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Evi Pappa

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Introduction

There's a proverb that says that many hands make light work and another that states that too many cooks spoil the broth. Both proverbs attempt to describe the same thing: teamwork. Teamwork can make a task easier, but it can also complicate it when all members of the team have to take common decisions and cooperate in the accomplishment of the task. The proverbs refer to the teamwork of different individuals, but they can also refer to different countries in a monetary union.

The creation of a monetary union can bring a lot of benefits to the country members but entails many complications too. For example, it eliminates exchange rate risks and promotes trade between the union members. On the other hand, it implies that domestic monetary policy cannot be used to respond to region-specific economic disturbances. Interest rates, for example, can no longer serve to meet regional targets for inflation and output and, for a region wishing to exert influence over its domestic economic conditions, fiscal policy is the only instrument left for manoeuvre.

The use of fiscal policy as a stabilization tool in a monetary union poses several questions: Can regional fiscal policy affect domestic macroeconomic conditions and how? Are country-members bound by fiscal constraints able to offset the effects of shocks to regional variables? What are the welfare consequences of fiscal constraints? Are there alternative arrangements to fiscal constraints that are welfare improving?

All these questions arise naturally in the European Monetary Union (henceforth EMU). The fiscal framework exemplified in the Stability and Growth Pact attempts to combine flexibility, for coping with cyclical downturns, with discipline, for limiting negative externalities produced by individual members' irresponsible policies. The presence of such rules designed to produce similar levels of inflation, public deficits and debt signals the aversion of political leaders to regional dispersion in fiscal positions. There is some economic logic behind this concern. For example, differentials in the level of public debt may generate political games where a virtuous region has to bail out a less virtuous one to avoid the collapse of the union. Similarly, differentials in price dynamics may interfere with the goal of price stability (see, e.g., ECB Monthly Bulletin, 2003). In this respect, a monetary authority concerned only with the average rate of inflation in the union may impart perverse nominal dynamics in individual regions, with large inflation differentials when deciding on a common interest rate policy.

The current *opuscle* is a summary of recent research I have done on the subject. In particular, it brings together my work with Vanghelis Vassilatos on "The Unbearable Tightness of Being in a Monetary Union: Fiscal Restrictions and Regional Stability," published in the *European Economic Review*, and my work, with Fabio Canova on "Price Differentials in Monetary Unions: The Role of Fiscal Shocks," published in the *Economic Journal*. The two exercises offer a variety of results that can enrich our knowledge about the role of fiscal policy in monetary unions.

The first article is theoretical and tries to assess how much is lost in terms of welfare by restraining fiscal policy in a monetary union. In particular, it investigates how regional fiscal policy can affect regional inflation and output in a theoretical monetary union with two regions. Using this model we study the macroeconomic and welfare properties of different types of fiscal constraints. This is a very pertinent question since fiscal constraints have often been in the past but also very recently the subject of long debates. Since the Stability and Growth Pact (henceforth SGP) came into force in 1999, its implementation can be best characterized as mixed. The disappointing fiscal performance in some European countries after 2001 has placed a considerable pressure in the implementation of the Pact. The crisis reached its peak when the ECOFIN decided to put on hold the excessive deficit procedures for France and Germany, in November 2003. The reform of the SGP confirms that the implied restrictions were too inflexible in light of a changing economic reality and that they represented an impediment to the evolution of the union-wide economy (see, e.g., Blanchard and Giavazzi, 2003). For that reason, the reform of the Pact in September 2005 allowed for more flexibility in budgetary rules and put stronger emphasis on debt and regional idiosyncrasies. The article gives arguments in favour of the reform of the Pact.

The second article is empirical and tries to assess how much fiscal policy shocks can make regional variables diverge from union-wide ones. It studies the relationship between fiscal shocks and regional price, output and employment differentials in monetary unions using a sample of 9 European countries and 47 US states. Its results are

crucial for policy analysis. If regional fiscal shocks can affect regional output, employment and inflation, fiscal policy can be used as an additional tool for policy in the absence of the exchange rate in a monetary union.

The first part of the *opuscle* shows how fiscal policy variables can affect regional output and inflation theoretically and how fiscal policy can be used to increase stability and welfare in a monetary union. The second part of the *opuscle* validates the theory. It supports the theoretical argument by showing that regional fiscal policy shocks do have regional effects and, hence, fiscal policy can be used as a tool for regional stabilization purposes. Finally, given the crucial role of fiscal policy in the recent recession, it is essential to know whether regional fiscal policies can boost the actual regional economies from the economic downturn as well as the size of the multiplier effect they can induce on output. This is analyzed in the second part of the *opuscle*.

1. Theoretical analysis

1.1. An economy to study the necessity of fiscal rules

The model economy is a monetary union which consists of two regions, home and foreign, each populated by a continuum of identical, infinitely lived agents. The representative household in each region is endowed with one unit of time, and derives utility from consuming a basket of goods produced in both regions. Agents also derive utility from a domestic public good which is provided by the government. There is no migration, so households supply labour to domestic firms only. The two regions are subject to supply (productivity) shocks.

The economy features staggered price setting and imperfect competition in the goods market. Firms are price takers in the input market and monopolistic competitors in the product markets. Following Calvo (1983), at each period domestic producers are allowed to reset their prices with a constant probability, independently of the time elapsed since the last adjustment. Producers face domestic (private and public) and foreign demand for their product.

Regional governments can levy distorting taxes and issue nominal riskless debt to finance a given process of spending. The government in each region decides the amount of government expenditure in domestic goods, lump sum taxes and taxes on labour, and the level of debt. Monetary policy is conducted at the union level by a central bank that sets the union-wide interest rate.

The solutions of the households' and firms' problems characterize the equilibrium in our two-region economy. The dynamics of inflation in each region are described by the Phillips curve, which relates the domestic growth rate of prices to current and future marginal costs. We show that domestic and foreign fiscal policy affect marginal costs and thus the path of regional inflation.

In our economy real marginal costs in the home region can be affected by regional fiscal policy because the latter affects the labour market variables. Taxes on labour income affect real wages and, thus, marginal costs, while increases in government spending affect marginal costs through their impact on demand and, thus, on employment. Notice that domestic marginal costs are also affected indirectly by foreign fiscal policy since, with trade links, increases in foreign demand affect the terms of trade (terms of trade externality). Thus, in our theoretical framework, both domestic and foreign fiscal policy affects the evolution of

domestic inflation in each region. This implication is crucial for the derivation of our results.

Our goal is to analyze the welfare and macroeconomic stability properties of different fiscal policy arrangements for a given monetary policy. As a benchmark, we first analyze the optimal regime in which both fiscal authorities and the central bank cooperate. We model such a regime by assuming that a world planner chooses the fiscal instruments in the two regions and the monetary instrument so as to maximize world welfare. Then, we study the welfare and stability properties of alternative fiscal rules for a given monetary policy. We assume that regional governments commit to follow the fiscal rules.

1.2. Optimal monetary and fiscal policy

The planner chooses monetary policy for the whole area and fiscal policy for the two countries to maximize the present discounted value of a welfare objective for the monetary union. We characterize this policy as the optimal plan. The behaviour of this ideal economy serves as a benchmark to evaluate the performance of alternative simple but more realistic rules for monetary and fiscal policy.

A natural welfare criterion in our model is the representative household's utility. Following the approach described in Liu and Pappa (2008), we derive an analytical expression for the welfare criterion based on the sum of the households' utility function in the home and the foreign region. Then we find the allocations under the optimal plan by maximizing the welfare objective subject to the set of equilibrium conditions of the two regional economies.

There are many distortions in this economy. First, prices are sticky in the short run in both countries, moreover, the exchange rate is fixed in a monetary union, so relative prices of goods are also sticky, and finally there exist distortionary labour income taxes[1]. The planner can use the union-wide interest rate and government spending and taxes in each region to undo these distortions. Moving the government expenditure is costly because the agents care about the provision of public goods and moving taxation is also harmful since taxes affect the long run level of output. Thus, the planner has to strike a balance between these multiple objectives and tools that are available for policy.

According to the planner's objective function, welfare depends crucially on regional inflation variability and on the deviations of private and public consumption from their flexible price values, which we call gaps. This is so because under flexible prices the economy is closest to its efficient level. As a result, the planner prefers to bring the economy close to an allocation that resembles the allocation under flexible prices. The optimal plan has the following properties: regional inflation rates are completely stabilized and government consumptions mimic their flexible price path, while taxes and debt vary. The stabilization of prices undoes the sticky price distortion, since if no firm changes its price, the fact that prices are sticky creates no tension between the different monopolistic competitive firms. However, this comes at a cost: given the stabilization of regional inflations, the terms of trade cannot reallocate resources as when prices are flexible and, in turn, private consumptions deviate from their flexible price values as well. Thus, the planner opts for a policy of inflation stabilization using the tax rate as an instrument for smoothing variations in real marginal costs and allows for deviations of private consumption and output from their flexible price levels[2].

1.3. Decentralized policies

The previous section has underlined an important feature of our economy: in a monetary union when regional prices are sticky the most advantageous allocation of resources can be achieved when regional inflations are stabilized. In this section we study the effects of different types of decentralized fiscal policy on regional stability and welfare. We assume that the central bank follows a monetary policy that targets union-wide inflation, while regional fiscal authorities commit to follow specific fiscal policy rules.

We define union-wide inflation as the weighted sum of regional inflations and we model the behaviour of the central bank by assuming a Taylor-type of rule for the setting of the union-wide interest rate. Under a Taylor rule the central authority reacts to union-wide inflation pressures by increasing the interest rate.

We consider general rules for fiscal policy in the two regions that try to include the SGP requirements for fiscal policy performance as special cases and study the welfare and stability properties for different specializations of these rules. The government deficit is defined according to the accounting definition of the SGP, as the sum of government spending and interest payments on debt minus tax revenues.

We formulate the fiscal policy rules using both government spending and income tax as tools, since both can be used to determine the fiscal stance and can affect marginal costs and output in equilibrium. In each case the fiscal instrument is modeled to react to its past value, allowing for tax or government spending smoothing; to deviations of regional debt and deficit from their target level; and to changes in regional macroeconomic variables such as inflation, or the output gap, or both. The two instruments are not allowed to be simultaneously active. When taxes vary to form the fiscal policy stance, government spending is assumed to be constant and, by the same token, when government spending is used as the fiscal instrument, taxes are assumed to be constant.

When the speed of adjustment for the tax and government spending rules to deviations of debt or deficit from target is high, fiscal policy is passive in the sense defined in Leeper (1991) and its role is constrained in generating sufficient tax revenues or managing government spending to meet the debt/deficit requirements. In contrast, when this reaction is small, fiscal policy is active in the sense that it is not constrained by restrictions on the level of debt and deficit and is allowed to engage in regional stabilization policies. Thus, the general rules we consider can incorporate different types of fiscal policy regimes. Von Hagen, Hughess-Hallett and Strautch (2001) have suggested that successful consolidations in industrialized countries involve movements of expenditure in response to macroeconomic conditions. On the other hand, Leeper (1991) introduces fiscal rules in which taxes respond to debt variability. Our analysis allows studying the effectiveness of the two fiscal policy instruments.

We will analyze the welfare and macroeconomic stability properties of different variants of the two fiscal rules. Since our model does not have closed-form solutions, we resort to numerical simulations in order to calculate the welfare outcomes of different fiscal policy regimes. Numerical simulations, however, require the usage of specific values for the parameters of the model. For this purpose, we calibrate the parameters in the model using data for France and Germany. We start our analysis by assuming very strict rules in which the fiscal instrument adjusts so that deficit and debt remain constant at their steady state level.

1.4. Strict fiscal rules

The case of constant deficits and debt is obtained for fiscal rules with a high weight on debt or deficit stabilization and zero weights in regional macroeconomic stabilization[3]. We consider four different specializations to represent strict fiscal regimes: (a) deficit stabilization through variable taxation, (b) debt stabilization through variable taxation, (c) deficit stabilization through variable government spending and (d) debt stabilization through variable government spending. Table 1 reports the welfare losses and the macroeconomic stability properties of the four different regimes[4].

The welfare loss here is measured as the percentage of steady-state consumption equivalence, that is, the percentage increase in the long-run consumption required to keep the households indifferent between living in a world with optimal policy and in one with fiscal constraints.

The presence of strict debt and deficit constraints is costly. However, the losses, although considerable, are not as severe as one would expect. They range between 2.5 % to 3.4% of steady-state consumption. This is of a substantial magnitude but not extremely high, compared to the welfare losses stemming from other distortions in a two-country model, as, for example, the inefficient fluctuations in the relative price of non-traded goods due to price stickiness (Liu and Pappa, 2008)[5].

In order to understand the intuition for this result, note that strict regional debt and deficit constraints, together with a union-wide inflation target on the part of the central bank, can implement an equilibrium with regional inflation stability, which is highly important for welfare. This is because when government spending and taxes move to balance the budget they do not affect adversely

Table 1. Welfare losses for strict fiscal rules

Fiscal rules	Regime (a)	Regime (b)	Regime (c)	Regime (d)
Welfare loss (%)	2.53	2.18	2.52	3.40
Variance inflation	0.0003	0.0003	0.0003	0.0003
Variance output gap	0.0108	0.0140	0.0140	0.0216
Variance TOT gap	0.2567	0.0526	0.0694	0.1544
Variance government consumption	0.0527	0.0526	0.0694	0.1544
Variance private consumption	0.0045	0.0033	0.0135	0.0023
Variance income taxes	0.1040	0.0422	0.0000	0.0000

the behaviour of real marginal costs and, through the Phillips curve, the evolution of inflation. For example, suppose government spending is the fiscal instrument that targets deficit (i.e., scenario (c) in Table 1) and a positive productivity shock occurs. A positive productivity shock increases tax revenues since it increases employment and output. This implies that the deficit tends to decrease after a positive productivity shock. However, the fiscal rule implies constancy of the deficit in equilibrium. As a result, government spending should increase to keep the deficit constant. Now, regarding inflation, the increase in productivity reduces marginal costs, but the increase in government spending increases marginal costs, so that in equilibrium marginal costs remain almost constant. Since marginal costs do not change in equilibrium, the Phillips curve implies that inflation is also stable.

However, the movements in taxation and government spending do alter the behaviour of output and consumption. Since the inflation rates in the two regions remain constant, the terms of trade cannot adjust to implement the reallocation of consumption under flexible prices. For that reason, consumption and output gaps are non-zero. The variability of these gaps for the four different strict fiscal regimes is presented in Table 1.

1.5. Flexibility in fiscal rules

In what follows we study how increasing the flexibility of the fiscal rules affects regional stability and welfare in our two-region currency area. To this end we analyze the macroeconomic stability and welfare properties of the four regimes described in the previous section, when we increase the coefficients on inflation and the output gap from zero to positive values in the strict fiscal rules.

Inflation stabilization

We first consider more flexible fiscal rules that target the domestic growth rate of prices in each region. To this end we allow fiscal policy to react to changes in domestic inflation apart from deviations of debt or deficit from their target values. In Figure 1 we show how welfare changes when we gradually increase the response of the fiscal authorities to variations in domestic inflation. The left panel of the figure presents welfare losses as a function of the inflation coefficient in the fiscal rule when the income tax is used as the fiscal instrument in each region to either stabilize real debt (regime (a): continuous line), or deficits (regime (b): discontinuous line). The right panel of the figure plots similarly welfare losses when government spending is used as the fiscal tool.

When fiscal authorities in the two regions react to domestic inflation, besides stabilizing the debt or deficit, welfare is improved in almost all cases. This is because stronger regional inflation targeting implies higher regional inflation stability, which is very important for welfare. However, since most of inflation stabilization is achieved at the central level, the additional gains from inflation stabilization at the regional level are relatively small. Hence, the welfare losses decrease with the size of the inflation coefficient, but not substantially.

Output gap stabilization

Can fiscal policy improve welfare when it targets the regional output gap? The answer is yes and is depicted in the two panels of Figure 2 where we let the fiscal authority react to output gap movements in each region besides stabilizing the regional debt or deficit. Again, the left panel shows how variations in the coefficient of the output gap in the fiscal rule change the consumption

Figure 1. Welfare losses as a function of the inflation coefficient of the fiscal rule

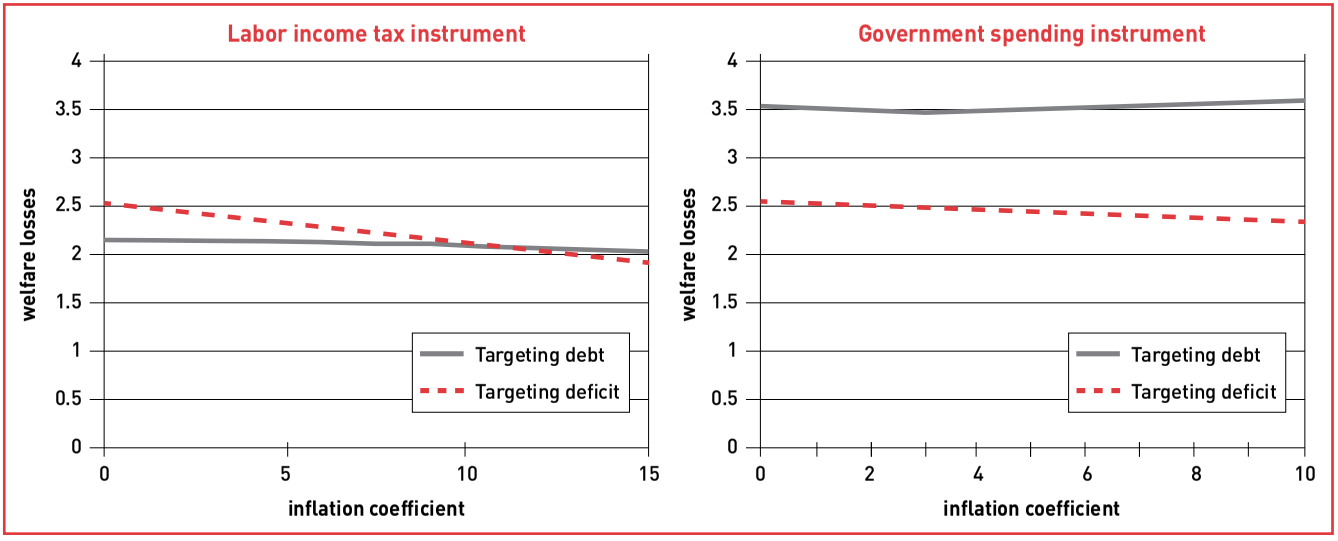
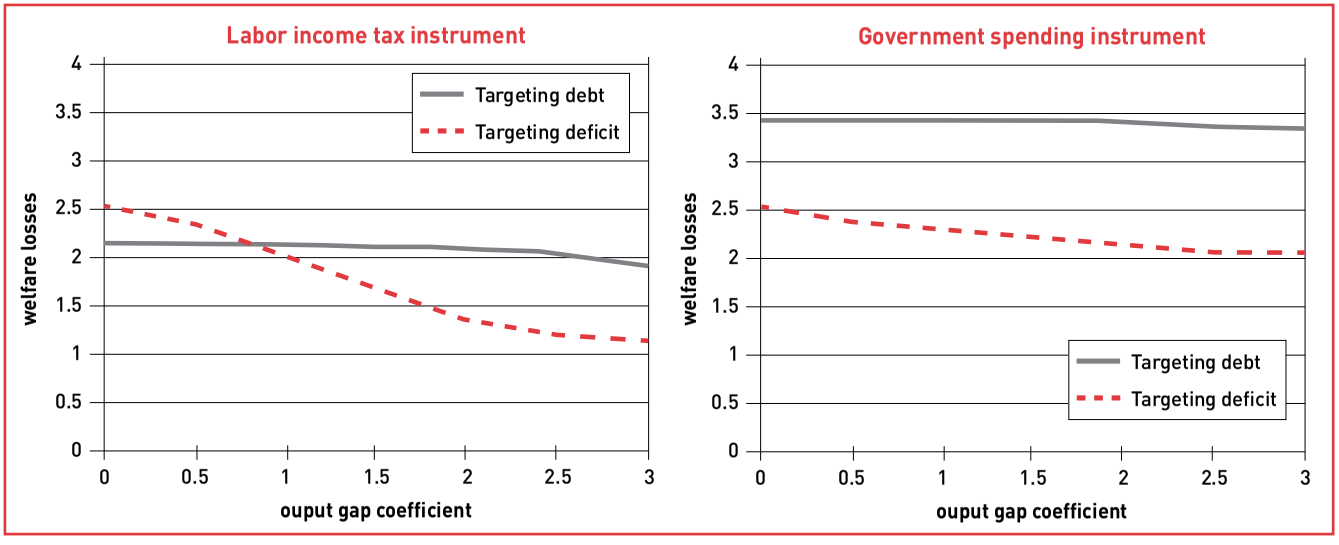


Figure 2. Welfare losses as a function of the output gap coefficient of the fiscal rule



equivalence losses when the fiscal instrument is income taxation and the right panel plots the case of variable government spending. The continuous lines refer to the case of debt stabilization, while the discontinuous lines to the case of deficit stabilization.

The general pattern is very similar to the case of inflation stabilization except that welfare losses decrease with the size of the output gap coefficient more substantially. Starting from a deficit targeting regime, with a tax rule, regional output gap stabilization reduces welfare losses from 2.5% to 1.1% of steady state consumption equivalence and with a government spending rule from 2.5% to 2.1%. Strengthening the reaction of regional policy to output gap variations delivers higher welfare gains relative to strengthening the reaction of regional policy to inflation variations. The reasoning behind this pattern is quite intuitive. Since the monetary authority targets inflation, regional fiscal policy complements the central authority's policy by focusing on regional output stability.

Our results are in accordance with the ones of Ferrero (2009) who finds regional fiscal policy flexibility to be crucial for regional stabilization in a monetary union. Also, they can be compared with the study of Beetsma and Jensen (2004), who confirm the central role of fiscal policy in stabilization of relative shocks and with Canzoneri, Cumby and Diba (2005), who support that monetary policy in a currency union should target price stability whereas fiscal policy should provide stabilization to asymmetric shocks.

1.6. What rule to choose?

The objective of the SGP reform that was agreed by the EU states in September 2005 is to enhance the economic relevance of the SGP framework and strengthen credibility and enforcement. Some of the key changes involving the deficit criteria include (a) the presence of differentiated "medium-term objectives" (henceforth, MTO) for every region in the EMU that take into account the economic characteristics and the cyclical position of each country, and (b) differentiated adjustment efforts to the MTO that take into account the regional business cycle position. On the other hand, the reformed pact prescribes an increasing focus on debt and sustainability. The debt surveillance framework is strengthened by applying the concept of a government debt ratio that is "sufficiently diminishing and approaching the reference value at a satisfactory pace" in qualitative terms and by also taking into account macroeconomic conditions and debt dynamics.[6]

Our results justify the SGP reform: more flexibility should result in welfare gains and macroeconomic stability as long as fiscal authorities engage in domestic stabilization policies. Another important policy implication of our results is that regional fiscal policy should focus on regional output gap stabilization. Thus, our analysis justifies the adoption of differentiated adjustment efforts to the MTO that take into account the regional business cycle position.

Hence, our results tone well with the change of focus towards debt stabilization in the reformed pact and the increased flexibility of the deficit criteria. They further suggest that the tightness of fiscal constraints is not that unbearable in terms of welfare costs. These results are in line with the empirical results of Canova and Pappa (2006) that find that macroeconomic stability is barely affected by the presence of budgetary restrictions in the US states. They reflect the fact that in our model welfare gains arise essentially from inflation stabilization which is under the control of the central bank.

2. Empirical analysis

2.1. The need for empirical support

One of the main theoretical predictions of the previous analysis was that fiscal policy, both in the form of government expenditure and in the form of distortionary taxation, can affect regional inflation in a two-country model of a monetary union. In what follows we examine whether this hypothesis is validated by the data. That is, we study empirically the relationship between fiscal disturbances and regional price and output differentials in monetary unions using a sample of 9 European countries and 47 US states using Structural Vector Autoregressions (henceforth VARs).

We identify fiscal shocks as innovations in the government spending and in the government revenue processes. Fiscal shocks are supposed to represent unexpected changes in the fiscal stance. Identifying economically meaningful shocks is always a difficult enterprise and fiscal disturbances are not an exception. Endogeneity of fiscal variables, interactions between fiscal and monetary policy decisions, delays between planning, approval and implementation of policies, and shortage of reasonable restrictions make fiscal disturbances difficult to recover. In this work we circumvent these problems, using sign restrictions on the dynamics of output and deficits generated by a large class of dynamic stochastic general equilibrium (DSGE) models (see, e.g., Baxter and King, 1993; Ludvigson, 1996; Ohanian, 1997; Fatas and Mihov, 2001 and Pappa, 2009).

Notice that the previous section involved the analysis of fiscal rules while in this section the focus is on fiscal shocks. The two issues are interrelated. By studying the effects of fiscal shocks on regional output, employment and inflation, we learn many things that are important for policy analysis. First, it is essential to know if such shocks have real effects. If the empirical analysis reveals that regional fiscal shocks have no significant regional real effects, the theoretical analysis in the first section is incongruous. Second, knowing the size of the impact of fiscal shocks on regional variables is also useful for policy. In particular, measuring the multiplier effect of fiscal shocks on output can help determine the effectiveness of fiscal policy. Third, determining in which directions such shocks affect macroeconomic variables is useful for the design of fiscal rules. If, for example, we find that exogenous increases in regional government expenditure increase substantially regional output in the data, then we can justify rules in which government consumption reacts to deviations of output from potential. Hence, the results of the empirical analysis can justify the assumptions adopted in the first part of the *opuscle*.

2.2. The reduced form model

We model the VAR for each unit using five endogenous variables, a few exogenous variables and a constant for both unions. The endogenous variables, all logarithmically transformed are: the ratio of the local to the union wide price level; the ratio of the local to the union wide real per-capita GDP; the ratio of the local to the union wide employment level; the local real government revenues and the local real government expenditure, both in per-capita terms and deflated by local prices. The exogenous variables we include are the area-wide nominal interest rate, the level of oil prices and, for the US, the area-wide deficit and the local debt. Oil prices are used to capture aggregate area-wide supply effects, while with the nominal interest rate and the area wide deficit we attempt to control for aggregate cyclical effects which are demand driven. Favero and

Monacelli (2002) estimate fiscal policy rules and found that debt is an important determinant of taxes and expenditures. We include local debt in the specification for US states but exclude it from the EMU models since only annual data, displaying very little variations over the sample, is available. Similarly, we exclude the area-wide deficit from the EMU specification since no federal fiscal authority exists.

2.3. Identifying fiscal shocks

While structural VARs have been extensively used to study the transmission of monetary policy shocks, (see Christiano, Eichenbaum and Evans (1999) and Leeper, Sims and Zha (1996) for references), considerably less work has been done to identify fiscal disturbances and to examine their macroeconomic effects[7].

This apparent lack of interest is due, in part, to the fact that fiscal policy is rarely unpredictable. A fiscal change is usually subject to long discussions and political debates before it is implemented. These delays make standard innovation accounting problematic: agents adjust their behaviour to the new conditions when the old regime still prevails; macro variables start moving before the shock occurs and no surprise is measurable at the time when the policy change actually takes place. This "non-fundamentalness" problem plagues fiscal shocks more than other types of policy disturbances. A second conceptual problem has to do with the fact that, even when the policy stance is unchanged, expenditures and revenues move with the state of the economy. For example, tax revenues increase in an economic boom and expenditures expand in a recession without necessarily having observed any change in the fiscal stance. Hence, to make the exercise meaningful it is necessary to carefully distinguish variations in fiscal variables due to exogenous policy shifts from those due to endogenous reactions to business cycle conditions. Third, as it is for example suggested in the fiscal theory of the price level (see e.g. Christiano and Fitzgerald (2000) for a survey), fiscal and monetary policy actions may be related. This was true in the past in many EMU countries were monetary authorities residually satisfied the government budget constraint. Whenever fiscal and monetary decisions are related, identifying fiscal shocks in isolation from other policy disturbances may be misleading (see e.g. Neri, 2002).

Our setup is designed to avoid, in principle, all these problems. First, because we consider monetary unions, we can take monetary policy as given when examining regional fiscal policy. We do this by imposing the exogeneity of the economy wide interest rate with respect to regional variables. Second, since in the VAR all variables are endogenous we can control for the state of the local business cycle while the state of the aggregate economy is automatically factored out by taking real variables in deviation from union wide variables and introducing a number of additional area wide controls. Third, since we precisely define the kind of fiscal disturbances we are looking for and the timing of the responses of the endogenous variables is largely unrestricted, the non-fundamentalness problem is also considerably eased.

The identification restrictions

In this exercise, we seek expenditure shocks with the following characteristics:

1. (G) They must produce contemporaneous positive comovements in regional deficit and positive comovements in regional output.

2. (BB) They must leave contemporaneous regional deficit unchanged and produce negative comovements in regional output.

The first type of expenditure shocks is the one usually encountered in macroeconomic textbooks, in dynamic real business cycles (RBC) or sticky price models (see e.g. Baxter and King, 1993; Ludvigson, 1996; or Pappa, 2009). An unexpected increase in government spending, financed either by lump sum taxation or by bond creation, increases by definition regional deficit, stimulates aggregate demand and boosts output. In identifying this type of shocks we are ignorant about the behaviour of tax revenues: they are allowed to stay unchanged or move together with expenditure as long as the correlation with the latter is not perfect. We are also ignorant about the timing of output responses (they could be contemporaneous, lagged or leading the shock).

The second type of shocks we consider are balanced-budget shocks: these disturbances produce instantaneous positive comovements in revenues, leave regional deficits unchanged and generate negative comovements in regional output. These dynamics are standard in general equilibrium models of fiscal policy. For example, Baxter and King (1993) and Ohanian (1997) showed that in a RBC type model an increase in government spending financed through labour taxation, temporarily decreases consumption and investment and has protracted negative output effects. This occurs because the change in the labour taxes more than outdoes the positive effects of increases in spending in demand. That is, although government spending increases aggregate demand, tending to increase output, the increase in taxation decreases private demand for goods. The decrease in private demand is stronger than the initial upsurge in public demand and output is reduced in equilibrium.

For revenue disturbances, we also seek two types of shocks:

1. (T) Those producing contemporaneous negative comovements in local deficits and negative comovements in local output.

2. (RL) Those which leave local deficits either unchanged or make them positively comove with the disturbance and produce negative comovements in local output.

The first type of revenue disturbance is again standard (see e.g. Fatas and Mihov, 2001). An unexpected decrease in tax revenues increases local deficits and stimulates output by reducing the tax burden on the local economy. Here government expenditure is not assumed to be unchanged: in fact, it could negatively comove with output if government consumption partially plays an automatic stabilizer role. What is crucial for identification is that the comovements of expenditure and taxes are low so that budget deficits negatively comove with revenue disturbances. Also here the timing of output responses is unrestricted.

The second type of disturbance is a "Reagan-Laffer" shock. Whenever the distortionary taxation is high, a decrease in tax revenue (engineered via a decline in average or marginal tax rates) may stimulate output to such an extent that the initial cut in revenue is more than compensated by the larger tax base over which the lower tax applies. Consequently, deficits may be left unchanged or even decrease. Revenue shocks with these characteristics are hard to produce in general equilibrium models — the marginal level of income taxation should exceed 60-70% — and therefore the data may not contain a sufficient number of episodes to make the effort meaningful.

Once again, we place no restriction on the dynamics of expenditure: we only require that it is consistent with the sign restrictions imposed on deficits. Notice that the RL shocks are very dif-

ferent from the BB shocks. In the case of BB shocks taxes move to balance the budget, while for RL shocks it is not necessary for government spending to react to the tax cut. It is important to understand that the budget is balanced for the RL shocks not by movements in government expenditure, but instead as an endogenous reaction of the economy to the shock. That is, the tax cut itself leads to such increases in output that more than compensate the initial drop in revenues due to the lower tax rate.

We summarize the identification restrictions in Table 2. Since no restrictions are placed on price differentials, we are in the position to examine their dynamic behaviour in response to fiscal shocks.

Since our approach to identification differs from the one typically used in the literature, it is useful to highlight major differences and the advantages of our strategy. The existing literature typically uses case study approaches and extraneous information (zero restrictions) to disentangle fiscal shocks from reduced form innovations in the VAR. Case studies (see, e.g., Ramey and Shapiro, 1998; or Burnside, et al, 2004) are powerful way to study fiscal policy whenever one can make sure that the fiscal change is truly exogenous and that the shock is the relevant shock to study. Relative to standard identification approaches, our restrictions are theory based, while those employed in the literature are, to a large extent, conventional. For example, assuming that tax revenues do not respond to expenditure shocks within a period — an assumption used in the literature to disentangle revenue and tax shocks — is problematic with annual data. Similarly, the restrictions needed to identify expenditure shocks in quarterly data — for example, output and prices do not contemporaneously respond to expenditure shocks (Edelberg et al, 1999) or that it takes more than a quarter for

Table 2. The identification of fiscal shocks

	Correlation (G,Y)	Correlation (T,Y)	Correlation (G,DF)	Correlation (T,DF)	Correlation (G,T)
G shocks	>0		>0		>0
BB shocks	<0		=0		=1
T shocks		<0		<0	
RL shocks		<0		≥0	

government spending to respond to unexpected output movements (Blanchard and Perotti, 2002) — are unappealing in annual data because of the presence of automatic stabilizers. Since our methodology does not make use of conventional restrictions, to identify structural disturbances, both the endogeneity which plagues exercises where delay restrictions are used and the inherent underidentification which results from the general equilibrium nature of fiscal shocks are resolved.

2.4. Meta-analysis: Combining the information from different units

Given the panel nature of the data, our exercises are concerned in characterizing both average tendencies and in highlighting cross sectional differences. Since the data sets are short in both time and units and the model dynamic, standard techniques are unsuited for the analysis. The approach we take is Bayesian: we model the cross section of experiments as repeated observations on the same unknown phenomena (the response of regional price differentials to fiscal shocks). In this sense, information coming from, say, Portugal data may be useful in estimating the effects of fiscal shocks in, say, Greece. We construct posterior distributions which reflect our a priori assumptions and the information contained in the cross country and individual unit data. For US states we assume little

knowledge *a priori* for the effects of the shocks. For EMU countries we employ the information coming from the US states to "calibrate" the prior. In particular, we assume that the average estimates for US states may be proportional to the average estimates of EMU countries. Clearly, this does not imply that the two experiences are necessarily the same: it simply suggests that, *a priori*, the average of US outcomes roughly corresponds to the expected average of outcomes for EMU countries.

2.5. The results

Identification and multipliers

The identification of structural shocks was partially successful. While in most US states and EMU countries we were able to identify G and T shocks, we were less, or not at all successful in identifying the other two types of fiscal disturbances. For example, we managed to recover balance budget shocks only in a few US states, and this despite the presence of balance budget requirements, while Reagan-Laffer shocks are absent in both US states and EMU countries. We conjecture that our failures are due to three facts: first, several US states use funds external to the yearly budget (e.g., stabilization funds) to smooth out those revenue fluctuations that would otherwise require changes in expenditure to maintain a balance budget; second, essentially no events which have the characteristics of Reagan-Laffer shocks are present in our samples; and third, EMU data is short.

For the USA, we identify G shocks in 36 states, BB shocks in 12 states and T shocks in 31 states. To examine the multiplicative effects of the fiscal shocks in output we look at output multipliers. Output multipliers refer to the idea that the initial change in aggregate demand due to the fiscal shock causes a change in aggregate output for the economy that is a multiple of the initial change.

For G shocks two-thirds of the output multipliers exceed one, the median value equals 1.40 and the interquartile range is [0.98, 2.54].

Output multipliers are larger following T shocks suggesting that deficit financed expenditure shocks crowd out either consumption or investment more than deficit financed tax cuts. In fact, there are only 7 of the 31 states for which multipliers are less than one; the median value is 1.72 and the interquartile range is [1.19, 3.73]. Finally, the output multipliers generated by balance budget shocks are typically large. In fact, in 10 of the 12 cases the multiplier exceeds -1.0, in six it exceeds -5.0 and the median value is -3.78.

The size of the output multipliers suggests that the multiplicative effect of fiscal shocks on output is considerable. Moreover, the size of the multipliers in the state level are much higher than the multipliers reported for the federal level (see, e.g., Blanchard and Perotti, 2002). The latter observation suggests that in order to boost output it is more efficient to use the state level budget and, in particular, to reduce the state level taxes. This is a very important lesson to learn in face of the current recession. Countercyclical fiscal policy should be conducted at the state rather than the federal level.

For the EMU area we identify G shocks in 8 countries (Austria, Belgium, Finland, Germany, Ireland, Italy, the Netherlands and Spain) and T shocks in 5 countries (France, Germany, Ireland, Italy and Spain). Instantaneous output multipliers are larger than one in 6 cases for G shocks (with median annual response equal to 1.70) and in 3 cases for revenue shocks (with median annual response 1.98). These numbers are comparable to those reported by Perotti (2002) for 5 OECD countries despite the different identification strategies used and the much larger sample size. Compared with US states, yearly tax multipliers are typically

larger, reflecting the relative importance of revenues in total GDP. However, in the Netherlands and Germany output multipliers are small and insignificantly different from zero.

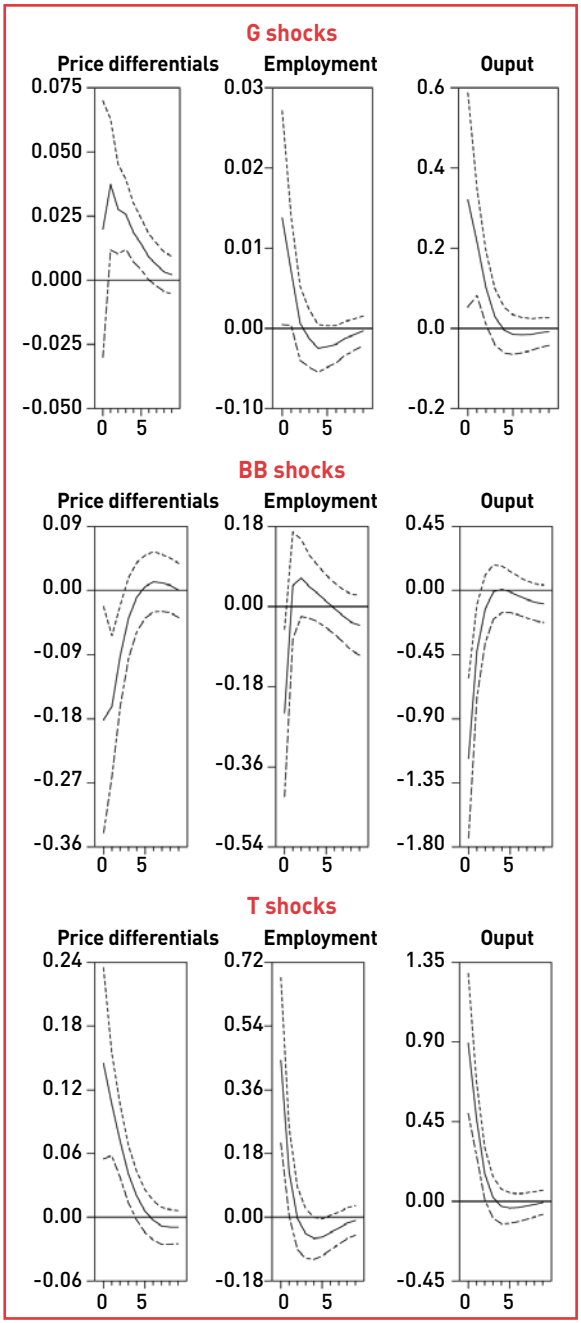
Two interesting features emerge when comparing regional responses between the two monetary unions. First, expenditure shocks produce instantaneous output and employment responses which are twice as large in the EMU as in the US, while the instantaneous employment effect of tax cuts in the EMU is much smaller than in the US. Second, productivity increases in all EMU countries but Finland following G shocks, and the average size of the increase is much larger than in the US. Since output multipliers are larger in the EMU, one must conclude that productivity increases do not automatically pass-through to wage increases or that such an effect is muted by the different labour market institutions. Hence, in terms of policy conclusions and, differently for the US, in the EMU fiscal expenditure is the valuable tool for countercyclical policy.

Typical effects

We start by describing the typical dynamic responses of the macroeconomic variables in the two monetary unions. By typical we refer to the average effect that is estimated using the meta-analysis technique. In all figures we present below, we normalize the expenditure impulse to be positive and of unitary size and the revenue impulse to be negative and of unitary size.

Figure 3 reports the cross sectional typical response of price differentials (column 1), of employment differentials (column 2), and of output differentials (column 3) to the three types of disturbances. Each box plots the posterior mean and the 68% posterior range. Overall, the plots are consistent with theoretical predictions.

Figure 3. Average responses in the USA



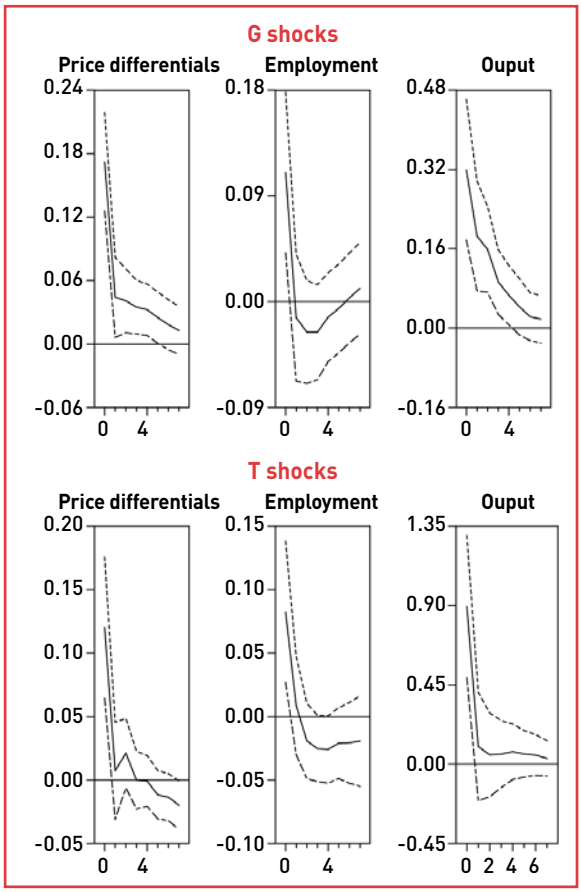
On average, G and T disturbances significantly increase price differentials. Recall that our identification requires these shocks to increase output and deficits. Standard textbook analysis suggests that following the fiscal expansion the local demand curve moves to the right. Whenever local demand is biased toward locally produced goods (which appears to be the case on average, given the responses of relative employment), local prices increase more than union wide prices.

A BB type disturbance, on average, significantly decreases price differentials. Such a pattern can be easily interpreted by recalling the identification restrictions. An expenditure increase, financed by distortionary taxation, is in fact assumed to have contractionary effects on output. Therefore, although the increase in government spending may shift local demand to the right, the increase in distortionary taxation, needed to maintain a balanced budget, shifts the same curve to the left.

Note that, while price differential responses are contemporaneously significantly different from zero for BB and T shocks, it takes a year for G shocks to exercise a statistically significant effect. Furthermore, while for the first two shocks significant price differentials responses are noticeable for up to 2-3 years, in the latter case, responses become insignificant again only after 6 years. In other words, G shocks take time on average to spill onto prices but their effect is more persistent.

The magnitude of the responses also differs across types of shocks. In fact, the mean of the posterior price differential response is -0.18% in the case of BB shocks; 0.15% in the case of T shocks and a mere 0.025% in the case of G shocks. This ordering of magnitudes squares well with the ordering of relative output and relative employment responses to the three shocks and

Figure 4. Average responses in the EMU



with the findings of Mountford and Uhlig (2009) for aggregate data.

Price differential responses for the EMU are also in line with the theoretical predictions (see Figure 4): both G and T disturbances increase, on average, price differentials. The effect lasts longer for G shocks (5 quarters) than for T shocks (1 quarter) and, contrary to what we have documented for the US, responses peak instantaneously in both cases.

The magnitude of the mean of the posterior response of price differentials to G disturbances is 0.18 and to T shocks is about 0.12. Therefore, contrary to what we have found in US states, expenditure shocks have larger effects on price differentials than revenue shocks. This difference has to do with the size of consumption expenditure to output ratio, which is more than two times as large on average in the typical EMU country as in a US state (0.21 to 0.09).

Recall that estimates of the structural responses in the EMU are obtained under the assumption that, *a priori*, the distribution of the vector of average structural responses, is similar to the posterior distribution of average response of US states. Although qualitatively similar, the features of the price differential responses are quantitatively different in the two areas. Hence, despite the short sample, there is information in the data to pull the posterior away from the prior.

Individual unit patterns

The individual unit patterns are very heterogeneous in the US in terms of the size, shape, or significance of the responses. Despite the heterogeneity, several common qualitative features remain: price differential responses to balance budget shocks are typically larger than those to T or G shocks; and G shocks produce lagged and more persistent responses than T shocks. In the EMU countries price differential responses to G shocks are also heterogeneous. For example, in three countries responses peak instantaneously and five have a hump with location varying from 1 to 5 quarters; responses are significant for only one quarter in Austria and last up to 8 quarters in Italy. Finally, the maximum size of the responses varies from 0.06 (Germany) to 3.61 in Belgium. The response to revenue shocks are more similar in shape (they all peak instantaneously) and persistence (they die out after two quarters) but the magnitude of the peak response varies from 0.07 (Germany) to 0.28 (Italy).

It is worth relating price differential responses to one particular episode which has attracted attention in the policy circles. To induce foreign investments into the country, the Irish government reduced taxes on capital income in the third quarter of 1999 and this led to a significant increase in output in 2000 and the first quarter of 2001. In February 2001 the European Council issued a warning[8] calling Irish authorities to restraint their attempts to reduce the cyclically adjusted surplus. In particular, the Council was concerned with the effects that such policy had on the inflation differential. Our investigation suggests that such a worry is probably excessive. In fact, the maximum price differential response is "only" 0.25 and this occurs in conjunction with a huge expansionary output effect (instantaneous output response is around 7.0). Interestingly, such a number is much larger than the magnitude of price differential responses produced in Germany (maximum about 0.07) or France (maximum 0.09), two countries that have also violated the SGP limits.

The importance of fiscal shocks for regional fluctuations

Central Banks worrying about regional inflation differentials and their potential effects on price stability may be interested in knowing how important are the shocks we have identified in explaining quantitatively price differential variability. Table 3 presents this information at the 10 years horizon: we report the average, the median and the interquartile range across US states (min-max for EMU) of the price differential movements explained by the three types of shocks. On average, expenditure shocks explain 14%, balance budget shocks 23% and revenue shocks about 19% of price differential variability.

Table 3. **Variance decomposition**

USA			
10 year horizon			
	Mean	Median	Interquartile range
G Shocks	0.14	0.11	[0.05, 0.17]
BB Shocks	0.23	0.21	[0.10, 0.30]
T Shocks	0.19	0.14	[0.05, 0.20]

EMU			
8 quarters horizon			
	Mean	Median	Min-Max
G Shocks	0.21	0.18	[0.03, 0.77]
BB Shocks			
T Shocks	0.15	0.14	[0.03, 0.34]

The percentage of price differential variability explained by fiscal disturbances in EMU countries is qualitatively similar to what we have found for US states. Expenditure shocks account on average for 21% and revenue shocks for 14% of price differential variability. Heterogeneities are clearly noticeable here: G shocks explain more than 40% of the variability of price differentials in Ireland and Finland and roughly zero in Germany or Spain, while tax shocks explain about 34% of price differential variability in Spain and negligible amounts in Belgium, France and Germany. Clearly, one should be careful with these estimates: the sample includes almost a full economic cycle but it may not be representative of the typical conditions in the EMU.

Hence, fiscal disturbances can significantly affect price differential variability. In the majority of the cases the contribution is modest, but there are instances where fiscal disturbances are a powerful engine for price differential fluctuations.

To conclude the results of the empirical analysis suggest that fiscal policy is a modest but statistically significant source of price differentials. The magnitude of the effects varies with the unit and the type of shocks but fiscal disturbances explain, on average, between 14% and 23% of price differential fluctuations in both unions. Heterogeneities however exist and there are states (countries) where more than 40% of the price differential variability is attributable to some fiscal shock.

Our empirical analysis provides some fiscal policy guidance. First, it shows that balanced-budget shocks have large effects on both local output and local prices. Since these shocks produce large swings in important macroeconomic variables, they need to be used with considerable care. Second, since deficit financed expenditure shocks produce more persistent and revenue shocks larger price differential responses, and keeping tax smoothing motives aside, revenue cuts could be an important stabilization instrument while expenditure changes could end up having undesirable procyclical effects. Third, while there are similarities between the USA and the EMU, there are also important quantitative differences. Expenditure shocks stimulate more economic activity relative to tax shocks in the EMU, while the opposite is true in the USA. Forth, fiscal policy is more effective to stimulate output at the regional rather than the federal level in the USA.

3. Conclusions

Many books could be written to analyze the role of fiscal policy in the EMU. In this study we focus on the stabilization role that fiscal policy can have in monetary unions and in the EMU in particular. We have shown in a theoretical model of a monetary union with price rigidities that fis-

cal constraints are not as harmful as one would expect for macroeconomic stability and welfare and that the stabilization of the regional output gap could be an adequate target for regional fiscal authorities. To validate our policy prescription in the second part of the opuscle we have demonstrated that regional fiscal policy can stimulate domestic demand for two big monetary unions, such as the USA and the EMU. In particular, we have shown that both government spending increases and tax cuts increase regional output and employment and the price level relative to the union average.

The present *opuscle* offers a variety of findings that are useful for the design of policy. I summarize here what I believe are the most important results for fiscal policy analysis in the EMU today. First, the empirical results reveal that fiscal policy when constrained (BB shocks) can have significant adverse real and price effects. This demonstrates that strict budgetary rules as the ones advocated by the original SGP might not be the right way to constrain fiscal policy in order to avoid regional asymmetries and points to the usage of more flexible rules that take also the stabilization of regional inflation and output into account, as the ones we have proposed in the first part of the *opuscle*. Second, since fiscal policy shocks can affect significantly regional output and inflation in the EMU, the design of systematic policies that target regional output and inflation can be beneficial for regional stability. Third, using taxes as the fiscal instrument seems more adequate in the USA, while using government spending as the fiscal tool seems more adequate in Europe. The theoretical model in the first section of the *opuscle* considers rules that included both cases. However, the theory suggests the usage of government spending that excludes items that enhance private utility as a suitable stabilization tool. Thus, we can conclude that government spending components that exclude welfare state expenses is the right fiscal tool in Europe. Finally, our results should induce optimism in policy circles in light of the recent recession and the inability of monetary policy to react alone to the global downturn and to regional asymmetries. The size of the regional fiscal multipliers in both the USA and Europe indicates that fiscal policy can be a powerful tool for stabilization policies. Of course, the fiscal shocks we have analyzed are very different in nature from the current increases in fiscal spending, both in terms of magnitude and economic environment, but they do indicate that fiscal policy expansions can be the right way out of the current recession.

There are still many open questions for investigation that we do not address in this *opuscle*. For example, our results do preclude the possibility that one may want to constrain fiscal policy for other reasons (e.g., to enhance the credibility of monetary authorities or reducing the probability of debt monetization). Decentralized fiscal policies may give rise to free-riding behaviours. One country could implement too large a budget deficit that could lead to an increase in the interest rate for the monetary zone as a whole and/or a currency appreciation with its consequences on investment and growth. Based on the free riding argument many economists have theoretically studied the desirability of fiscal constraints in a monetary union and reached conflicting conclusions. Such concerns were absent from our analysis.

Recently many economists discuss the necessity of some form of fiscal federalism in the Eurozone. In the 1980s the European Commission launched the slogan “One market - one money,” to support the creation of a common currency. Are 30 years a long enough time to take the next step and think of a slogan for a common European budget? Although the empirical results demonstrated that the EMU and the US experiences are

very different, we have not taken the analysis further in order to understand whether the existence of a federal government in the USA is responsible for these differences. Future work could try to evaluate theoretically whether these differences are important and give prescriptions for this possible institutional change in the fiscal system of the EMU.

Notes

(1) In order to derive the welfare criterion we assume that the monopolistic competition distortion is offset with an employment subsidy that is financed with lump sum taxes, so that policy is not concerned with correcting this distortion.

(2) Galí and Monacelli (2008), analyzing optimal fiscal policy in a monetary union characterized by a large number of small countries, reach similar conclusions for the properties of the optimal plan.

(3) The weights on debt and deficit stabilization are chosen so that the variability of these variables is zero in equilibrium.

(4) Notice that the government debt evolution and the definition of deficit imply that when regional fiscal policies target deficits they actually control the evolution of debt and vice versa. Thus, for example, when the fiscal instrument focuses on the stabilization of debt, deficit is also under control. For that reason we do not consider rules in which the fiscal instrument reacts to both debt and deficit deviations.

(5) Liu and Pappa (2008) find that the losses for inefficient movements in relative prices of non-traded goods can reach 5% of steady-state consumption.

(6) We only consider the changes of the SGP that concern the preventive arm of the pact, since our model cannot address the changes in the corrective arm.

(7) Relevant exceptions include Ramey and Shapiro (1998), Edelberg, Eichenbaum and Fisher (1999), Fatas and Mihov (2001), Mountford and Uhlig (2009), Blanchard and Perotti (2002), Burnside, Eichenbaum and Fisher (2004) and Perotti (2002).

(8) Action against Ireland, Euro Official Journal, 9/3/2001, C077, pp.7.

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Evi Pappa

Evi Pappa joins the European University Institute in September 2011 from Universitat Autònoma de Barcelona, where she is Associate Professor, and also Affiliated Professor of Barcelona GSE. She received her PhD from Universitat Pompeu Fabra in 2001. After graduating from UPF, she was an assistant professor of economics at the LSE, 2001-2006, Bocconi University (Milan), 2004-2005, and UAB, 2005-2006.

Her main research interests are International Macroeconomics and Monetary and Fiscal Policy. Given Evi's interest in monetary policy analysis, she has been a visiting researcher in many Central Banks, like the Bank of England, the European Central Bank, the Federal Reserve Bank of Atlanta, and the Riksbank (Sweden). She is a member of the Applied Macroeconomics Network (Amen), is a MOVE (Markets Organizations and Voting in Economics) Research Fellow and a Research Affiliate with the Center for Economic Policy Research (CEPR). She has received the IGIER Scholarship for Young Researchers in 2003-2004, the Paolo Baffi Fellowship in 2008 and the Ramon Areces Scholarship in 2010. She has published in international journals such as *Journal of Monetary Economics, International Economic Review, Journal of Public Economics* and *Economic Policy*.

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