The EMU and Worsening Budgetary Balances: Fiscal Management or Fiscal Fatigue

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Abstract

By most accounts the European Monetary Union (EMU) has been a successful experiment in monetary integration, but one area of continued disagreement is the management of fiscal positions. Deficits across member states dramatically decreased in the decade preceding the formation of the EMU, but have subsequently worsened. Two possible explanations for this reversal are empirically tested. First, joining a monetary union could lead to increased reliance on fiscal policy if shocks across the union are asymmetric or if the conduct of policy by the new central monetary authority is significantly different than that of the previous authority. Second, fiscal policy makers could be experiencing fiscal fatigue, a loss of political will to maintain tight fiscal balances. Long run restrictions on structural VARs are used to identify supply and demand shocks of EMU members. Empirical tests indicate that structural shocks are sufficiently similar across the union. Fiscal and monetary reaction functions are estimated and impulse response functions are derived using timing restrictions on a panel SVAR.[1] The results of this estimation indicate that the conduct of stabilization policy has changed little since the formation of the EMU, and the change in the response of the monetary authority to fiscal shocks lessens the need for fiscal intervention. Fiscal movements, on the other hand, have become more deficit biased since the advent of the EMU, indicating the existence of fiscal fatigue.

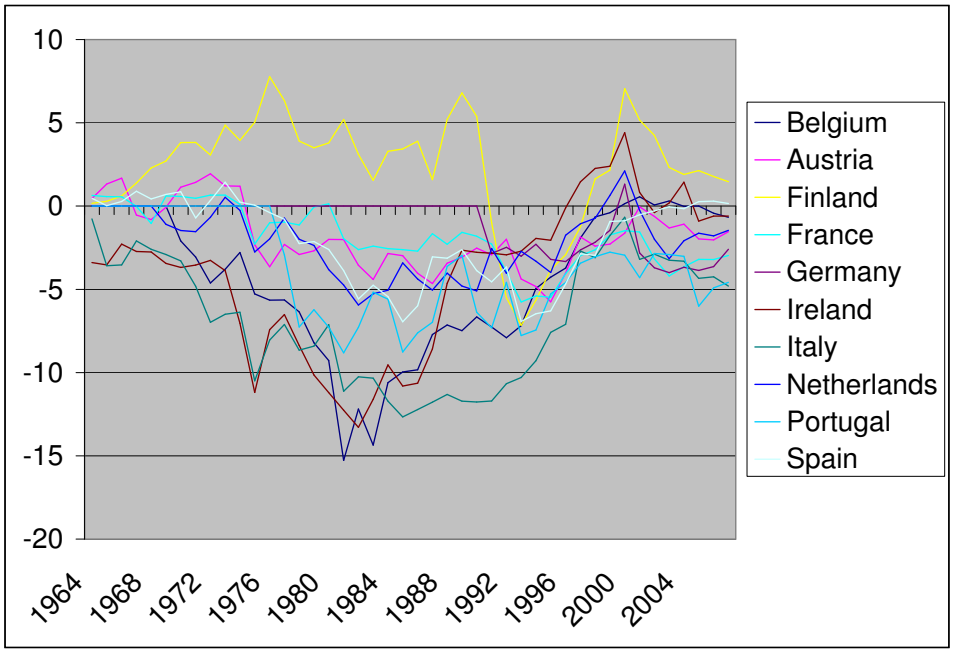
[1]Thank you to Inessa Love for providing the code to perform the panel VAR

1 Introduction

The European Monetary Union (EMU), established in 1999, is a grand experiment in economic integration. In many aspects, the monetary union has surpassed the expectations of its original framers. This success has attracted the attention of many other countries whose desire to join the monetary union has led to its continued expansion. In May 2004, the European Union (EU) was expanded to include many countries in Central and Eastern Europe. In 2007, the EU expanded again to include Bulgaria and Romania. In joining the EU, each of these countries agreed to eventually join the monetary union.

In spite of the continued expansion and seeming success of the EMU, there are unification issues that have not been completely resolved. One that has received attention is the role of government budgetary restrictions designed to keep deficits under control. Figure 1 illustrates the evolution of deficits for the current EMU members. There is a

Figure 1: Deficit to GDP Ratio 1964-2006



long period of deficit expansion in the late 1970's and early 1980's. This was a period of general economic unrest and expansion of the government's role in welfare and production across Europe. Deficits fell dramatically in the 1990's. This reduction coincided with the signing of the Maastricht Treaty, which stipulated that deficits must be within 3 percent of GDP before admittance into the future EMU. Since the creation of the EMU in 1999, there has been a noticeable worsening of deficit positions. The deficit restrictions stipulated in the Maastricht Treaty were maintained in the Stability and Growth Pact (SGP) which came into effect with the formation of the Union.

The worsening of deficit positions and subsequent violation of the SGP deficit threshold by some has caused discord among members. As a result, there has been continual pressure to modify the SGP and loosen deficit restrictions. As the SGP comes under increased pressure, it is important to understand why budget positions have deteriorated. The reversal in the direction of fiscal balances within one year of the creation of the EMU suggests that the explanation lies in some feature of the monetary union. Understanding how the monetary union has modified the role and preferences of its policy makers is essential to evaluating deficit positions and restrictions.

This paper addresses the possible explanations for the apparent loss of fiscal austerity as a result of becoming a member of the EMU. By expanding on Uhlig's (2002) New-Keynesian micro-foundation model of policy interaction and applying it both pre- and post-monetary union, two possible explanations for worsening balances are identified. First, fiscal balances may be worsening as a result of a country's increased reliance on fiscal policy to manage economic fluctuations. Increased reliance on fiscal management would be needed if 1) shocks are asymmetric across members of the EMU, 2) the policy weights of the monetary authority have changed pre- and post-EMU, or 3) the interaction between authorities has changed. In these cases an economic downturn could make the SGP overly binding. Second, member countries may have experienced "fiscal fatigue", or what Lewi and Hughes-Hallet (2004) refer to as post-entry fatigue. This fatigue is the loss of political will to maintain the strong fiscal stances taken in the run up to the formation of the union. If this is true, then there is reason to maintain and possibly strengthen the SGP.

In order to test for shock asymmetry across members, the structural shocks must

be identified. A structural VAR with long run restrictions can be used to identify aggregate supply and demand shocks. Long run restrictions for shock identification were introduced by Blanchard and Quah (1989). Bayomi and Eichengreen (1993) use this technique to test shock symmetry across Europe before the union was formalized in 1991. Extending this analysis to include current data, this paper finds that structural shocks are similar across EMU members.

This paper also tests whether monetary and fiscal authorities have changed the way they have reacted to fluctuations in the economy as well as to each other as a result of joining the EMU. A panel VAR is used to estimate the reaction functions of the monetary and fiscal authorities pre- and post-EMU. Using contemporaneous restrictions introduced by Blanchard and Perotti (2002) to identify fiscal shocks and extended by Perotti (2002) to include monetary shocks, the structural impulse response functions are compared pre- and post-EMU. The results of this estimation indicate that the conduct of stabilization policy has changed little since the formation of the EMU. It also indicates that the change in the response of the monetary authority to fiscal shocks lessens the need for fiscal intervention. Fiscal movements, on the other hand, have become more deficit biased since the advent of the EMU, indicating the existence of fiscal fatigue.

Section 2 explains the motivation for and experience with deficit restrictions in the EMU. In Section 3 a model of monetary and fiscal policy interaction is constructed that explores the possible reasons for worsening budgetary balances in the EMU as a result of becoming a member of a monetary union. Sections 4 and 5 contain the empirical tests of the possible causes of worsening budgetary balances. The conclusions are presented in Section 6.

2 Deficit Restrictions

The Maastricht Treaty and the SGP were designed to protect the EMU from an individual member's deficit-induced economic crisis. One member's economic crisis has an immediate effect on all other members through changes in the value of the common currency. In addition, the risk of contagion increases with greater integration. The cost to the whole union of one member's mismanagement is high enough that the European

Central Bank (ECB) or other members have an incentive to bail out members whose economic situation has became dire. Therefore, being a member of a monetary union in which members maintain fiscal control presents a moral hazard. Specifically, there exists an incentive for governments to spend or tax to appease domestic political demands, thus maintaining riskier budget positions with less concern for the deficit and accumulating debt. The deficit bias which has existed in much of Europe since the 1970's makes this threat even more real. The framers of the EMU determined that the best way to prevent such action was through monitoring government budget deficits and debt levels (Alesina and Perotti, 2004). By placing an enforceable rule on the size of the government deficit and debt, the ECB[2] or other members would not run the risk of having to bail out a country that had accumulated an unsustainable level of debt.

Both Maastricht and the SGP specify that member countries must maintain a deficit to GDP ratio under 3 percent and a debt to GDP ratio under 60 percent, except when the country experiences a strong economic downturn (a drop in GDP exceeding 2 percent). The difference lies in the enforcement of the deficit rule. The punishment for not meeting the Maastricht criterium was exclusion from the EMU. This threat was carried out on Greece, which had to delay entrance until it was able to bring its deficits under control. Under the SGP exclusion is not a viable option, instead the EMU has a committee (ECOFIN) made up of representatives from each country in the union that monitors the fiscal positions of each member. If a member is found to be violating the SGP then they can be fined.

As Figure 1 illustrated, deficits were reduced across all EMU candidates in the few years preceding the advent of the common currency. Every country managed to meet the Maastricht deficit criterion before joining the EMU. However, under the SGP and a weaker enforcement mechanism, deficits begin to rise and surpluses begin to fall. After 2000 there is only one country, Spain, which has not experienced some worsening of its balance.

The worsening of fiscal balances has been severe enough that a number of countries have violated the SGP deficit threshold. Table 1 shows the countries that have violated

[2]The charter of the ECB has a provision that prevents the ECB from bailing out any member, but it is up to debate if they would abide by this rule if the situation were serious enough.

or currently are violating the SGP.

Table 1: Stability and Growth Pact Violations

Country	Years of Violation
Germany	2003-2006
France	2003-Present
Italy	2003-Present
Netherlands	2004-2005
Portugal	2002; 2005-Present
Greece	2003-2006

Source: Public finance in the EMU - 2006 (European Commission, 2006)

France, Germany, and Italy, all major players in the creation of the EMU and its largest members, are among the notable offenders.

The inability of ECOFIN to enforce the SGP[3] and pressure from the violators has led to changes in the rules. These changes came on March 20th, 2005. They allowed a member to exceed the 3 percent deficit limit if it can be shown that the excessive deficit was the result of international aid, economic reform, European unification, or pension reform. This concession was agreed to by the more hawkish countries only if the deficit to GDP ratio is slightly and temporarily above 3 percent.

The ineffectiveness of the SGP has strained relationships across the union while its subsequent softening has weakened its ability to overcome the moral hazard problem and deficit biases. Some have argued that the SGP should be further softened as it does not allow enough room for counter-cyclical fiscal policy or continued restructuring. Others see the violations as a reversion to deficit biases and a lack of political will to confront the problems the SGP was set out to overcome.

3 What has been the cause of these worsening balances?

While a weakened enforcement mechanism makes it easier to violate deficit restrictions post-EMU, there are different reasons why a member may loosen its fiscal stance as a

[3]For a summary of the SGP action (or better yet inaction) in response to growing deficits see de Haan, Berger and Jansen (2004)

result of joining the monetary union. The most obvious change for members pre- and post-EMU is the loss of the ability to conduct independent monetary policy. As the member turns over control of monetary policy to the ECB, the relationship between monetary and fiscal authorities could change. It is possible that this change could lead to greater reliance on fiscal policy in a monetary union and subsequent counter-cyclical deficit spending in order to contain output and inflation fluctuations. A model of the relationship between monetary and fiscal authorities and how this relationship changed once in a monetary union will demonstrate possible pitfalls.

Early models of monetary and fiscal interaction represent the fiscal authority as solely a provider of public goods with a limited role in stabilization. Dixit and Lambertini (2001) focus on the counter-cyclical role of fiscal policy as well as the interaction between the central monetary authority and the independent fiscal authorities in the European Monetary Union (EMU). The model they use to represent the economy is non-standard, but they find important differences in how the authorities act pre- and post-EMU. Uhlig (2002) presents a New-Keynesian macroeconomic model to assess the dangers of coordination failure in the EMU. Van Aarle, Gerretsen, and Huart (2004) assume a similar model to simulate how different weights in policy functions for fiscal rules can cause nominal divergence.

Empirical tests of the relationship between monetary and fiscal authorities have been carried out by Muscatelli, Tirelli, and Trecroci (2003). Using data from the United States, they find that monetary and fiscal authorities move in similar directions after an output shock. However, in the face of policy or inflation shocks, policy makers move in opposite directions, with fiscal policy being more inflationary.

For this representation a New-Keynesian macroeconomic model similar to Uhlig (2002) is used, but unlike Uhlig the change in the relationship pre- and post-EMU is represented. A typical model with Calvo sticky prices, no capital, and a role for government is used. Following the micro-foundations of such models, the household's optimization conditions, the firm's optimization decision, and the market clearing conditions are used to model the economy. In order to provide a tractable solution and clear illustration of the changes in how fiscal and monetary authorities interact pre- and post-EMU, a non-dynamic version of the model is used. Using these conditions the log

linearized IS and Phillips curves for each country (i) can be represented by

$$y_i = -a_i(i_i - \pi_i^e) + b_i(g_i) + v_i \tag{1}$$

$$\pi_i = \pi_i^e + \kappa_i y_i + u_i \tag{2}$$

where y is the output gap, i is the nominal interest rate, π is inflation, π^e is expected inflation, v is an IS shock, and u is a supply shock (where a positive shock is inflationary; consistent with a negative supply shock or some cost-push shock). g represents government deficits and so an upward movement in g causes an increase in output and a worsening of budgetary positions.

The monetary authority cares about limiting inflation and output gap fluctuations. The monetary authority chooses the nominal interest rate to maximize:

$$-\frac{1}{2}(\theta_i^j y_i^2 + \pi_i^2) \tag{3}$$

where θ^j is the relative weight the monetary authority places on output gap verses inflation stabilization (j=m represents the domestic monetary authority. Post-EMU the relative weight placed on output stabilization is the ECBs represented by j=M). The difference between the domestic monetary authority pre-EMU and the ECB post-EMU is that the ECB will respond to aggregate levels of the output gap and inflation instead of the country specific value. It is also possible that the ECB has a different weight on relative output gap stabilization than the domestic monetary authority had pre-EMU.

In addition to caring about smoothing output gap and inflation fluctuations, the fiscal authority of each country also wants to limit budgetary fluctuations. Thus the fiscal authorities of each country maximize:

$$-\frac{1}{2}(\theta_i^f y_i^2 + \pi_i^2 + \alpha_i(g_i - \epsilon_i)^2) \tag{4}$$

where θ^f is the relative weight the fiscal authority places on output gap verses inflation stabilization and can be different than the weight of the monetary authority. α is the weight placed on budget stabilization, while ϵ is an exogenous fiscal shock which moves the budget away from the steady state level. A positive shock would allow for a higher value of g (deficits) in the optimal solution. This would entail changes to the budget beyond optimal stabilization, including politically motivated deficit spending as the result of fiscal fatigue.

The timing of policy is important for how the monetary and fiscal authority decide to conduct policy. First, agents form inflation expectations, which before any shocks are realized is zero. After those expectations have been formed, shocks hit the economy; a government shock (ϵ_t), a non-government IS-demand shock (v_t), or a supply shock (u_t). Once the shock is realized, the monetary authority responds first, reflecting their short inside lag in policy making. The fiscal authority then responds taking into account the monetary authority's actions. The model is solved backwards as the monetary authority takes into account the fiscal authority's optimal response when it makes its policy decision.

Pre-EMU, each country had control over its own monetary and fiscal policy. Therefore, each country (i) solves its own individual country specific problem. Solving backwards the fiscal authority maximizes its objective function (4) subject to the IS curve (1) and the Phillips curve (2), taking the nominal interest rate and expected inflation as given. The optimal response becomes

$$g_i = \frac{1}{\sigma_i}[a_i b_i(\theta_i^f + \kappa_i^2)i_i - b_i(\theta_i^f + \kappa_i^2)v_i - \kappa_i b_i u_i + \alpha_i \epsilon_i] \tag{5}$$

where $\sigma_i = (b_i^2(\theta_i^f + \kappa_i^2) + \alpha_i)$.

The domestic monetary authority takes into account the optimal reaction of the fiscal authority as well as inflation expectations and maximizes its objective function (3) with respect to the IS curve (1) and the Phillips curve (2), as well as the fiscal reaction (5). The optimal response of the monetary authority thus becomes:

$$i_i = \frac{1}{a_i}v_i + \frac{(\kappa_i b_i^2(\theta_i^f - \theta_i^m) + \kappa_i \alpha_i)}{a_i \alpha_i(\kappa_i^2 + \theta_i^m)}u_i + \frac{b_i}{a_i}\epsilon_i \tag{6}$$

Using the optimal monetary reaction, the optimal fiscal reaction function can be completed by substituting (6) into (5). Thus the optimal fiscal reaction becomes:

$$g_i = \frac{\kappa_i b_i^3((\theta_i^f)^2 - \theta_i^f \theta_i^m) + \kappa_i^3 b_i^3(\theta_i^f - \theta_i^m) + \kappa_i b_i \alpha_i(\theta_i^f - \theta_i^m)}{\sigma_i \alpha_i(\kappa_i^2 + \theta_i^m)}u_i + \epsilon_i \tag{7}$$

The monetary authority reacts to each type of shock. It raises the interest rate in response to expansionary IS and fiscal shocks. Supply shocks are more complicated and depend on the relative weight that the monetary and fiscal authority place on the output gap. If the weights are the same then the monetary authority raises interest rates in

response to a supply shock to combat inflation. The fiscal authority, on the other hand, does not respond to IS shocks because the monetary authority overcomes such a shock with its initial policy. Response to a supply shock depends on the relative weight that fiscal and monetary authorities place on output gap stabilization relative to inflation stabilization. If the weights are the same then the fiscal authority does not respond; the monetary authority's reaction accomplishes the same goal that the fiscal policy maker would have set out to do. If weights are different then there will be a response by the fiscal authority, even with the optimal monetary reaction. The most likely case would be that the fiscal authority places greater weight on output stabilization than does the monetary authority in relation to inflation ($\theta^f > \theta^m$). In this case, the fiscal authority would increase deficit spending to move output higher than the monetary authority caused it to be in response to a supply shock.

The output gap and inflation can be found by putting the optimal fiscal (7) and monetary (6) reaction function back into the the IS (1) and Phillips curve (2). The resulting levels are as follows:

$$y_i = -\frac{(\kappa_i b_i^2 \theta_i^f + \kappa_i^3 b_i^2 + \kappa_i \alpha_i)}{\sigma_i(\kappa_i^2 + \theta_i^m)} u_i \tag{8}$$

and

$$\pi_i = \frac{(b_i^2 \theta_i^f \theta_i^m + b_i^2 \kappa_i^2 \theta_i^m + \alpha_i \theta_i^m)}{\sigma_i(\kappa_i^2 + \theta_i^m)} u_i \tag{9}$$

The monetary and fiscal authorities are able to overcome the effect of an IS or fiscal shock on output and inflation. Supply shocks, on the other hand, still affect output and inflation even if the weights are the same and the fiscal and monetary authority act optimally. This result is consistent with optimal monetary reaction and monetary and fiscal interaction in previous studies.

Once countries become members of the monetary union, their fiscal choices change as the monetary system changes. The ECB's reaction to economy-wide fluctuations introduces a mechanism for each member's shocks to have an indirect effect on the economies of the other members. In order to model this, the output gap and inflation to which the ECB responds is a weighted aggregate of each individual member's output gap and inflation.

$$y^* = \Gamma' y \tag{10}$$

$$\pi^* = \Gamma' \pi \tag{11}$$

where Γ is an (n×1) vector of weights corresponding to the relative economic size of the EMU members. The individual weights add up to one. y and π are (n×1) vectors of the output gap and inflation of each of the member states.

In solving the problem backwards, the domestic fiscal authority, taking the interest rate as given, makes the same decision as before. The only difference is that the interest rate is not dictated by the domestic monetary authority, but by the ECB. The fiscal optimization result thus becomes:

$$g_i = \frac{1}{\sigma}[ab(\theta^f + \kappa^2)i^* - b(\theta^f + \kappa^2)v_i - \kappa b u_i + \alpha\epsilon_i] \tag{12}$$

where i^* is the European nominal interest rate. The subscript i has been dropped from the parameters because it has been assumed for clarity and illustrative purposes that each country has the same parameters across the union.

The ECB now takes into account the aggregate output gap and inflation of the member states, as well as the aggregate fiscal reaction, and maximizes:

$$-\frac{1}{2}(\theta^M (y^*)^2 + (\pi^*)^2) \tag{13}$$

The optimal monetary policy for the ECB thus becomes:

$$i^* = \frac{1}{a}\Gamma' v + \frac{\kappa b^2(\theta^f - \theta^M) + \kappa\alpha}{a\alpha(\theta^m + \kappa^2)}\Gamma' u + \frac{b}{a}\Gamma'\epsilon \tag{14}$$

where v, u, ϵ are (n×1) vectors of country specific shocks. This reaction is similar to the pre-EMU domestic central bank's actions except the ECB reacts to weighted averages of the country specific shocks. It is also possible that the relative weight the ECB places on output gap fluctuations is different than the pre-EMU central bank ($\theta^M \neq \theta^m$). In order to solve for the domestic optimal fiscal policy once the ECB has acted, it is convenient to rewrite (14) as:

$$\begin{aligned} i^* = {} & \frac{1}{a}\overline{\Gamma}'\overline{v} + \frac{\kappa b^2(\theta^f - \theta^M) + \kappa\alpha}{a\alpha(\theta^m + \kappa^2)}\overline{\Gamma}'\overline{u} + \frac{b}{a}\overline{\Gamma}'\overline{\epsilon} \\ & + \frac{1}{a}\gamma_i v_i + \frac{\kappa b^2(\theta^f - \theta^M) + \kappa\alpha}{a\alpha(\theta^m + \kappa^2)}\gamma_i u_i + \frac{b}{a}\gamma_i\epsilon_i \end{aligned} \tag{15}$$

where $\overline{\Gamma}$ is the the ((n-1)×1) vector of weights (γ_i) excluding the weight of country (i). Similarly $\overline{v}, \overline{u}, \overline{\epsilon}$ are the ((n-1)×1) vectors of shocks excluding country (i). Plugging expression (15) into (12) gives the following optimal fiscal response:

$$g_i = \frac{b(\theta^f + \kappa^2)}{\sigma}\overline{\Gamma}'\overline{v} + \frac{\kappa b^3(\theta^f - \theta^M)(\theta^f + \kappa^2) + \kappa b\alpha(\theta^f + \kappa^2)}{\alpha\sigma(\theta^M + \kappa^2)}\overline{\Gamma}'\overline{u} + \frac{b^2(\theta^f + \kappa^2)}{\sigma}\overline{\Gamma}'\overline{\epsilon}$$
$$+(1-\gamma_i)\left[-\frac{b(\theta^f + \kappa^2)}{\sigma}\right]v_i + \frac{\gamma_i b^2(\theta^f + \kappa^2) + \alpha}{\sigma}\epsilon_i$$
$$+\frac{(1-\gamma_i)(-\kappa^3 b\alpha) + \gamma_i[\kappa b^3((\theta^f)^2 - \theta^f\theta^M) + \kappa^3 b^3(\theta^f - \theta^M)] + \kappa b\alpha(\gamma_i\theta^f - \theta^M)}{\sigma\alpha(\theta^M + \kappa^2)}u_i \tag{16}$$

If shocks and weights are identical across the EMU, this expression is the same as the one country case.[4]

Contrary to the pre-EMU case, the fiscal authority must take into account how large its country is in relation to other members as well as how similar country specific shocks are to those in the rest of the union. It also must take into account how the ECB's weight on output stabilization may be different than that of the pre-EMU domestic central bank.

Using the monetary response (15) and the fiscal response (16) in the country specific IS and Phillips curve, the output gap and inflation are derived:

$$y_i = \frac{\alpha}{\sigma}[(1-\gamma_i)v_i - \overline{\Gamma}'\overline{v}] + \frac{b\alpha}{\sigma}[(1-\gamma_i)\epsilon_i - \overline{\Gamma}'\overline{\epsilon}] - \frac{\kappa b^2\theta^M}{\sigma(\theta^M + \kappa^2)}[(1-\gamma_i)u_i - \overline{\Gamma}'\overline{u}]$$
$$-\frac{\kappa(b^2\theta^f + \alpha)}{\sigma(\theta^M + \kappa^2)}[u_i + \overline{\Gamma}'\overline{u}] - \frac{\kappa^3 b^2}{\sigma(\theta^M + \kappa^2)}u_i \tag{17}$$

$$\pi_i = \frac{\kappa\alpha}{\sigma}[(1-\gamma_i)v_i - \overline{\Gamma}'\overline{v}] + \frac{\kappa b\alpha}{\sigma}[(1-\gamma_i)\epsilon_i - \overline{\Gamma}'\overline{\epsilon}] - \frac{\kappa^2 b^2\theta^M}{\sigma(\theta^M + \kappa^2)}[(1-\gamma_i)u_i - \overline{\Gamma}'\overline{u}]$$
$$+\frac{b^2\theta^f\theta^M + b^2\kappa^2(\theta^M + \theta^f) + \theta^M\alpha + \kappa^2\alpha}{\sigma(\theta^M + \kappa^2)}u_i \tag{18}$$

Once again if the shocks and weights are the same across the EMU then equations (17) and (18) collapse down to equations (8) and (9).

A comparison of the fiscal authority's optimal reaction pre-EMU (7) and post-EMU (16) illustrates how the role of the domestic fiscal authority could change after the

[4] $\overline{\Gamma}'\overline{\epsilon} + \gamma_i\epsilon_i = \Gamma'\epsilon = \epsilon_i$ if all shocks are the same. Also $\overline{\Gamma}'v + (1-\gamma_i)v_i = 0$ if all shocks are the same. This relationship holds true for all shocks.

formation of the EMU. Joining the monetary union could lead to greater reliance on fiscal management if shocks are not sufficiently similar across the union or if the reaction of the monetary authority to fluctuations changes. If this is true, economic downturns would lead to greater deficit spending in order to maintain the same level of stabilization possible pre-EMU, thus making the SGP overly binding.

Insufficient similarity in shocks is not a new concern for monetary unions. Mundell (1961) included shock symmetry as a necessary criterion for a group of countries to be an optimal currency area (OCA). The problem of not meeting this OCA criterium for the fiscal authority can be seen by comparing equations (7) and (16). For example, pre-EMU the fiscal authority does not need to respond to any demand shocks because the monetary authority with its optimal reaction takes care of all resultant fluctuations. Yet post-EMU, the fiscal authority optimally responds to a demand shock as long as the country specific shock is different than that of the aggregate shock. Assume a member state experiences a country specific negative demand shock v_i while the average demand shock for all members in that period $\overline{\Gamma}\overline{v}$ is positive. The local fiscal authority must now increase spending in response to its negative country specific shock

$$\frac{\delta g_i}{\delta v_i} = -(1-\gamma_i)\left[\frac{b(\theta^f+\kappa^2)}{\sigma}\right] < 0 \tag{19}$$

and increase spending to overcome the monetary authorities response to the EMU wide positive demand shock

$$\frac{\delta g_i}{\delta \overline{\Gamma}'\overline{v}} = \frac{b(\theta^f+\kappa^2)}{\sigma} > 0 \tag{20}$$

The need for the fiscal authority to act in response to its own shock as well as to the reaction of the monetary authority, in the case of asymmetric shocks, holds true for supply and fiscal shocks as well. Mundell does not provide a threshold of how similar shocks must be, but significant asymmetry would indicate a greater need for increased reliance on fiscal intervention and will be tested in the next section.

Understanding the static relationship between shocks may not provide enough relevant information to address the role shock asymmetries play. The continued integration of Europe could in itself change the structure of the relationship between countries and thus the similarity of shocks. This argument suggests an endogenous cross-country relationship of country-specific exogenous shocks. This is not the same as saying the

reaction to shocks have become more or less similar across countries. Instead, the exogenous shocks to which those countries could react (the supply and non-government spending demand shocks from the model in the previous section) have become more or less similar across countries. Thus, regardless of whether the optimal currency area criteria were met or violated at the advent of the union, the continued pace of integration could cause this relationship to change.

Greater integration can be the result of both reduced trade barriers or a reduction in the transaction costs of trade (such as adopting a common currency as in the case of the EMU). The effect of greater integration on shock similarity however is not agreed upon. One argument is that the increased trade as a result of greater integration leads countries to produce more of those goods in which they have a comparative advantage. As countries become more specialized, and thus more economically distinct from each other, shocks could become more asymmetric (Krugman, 1991; Kenen, 1969). For example, a shift in preferences from one good to another could cause divergent demand shocks between two integrated countries which specialize in the two different goods. Another example would be a technological advance which improves production in a particular industry. If there has been greater specialization, those countries which have specialized in the production of the good that has the technological advancement enjoy a positive supply shock which the other countries do not. Similarly, Babetskii, Boone, and Maurel (2004) argue that if a country is in the process of catching-up they should experience greater supply shock asymmetry. As their industrial sector is in the process of upgrading, investment flows from the more advanced countries bring technology advances, which would lead to asymmetric positive supply shocks in the developing country.

An alternative view of the results of greater integration has been presented by the European Commission (1990) (European Commission 1990) and Frankel and Rose (1998). They argue that as trade increases, a shock in one country would have spillover effects on the country it trades with. This is predominant with demand shocks or where intra-industry trade accounts for most of the trade. For example, if there is a negative demand shock in one country which lowers its income and thus demand for its trading partner's goods, the trading partner will also experience a negative demand shock. This demand shock comes from a different source, net exports, but moves in the same direction as

the original country's shock. With both of these explanations, the integration process causes shocks to become more similar, even though the shocks that are observed in and of themselves are still country specific exogenous shocks (also explained and tested in Babetskii, 2005 for the new member states).

Greater reliance on fiscal policy may also be necessary if the monetary union's central bank has a response function different than that of the country's monetary authority. For example, the ECB's preference for output stabilization could be less than that of the country's central bank prior to joining the monetary union ($\theta^M < \theta^m$). This is a distinct possibility for many members, as the ECB adopted the German model of monetary policy which had an established reputation of being extremely responsive to inflation (Wyplosz, 2006). In order to maintain the same level of output stabilization as before, a fiscal authority may have to act more aggressively because of the weaker response of the central bank. To illustrate, assume that the shocks that hit the economy are the same so the optimal reaction for the fiscal authority is illustrated by equation (7). If the weight the monetary authority placed on output stabilization θ changes then the fiscal reaction changes.

$$\frac{\delta g_i}{\delta \theta^j} = -\frac{1}{(\kappa^2 + \theta^j)} \left[\theta^f \kappa b(2\kappa^2 b^2 + \kappa^2 \alpha) + \kappa^3 b(\kappa^2 b^2 + \kappa\alpha)\right] u < 0 \tag{21}$$

In this case, even if there is a common cost push shock across the union, the fiscal authority may take on a greater role if the new monetary authority is placing less weight on output stabilization (θ^m falls). The case is similar for demand and fiscal shocks; if there is some asymmetry the fiscal authority would have an even greater role.

It is also possible that the changes in the deficit are not structural at all, but that greater deficits are a result of changes in political will. In an attempt to meet the deficit criterion of the Maastricht Treaty, most countries had to implement sometimes painful structural as well as temporary changes to their budgets. For example, Italy went through major pension reform, raising the retirement age and increasing individual contributions in an attempt to cut down the budget deficit. In addition, temporary adjustments were made that did not affect the structure of the deficit but did bring it in line with the Maastricht criteria. Italy used the sale of public assets to increase government revenue, delayed contract renegotiations, and even imposed a Eurotax which

was to be repaid after entrance into the EMU. Such reforms and one-off measures are hard to maintain especially when the promised returns from joining the union have been slow in coming. Member state populations and politicians may tire from the fiscal constraints imposed on them. Eichengreen and Wyplosz (1998) suggest that European governments traditionally have a deficit bias. If politicians become tired of reform, run out of one-off measures, and see the enforcement of the SGP as weak, then worsening deficits would be expected.

The enforceability of the SGP versus the Maastricht Treaty is important if fiscal fatigue is the reason behind worsening deficit positions. Under the Maastricht criteria, rule violation would keep a country out of the union. Punishment for violating the SGP, on the other hand, comes in the form of fines. These fines are imposed by fellow members who have little incentive to strap their already strapped neighbors with further financial obligations. In such a way, governments have less incentive to meet the somewhat arbitrary deficit rules, especially when there are economic strains at home. Busemeyer (2004) has demonstrated that the weak enforcement mechanism and the existence of large countries with strong influences in the union allow for violation of the rule without fear of reprisal. The fact that it is the larger countries and those with greater political clout that are violating the SGP and that they have succeeded in changing the SGP rules supports this hypothesis.

Even those countries which have not violated the SGP have followed the lead of the larger countries and experienced worsening budget positions. Fear of reprisal is lessened as a result of the rule changes. This weakening of the SGP makes it more difficult to overcome moral hazard risks and deficit biases. It also weakens the ability of the SGP to induce needed changes to the structure of European budgets.

4 Testing the Nature of Fluctuations

In section three it was shown that if country specific supply (u_i) or demand (v_i) shocks are asymmetric across the union then there is a role for greater fiscal management. To test whether shocks are similar enough to meet the OCA criteria and to test if that relationship has changed over time, the structural shocks that affect the economies in

Europe must be identified. Once they are identified, the relationship of shocks between members of the EMU can be estimated.

4.1 Estimation Techniques

In order to illustrate analytically the changing relationship between monetary and fiscal authorities as a result of joining a monetary union, the model in section three was not dynamic. Empirical identification of the supply and demand shocks does however depend on the dynamic relationship between output and prices. den Haan (2000) shows that a dynamic Keynesian model with supply and demand shocks does capture a negative long run comovement in prices and output for the United States, an indication that supply shocks dominate in the long run. Using den Haan's method, this relationship also holds for the EMU as a whole (See online appendix). The long run dominance of supply shocks is a restriction that will be used to identify structural shocks.

Long-run restrictions for shock identification were first used by Blanchard and Quah (1989). Numerous studies since that time have been conducted separating economic fluctuations into supply and demand shocks using long-run restrictions on SVARs. Using annual data up to 1990 from the potential EMU members, Bayoumi and Eichengreen (1993) used this technique to test Europe's status as an optimal currency area. They compare the correlation of these shocks over specified time periods and find increased correlation for both demand and supply shocks. In addition to Bayoumi and Eichengreen, the majority of studies which use this method to look at the optimal currency area criteria concentrate on the new member states (Fidrmuc and Korhonen, 2003 and 2004; Babetskii et. al., 2004 and Kenen, 2001).

The identification of long-run aggregate demand and aggregate supply shocks hinges on the theory that the aggregate supply curve is vertical in the long-run (i.e. output supplied is not affected by prices). The assumption is that real wages will adjust to changes in prices in the long-run, which correct any short-run imbalances in the labor market that may result because of nominal rigidities. The aggregate demand curve is downward sloping in both the short- and long-run, as derived from the typical textbook IS/LM model. It is easy to see that any shock to the aggregate demand curve will have no effect on output in the long-run, but will have a long-run effect on prices. A supply

shock will shift the aggregate supply curve and have a permanent effect on both output and prices in the long-run. This suggests the following long-run SVMA representation of a VAR:

$$\begin{bmatrix} \triangle y_t \\ \triangle p_t \end{bmatrix} = \begin{bmatrix} C_{11}(1) & 0 \\ C_{21}(1) & C_{22}(1) \end{bmatrix} \begin{bmatrix} \nu^s \\ \nu^d \end{bmatrix} \tag{22}$$

where y_t is the log of real GDP, p_t is the GDP deflator, and C(1) is the sum of the infinite order VMA coefficients from the Wold decomposition of the VAR, i.e. $\sum_{i=0}^{\infty} C_i$. Using these assumptions, the structural supply (ν^s) and demand (ν^d) shocks can be identified.[5]

This identification technique differentiates between reactions to shocks and actual shocks which are exogenous to the economy. This is an advantage of using structurally identified shocks for studies of optimal currency areas. Had one just compared variables such as output or the real exchange rate, similarity across countries could be attributed not only to the similarity of shocks but also to the reaction to those shocks. This does not mean that the shocks are completely disconnected from the operation of the central bank or the fiscal authorities. They themselves can generate exogenous supply or demand shocks.

Recently, the use of long run restrictions to identify structural shocks has come under criticism. Erceg, Guerrieri, and Gust (2005) argue that long-run restrictions have trouble separating permanent shocks from those that are highly persistent. Though a complete solution to this problem has not been fully reached, Dupaigne and Feve (2007) have suggested one way to overcome a possible source of contamination. They show that technology shock identification using long-run restrictions is not robust to aggregation across countries. They conclude that foreign non-permanent but persistent shocks can contaminate the data and thus the identification of structural shocks. The same problem could exist when using long-run restrictions to identify supply shocks. For example, a favorable supply shock in one country leads to a permanent increase in domestic income. Through the income effect, this increase in domestic income could increase the demand for goods from a neighboring country. The neighboring country in turn experience a prolonged increase in GDP. Using long run identification, this protracted increase in the

[5] A detailed explanation of how these shocks were identified is found in an online appendix

trading partners GDP would be identified as a supply shock, when in fact it is just a persistent demand shock.

Dupainge and Feve suggest using a cross country aggregate for the variable supporting the identifying restriction (GDP in this case). The aggregated data provides a measure less contaminated by the cross country transmission of shocks. Thus in estimating the VAR, an aggregate measure of GDP is used in place of the country specific measure of GDP. The country specific price level is still used for each regression.

In testing the OCA of the EMU members it is not only important that the shocks are properly identified but that they are also free from policy driven similarities or dissimilarities. Clearly demand shocks identified using this technique could include monetary as well as fiscal shocks. Thus the demand shocks as identified above are not a good measure of structural similarity across EMU countries. They do, however, provide information on the difficulty a central monetary authority may have in addressing country specific fluctuations, even if they are policy driven.

Supply shocks, on the other hand, are less contaminated by policy driven shocks and provide a good source for assessing optimality of the currency area for the EMU members. This measure is not fully without policy contamination. Government spending on capital, infrastructure, and other forms of investment could also move out the aggregate supply curve and thus have long-run effects on both prices and output. To remove the possibility of these policy driven supply shocks, government investment expenditure is included as an exogenous variable in the estimated VAR.

Once the shocks have been correctly identified, similarity of shocks across the regions are measured by assuming the following relationship for each country for each type of shock:

$$X_t = c + \gamma_t X_t^{EMU} + \beta_{\mathbf{3}} \mathbf{X_t^{exog}} + \eta_{\mathbf{t}} \tag{23}$$

where X_t is the country specific demand or supply shock for members at time t, and X_t^{EMU} is the EMU weighted average demand or supply shock excluding the country being tested. $\mathbf{X_t^{exog}}$ is a vector of any exogenous variables included in the regression. In order to test for a change in the relationship over time γ_t is allowed to change.

$$\gamma_t = \beta_1 + \alpha \cdot t + \nu_t \tag{24}$$

Combining (24) with (23) the relationship among shocks is estimated with the following regression:

$$X_t = c + \beta_1 X_t^{EMU} + \beta_2 \left(t \cdot X_t^{EMU}\right) + \beta_{\mathbf{3}} \mathbf{X_t^{exog}} + \epsilon_{\mathbf{t}} \tag{25}$$

where t represents a linear time trend and $\epsilon_t = \eta_t + \nu_t \cdot X_t^{EMU}$ is a heteroskedastic error term.

β_1 measures the relationship between shocks of the EMU member and its neighbors. A value closer to one indicates greater similarity, while a value further from one indicates greater dissimilarity. In the tests conducted below, the null hypothesis is that shocks move perfectly together, or that β_1 is equal to one. Rejection of this hypothesis would indicate dissimilarity in shocks for that particular member and the EMU as a whole. The time component of the relationship among shocks is measured by β_2. A significant positive value of β_2 indicates an increase in similarity over time. Estimated supply and demand shocks for the United States are added to the regression to account for the possibility that EMU members may be more similar to countries outside of the EMU community. The significance of the coefficient on US shocks and not the EMU average shocks would indicate sufficient dissimilarity in shocks. In the tests below the null hypothesis is that the EMU members'shocks are not similar to the US, or that $\beta_3 = 0$.

4.2 Data and Estimation Preparation

To identify supply and demand shocks using long-run restrictions, quarterly measures from the OECD Economic Outlook 2007 of real GDP and the GDP deflator are used. An EMU aggregate level of GDP is used in all estimations except for the United States. The aggregate used is provided by the OECD and is a weighted average of the 12 Euro Area countries. The series consists of information from the first quarter of 1980 to the fourth quarter of 2006, providing 108 observations for each country. Government investment is also pulled from the OECD Economic Outlook, but quarterly measures are only available for three EMU members. Annual date was used to interpolate quarterly values for government investment, using a cubic spline interpolation. The sample consists of nine of the original members of the EMU,[6] excluding Austria, Greece, and Luxembourg

[6]Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain

due to a lack of data. The SVAR is also run for the United States. Dickey-Fuller tests for unit roots indicate that each country's GDP and deflator series are integrated of order one except for the price series in Portugal. Andrews and Zivot's (1992) test for structural breaks indicated that the Portugal's inflation data experienced a break in 1984 quarter 1. This break will be taken into account when running the VAR by including a dummy variable. Government investment is also differenced when included in the VAR.

HQIC criteria indicated a lag length of two for most countries in the sample. As such, a lag length of two is used for each country in the sample for comparison purposes in the regression.[7] In order to verify that the ordering of the long-run restrictions is correct, cumulative impulse response functions for each of the countries are estimated. These responses are checked to see if output and inflation move in the predicted direction in response to supply and demand shocks. An identified positive supply shock should cause prices to fall and output to rise permanently. A positive demand shock should lead to a permanent increase in prices but only a temporary increase in output. Checking for these correct movements provides an over-identifying restriction of the long-run ordering assumptions. The restrictions were met for all but Finland and Portugal where prices rose as a result of a positive supply shock.[8] Fearing that the identified supply and demand shocks for these countries are questionable, and not wanting them to influence the aggregate supply and demand shocks used in equation (24), these countries are excluded from the analysis.

Historical records point to the possibility of certain episodes, such as German re-unification, that lead to abnormally large individual country shocks that would unduly influence the regression. Tests for such episodes indicated outliers in the regression for France and Germany in 1991, Ireland in 1997 and Spain in 1986. Each episode is taken into account with a dummy variable in the individual country's regression.

[7] HQIC tests indicated a lag length of four for Finland, the Netherlands, and Germany. BIC tests for each of these countries indicated a lower lag.

[8] Using aggregate measures of GDP as opposed to country specific measures improved the impulse response functions (as in meeting the over-identifying restrictions) for France, Italy, and Germany.

4.3 Results

Table 2 presents the results of the estimation of equation (25) for supply shocks. The null hypothesis is that member shocks move one-to-one with EMU shocks as a whole, or that $\beta_1 = 1$. Also presented is the relationship of shocks with the US, where significance is reported for the null hypothesis that $\beta_3 = 0$. Significance for β_2 indicates a value significantly different than zero, which would be an indication of a changing relationship over time. The standard errors reported are Newey-West heteroskdastic corrected standard errors.

Table 2: Supply shock symmetry between members and the EMU

$X_t = c + \beta_1 X_t^{EMU} + \beta_2 \left(t \cdot X_t^{EMU}\right) + \beta_{\mathbf{3}} \mathbf{X_t^{exog}} + \epsilon_{\mathbf{t}}$

Country	β_1	β_2 - time trend	β_3 - USA	R^2
Belgium	0.8166*	0.0002	-0.0062	0.5645
	(0.1005)	(0.0029)	(0.0710)	
France	0.927	-.00052	-0.0203	0.7141
	(0.1041)	(0.0018)	(0.0593)	
Germany	0.794*	0.0012	-0.0104	0.7619
	(0.1127)	(0.0019)	(0.0493)	
Ireland	0.9066	0.00055	-0.0057	0.6972
	(0.1108)	(0.0031)	(0.0550)	
Italy	0.9881	-0.0006	0.1158**	0.7953
	(0.0972)	(0.002)	(0.0494)	
Netherlands	1.0332	-0.00075	0.0086	0.8204
	(0.113)	(0.00187)	(0.0460)	
Spain	0.965	-0.0013	-0.0285	0.7617
	(0.143)	(0.0023)	(0.0516)	

$H_0 = 1$ for β_1 and $H_0 = 0$ for β_2 and β_3

* significant at 0.1 level of significance

** significant at 0.05 level of significance

Estimated from 1980q3-2006q4

Supply shocks are highly similar; only Belgium and Germany are significantly different than one and this is only at a 10 percent level of significance. There is no discernable time trend in either direction. Neither view of the effects of integration is statistically apparent. Only in Italy does the US shock explain some of the variation of supply

shocks, yet this has not diminished the significant correlation that Italy has with the other member countries. There is little evidence to support the claim that the EMU members have not met the OCA criteria of shock similarity at a structural level, nor has the relationship changed as a result of greater integration.

The results for demand shocks are presented in table 3. Demand shocks show more dispersion than do supply shocks. France and Ireland are significantly different than the EMU average and Italy is very close to being significantly different. Once again there is no discernable time trend, and the United States does not play an important role. In all cases other than Belgium and Germany, the demand shocks are less similar than supply shocks. This feature may be due to differences in the conduct of policy, or from structural differences in demand.

Table 3: Demand shock symmetry between members and the EMU

$X_t = c + \beta_1 X_t^{EMU} + \beta_2 \left(t \cdot X_t^{EMU}\right) + \beta_{\mathbf{3}} \mathbf{X_t^{exog}} + \epsilon_{\mathbf{t}}$

Country	β_1	β_2 - time trend	β_3 - USA	R^2
Belgium	1.1020	-0.010	0.0148	0.2573
	(0.229)	(0.0029)	(0.0985)	
France	0.5837**	-.00227	0.0505	0.2761
	(0.1707)	(0.0031)	(0.0950)	
Germany	1.0057	-0.0048	0.0150	0.3448
	(0.2674)	(0.0047)	(0.1019)	
Ireland	0.5489***	0.00376	-0.0638	0.3653
	(0.1966)	(0.0048)	(0.1009)	
Italy	0.5812	0.00243	0.0580	0.2218
	(0.2720)	(0.0053)	(0.1240)	
Netherlands	0.9415	-0.00552	0.00493	0.2502
	(0.2762)	(0.0878)	(0.0878)	
Spain	0.8370	-0.0052	-0.1147	0.2033
	(0.2526)	(0.0048)	(0.1011)	

$H_0 = 1$ for β_1 and $H_0 = 0$ for β_2 and β_3

** significant at 0.5 level of significance

*** significant at 0.01 level of significance

Estimated from 1980q3-2006q4

These results indicate that large asymmetry of shocks does not provide a reason for

a greater need to rely on fiscal policy in order to manage economic fluctuations. As long as the ECB is responding to the aggregate shocks in the European economy by and large the members have not had to counteract those policies with fiscal policy because of shock asymmetry. In addition, no change in that relationship has occurred over the ongoing process of integration.

5 Testing the Nature of Responses

If shock asymmetry and a failure to meet the OCA criteria do not provide sufficient explanations for worsening budgetary balances then the reaction to such shocks might. As explained in Section 3, even if shocks are the same across the union, fiscal authorities my need to rely more on fiscal management as a result of aggregation or changes in the weight placed on inflation stabilization by the new central bank. There is also the possibility of fiscal fatigue and responses just being more deficit biased.

The behavior of fiscal variables across the EMU has been an active area of research. Fiscal reaction functions have been estimated to identify differences in the way policy responds to economic fluctuations and how the deficit rules have effected those movements (Gali and Perotti, 2003; IMF, 2005; Annett, 2006). These reaction functions consist of regressions where the dependent variable is some measure of fiscal policy. They then test how the contribution and direction of output gaps, monetary policy, budgetary balances, debt levels, and other possibly important features have changed during the different stages of monetary integration. These reaction functions do help explain how fiscal policy has changed, but they can only indirectly address fiscal fatigue. In this section a structural VAR estimation of the fiscal and monetary reaction functions are undertaken. This approach has advantages over the singular regression used in previous literature because of the simultaneous equation bias. In addition, the structural VAR with certain ordering restrictions, can identify fiscal and monetary shocks as well as map the reaction of fiscal and monetary variables to certain impulses in the economy through impulse response functions.

Comparisons of impulse response functions pre- and post-EMU will reveal differences in how authorities behave. Changes in reactions to economic fluctuations could indicate

a change in the weight policy makers put on stabilization. The reaction of fiscal policy in general as well as to monetary policy also provides important insight.

5.1 Estimation Techniques

As was introduced in section three the fiscal and monetary authorities respond to inflation and the output gap, yet their actions are not independent. For example a dynamic fiscal spending (s) reaction function could react to the output gap (y), inflation (π), government receipts (r), the monetary authority (i), as well as its own lag and the lags of the other variables:

$$s_t = \beta^0_{12} r_t + \beta^0_{13} y_t + \beta^0_{14} \pi_t + \beta^0_{15} i_t + \beta^1_{11} s_{t-1} + \beta^1_{12} r_{t-1} + \beta^1_{13} y_{t-1} + \beta^1_{14} \pi_{t-1} + \beta^1_{15} i_{t-1} + ... + \nu^s_t$$

Yet receipts also responds to spending, the output gap, inflation, the interest rate, and its lag as well as the lags of the other variables:

$$r_t = \beta^0_{21} s_t + \beta^0_{23} y_t + \beta^0_{24} \pi_t + \beta^0_{25} i_t + \beta^1_{22} r_{t-1} + \beta^1_{21} s_{t-1} + \beta^1_{23} y_{t-1} + \beta^1_{24} \pi_{t-1} + \beta^1_{25} i_{t-1} + ... + \nu^r_t$$

The output gap, inflation, and interest rate would have a similar representation. Thus an OLS estimation of the first equation would be biased because of simultaneity. Gali and Perroti (2003) use instrumental variables to overcome this problem, but finding a good instrument is often difficult. A structural VAR approach provides consistent estimates of the structural parameters of the model, specifically the structural error terms which will provide measures of structural fiscal and monetary shocks. The simultaneous system of equations can be collected and written in vector form as:

$$\mathbf{B_0 Y_t} = \mathbf{B_1 Y_{t-1}} + \mathbf{B_2 Y_{t-2}} + ... + \nu_\mathbf{t} \tag{26}$$

where ($\mathbf{Y}$) is a vector containing government spending, government receipts, output, inflation, and the interest rate. ($\mathbf{B_j}$) is a coefficient matrix and (ν) is a vector of structural error terms. The reduced form VAR can be obtained by pre-multiplying by $\mathbf{B_0^{-1}}$.

$$\mathbf{Y_t} = \mathbf{\Phi_1 Y_{t-1}} + \mathbf{\Phi_2 Y_{t-2}} + ... + \mathbf{u_t} \tag{27}$$

where $\mathbf{\Phi_j} = \mathbf{B_0^{-1} B_j}$ and $\mathbf{u} = \mathbf{B_0^{-1}} \nu$. The reduced form parameters can be estimated equation by equation using OLS, but this will not provide an estimation of the structural

parameters. Identification of the structural parameters and shocks requires that the unknown parameters in the $\mathbf{B_0}$ matrix have no more unknown parameters than distinct values in the covariance matrix. Because of the symmetry of the covariance matrix, there are only 15 free parameters for the (5×5) $\mathbf{B_0}$ matrix. This means that 10 restrictions must be placed on the $\mathbf{B_0}$ matrix in order to identify the structural shocks.[9] The timing and response to fiscal and monetary policy provide these restrictions.

In the established literature on monetary shock identification, the important assumption is that monetary authorities are able to react to contemporaneous changes in the economy. On the other hand, slow transition mechanisms of monetary instruments to the economy insure that output and prices react to monetary policy with a lag. The use of quarterly data is assumed to be a short enough frequency that these timing assumptions hold.[10]

Identification of discretionary fiscal policy shocks relies on the assumption that fiscal authorities react to economic fluctuations but are unable to do so contemporaneously because of the time necessary to draft and approve changes to spending or taxes. Blanchard and Perotti (2002) have one of the more influential initial papers on fiscal shock identification via a SVAR. Perotti (2002) and Canzoneri, Cumby, and Diba (2002) have expanded on Blanchard and Perotti's technique by including more variables.

The timing of fiscal policy and the restriction it imposes is complicated by the existence of fiscal automatic stabilizers. Blanchard and Perrotti, along with the other authors cited above, use government spending and tax revenue (net of transfers) as arguments in their SVAR. These series respond within the quarter to movements in output through more (less) unemployment claims or decreased (increased) tax revenues when output is falling (rising). These authors remove the cyclical component from the reduced form residuals using outside estimations of the elasticity of government spending and tax revenue to output found in Giorno, Richardson, Roseveare, and van der Noord (1995). These estimations allow them to construct a cyclically adjusted government spending and tax revenue residual. Using the cyclically adjusted residuals

[9] See Hamilton (1994)

[10] See Chistiano, Eichenbaum, and Evans (1999) for a good summery of the state of the literature on monetary shock identification

as instrumental variables, they are able to identify structural output, spending, and revenue shocks. The authors take an agnostic stance on the ordering of taxes and spending; with no exact theory to follow they run their analysis switching the ordering assumptions.

This exercise will assume similar ordering assumptions, which combine monetary and fiscal policy into the same SVAR. Instead of adjusting for automatic stabilizers in the residual, cyclically adjusted measures of government spending and taxes are used in the original SVAR. These values come from the OECD Economic Outlook database and are calculated using the same elasticities of government spending and taxes to output from Giorno et. al. that Blanchand and Perrotti use. They are constructed to remove the cyclical component (those portions that contemporaneously respond to output fluctuations i.e. automatic stabilizers) from the government accounts. The cyclically adjusted series can be seen as a measure of discretionary policy. Under this ordering assumption, the monetary authority reacts contemporaneously to movements in spending, taxes, GDP, and inflation. On the other hand, each of these responds with a lag to a monetary shock. Fiscal policy, in the form of cyclically adjusted tax or spending innovations, does not respond contemporaneously to GDP, inflation, or the interest rate. Output and inflation, on the other hand, do respond contemporaneously to these fiscal variables. These timing restrictions provide a $\mathbf{B_0}$ matrix that is lower triangular and can be obtained from a Cholesky decomposition of the covariance matrix from the reduced form VAR. Using the fact that $\mathbf{u} = \mathbf{B_0^{-1}v}$ the structural shocks used in the previous section are identified by pre multiplying u by $\mathbf{B_0}$.[11]

The strategy used to identify changes in the response of monetary and fiscal authorities to each other and to macroeconomic fluctuations is to compare impulse response functions pre- and post-EMU. Impulse response functions could be estimated for each country separately but these results must be interpreted with a measure of doubt. The EMU has been in existence since 1999, allowing for only thirty-one post-EMU observations. For a five variable VAR this is an alarmingly small number of observations. In order to get the most information from the available data the panel VAR is used instead.

[11]Structural output and inflation shocks are not specifically identified, and will be referred to as impulses.

The advantage of using a panel data set is greater efficiency (Nijman and Verbeek, 1990). The use of panel data, however, does require that the underlying structure of the model is the same for each country in the panel. This can be partially overcome by allowing fixed effects into the model. Unfortunately, the auto-regressive nature of the VAR means that usual fixed effects estimation, instrumental variable estimation with mean differencing, no longer provide an unbiased estimation.[12] Arellano and Bover (1995) show how this problem can be overcome using a 'Helmert procedure', which removes only the forward mean of the variable in the VAR. As a result the lagged original variables are orthogonal to the transformed variable and can be used as instruments just as in the normal fixed effects estimation. These orthogonal relationships provide moment conditions from which the panel VAR can be estimated using GMM.[13]

Once the impulse response functions have been estimated, a Wald test is performed testing the differences in whole impulse response functions up to three periods after the initial shock. The covariance matrix used in this Wald test is bootstrapped from 500 Monte Carlo simulations of the differences in impulse response function pre- and post-EMU. The null hypothesis tested is that there is no difference up to 3 periods after the shocks pre- and post-EMU.

5.2 Data

Proper identification of fiscal and monetary shocks, as well as estimation of the fiscal and monetary reaction functions and their impulse responses, requires data for government spending, government revenues, GDP, prices, and the interest rate. As explained above, proper identification of discretionary fiscal policy requires that quarterly data be used. Using quarterly data also increases the number of observations, which is critical in the relatively short estimations post-EMU. Data come from the OECD Economic Outlook. The government spending series is cyclically adjusted current government disbursements excluding interest payments, while the revenue is cyclically adjusted current government receipts. The GDP deflator is used for the price series while the three month market

[12] For a good summary of dynamic linear models with panel data refer to Verbeek (2000) pp. 327-336

[13] Love (2006) provides an example of this technique being used in firm level data. She has graciously provided the code for the estimation of the panel VAR (Love, 2001)

rate is used for the interest rate series. The GDP, spending, and revenue series are transformed into real per capita terms and logged for the analysis. Inflation is defined as the log difference in the GDP deflator.

The limited availability of quarterly data restricts the number of countries that can be used to Finland, France, Ireland, and the Netherlands[14]. Each of these countries has experienced a worsening of their budget, but only France and the Netherlands have violated the SGP as a result. The Netherlands drastically improved its budgetary position the last two quarters of 2006 and is no longer running excessive deficits. Ireland and Finland still have budget surpluses though they have diminished. These four countries will be combined to form a panel data series consisting of 444 observations, 128 of which are post-EMU (taking the start date of the EMU as 1999 quarter 1).

The reaction functions and estimates will be obtained using a VAR, therefore it is important that each series used in the VAR be stationary to obtain consistent estimators. Each of the panel series were tested for stationarity with Im, Pesaran, Shin (2003) tests for unit roots in a panel series. The test rejects the null hypothesis of non-stationarity for the inflation series. The GDP, spending, and revenue per capita series as well as the interest rate series fail to reject the null hypothesis. Further testing indicates that these series would be stationary if either a trend or other time effects were removed. The non-stationarity of the interest rate series is surprising, yet tests suggest that removing a trend would make the series stationary. Close inspection of the interest rate series for each of these countries does show a pronounced downward trend. This is a product of the time period over which the sample covers. Oil shocks in the 1970's caused high inflation to which monetary authorities across Europe responded with tight monetary policy. Since that time rates have steadily fallen as inflation has been brought under control allowing for looser monetary policy. In addition, the Maastricht treaty required a convergence to a lower interest rate in preparation for joining the union. Understanding that this downward trend cannot be sustained but still needing a stationary series for the VAR, a Hodrick-Prescott filter was applied to the interest rate series. The log of GDP

[14]The length of the series varied for each country: Finland 1976q4 - 2006q4, France 1972q1 - 2006q4, Ireland 1979q2 - 2006q4, Netherlands 1972q4 - 2006q4, I will use a balanced panel and take data from 1979q2 onward.

per capita as well as government receipts and spending per capita were also filtered using a Hodrick-Prescott filter with $\lambda = 1600$. Tests show that all filtered series are stationary. HQIC tests for each country suggest a lag length of two.

5.3 Results

Impulse response functions are first estimated across the whole sample. Responses to policy shocks generally follow what one would typically expect. In response to a positive monetary shock, output and inflation fall after a delay. In response to positive shock to government receipts, such as a tax increase, output and inflation fall. Government spending shocks cause a initial increase in output and, in the only anomaly, an immediate fall in inflation. This drop in inflation is small and only last for one period, after which the response is not significantly different than zero.

Important for this paper is the response of policy variables to movements in output and inflation. In the case of monetary policy, an increase in inflation leads to a significant initial rise in the monetary instrument. The initial response to an increase in output is insignificant, but also positive, and becomes significantly positive after two periods. These observations both suggest that monetary policy has been used in a counter-cyclical manner. Fiscal policy has also responded with a delay counter-cyclically to output, with taxes raised and spending reduced in response to a positive output impulse. The response is stronger in significance and magnitude on the revenue side. In the case of inflation, the revenue response combats inflation while the spending response is inflationary. This is similar to what Muscatallli and Tirelli found for the United States. This suggests that in making spending decisions, policy makers have been less concerned about the inflationary consequences.

Impulse response functions do show some interaction between policy makers. In response to a positive shock to government receipts, interest rates fall and in response to in positive shock to interest rates government spending increases. Thus monetary and fiscal authorities are competing with one another; contractionary monetary policy is met with expansionary fiscal policy and vise versa. The interaction between the two fiscal instruments is deficit biased, spending shocks are met with increased government receipts, but the revenue increase is not as large as the original spending shock.

To determine differences in the responses pre- and post-EMU the SVAR is estimated and impulse response functions are generated separately from 1980q1 to 1998q4, and from 1999q1 to 2006q4. In order to test for differences in the responses pre- and post-EMU the difference in the responses through the four quarters following the initial shock are tested with a Wald test. The null hypothesis is that there is no difference between impulse responses up to three quarters from the time of the shock pre- and post-EMU. The Wald test statistics for the relevant tests are listed in figure 2. As the Wald test

Figure 2: Wald Test Statistics - Difference in Impulse Response Functions

Impulse	Policy Response				Shocks	Policy Interaction			
		s	*r*	*i*			*s*	*r*	*i*
	y	7.17	4.35	2.30		*s*		9.14*	2.00
	π	2.38	0.70	4.39		*r*	4.353		18.2***
						i	0.59	9.49*	

* significant at 10% level of significance
*** significant a 1% level of significance
H_0: difference in impulse response the same pre and post EMU, critical value from Chi distribution with 4 degrees of freedom
s = spending, r = receipts, i = interest rates (monetary shocks), y = output, and π = inflation

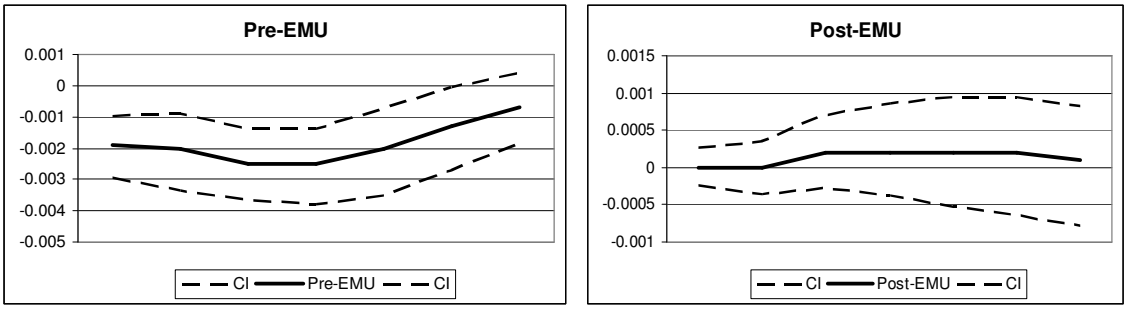
indicates, there has been no significant difference in the way that policy makers have responded to fluctuations in the economy pre- and post-EMU. Recall from the model presented in section three, that differences in the conduct of fiscal policy pre- and post-EMU could be tied to different weights placed upon output and inflation stabilization by the policy regimes pre- and post- EMU. This result suggests that the differences in weight placed on smoothing fluctuations have not been significant enough to account for changes in deficit positions.

There are significant differences in policy interaction pre- and post- EMU. The test indicates a significant difference in the way government receipts (r) respond to monetary shocks (i). A visual inspection of the difference in impulse response functions with confidence intervals generated by Monte Carlo simulation indicates that the difference does not appear until at least three periods after the initial shock, where the interpretation of such differences are not as forthright.

Figure 3 shows the response of the monetary instrument to a government receipts

shock with Monte Carlo generated 95 percent confidence bands. There is a significant

Figure 3: Interest Rate Response to a Fiscal Receipt Shock

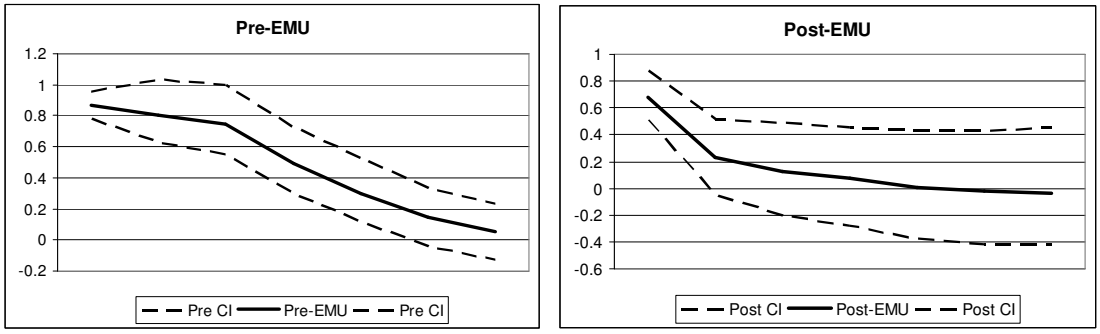


negative response pre-EMU indicating that the monetary authority would fight against the fiscal authority actions. A contraction by the fiscal authority (a positive receipts shock) is met by an expansionary lowering of the interest rate. Post-EMU there is no significant response of the monetary instrument to the fiscal action. This is most likely due to the aggregation of fiscal policies to which the ECB would have to respond. In addition, there is no change in how monetary authorities respond to spending shocks, government spending responds to monetary shocks, or government receipts respond to monetary shocks in the first three quarter. The fact the the only significant change in the response of authorities to each other makes reliance on fiscal policy less important, excludes this as possible explanation of worsening fiscal balances.

One significant difference remains between the response of the different fiscal instruments to each other. A significant difference pre- and post-EMU was found in the response of receipts to a spending shock. Figure 4 illustrates the differences in the reactions pre- and post-EMU. This significant differences is an indication of fiscal fatigue. A positive response of receipts to a positive spending shock does indicated a balanced fiscal move. A positive spending shock which would increase the deficit is met by an increase in government receipts. This increase, however, does not match the size of the shock to spending.[15] Thus the spending shock worsens deficit positions. Within the first three quarters, the response of receipts to a spending shock is significantly smaller

[15]All shocks have been normalized to be one percent pre- and post-EMU.

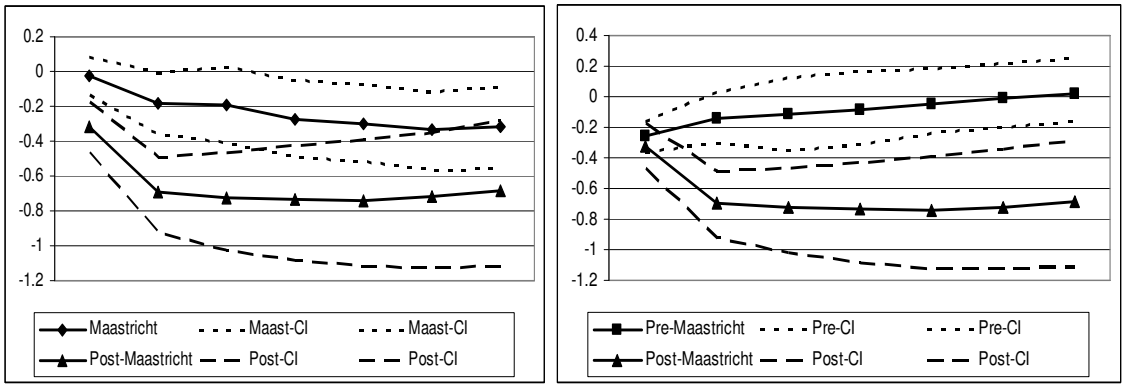
Figure 4: Receipt Response to a Spending Shock



post-EMU and thus more deficit biased.

To illustrate the sample has been split into three distinct periods; pre-Maastricht (1980q1-1991q1), the Maastricht period (1991q2-1998q4), and post-Maastricht (1999q1-2006q1). Deficits in response to positive spending shocks are depicted in figure 5. The

Figure 5: Deficits after a Positive Spending Shock (90% Confidence Interval)



only period in which the initial spending shock is met with a non-deficit inducing increase in receipts is during the Maastricht period, when enforcement of deficit rules was credible. The initial response post-Maastricht, in which deficit rules remain under the SGP, has essentially the same deficit response as did the pre-Maastricht period under no deficit rules. Over the whole response function deficits biased responses have been largest post-Maastricht. When the order of spending and receipts are reversed in the VAR, the deficit bias remains in response to a negative receipts shock. This response

would be consistent with a fiscal authority trying to meet political aims with less regard for budget balances, a sign of fiscal fatigue after the tight period under the Maastricht treaty.

This conclusion of deficit bias is only true if fiscal shocks are expansionary. If, on the other hand, shocks are contractionary the estimated outcome above would lead to a deficit reduction. Table 4 presents the post-EMU average of the estimated fiscal shocks for each country. The average spending shock for each member post-EMU is positive,

Table 4: Average Fiscal Shocks Post-EMU

Country	Spending	Receipt
Finland	0.0003	0.1133
France	0.1105	-0.0186
Ireland	0.0238	-0.0929
Netherlands*	0.0897	-0.0207

* Netherlands excludes 2006 quarter 3 and 4

though relatively small for Finland.[16] Post-EMU average revenue shocks are negative for each member in the sample excluding Finland. Finland's smaller spending shocks and positive revenue shocks reflect their budgetary position, which has been one of the strongest throughout integration. The results do indicate that fiscal shocks have been predominantly expansionary post-EMU. Thus the change in fiscal reaction among instruments have been deficit biased, making fiscal fatigue a significant contributor to worsening budgetary conditions.

6 Conclusions

After successful efforts to bring deficits into compliance with the Maastricht treaty, EMU members' budgetary balances have deteriorated. Some members have even violated

[16]If the last two quarters of 2006 are included for the Netherlands the average spending shock is negative. This reflects the Netherlands sharp deficit contraction in the last two quarters of 2006 after a steady worsening of deficit positions post-EMU

the deficit rules set out by the SGP. The worsening of budgetary balances could be linked to a greater reliance on fiscal policy as a result of losing the ability to conduct independent monetary policy. The problem arises if members do not meet the OCA criteria or if shock asymmetry worsens as a result of greater integration. The conduct of fiscal policy could also change in the way authorities respond to output and inflation fluctuations. Specifically, if the ECB responds differently to fluctuations than did the individual monetary authorities. It is also possible that the loosening has little to do with structural changes, but more to do with political factors. The inability of ECOFIN to enforce the SGP and the tough reforms undertaken to meet the entrance criteria have made sustaining the same austerity politically difficult. Fiscal fatigue could have set in as countries lost the will and incentive to maintain tight balances by reverting to the deficit biases that were common in Europe starting in the 1970's.

The limited amount of data since the advent of the monetary union has made it difficult to differentiate empirically between possible causes of the worsening of fiscal balances. Yet even with the limited data, this study finds support for fiscal fatigue. Identification and correlation of supply and demand shocks suggests that, in general, structural supply shocks are similar across members. This indicates that the structures of the EMU members are similar enough that a common monetary policy should not force excessive reliance on fiscal policy to smooth country specific fluctuations. Demand shocks are also similar, though not as much as supply shocks. This could be driven by non-structural differences, such as fiscal policy, as fiscal shocks are much less correlated in this sample. There is no evidence to suggest that shocks have become more or less asymmetric as a result of joining the EMU.

Estimation of SVAR response functions and generated impulse response functions from four EMU countries illustrate how policy has changed as a result of joining the EMU. There is no statistical difference in how the fiscal or monetary authorities have responded to fluctuations in output and inflation. Thus, fiscal authorities have not needed to increase their role to make up for differences in how the ECB conducts policy compared to when they had their own independent monetary authorities. Differences in responses have been detected in how authorities interact with each other. Monetary authorities have become less obtrusive to fiscal policy shocks, lessening the need for

stronger reliance on fiscal policy. On the other hand, fiscal policy has become more deficit oriented in the face of expansionary policy since the start of the EMU. Revenues do not increase enough in response to a positive spending shock to prevent deficits. This response is most pronounced under the SGP, whereas under the Maastricht criterion, initial spending shocks were met with equivalent revenue increases.

This result indicates that fiscal fatigue is largely responsible for worsening deficit positions post-EMU. Shocks are not sufficiently different and the relationship is not changing across time. Responses to economic fluctuations are similar pre- and post-EMU, yet fiscal shocks have been more deficit inducing. Such a response is consistent with a fiscal authority trying to meet political aims with less regard for budget balances.

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