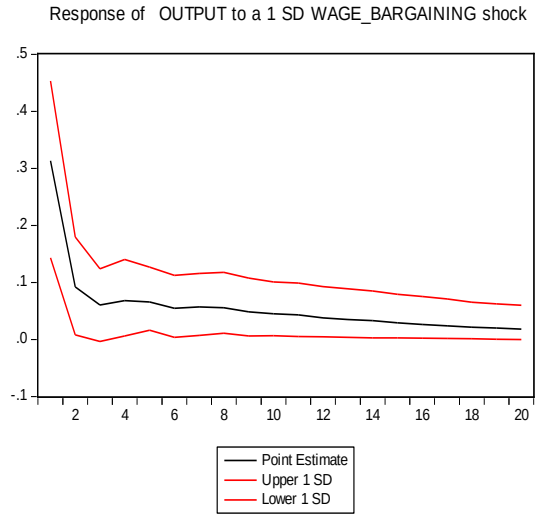
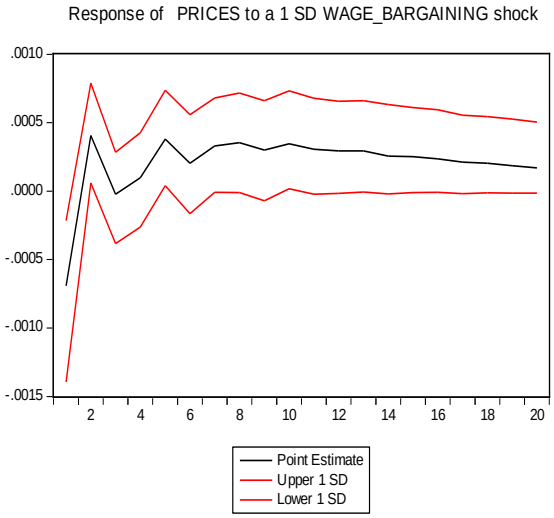
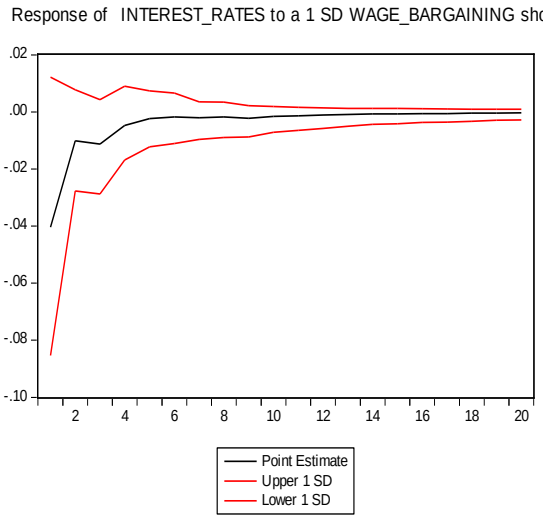
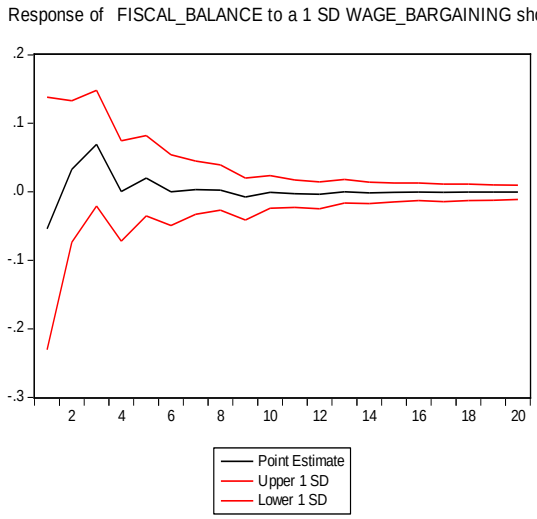


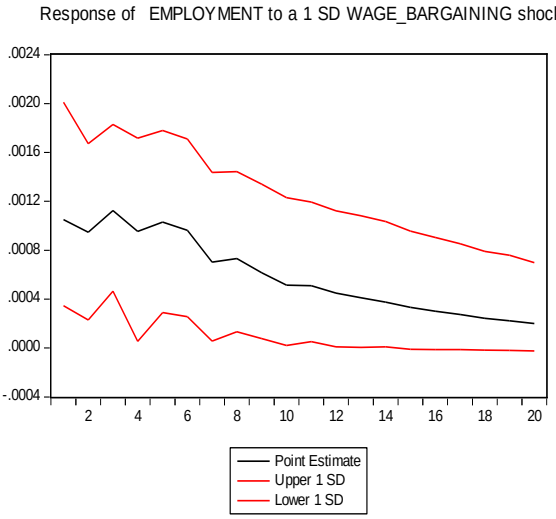
Figure 4.1E: Supply – Wage Bargaining Shock IRFs











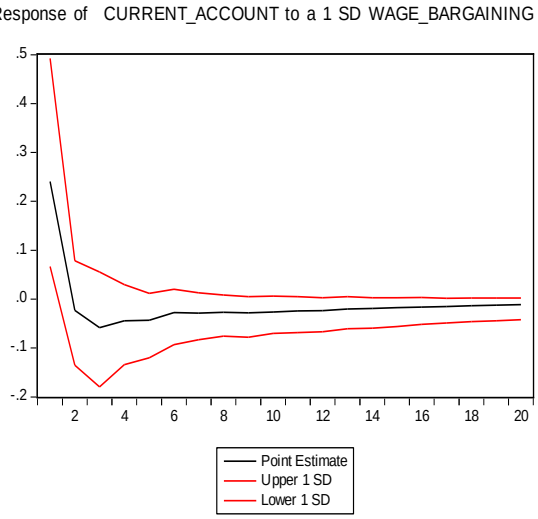
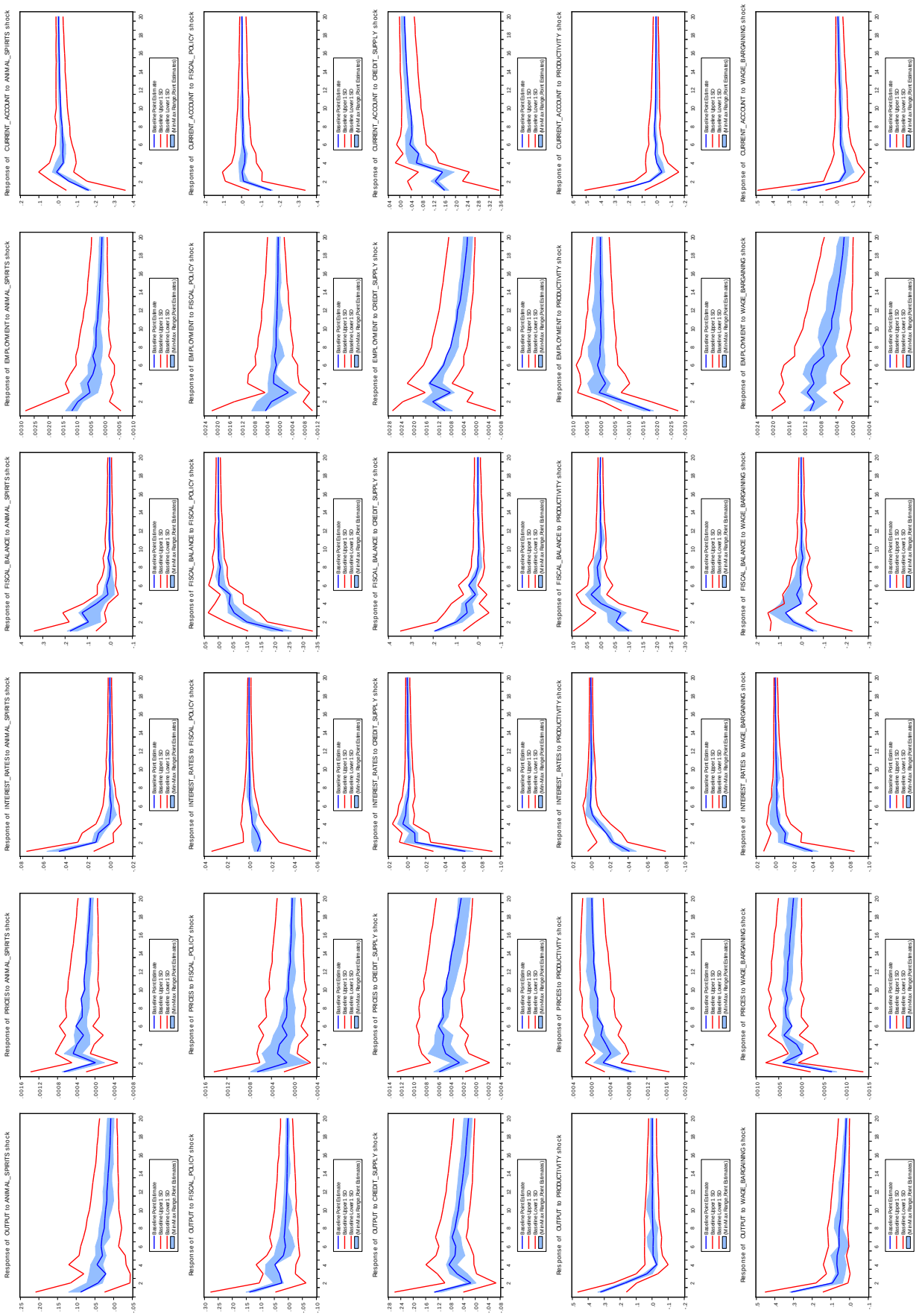


Figure 4.1F: Robustness – impulse responses



4.2 Steady state

The steady state impacts of one standard deviation structural shocks are shown in Figure 4.2. There are a number of noteworthy features. First, there is a consistent negative relationship between relative prices and current account imbalances. Second the Phillips curve relationship is fairly stable across the three demand shocks. Third, the fiscal multiplier is around 0.8 while fiscal pass-through to current account imbalances is just over 0.5, results which are consistent with the findings in the literature using action-based measures of fiscal policy. Fourth, the credit supply shock implies a strong response to relatively small movements in interest rate spreads between economies.

The most important result, however, is that the wage bargaining shock is found to lead to a deterioration in the current account imbalance. This seems to be a consequence of the very strong output and employment response leading to an increase in relative prices despite the shock having been identified via a contemporaneous negative impact effect on relative prices. This suggests that for wage bargaining shocks the income expectations effect (and hence domestic absorption) dominates the competitiveness effect (and hence expenditure switching). This raises important questions about the role of structural reforms to labour markets in addressing imbalances.

Figure 4.2: Steady state impacts*

Steady state impact of a one standard deviation shock	**Animal spirits**	**Fiscal policy**	**Credit supply**	**Productivity**	**Wage bargaining**
Output	0.48 [0.34 to 0.66]	0.35 [0.16 to 0.62]	1.02 [0.79 to 1.13]	0.46 [0.28 to 0.75]	1.15 [0.82 to 1.39]
Prices	0.48 [0.24 to 0.48]	0.27 [0.06 to 0.38]	0.83 [0.67 to 0.85]	-0.34 [-0.08 to -0.34]	0.41 [0.31 to 0.51]
Interest rates	0.07 [0.05 to 0.09]	-0.03 [-0.02 to -0.04]	-0.09 [-0.05 to -0.11]	-0.09 [-0.08 to -0.11]	-0.09 [-0.04 to -0.11]
Fiscal balance	0.49 [0.28 to 0.54]	-0.49 [-0.43 to -0.64]	0.43 [0.30 to 0.43]	-0.20 [0.02 to -0.24]	0.06 [0.01 to 0.45]
Employment	0.67 [0.32 to 0.79]	0.16 [-0.09 to 0.38]	1.40 [1.20 to 1.50]	-0.30 [0.21 to -0.46]	1.20 [0.83 to 1.48]
Current account	-0.48 [-0.31 to 0.52]	-0.27 [-0.10 to -0.32]	-1.02 [-0.82 to -1.03]	0.33 [0.14 to 0.33]	-0.24 [-0.16 to -0.43]

* *Numbers in parentheses are the range of estimates from the benchmark model and the eight alternative models used in the robustness tests.*

5. Managing macroeconomic imbalances: a political economic approach

The impulse response functions and steady state impacts can be used as a basis for assessing policy strategies for managing macroeconomic imbalances. The economic welfare approach would suggest that a clearly dominant strategy is to implement structural reforms to raise productivity to manage imbalances. This is because these policies alone have the capacity to simultaneously address macroeconomic imbalances and raise output. However, this approach assumes a benevolent policymaker whose objective function aligns with the economic welfare objective function. In practice euro-area governments have shown themselves to be highly resistant to introducing structural reforms even in the case of more pressing and protracted problems such as high levels of unemployment and low potential growth. This reflects the high political costs of implementing structural reforms and raises serious questions about the plausibility of using structural reforms alone to manage macroeconomic imbalances.

Reflecting these issues it seems more realistic to adopt a political economic approach in which all policy tools available to the policymaker incur political costs when designing policy strategies. To do this it is assumed that the political cost of using each policy is a quadratic function of its cost. In this way, the policymaker adheres to the following political economic objective function:

$$\mathcal{L}_{min} = \sum_{i=1}^{n} c_i^2 \quad s.t.\ \Delta x = \Delta x^*$$

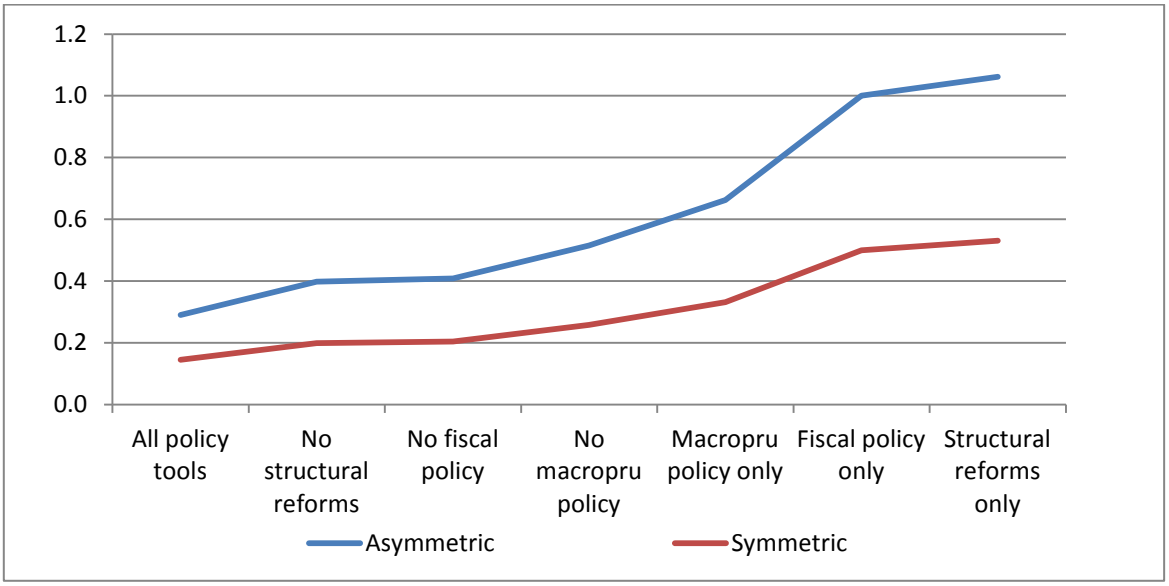
Where $\mathcal{L}$ is the government's loss, n is the number of policy tools being used, c_i is the cost of using tool i, Δx is the change in the current account imbalance, and Δx^* is the desired change in the current account imbalance. The cost is not directly measured but is approximated in two ways (i) the nominal adjustment associated with the policy (ii) the magnitude of the policy shock required. The policy tools available include fiscal and macro-prudential policies on the demand side and structural reforms

to product markets on the supply side.[9] These policies correspond directly to three of the shocks identified in the model (ie, fiscal policy, credit supply, and productivity shocks).

5.1 Nominal adjustment costs

Figure 5.1 shows the losses associated with achieving a 1% of GDP reduction in current account imbalances from seven alternative policy strategies. The strategies are ranked in ascending order. Clearly, the optimal strategy is to utilise all the available tools for managing imbalances and the worst strategies involve using only a single policy tool. There are five main results from this analysis. First, a decision to use only two of the three tools does not appear to incur a great cost. Second, losses do start to escalate once there is reliance on only a single tool. Third, relying only on structural reforms is the most costly strategy of all. Fourth, adherence to the Stability and Growth Pact – ie, not using fiscal policy to manage imbalances – does not impose significant additional political costs provided macro-prudential policies are used in conjunction with structural reforms. Fifth, asymmetry doubles the costs whichever policy strategy is used. This analysis suggests that there could be significant advantages to using macro-prudential policies in conjunction with structural reforms and ensuring that policies are always implemented symmetrically when managing macroeconomic imbalances.

Figure 5.1: Losses from alternative policy strategies measured by required nominal adjustment

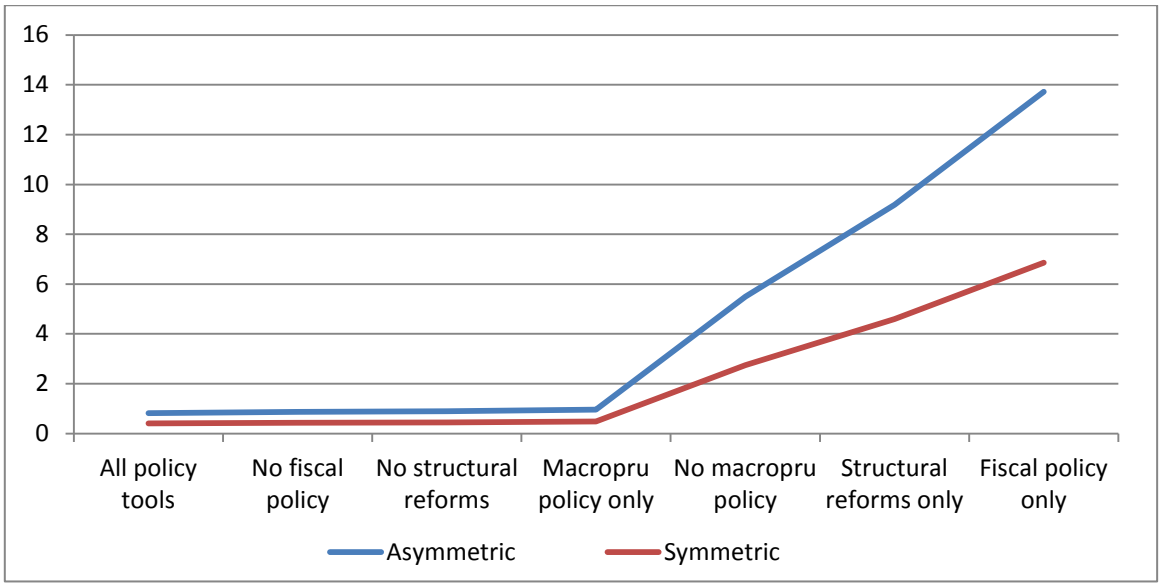


[9] Owing to the perverse impact of the wage bargaining shock on the current account explained in section 4.2 structural reforms to labour markets are not considered to be a plausible tool for managing macroeconomic imbalances.

5.2 Policy adjustment costs

Nominal adjustment may not be a good measure of the costs imposed on a government from managing macroeconomic imbalances. For example, there is no particular reason to think that a reduction in relative prices via a contraction in demand should incur the same political cost as a reduction in relative prices via structural reforms even if they are both likely to incur sizeable political costs. In order to assess the robustness of the previous results, therefore, Figure 5.2 shows the results from an identical exercise but this time based on the magnitude of the policy shock itself when measured in terms of its sample period standard deviation. On this alternative measure of costs the previous results are broadly confirmed: there is limited extra cost from using only two of the three tools; losses are largest when using a single tool (with the exception of macro-prudential policies); and there is virtually no additional cost from not using fiscal policy. This second set of results supports the conclusion that there could be significant advantages from using macro-prudential policies in conjunction with structural reforms to manage imbalances. It is also confirms that symmetric implementation of policies is significantly less politically costly than asymmetric implementation.

Figure 5.2: Losses from policy strategies losses measured by required policy shocks



6. Conclusions

[Text here].

APPENDIX A: A Model of Euro-Area Macroeconomic Imbalances

We start with a simple open economy New Keynesian (NK) model comprising a production function, open economy dynamic IS equation, and open economy New Keynesian Phillips Curve:

$$\bar{y}_t = a_t + n_t$$

$$\{y_t - \bar{y}_t\} = E_t\{y_{t+1} - \bar{y}_{t+1}\} - \rho(r_t - E_t\{\Delta p_{t+1}\} - \overline{rr}_t) + \theta g_t - \vartheta q_t$$

$$\Delta p_t = E_t\{\Delta p_{t+1}\} + \lambda\{y_t - \bar{y}_t\} - \delta q_{t-1}$$

$\bar{y}$ is potential output, a is technology, n is employment, y is output, r is the effective interest rate, p is prices, $\overline{rr}$ is the neutral interest rate, g is the fiscal balance, and q is the real exchange rate.

The trade balance, x, is assumed to have no implications for the dynamic equilibrium but is determined endogenously by the level of the real exchange rate. This reflects the impact of relative price changes on both consumption in the Euler equation and expenditure switching effects:

$$x_t = -\phi q_t$$

To adapt the NK model to the issue of macroeconomic imbalances we make three simplifying assumptions: (i) the Euro area as a whole is a large closed economy (ii) members of the Euro area are small open economies that share an identical economic structure (iii) throughout the Euro area inflation expectations are anchored at the ECB's inflation target. This enables the model to be re-written 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:

$$y_{it} = a_{it} + n_{it} + E_t\{y_{it+1} - \bar{y}_{it+1}\} - \rho r_{it} + \theta g_{it} - \vartheta p_{it}$$

$$p_{it} = (1 - \delta)p_{it-1} + \lambda\{y_{it} - \bar{y}_{it}\} \quad (9)$$

$$x_{it} = -\phi p_{it}$$

We then identify a number of structural shocks that are consistent with the main post-crisis explanations of macroeconomic imbalances discussed in Section 2.2:

$$E_{it}\{y_{it+1}\} = E_{it-1}\{y_{it+1}\} + u_{it}^{E\{y\}} \quad [growth\ expectations/animal\ spirits\ shock]$$

$$g_{it} = g_{it-1} + u_{it}^{f} \quad [government\ spending/fiscal\ policy\ shock]$$

$$r_{it} = r_{it-1} + u_{it}^{c} \quad [interest\ rate/credit\ supply\ shock]$$

$$a_{it} = a_{it-1} + u_{it}^{p} \quad [technology/productivity\ shock]$$

$$n_{it} = n_{it-1} + u_{it}^{w} \quad [labour\ supply/wage\ bargaining\ shock]$$

These equations constitute the equilibrium dynamics. In steady state $p_{it} = p_{it-1} = p_i^*$ etc. and macroeconomic imbalances are shown to be persistent as required by the consensus narrative of the Euro-area crisis:

$$y_i^* = a_{it}^* + n_{it}^* + \frac{E_t\{y_i^* - \bar{y}_i^*\} - \rho r_i^* + \theta g_i^*}{\delta}$$

$$p_i^* = \frac{E_t\{y_i^* - \bar{y}_i^*\} - \rho r_i^* + \theta g_i^*}{\Pi}$$

$$x_i^* = -\phi \left\{\frac{E_t\{y_i^* - \bar{y}_i^*\} - \rho r_i^* + \theta g_i^*}{\Pi}\right\}$$

Where $\Pi = \left[\frac{\delta}{\lambda} + \frac{1}{\varphi}\right]$

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

$$\boldsymbol{B_0}\begin{bmatrix}\Delta y_t\\ \Delta p_t\\ \Delta g_t\\ \Delta r_t\\ \Delta n_t\\ \Delta x_t\end{bmatrix} = \boldsymbol{B_1}\widetilde{\boldsymbol{E}}_{\boldsymbol{t-1}}[\Delta y_{t+1}] + \boldsymbol{B_2}\begin{bmatrix}\Delta y_{t-1}\\ \Delta p_{t-1}\\ \Delta g_{t-1}\\ \Delta r_{t-1}\\ \Delta n_{t-1}\\ \Delta x_{t-1}\end{bmatrix} + \begin{bmatrix}u_{1t}\\ u_{2t}\\ u_{3t}\\ u_{4t}\\ u_{5t}\\ u_{6t}\end{bmatrix}$$

Or more compactly:

$$\boldsymbol{B_0 Z_t = B_1 \widetilde{E}_{t-1}[\Delta y_{t+1}] + B_2 Z_{t-1} + u_t}$$

The bold characters refer to matrices and vectors; $\boldsymbol{Z_t}$ is a vector of potentially endogenous variables; and $\boldsymbol{u_t}$ is a vector of white noise disturbances. $\boldsymbol{\widetilde{E}_t}$ 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 and the animal spirits explanation of imbalances.

There are several ways in which expectations might be formed non-rationally. De Grauwe (2012) 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 adaptively:

$$\boldsymbol{\widetilde{E}_{t-1}[\Delta y_{t+1}] = C_1 Z_{t-1}}$$

With this simple formulation, equation (19) can now be re-written as:

$$\boldsymbol{A_0^{-1} Z_t = A_1 Z_{t-1} + u_t}$$

Where $\boldsymbol{A_0^{-1} = B_0}$ and $\boldsymbol{A_1 = [B_1 C_1 + B_2]}$. Pre-multiplying by $\boldsymbol{A_0}$ then gives:

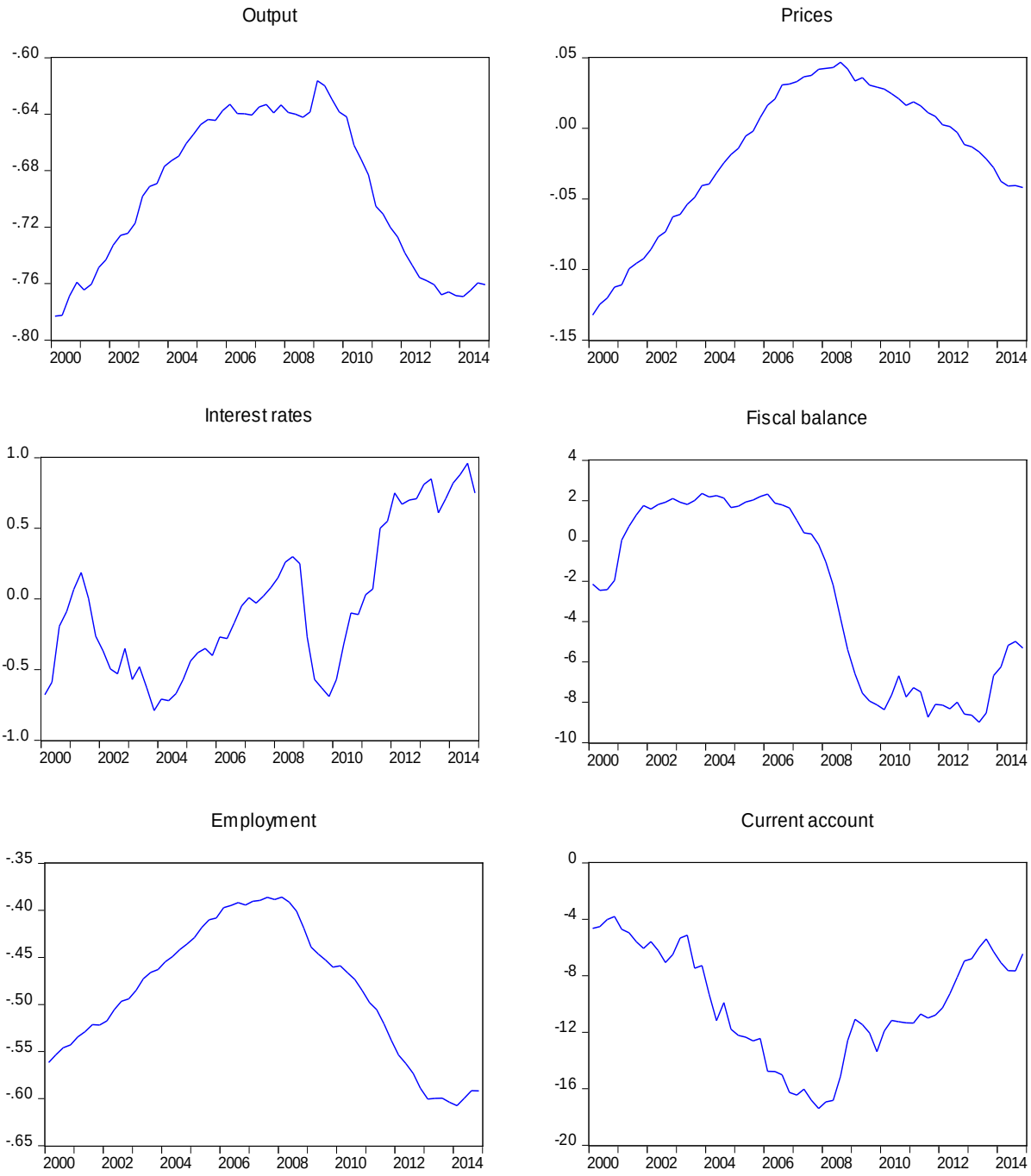
$$\boldsymbol{Z_t = A_0 A_1 \, Z_{t-1} + A_0 u_t}$$

Or:

$$\boldsymbol{Z_t = \Gamma_0 Z_{t-1} + v_t} \quad (20)$$

Where $\boldsymbol{\Gamma_0 = A_0 A_1}$ and $\boldsymbol{v_t = A_0 u_t}$. Equation (20) gives the reduced-form VAR representation of the model that is estimated.

APPENDIX B: Data used in estimation*



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

REFERENCES

Abbas, S, Bouhga-Hagbe, J, Fatas, A J, Mauro, P, Velloso, R C, (2010), "Fiscal Policy and the Current Account", *IMF Working Papers*, No. 10/121.

Abiad, A, Leigh, D, Mody, A, (2009), "Financial Integration, Capital Mobility, and Income Convergence", *Economic Policy*, Vol.24, No. 4, pp.241-305.

Adam, K, Jappelli, T, Menichini, A, Padula, M, Pagano, M, (2002), "Analyse, Compare, and Apply Alternative Indicators and Monitoring Methodologies to Measure the Evolution of Capital Market Integration in the European Union", *CSEF Paper*, University of Salerno.

Alcidi, C, Gros, D, (2013), "Economic Policy Coordination in the Euro Area under the European Semester", CEPS Special Report, No. 123, December.

Bems, R, Dedola, B, Smets, F, (2007), "US Imbalances: The Role of Technology and Policy", *Journal of International Money and Finance*, vol. 26(4), pages 523-545, June.

Baele, L, Ferrando, A, Hordahl, P, Krylova, E, Monnet, C, (2004), "Measuring European Financial Integration", *Oxford Review of Economic Policy*, Volume 20, Issue 4, December.

Baldwin, R, Giavazzi, F, (2015), "The Eurozone Crisis: A Consensus View of the Causes and a Few Possible Solutions", *VoxEU ebook*.

Benassy-Quere, A, Ragot, X, (2015), "A Policy Mix for the Euro Area", *Les notes du conseil d'analyse economique*, no 21, March.

Berger, H, Nitsch, V, (2010), "The Euro's Effect on Trade Imbalances", *IMF Working Papers*, No. 10/226, October.

Biroli, P, Mourre, G, Turrini, A, (2010), "Adjustment in the Euro Area and Regulation of Product and Labour Markets: An Empirical Assessment", *European Economy*, Economics Papers No. 428, October.

Blanchard, O, Giavazzi, F, (2002), "Current Account Deficits in the Euro Area: The End of the Fedlstein-Horioka Puzzle?" *Brookings Papers on Economic Activity*, 2: 2002.

Bluedorn, J, Leigh, D, (2011), "Revisiting the Twin Deficits Hypothesis: The Effect of Fiscal Consolidation on the Current Account", *IMF Economic Review*, vol. 59, issue 4, pp. 582-602.

Bracke, T, Fidora, M, (2008), "Global Liquidity of Global Savings Glut? A Structural VAR Approach", *ECB Working Papers*, No. 911.

Cabral, I, Dierick, F, Vesala, J, (2002), "Banking Integration in the Euro Area", *ECB Working Papers*, No. 6, December.

Canova, F, De Nicolo, G, (2002), "Monetary disturbances matter for business fluctuations in the G-7", *Journal of Monetary Economics*, Volume 49, Issue 6, pp. 1131-1159.

Canova, F, Paustian, M, (2011), "Business cycle measurement with some theory", *Journal of Monetary Economics*, Vol.58, pp. 345-361.

Ca'Zorzi, M, Rubaszek, M, (2008), "On the Empirical Evidence of the Inter-temporal Current Account Model for the Euro Area Countries", *ECB Working Papers*, No. 895.

Coeurdacier, N, Martin, P, (2007), "The Geography of Asset Holdings: Evidence from Sweden", *Riksbank Research Paper Series*, No. 202, January.

Daborwski, M, (2015), "Monetary union and fiscal and macroeconomic governance", *mimeo*

Dalsgaard, T, de Serres, A, (2001), "Estimating Prudent Budgetary Margins", *The Stability and Growth Pact*, Palgrave MacMillan, Basingstoke, England.

De Grauwe, P, (2010), "The Financial Crisis and the Future of the Eurozone", *Bruges European Economic Policy Briefings*, No. 21.

De Grauwe, P, (2012a), "Lessons from the Eurocrisis for East Asian Monetary Relations", *The World Economy*, Volume 35, Issue 4, April.

De Grauwe, P, (2012b), "Lectures on Behavioural Macroeconomics", Princeton: Princeton University Press.

Ederer, S, (2015), "Macroeconomic imbalances and institutional reforms in the EMU", *WWWforEurope Working Papers*, No. 87, March.

Eichengreen, B, (2010), "Imbalances in the Euro Area", mimeo, November.

Faust, J, (1998), "The robustness of identified VAR conclusions about money", *Carnegie-Rochester Conference Series on Public Policy*, vol. 49, issue 1, pp. 207-244.

Fry, R, Pagan, A, (2011), "Sign Restrictions in Structural Vector Autoregressions: A Critical Review", *Journal of Economic Literature*, Vol.49, No. 4, pp. 938-960.

Gourinchas, P, (2002), "Comments on Current Account Deficits in the Euro Area: The End of the Feldstein-Horioka Puzzle?" *Brookings Papers on Economic Activity*, 2: 2002.

Gros, D, (2012), "Macroeconomic imbalances in the euro area: symptom or cause of the crisis?", *CEPS Policy Brief*, No. 266, April.

Hancke, B, (2013), "Unions, Central Banks and EMU: Labour Market Institutions and Monetary Integration in Europe", Oxford: Oxford University Press.

Hancke, B, Soskice, D, (2003), "Wage-setting and Inflation Targets in EMU", *Oxford Review of Economic Policy*, vol. 19, issue 1, pp. 149-60.

Ju, J, Wei, S, (2007), "Current Account Adjustment: Some New Theory and Evidence", *NBER Working Papers*, No. 13388.

Kamps, C, De Stefani, R, Leiner-Killinger, N, Ruffer, R, Sonderman, D, (2014), "The Identification of Fiscal and Macroeconomic Imbalances: Unexploited Synergies Under the Strengthened EU Governance Framework", *ECB Occasional Paper Series*, No 157, November.

Kennedy, M, Slok, T, (2005), "Are Structural Reforms the Answer to Global Current Account Imbalances", *OECD Economic Studies*, No. 41, pp. 47-73.

Kincaid, R, Watson, M, (2015), "Avoiding Another Crisis in the Euro Area: Public and Private Imbalances and National Policy Responses", *Journal of European Integration*, September.

Lane, P, (2010), "A European Perspective on External Imbalances", *Swedish Institute for Policy Studies Report*, May.

Lane, P, Milesi-Ferretti, G, (2005), "Financial Globalization and Exchange Rates", *IMF Working Papers*, No. 05/03.

Lane, P, Pels, B, (2012), "Current Account Imbalances in Europe", *CEPR Discussion Papers*, No. 8958, May.

Leeper, E, Richter, A, Walker, T, (2012), "Quantitative Effects of Fiscal Foresight", *American Economic Journal: Economic Policy*, Vol. 4(2), pp. 115-144, May.

Leeper, E, Walker, T, Shu-Chun, S, (2013), "Foresight and Information Flows", *Econometrica*, Vol. 81, No.3, pp. 1115-1145, May.

Obstfeld, M, Rogoff, K, (1996), "Foundations of International Macroeconomics", Cambridge: MIT Press.

Pagano, M, von Thadden, E, (2004), "The European Bond Markets under EMU", *CSEF Paper*, University of Naples.

Rubio-Ramirez, J, Waggoner, D, Zha, T, (2010), "Structural Vector Autoregressions: Theory of Identification and Algorithms for Inference", *The Review of Economic Studies*, Vol. 77, No. 2, pp. 665-696, April

Schmitz, B, von Hagen, J, (2011), "Current Account Imbalances and Financial Integration in the Euro Area", *Journal of International Money and Finance*, Vol. 30, pp. 1676-1695.

Soskice, D, Iversen, T, (2000), "The Non-Neutrality of Monetary Policy with Large Price or Wage Setters", *Quarterly Journal of Economics*, Vol. 115, Issue 1, pp.265-84.

Peersman, G, Straub, R, (2009), "Technology Shocks and Robust Sign Restrictions in a Euro Area SVAR", *International Economic Review*, Vol. 50, Issue 3, pp. 727-750, August.

Uhlig, H, (2005), "What are the effects of monetary policy on output? Results from an agnostic identification procedure", *Journal of Monetary Economics*, Vol. 52, pp. 381-419.

Waysand, C, Ross, K, de Guzman, J, (2010), "European Financial Linkages: A New Look at Imbalances", *IMF Working Papers*, No. 10/295, December.

Zemanek, H, Belke, A, Schnabl, G, (2010), "Current Account Balances and Structural Adjustment in the Euro Area", *International Economics and Economic Policy*, Vol. 7, pp. 83-127.