TRANSATLANTIC MONETARY AND FISCAL POLICY INTERACTION

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Abstract

This paper studies the design, effects and interactions of monetary and fiscal policies in the euro-area and between the euro-area and the non euro-area. To do so, a stylized three-country model of monetary and fiscal policy rules is constructed. It is analyzed how monetary and fiscal rules affect the adjustment dynamics in the individual euro-area countries, the aggregate euro-area and the US, which is used as a proxy of the non euro-area. Four aspects play an important role in the analysis: (i) the consequences of alternative monetary and fiscal policy rules, (ii) transatlantic spillovers and policy interactions, and the dynamics of the euro and euro-area current account, (iii) the consequences of asymmetries between euroarea countries - asymmetries in macroeconomic shocks, macroeconomic structures or policy preferences-, and between the euro-area and the US, (iv) the role of alternative degrees of backward and forward looking (expectations) in output and inflation.

JEL Code: F31, F41, G15.

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1. Introduction.

The implementation and organization of the European Economic and Monetary Union (EMU) has been a unique experience. Since January 1, 1999, several European countries (twelve countries since January 2001) have been sharing a single currency, the euro, and a common central bank, the ECB. In contrast to other monetary unions, the euro area does not function with a federal budget for stabilization purposes. Instead, member countries have kept the responsibility of conducting fiscal policy at the national level. However, in order to secure the independence of the ECB and her primary objective of price stability, member countries adopted the Stability and Growth Pact (SGP) as a tool for fiscal policy coordination. The rules of the SGP aim at fiscal sustainability in strengthening fiscal discipline (excessive public deficits above 3% of GDP are forbidden and EMU member states are to follow a "medium-term objective of budgetary positions close to balance or in surplus"). The Broad Economic Policy Guidelines of the SGP also provide a framework for coordinating the objectives of national fiscal policies over the medium term.[1]

EMU has not only affected the participating countries, it also affects non-members via various international trade and financial interdependencies. With a single monetary policy and more coordinated fiscal policies, the policy mix in the euro area are of direct relevance for non-euro area countries and from the perspective of international policy coordination. In this light, it is useful to distinguish between internal and external dimensions of EMU and between the internal (the price level in the euro-area) and the external value of the euro (the level of the euro exchange rate). The internal dimensions of EMU concern the design and implementation of monetary and fiscal policies in the euro-area and the resulting effects on macroeconomic adjustment in the euro-area. External dimensions relate to the interactions of the euro-area and the non euro-area (in our analysis approximated as a single entity, referred to as "the US") and the role of the euro-area and its currency in a global context.

This paper analyses the design and effects of monetary and fiscal policies in the euro-area and the interactions with the non euro-area (which in the analytical part is lumped together as one entity, denoted "the US"). To do so, a New-Keynesian macroeconomic model is constructed. It consists of a stylized dynamic three-region model of a two-country EMU and a third country, the US. In the spirit of the literature on policy rules, the ECB and FED are modeled as operating a monetary rule geared at stabilizing inflation and output. Fiscal authorities operate a fiscal rule targeted at stabilizing output in their own country, subject to constraints e.g. relating to the SGP for the euro-area or various federal budget acts in the US case. This setting enables us to distinguish between internal effects and external effects and to analyze macroeconomic policy (rules), issues relating to transatlantic macroeconomic policy design, the euro exchange rate and euro-area current account dynamics. Simulations of the model concentrate on four crucial issues: (i) the consequences of alternative monetary and fiscal policy rules, (ii) transatlantic spillovers and policy interactions, and the dynamics of the euro and euro-area current account, (iii) the

[1] A thorough analysis of the workings and underlying rationales of the SGP can be found e.g. in Buti and Sapir (1998) and European Commission (2000), (2001), (2002).

consequences of asymmetries between EMU countries -asymmetries in macroeconomic shocks, macroeconomic structures or policy preferences/rules-, and between the EMU-area and the US, (iv) the role of alternative degrees of backward and forward looking in output and inflation.

This paper extends the literature on monetary and fiscal policy design in the EMU and on transatlantic macroeconomic (policy) interactions. It does not analyze the interactions using a game-theoretic perspective, as in a large part of the literature. Instead, it looks at policy interactions from the perspective of policy rules. The policy rules in place reflect the institutional setting in which policy making takes place; they shape the various policy interactions and affect the adjustment dynamics produced by macroeconomic shocks. This perspective is more in line with a recent literature that sees policy coordination mostly in terms of designing and coordinating monetary and fiscal policy rules (see e.g. Issing (2002), Canzoneri et al. (2002)).

The paper is structured as follows: Section 2 provides a few stylized facts of recent macro-economic developments in the euro-area and the US and gives a brief overview on issues relating to the euro exchange rate and transatlantic macroeconomic interaction. Section 3 sets out our three-country transatlantic EMU model with monetary and fiscal policy rules. Section 4 discusses the simulation results for various shocks and three alternative regimes for inflation expectations. In section 5, we deal with the implications of instrument smoothing and carry out a simple efficiency analysis. The conclusion summarizes our main results.

2. The Euro and Policymaking in the Euro-Area: Stylized Facts and Literature Overview

In this section we discuss a few stylized facts of macro-economic developments in the euro-area and the US and we provide a brief summary of issues discussed in the literature relating to the euro exchange rate and transatlantic macroeconomic interaction.

The euro depreciated steadily against the dollar during 1999-2000, stabilized during 2001 and appreciated during 2002 and the first halve of 2003. The recent years also witnessed several similarities and differences in macro-economic adjustments in the euro-area and the US as the following figure suggests.

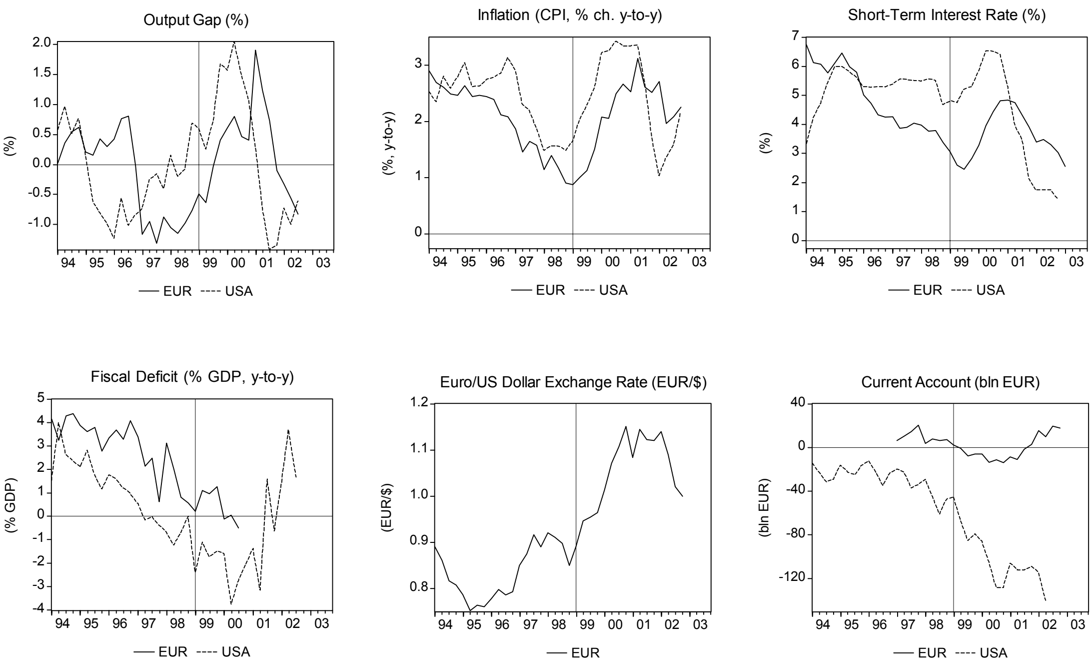

Figure 0
Stylized Macro-Economic Adjustments in the Euro-Area and US, 1994-2002.

From 1996 onwards, the US economy experienced a strong surge as indicated the improvement in the output gap. With the September 11 attacks, the US business cycle had definitively turned around. With a lag of a year or so, similar adjustment of output can be detected for the euro-area. Inflation adjusted relatively similarly during the period 1994-2002: from 1994 till 1998, inflation decreased, from 1998 till 2001 it increased and during 2001 and 2002 it decreased again. Inflation differentials between the US and the euro-area were relatively narrow. Interest rates differed more during the period 1994-1998: short-term interest rates in the euro-area were lower, with exceptions at the beginning and end. During the period 1994-2000 fiscal deficits declined both in the euro-area and the US. Fiscal deficits in the euro-area were consistently higher than that of the US. Since 2001, fiscal policy in the US has been more expansionary. A strong divergence is also seen in current account deficits: whereas the euro-area maintained a small surplus throughout the period, the US displays a rapidly increasing current account deficit.[2]

A substantial literature has emerged on the euro and its functioning in international financial markets and international policy fora. This interest was not in the last place sparked by the substantial fluctuations the euro displayed vis-à-vis the major international currencies since its launch on January 1999. A large number of empirical studies, surveyed in Koen et al. (2001) and Coppel et al. (2000), have studied empirical determinants of the adjustment and volatility of the nominal and real euro exchange rate. In these studies, in particular the question has been addressed whether the fluctuations and volatility reflect mainly fundamentals[3] or also more speculative factors and must be regarded as “excessive”.

A large literature has analyzed the international role of the euro and the euro-area economy in a global context, see e.g. Benassy-Quere et al. (1998), Coppel et al. (2000) and Hartmann and Issing (2002) for detailed analyses on the international role of the euro. This literature addresses the question to which extent and at what pace the euro will become a vehicle currency in international trade, finance and official reserves. It is also asked if the euro-area will become a more important player in international for macroeconomic policy coordination like the G7, OECD, IMF, and BIS e.g.

Aspects of transatlantic (policy) spillovers and interactions have received a continuous interest from policymakers and macroeconomic researchers alike and already since long before the EMU was introduced. The introduction of EMU has led to a renewed interest also because of the fundamental institutional changes it implies. A number of papers analyze the consequences of these institutional changes on transatlantic interactions. Eichengreen and Ghironi (2002) concentrate on strategic aspects in transatlantic monetary and fiscal policy interactions. They analyze which policy trade-offs the monetary and fiscal policymakers in both the EMU and the US face under (i) flexible exchange rates in the EU, (ii) managed exchange rates in the EU, and (iii) a monetary union in the EU, and the role of various regimes of policy coordination therein. Van Aarle, Garretsen and van Moorsel (2001) use a three-country model to

[2] This accumulation of current account balances also witnesses the current net foreign asset positions of the euro area (15% of GDP) and the US (-25% of GDP).

[3] Cohen and Loisel (2001) e.g. attribute the fluctuations of the euro entirely to the observed supply hocks and the policy responses in the euro-area. De Grauwe (2000) focuses on possible speculative forces and “framing” effects resulting from the fact that the euro is an (almost) entirely new currency.

analyze in a stylized manner how EMU may affect the internal and external transmissions of monetary and fiscal policies. Coenen and Wieland (2002) estimate a dynamic model to study the inflation dynamics international linkages of the US, the euro area and Japan. Monetary policy rules in the form of Taylor rules are estimated. Also a possible feedback of the exchange rate in the policy rules is investigated, a possibility that plays also some role in our analysis. However, these authors find little empirical support for such a feedback. Haber, Neck and McKibbin (2002) analyze various aspects of monetary and fiscal policy rules and policy coordination –including forms of transatlantic policy coordination- using simulations with the McKibbin-Sachs global model.

3. A Model of Monetary and Fiscal Policies and Transatlantic Interactions.

The analytical framework that we will use is in the spirit of the recent "New Neo-Classical New Keynesian synthesis". This "new normative macroeconomic research" uses quantitative dynamic stochastic models combining theoretical insights from both new classical macroeconomics and new Keynesian macroeconomics and contains both rational behavior and short-run rigidities. A part of that literature concentrates on the micro-economic foundations of the approach. It also strongly emphasizes the importance of policy rules, like the well-known Taylor rule for monetary policy (Taylor (1993)). These New-Keynesian models display a short-run trade-off between inflation and output/unemployment variability which can be explored by monetary and fiscal policies. In the long-run there is no such a trade-off and macroeconomic policies are neutral. In the purely forward-looking case, prices are inertial but inflation is a purely forward-looking "jump" variable. Adding backward-looking elements increases real and nominal inertia in the model, thereby raising e.g. the costs of disinflation and the scope for active stabilization policies.[4]

In van Aarle et al. (2003) we have studied in detail a setting of a closed EMU economy. This paper extends that work by considering the interactions of the euro-area and the US economy (which given the stylized nature of the analysis may therefore also be considered as representing the rest of the world). The model consists of a three-country setting in which two countries, country 1 and 2, form a monetary union, labeled "EMU" or "euro-area" and a third country labeled "country 3" or "US" which does not participate in the monetary union.[5] The model consists of a few building blocks: a goods market equilibrium, inflation dynamics policy rules and exchange rate formation/international finance.

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[4] For a detailed overview of this approach see e.g. Fuhrer and Moore (1995), Leeper and Zha (2000), Clarida et al. (1999) and Leith and Malley (2002) for the closed economy case. Clarida et al. (2002), Gali and Monacelli (2002), Caputo (2003) and Leith and Malley (2003) extend the analysis to the open economy case. The two-country monetary union model suffices to analyse the most crucial implications of a monetary union between countries. A general *n*-country framework could have been formulated where *n-k* countries would form a monetary union and the remaining *k* countries do not participate in the monetary union, but it would not have delivered fundamentally different insights here.

[5] As the model is highly stylized, one can not take the analysis too far: it is clear that the actual economies of the euro-area and the US will function in a much more complicated manner. Those readers who prefer not to link the model to the actual economies of the euro-area and the US may also read "a monetary union of country 1 and 2"

Aggregate Demand

The goods market equilibrium, or IS curve, in the three countries takes the following form:

$$x_{1,t} = \psi_1 x_{1,t-1} + (1-\psi_1)E_t x_{1,t+1} - \alpha_1 \left(i_{E,t} - E_t \Delta p_{1,t+1} - \bar{r}_E\right) + \sigma_{12} x_{2,t} + \sigma_{13} x_{3,t} + \eta_1 g_{1,t}$$
$$+\delta_{12}(p_{2,t} - p_{1,t}) + \delta_{13}(e_t + p_{3,t} - p_{1,t}) + u^d_{1,t} \quad (1a)$$

$$x_{2,t} = \psi_2 x_{2,t-1} + (1-\psi_2)E_t x_{2,t+1} - \alpha_2 \left(i_{E,t} - E_t \Delta p_{2,t+1} - \bar{r}_E\right) + \sigma_{21} x_{1,t} + \sigma_{23} x_{3,t} + \eta_2 g_{2,t}$$
$$-\delta_{21}(p_{2,t} - p_{1,t}) + \delta_{23}(e_t + p_{3,t} - p_{2,t}) + u^d_{2,t} \quad (1b)$$

$$x_{3,t} = \psi_3 x_{3,t-1} + (1-\psi_3)E_t x_{3,t+1} - \alpha_3 \left(i_{F,t} - E_t \Delta p_{3,t+1} - \bar{r}_F\right) + \sigma_{31} x_{1,t} + \sigma_{32} x_{2,t} + \eta_3 g_{3,t}$$
$$-\delta_{31}(e_t + p_{3,t} - p_{1,t}) - \delta_{32}(e_t + p_{3,t} - p_{2,t}) + u^d_{3,t} \quad (1c)$$

in which x_i denotes the output gap in country i, $i=\{1,2,3\}$, at time t; $i_{E,t}$ the euro-area short-term nominal interest rate, (the policy instrument of the ECB); $i_{F,t}$ the US nominal interest rate, (the policy instrument of the FED). $p_{i,t}$ is the general price level in country i; $g_{i,t}$ the fiscal balance in country i (a positive value of $g_{i,t}$ denotes a fiscal deficit); e is the euro-dollar exchange rate (units of euro per dollar); $\bar{r}$ is the equilibrium real interest rate[6], $u^d_{i,t}$ is an aggregate demand shock. All macroeconomic shocks in the analysis will be assumed to follow stationary AR(1) processes, $u_t = \phi\, u_{t-1} + \varepsilon_t$, with $0 \le \phi < 1$ and ε_t is white noise, $\varepsilon \propto N(0,\sigma^2_\varepsilon)$. Note that the output gap equals the actual output level, $y_{i,t}$, minus the equilibrium level of output, $\bar{y}_i$, i.e. $x_{i,t} \equiv y_{i,t} - \bar{y}_i$.[7] All variables are given in logarithms, except for the interest rates which are in perunages.

In this reduced form the output gap depends on the past output gap, the expected future output gap, the real interest rate (expressed as a deviation from the equilibrium real interest rate), net government spending, net exports and a demand shock. This IS curves nests several alternative formulations that can be found in the literature: the current output gap can be positively related to past output gaps only (Fuhrer and Moore (1995), Huh and Lansing (2000)), both past and expected future output gaps (Leeper and Zha (2000), Clarida et al., (1999)), or expected future output gaps only (McCallum (2001), Woodford (2001)). The backward-looking component in the IS curve results from "habit formation" in consumption decisions[8]. The forward-looking part is produced by rational, intertemporally maximizing agents that

instead of "EMU" and "country 3 that is not part of the monetary union" instead of "the US".

[6] In practice, it may be quite complicated to determine the equilibrium real rate of interest, $\bar{r}$, in practice as the study on real equilibrium interest rates in the euro-area by Giammarioli and Valla (2003) shows. Similar to estimating equilibrium output, $\bar{y}$, and equilibrium inflation, $\Delta\bar{p}$ it would be crucial, however, for the monetary authority to get its estimations on this variable right.

[7] Output and output gap in fact can be used interchangeably as long as equilibrium output remains constant, as we will assume throughout the paper. Ehrmann and Smets (2003) analyze the case where monetary authorities are uncertain whether supply shocks are the result of cost-push shocks or shocks to equilibrium output. They analyze the implications of such a "signal-extraction problem" facing (optimal) monetary policy.

[8] Leith and Malley (2002), Leith and Wren-Lewis (2001), Batini and Haldane (1999) and McCallum and Nelson

apply the principles of optimal "consumption smoothing". In case consumers are entirely forward looking ($\psi_i = 0$), (1) is also sometimes referred to as the "intertemporal IS".

Net exports are a function of domestic and foreign output and price competitiveness.[9] In the three-country framework *intra*-EMU trade (trade between country 1 and 2) can be distinguished from *extra*-EMU trade (i.e. the trade of country 1 and 2 with country 3). By definition, EMU implies that the intra-EMU exchange rate has become irrevocably fixed at the conversion rates (and therefore has dropped out of (1) given a normalization to zero) and that internal nominal exchange rate adjustment has disappeared as a shock-absorber. External exchange rate adjustment in the form of changes of the euro-dollar exchange rate, e_t, however, remains as a potentially important shock absorber. If countries would differ in their structural parameters, the transmission of changes in the euro-dollar exchange rate will also start to differ across the EMU countries, much similar to the problem of asymmetric transmissions of changes in the common interest rate in case of structural asymmetries.

Aggregate Supply

Inflation dynamics are given by hybrid Phillips-curves which contain elements of both forward and backward-looking price setting. In addition, demand-pull and cost-push factors affect inflation,

$$\Delta p_{1,t} = \omega_1 \Delta p_{1,t-1} + (1-\omega_1) E_t \Delta p_{1,t+1} + \gamma_1 x_{1,t} + \mu_{12}\Delta p_{2,t} + \mu_{13}\Delta(p_{3,t} + e_t) + u^s_{1,t} \tag{2a}$$

$$\Delta p_{2,t} = \omega_2 \Delta p_{2,t-1} + (1-\omega_2) E_t \Delta p_{2,t+1} + \gamma_2 x_{2,t} + \mu_{21}\Delta p_{1,t} + \mu_{23}\Delta(p_{3,t} + e_t) + u^s_{2,t} \tag{2b}$$

$$\Delta p_{3,t} = \omega_3 \Delta p_{3,t-1} + (1-\omega_3) E_t \Delta p_{3,t+1} + \gamma_3 x_{3,t} + \mu_{31}\Delta(p_{1,t} - e_t) + \mu_{13}\Delta(p_{2,t} - e_t) + u^s_{3,t} \tag{2c}$$

Inflation equals the first difference of the general price level, p, and is assumed to be a function of past inflation, expected future inflation, the output gap, reflecting demand pull inflation, and inflation of import prices, which induces cost-push inflation.[10] $u^s_{i,t}$, are domestic cost push shocks which will be interpreted

(1999) provide micro-foundations for the presence of habit formation in consumption. Empirical evidence is provided that the backward looking component in consumption is substantial.

[9] In (1), $\delta_{ij} > 0$ implies that the Marshall-Lerner condition holds. At a given level of competitiveness vis-à-vis country 2 and 3, country 1's net exports depend only on the output gaps: $\sigma'_{12}x_{2,t} + \sigma'_{13}x_{3,t} - \sigma_{11}x_{1,t}$. σ'_{12} equals the elasticity of country 1's exports w.r.t. country 2's output gap. σ_{11} equals the elasticity of country 1's imports w.r.t. country 1's output gap, the import leakage. Bringing the latter term to the LHS of (1a) and multiplying out, one obtains that the spillover effects of the output (gaps) of country 2 and 3 on country 1's output gap (via net exports), equal $\frac{\sigma'_{12}}{1+\sigma_{11}}$ and $\frac{\sigma'_{13}}{1+\sigma_{11}}$. Defining $\sigma_{12} = \frac{\sigma'_{12}}{1+\sigma_{11}}$ and $\sigma_{13} = \frac{\sigma'_{13}}{1+\sigma_{11}}$, we obtain the IS curve (1a). A similar note pertains to (1b) and (1c). The intra-EMU trade balance equals $tb_{12,t} = \sigma_{12}x_{2,t} - \sigma_{21}x_{1,t} + \delta_{12}(p_{2,t} - p_{1,t})$. The euro-area trade balance, is defined as: $tb_{E3,t} = (\sigma_{13} + \sigma_{23})x_{3,t} - \sigma_{31}x_{1,t} - \sigma_{32}x_{2,t} + (\delta_{13} + \delta_{31})(e_t + p_{3,t} - p_{1,t}) + (\delta_{23} + \delta_{32})(e_t + p_{3,t} - p_{2,t})$.

[10] See e.g. Gagnon and Ihrig (2002), Leitemo et al. (2002), Coenen and Wieland (2002) that use similar open economy Phillips curves. Caputo (2003) and Leith and Malley (2003) provide the underlying microeconomic

as supply-shocks in the remainder of the analysis since (2) can also be considered as describing the short-run aggregate supply (AS) curve. If $\omega_i = 1$, we obtain the backward-looking Phillips curve, if $\omega_i = 0$, on the other hand, we obtain the forward-looking New-Keynesian Phillips curve[11]. In the first case, only past economic conditions matter for determining current inflation. In the presence of forward-looking expectations, current price setting depends on expectations about future economic conditions solely. The hybrid Phillips curve assumes that both backward and forward-looking price setting are present, it results if ω_i lies in between 0 and 1.[12] The hybrid Phillips curve allows for both a forward-looking component and a backward-looking component, reflecting e.g. learning effects, staggered contracts or other institutional arrangements that affect pricing behavior.

The output gap proxies the effects of demand-pull factors on the general price level. Foreign inflation spillovers affect domestic prices via the price of imported raw-, intermediate and final goods used in the domestic production process. The strength of the foreign inflation and depreciation spillovers, as proxied by the μ_{ij}'s depends not only on the intensity with which foreign goods are absorbed but also on the amount of pass-through in import pricing. Recent empirical research suggests that pass-through is generally non-negligible.[13] Consumer price inflation will be affected by changes in the exchange rate through the direct effect on import prices. Exchange rate changes can also affect consumer price inflation indirectly through aggregate demand, since they will affect the relative price between domestic and foreign goods, thereby influencing net exports and domestic output, which in turn will affect consumer prices through demand-pull inflation.

foundations.

[11] See e.g. Clarida et al. (1999) for a similar analytical framework and a detailed discussion on the generalised IS (1) and Phillips curves (2). They illustrate how ψ and ω jointly determine the endogenous inflation and output persistence. Note that labour markets are implicitly behind (2): wage setting/contracting determines inflation dynamics and unemployment and the output gap are related by (variants of) Okun's Law, see e.g. Huh and Lansing (2000). Leith and Malley (2002) derive (2) from the overlapping contracts model of Calvo. With ω different form zero, workers care about their real wages relative not only to those groups who have not signed new wage contracts yet, but also those groups that have already signed new wage contracts.

[12] In empirical applications, more lags of output (in case of the IS curve) and output and inflation (Phillips curve) are often included to improve the empirical fit. Adding these lags will also induce a more persistent and therefore more realistic adjustment to shocks. In empirical studies and monetary policy analysis sometimes concepts of equilibrium and/or core inflation are added to (2), to distinguish short-run fluctuations of inflation from longer term, equilibrium inflation. In our analysis this issue is not dealt with and inflation (as all other variables) is defined in terms of deviations from (possibly non-zero inflation) the steady-state. See Vega and Wynne (2001) and references therein on core inflation in the euro-area.

[13] See e.g. Gagnon and Ihrig (2002) and Anderton (2003). Apart from "pass-through" by importers of foreign price changes, including exchange rate changes, it is sometimes also argued that importers will consider domestic inflation when setting import prices as they seek to react to the pricing of domestic competitors. Such a "pricing to market" could be added to our analysis as well by adding domestic inflation to the RHS of (2). When bringing this term to the LHS and multiplying out this term, this would effectively imply that all reduced other reduced form parameters of (2) are reduced by the same factor in a similar way as the relation of domestic output on domestic imports was shown to affect the reduced form parameters of (1) (see footnote 9).

Monetary Policy Rules

Taylor rules relate the short-run interest rates targets of the ECB and FED to deviations of inflation from the inflation target, the output gap and the euro-dollar exchange rate:

$$i^*_{E,t} = \bar{i}_E + \nu_E(\Delta p_{E,t} - \Delta\bar{p}_E) + \chi_E x_{E,t} + \tau_{E,0}e_t + \tau_{E,1}e_{t-1} \qquad (3a)$$

$$i^*_{F,t} = \bar{i}_F + \nu_F(\Delta p_{3,t} - \Delta\bar{p}_F) + \chi_F x_{3,t} + \tau_{F,0}e_t + \tau_{F,1}e_{t-1} \qquad (3b)$$

where, $\bar{i}_E \equiv \bar{r}_E + \Delta\bar{p}_E$ and $\bar{i}_F \equiv \bar{r}_F + \Delta\bar{p}_F$, The EMU aggregate rate of inflation and real output are defined as a weighted average of individual countries: $\Delta p_{E,t} \equiv \theta\Delta p_{1,t} + (1-\theta)\Delta p_{2,t}$, $x_{E,t} \equiv \theta x_{1,t} + (1-\theta)x_{2,t}$, in which θ measures the relative size (e.g. in terms of trend output) of country 1 in the EMU aggregate economy.

The feedback on the output gap and inflation are standard in closed economy models with a Taylor rule. A feedback on the exchange rate has been investigated in some open-economy models, and we have followed Taylor (2001) in this specification[14]. We allow for flexibility on the sign and size of $\tau_{i,0}$ and $\tau_{i,1}$ and note that if $\tau_{i,0} = -\tau_{i,1}$ the rate of exchange rate depreciation is targeted rather than its level. Most empirical studies suggest a small if not negligible impact of the exchange rate on interest rates in the monetary policy rules. This may also be seen as evidence that the ECB and FED follow a policy of "benign neglect" towards the euro-dollar exchange rate and ignore fluctuations in the exchange rate, (unless they would form a direct threat to their prior objectives). Moreover, on both theoretical and empirical grounds, there isn't any consensus on whether or not an exchange rate augmented monetary policy rule is welfare improving. Taylor (2001) concludes that there is no need to include the exchange rate in the policy rule because the impact of the exchange rate on the short-term nominal interest is already indirectly taken into account via the effects of exchange rate changes on CPI inflation. This argument is confirmed by Adolfson (2002). On the other hand, Monacelli (1999) shows that, under incomplete exchange rate pass-through, an exchange rate augmented Taylor rule performs better than the standard Taylor rule (be it based on CPI inflation or domestic inflation) in terms of inflation stabilization (but not in terms of output stabilization).

As in the recent literature we consider a general form of the policy rules that allow for an instrument smoothing objective of the policymakers. In case of instrument smoothing policymakers perceive instrument variability as undesirable/costly and thus prefer a gradual adjustment of the policy instruments to rapid changes in policy variables. In the presence of instrument smoothing, the current value of the instrument variable is expressed as a weighted average of its lagged value and an optimal

[14] In Taylor (2001) the real rather than the nominal exchange rate features in the policy rule. Like Clarida (2001) we adopt nominal exchange rate targeting here as it seems to be a more realistic and operational target in the monetary policy rule. Given price-stickiness in the model, it should be stressed that this difference may in fact have only minor implications and the more so if the exchange rate feedback is small, of course.

value (therefore it is also sometimes referred to as a partial adjustment mechanism), here represented by the outcomes of the original Taylor rules (3a), (3b), therefore,

$$i_{E,t} = \rho_E i_{E,t-1} + (1-\rho_E) i^*_{E,t} + u^i_{E,t} = \rho_E i_{E,t-1} + (1-\rho_E)\left(\bar{i}_E + \nu_E (\Delta p_{E,t} - \Delta \bar{p}_E) + \chi_E x_{E,t} + \tau_{E,0} e_t + \tau_{E,1} e_{t-1}\right) + u^i_{E,t} \quad (3a')$$

$$i_{F,t} = \rho_F i_{F,t-1} + (1-\rho_F) i^*_F + u^i_{F,t} = \rho_F i_{F,t-1} + (1-\rho_F)\left(\bar{i}_F + \nu_F (\Delta p_{3,t} - \Delta \bar{p}_F) + \chi_F x_{3,t} + \tau_{F,0} e_t + \tau_{F,1} e_{t-1}\right) + u^i_{F,t} \quad (3b')$$

The preference for instrument smoothing is measured by the value of ρ, where $0 \le \rho_i \le 1,\ i \in \{E, F\}$ if ρ goes to zero the original Taylor rule, which ignores instrument-smoothing objectives, is obtained. Empirical research for the US economy and the euro-area suggests that significant instrument smoothing is often present and that a value of 0.8 may indeed well be reached.[15] u^i_t denotes a monetary policy innovation: it consists of any non-systematic change in the interest rate that affects interest rates in addition to the systematic part given by the Taylor rule.

Fiscal Policy Rules

Fiscal policy is also determined by a policy rule. Following the approach of Taylor (2000), we define the fiscal policy targets as:

$$g^*_{1,t} = \bar{g}_1 - \chi_1 x_{1,t} \quad (4a)$$

$$g^*_{2,t} = \bar{g}_2 - \chi_2 x_{2,t} \quad (4b)$$

$$g^*_{3,t} = \bar{g}_3 - \chi_3 x_{3,t} \quad (4b)$$

These "fiscal Taylor rules" express that the net government spending is the sum of the structural fiscal balance, $\bar{g}_i$, and the cyclical fiscal stance, as measured by $-\chi_i x_{i,t}$, the elasticity of the deficit to cyclical output fluctuations times the output gap.

Like in the case of monetary policy, we assume that the fiscal policy rules that are actually implemented also contain the possibility of instrument smoothing and possible random policy shocks

$$g_{1,t} = \rho_1 g_{1,t-1} + (1-\rho_1) g^*_{1,t} + u^g_{1,t} = \rho_1 g_{1,t-1} + (1-\rho_1)\left(\bar{g}_1 - \chi_1 x_{1,t}\right) + u^g_{1,t} \quad (4a')$$

$$g_{2,t} = \rho_2 g_{2,t-1} + (1-\rho_2) g^*_{2,t} + u^g_{2,t} = \rho_2 g_{2,t-1} + (1-\rho_2)\left(\bar{g}_2 - \chi_2 x_{2,t}\right) + u^g_{2,t} \quad (4b')$$

$$g_{3,t} = \rho_3 g_{3,t-1} + (1-\rho_3) g^*_{3,t} + u^g_{3,t} = \rho_3 g_{3,t-1} + (1-\rho_3)\left(\bar{g}_3 - \chi_3 x_{3,t}\right) + u^g_{3,t} \quad (4c')$$

[15] A very large literature has arisen on empirical estimates of Taylor rules for the US and the euro-area. This literature is far too large to be surveyed here, see Taylor (1999). We restrict ourselves to pointing at interesting examples such as Clarida et al. (2001), Gerlach and Schnabel (2000), Sack and Wieland (2000), Breuss (2002), Domenech et al. (2002).

where $0 \leq \rho_i \leq 1,\ i \in \{1,2,3\}$. $u^g_{i,t}$, represent unsystematic fiscal shocks that could affect net government spending. The parameter ρ_i captures the degree of fiscal policy inertia/activism: a high value of ρ_i would mean a very inert fiscal policy that could be explained by difficulties to implement changes in tax policies (e.g. pension reforms) and government spending (e.g. healthcare reforms). The fiscal policy rules (4') enable to represent in the model -albeit in a highly stylized way- the various budgetary rules and strategies one may observe in practice. Here, we would like also to relate the fiscal policy rules with the provisions in the Stability and Growth Pact. The budgetary target $\bar{g}_i$ can be thought e.g. as being the "close-to balance or in surplus medium term objective", reflecting a preference for long-run sustainability and neutrality. The build-in flexibility in the Stability Pact relies on allowing as much as possible the workings of the automatic stabilizers in the short-run. Finally, the amount of inertia in fiscal policy, summarized by ρ_i, reflects the ability of fiscal policymakers to adjust fiscal policy in the short-run. Recent discussions focus on the question if the SGP is not too rigid in some circumstances and should not be amended in any form.

Uncovered Interest Parity

The euro/$ exchange rate adjusts in such a manner that uncovered interest rate parity holds throughout:

$$E_t e_{t+1} - e_t = i_E - i_F + u^r_t \qquad (5)$$

where u^r_t represents random shocks (risk premium shocks, expectation shocks or other shocks in international financial markets causing -rational and stochastic- exchange rate bubbles) that may cause temporary deviations from Uncovered Interest Parity (UIP).[16] In the model, demand and supply shocks in (1 and 2), result in output and price fluctuations which induce fiscal and monetary policy reactions, by (3' and 4'). This will affect interest rates and through (5) the exchange rate.

Before proceeding on the simulations, we expose the working of various channels through which policies affect inflation and output and the most important spillovers and interactions between EMU and non EMU in the model. The three direct transmission channels of the interest rate (the interest rate channel of monetary policy) in the model are: (i) a change in nominal interest rates, changes the real interest rate in the short-run, thereby output, (ii) a change of the interest rate affects the rate of exchange rate depreciation through the uncovered interest rate parity condition (5) and (iii) by influencing macro-economic conditions, an interest change may also induce policy responses of the fiscal authorities and/or transatlantic policy responses. The three direct transmission channels of the euro exchange rate (the

[16] For empirical studies on deviations of UIP see e.g. Mark and Wu (1998), and Jeanne and Rose (2002). Fratscher (2002) concentrates on the US, Japan and euro-area case addressing also policy implications relating to monetary

exchange rate channel of monetary policy) in the model are: (i) a nominal depreciation (viz. higher foreign prices) stimulates net exports in the short-run because of the induced real depreciation, (ii) a nominal depreciation (viz. higher foreign prices) generates a positive spillover on domestic inflation and (iii) a nominal depreciation may elicit a policy response of the monetary authorities. The transmission of fiscal policy takes the form of (i) a direct impact on aggregate demand, (ii) thereby an indirect effect on prices, interest rates and exchange rate, (iii) fiscal policies in one country may elicit, by impacting on macro-economic conditions, policy responses of the other fiscal authorities and of the monetary authorities.

Finally, it is useful to consider the macroeconomic policy regime in place. A macroeconomic policy regime consists of the monetary and fiscal policy strategies that are implemented. The monetary and fiscal policy strategies are interacting and their joint implementation affects macroeconomic adjustments. Both inside the EMU and in the US, there is the aspect of internal monetary and fiscal policy interaction, and in addition we have the dimension of the transatlantic policy stances. In the various interactions of macroeconomic policies, clearly issues of policy coordination[17] arise: in particular we can distinguish cases where policies act as substitutes and where they act as complements. In the first case policies are reinforcing each other, in the latter case they opposing each other e.g. in their effects on output or inflation. In the simulations in the next section we will use a specific perspective on policy regimes by focusing on policy smoothing parameters in the monetary and fiscal policy rules as these will have a direct relation with the degree of policy activism, and thereby actual policies. A difference in smoothing parameters between monetary and fiscal policies may e.g. reflect the different amount of flexibility in adjusting policies in the short-run. In the euro-area, a difference in fiscal smoothing between countries may reflect the possibility that not all countries will be restricted by the SGP to the same degree, etc.

4. Macroeconomic Adjustment and Transatlantic Policy Interactions: A Simulation Analysis.

This section uses simulations to illustrate the main insights that can be obtained from the model introduced in Section 3. We simulate the effects of monetary shocks (case I), supply shocks (case II), fiscal shocks (case III), demand shocks (case IV and V) and financial shocks (case VI). All shocks are unanticipated and incur at period 0. Algorithms are readily available to obtain numerical solutions to our small model, both in case of fully rational expectations and in case of (partially) backward-looking expectations, see e.g. Fisher (1982) for an extensive methodological overview. To solve the model, model consistent expectations are imposed in the algorithm that derives the forward-looking solutions. The Stacked Newton solution method is used, which is known for its fast convergence and robustness in calculating the solutions for smaller scale models with rational expectations.

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policy autonomy and dominance. McCallum and Nelson (1999) analyze the effects of deviations from UIP on the exchange rate and the current account in a framework that is related to ours.

[17] As noted in the introduction, we don't analyze the various interactions between policymakers in an explicit game theoretic analysis: in such a framework the policy-rules we have assumed are unlikely to be optimal strategies in the first place.

In these simulations we in particular want to obtain insights into: (i) the consequences of alternative monetary and fiscal policy rules, (ii) transatlantic spillovers and policy interactions, and the dynamics of the euro and euro-area trade balance, (iii) the consequences of asymmetries between EMU countries -asymmetries in macroeconomic shocks, macroeconomic structures or policy preferences/rules-, and between the EMU-area and the US, (iv) the role of alternative degrees of backward and forward looking in output and inflation. Underlying all the simulations in this section is a baseline set of model parameters, given in Table 1.

Table 1 Baseline Parameters

σ_{ij}	0.25	δ_{ij}	0.25	$\tau_{E,0} = \tau_{E,1}$	0	$\tau_{F,0} = \tau_{F,1}$	0
μ_{ij}	0.1	γ_i	0.1	$\overline{r}_E$	0	$\overline{r}_F$	0
α_i	0.25	η_i	0.75	$\Delta\overline{p}_E$	0	$\Delta\overline{p}_F$	0
ψ_i	0.5	ω_i	0.5	ϕ^d	0	$\sigma_{\varepsilon d}^2$	0.01
ρ_i	0.5	χ_i	0.25	ϕ^s	0	$\sigma_{\varepsilon s}^2$	0.01
$\overline{g}_i$	0	$\overline{y}_i$	0	ϕ^i	0	$\sigma_{\varepsilon i}^2$	0.01
ρ_E	0.5	ρ_F	0.5	ϕ^g	0	$\sigma_{\varepsilon g}^2$	0.01
ν_E	1.5	ν_F	1.5	ϕ^r	0	$\sigma_{\varepsilon r}^2$	0.01
χ_E	0.5	χ_F	0.5				

In the baseline case, all three countries have the same values of the structural parameters –including policy parameters-. In our model, asymmetries in the adjustments between EMU countries can arise because of (i) the occurrence of asymmetric shocks, (ii) the possibility that countries differ in structural and fiscal policy parameters. While in the EMU, adjustment of the intra-EMU nominal exchange rate has disappeared as shock-absorber and transmission channel of monetary and fiscal policies, adjustment of the extra-EMU exchange rate remains as a potentially important transmission variable.[18] Asymmetries in the adjustments between the euro-area and non members result from (i) the occurrence of asymmetric shocks, (ii) the possibility that the euro-area and non euro-area countries differ in structural and policy parameters, (iii) the adjustments resulting from fluctuations in the euro exchange rate.

Inevitably, there remains an element of arbitrariness in the set of baseline parameters. Nevertheless, this set of baseline parameters is broadly consistent with empirical studies and simulation studies by others that use a similar framework (see e.g. the references)[19]. Moreover, we have studied a large set of baseline parameters, concluding in the end that the above configuration implies both representative and plausible adjustment dynamics.

[18] That the institutional changes resulting from the introduction of a monetary union may crucially affect the intra-EMU and extra-EMU transmission of macroeconomic shocks, is e.g. emphasized by van Aarle et al. (2001). They emphasise the important role that the euro exchange rate plays therein.

[19] See e.g. the open-economy frameworks of Monacelli (1999), Gagnon and Ihrig (2002), Adolfson (2002), and Leitemo et al. (2003).

I. A Monetary Shock in the EMU

This first example studies the effects of a temporary positive shock of 1% to the euro-area interest rate. The euro-area interest rate i_E is shocked by 1% during period 0 (the interest rate rule is turned off during period 0). For country 1 and 2 that form the euro-zone, this interest rate shock is by definition a common shock. In a transatlantic perspective it is an asymmetric shock in the sense that it hits the euro-zone but not the US. Three alternative regimes are distinguished: regime (a) (solid lines in the graphs) has hybrid Phillips curves in all three countries, $\omega_i = 0.5$, and a hybrid IS curve, $\psi_i = 0.5$. Regime (b) (dashed lines in the graphs) has the New-Keynesian Phillips curve with purely forward-looking inflation expectations, $\omega_i = 0$ and a forward-looking IS-curve, $\psi_i = 0$. Regime (c) (dotted lines in the graphs) assumes backward-looking inflation expectations, $\omega_i = 1$, implying a traditional Phillips curve with adaptive expectations, and a backward looking IS curve, $\psi_i = 1$. Figure 1 displays the adjustments that are produced by the monetary shock in the euro area.

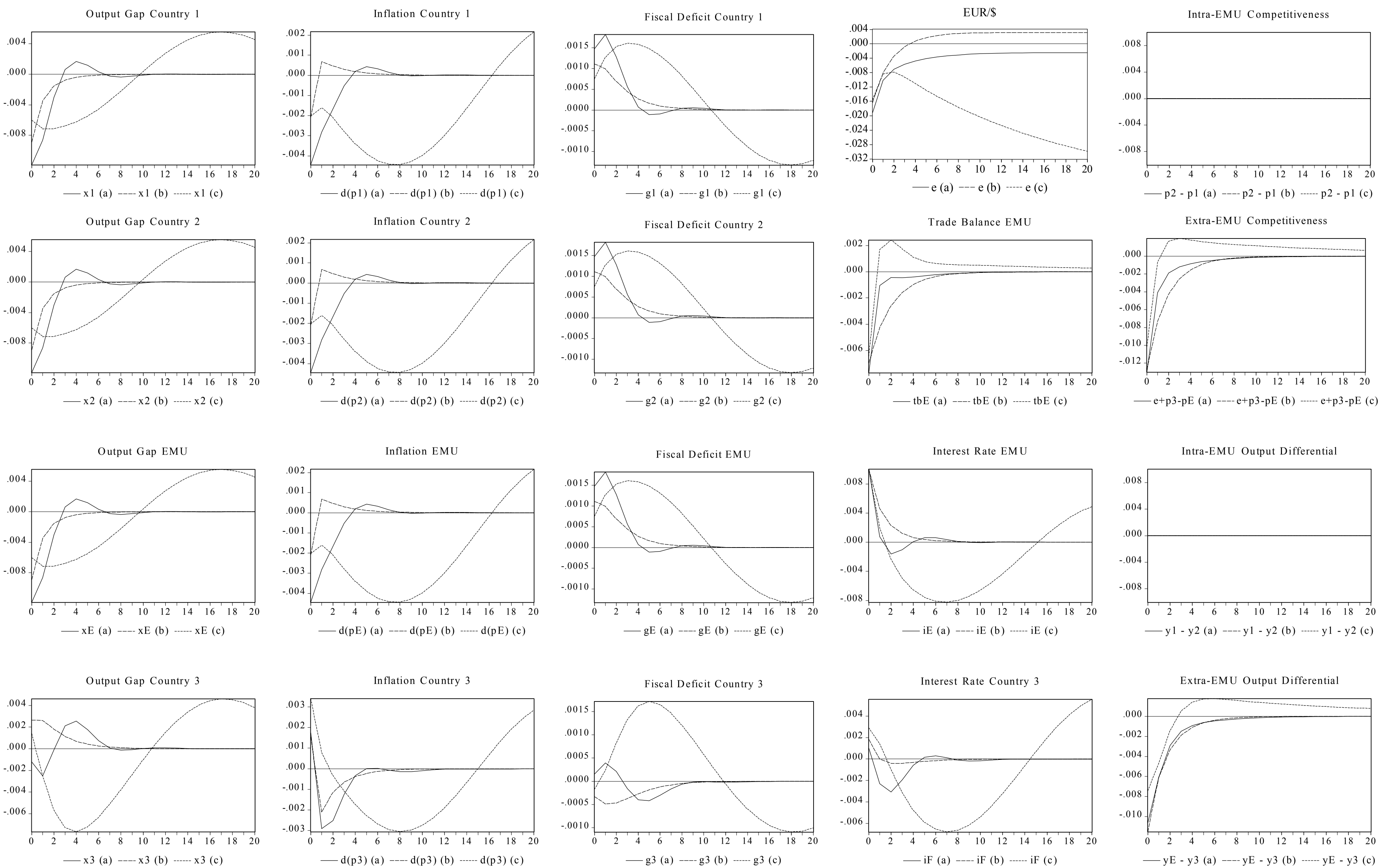

Figure 1

I. A Positive Interest Rate Shock with Symmetric Countries.

___ (a): $\omega_i, \psi_i = 0.5$ ------ (b): $\omega_i, \psi_i = 0$ …… (c): $\omega_i, \psi_i = 1$

The restrictive monetary innovation produces an initial drop in output and inflation in the euro area. This induces an expansionary fiscal policy/fiscal deficit through the automatic stabilizers. Compared to the forward-looking case, adjustments are larger and more prolonged in the hybrid model and even more so in the backward looking case where adjustments are of an oscillatory nature and take a long time (even there the adjustment is globally stable though, we have however not displayed the adjustments beyond period 20).[20] Since the EMU countries are identical in structures and fiscal policy rules, they display the same adjustments and the intra-EMU competitiveness variable and the intra-EMU output differential are always equal to zero.

Similar to the overshooting effects present in the sticky-price model of Dornbusch, the euro dollar appreciates instantaneously to maintain UIP. After which it depreciates to its new steady-state. The substantial initial appreciation of the common currency aggravates the stabilization burden in the euro area as it leads to a negative value of extra-EMU competitiveness, reducing net exports and contributing thereby to a larger output gap. Because of the pass-through effect, it contributes to lower inflation in the euro-area, although this effect, as measured by μ_{ij} has been kept relatively low in our examples. On the other hand, the appreciation of the euro fosters output adjustment in the US (country 3) which has actually a positive output gap, positive inflation, positive interest rates and fiscal surpluses in the forward looking case. Although the US has the same structural and policy parameters it adjusts clearly differently from the euro-area. The differences in the adjustment patterns of the EMU and the US are therefore here entirely driven by the asymmetric character of the monetary shock and the effects produced by the adjustment of the euro exchange rate, indicated above.[21]

II. A Symmetric Supply Shock in an Asymmetric EMU

The second example deals with a symmetric negative supply shock in the euro area, in a setting where the EMU countries differ in the inflation-output nexus in their Phillips-curves. Indeed, it is often argue that the EMU countries are quite different in the flexibility of their goods and labor markets, resulting in different adjustment capacities in the supply side of their economies. Here country 2 is assumed to be more flexible than country, $\gamma_2 = 0.3$ whereas $\gamma_1 = 0.1$ like in the baseline case. Also all other parameters –including those of country 3- remain as in the baseline case. The shock hits the EMU at period 0, after which it dissipates –i.e. $u_1^s(0) = u_2^s(0) = 0.01$, $\phi_1^s = \phi_2^s = 0$-, one could think of a one-time wage increase or other autonomous inflationary shocks. The resulting adjustments are found in Figure 2,

[20] We note that these adjustments that are produced by a monetary shocks do not seem to be completely out of line with empirical studies that use (S)VAR models to analyze monetary transmission in the euro-area, see e.g. Peersman and Smets (2001).

[21] In fact, in case we would assume a fixed euro dollar exchange rate, also country 3 would by definition experience the same shock and display identical adjustment as the euro-area.

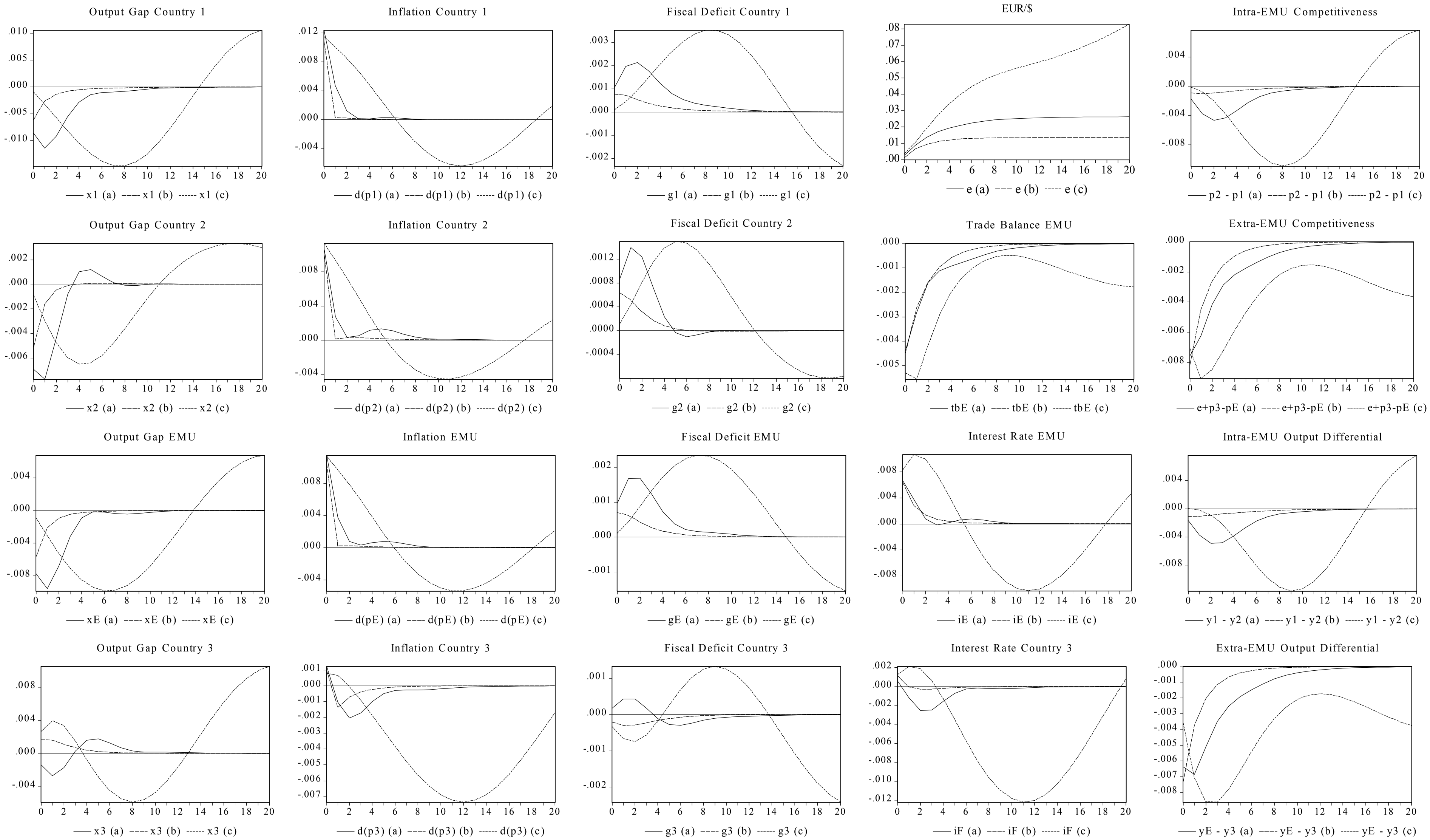

Figure 2

II. A Negative Supply Shock in the EMU with Asymmetric EMU Countries ($\gamma_1 = 0.1,\ \gamma_2 = 0.3$).

___ (a): $\omega_i, \psi_i = 0.5$ ------ (b): $\omega_i, \psi_i = 0$ …… (c): $\omega_i, \psi_i = 1$

The supply shock results in considerable adjustments. Clearly visible is the stronger shock-absorbing capacity of country 2: it features smaller and less persistent output gaps, inflation and fiscal deficits. The intra-EMU competitiveness and output differential indicators show that country 2 gains in competitiveness and has lower output losses than country 1. To curb inflation, a restrictive monetary policy is implemented by the ECB. The euro depreciates but because of the initial price jump the euro-area faces deteriorating competitiveness vis-à-vis country 3 during the entire adjustment (a real appreciation of the euro against the dollar). Country 3 is partially affected by the adverse developments in the euro-area, although the effects are limited, except for the backward-looking case where as in the previous example, more substantial and persistent adjustments are induced. It benefits from increased competitiveness vis-à-vis the EMU as indicated by the real appreciation of the euro and the trade balance deficit of the euro-area. Among others this example illustrate that a symmetric shock can lead to significant divergences in an EMU that displays structural disparities and that these divergences moreover vary with the amount of forward- and backward-looking in output and inflation.

The nature of the shock (a supply shock) is an additional complication since monetary and fiscal policies can not stabilize directly such shocks that operate at the supply side of the economy. In particular if price and output become more backward-looking, the economies are –not surprisingly- seen to adjust slower, increasing slack and policy ineffectiveness. A second reason why the impact of the supply shock is greater and more persistent than that of the monetary shock is that in that case there is a trade-off in the stabilization of inflation and output variability. Given the higher weight in the stabilization of inflation in the monetary policy rule, the rise in the short-term nominal interest-rate to stabilize inflation comes at the cost of delaying real adjustment. The restrictive monetary policy goes along with expansionary fiscal policies. Both policy instruments act here as substitutes, counteracting each other. As a result, the supply shock produces real divergence (output differential) and nominal divergence (price differential, competitiveness) between countries.

III. An Asymmetric Fiscal Shock in a Symmetric EMU

A large part of the literature on EMU deals with the consequences of asymmetric shocks: in that case the absence of national monetary policy seems most problematic, in particular in the absence of alternative adjustment mechanisms such as labor mobility, fiscal flexibility at the national level or federal fiscal stabilizers. In the third and fourth example, we therefore shift our attention to asymmetric shocks in the EMU. First, we analyze the effects of a positive fiscal impulse in country 1. In period 0, country 1 experiences an expansionary fiscal impulse of one percent, i.e. $u_1^g(0) = 0.01, \phi_1^g = 0$. In Figure 3 the adjustments that result, are displayed.

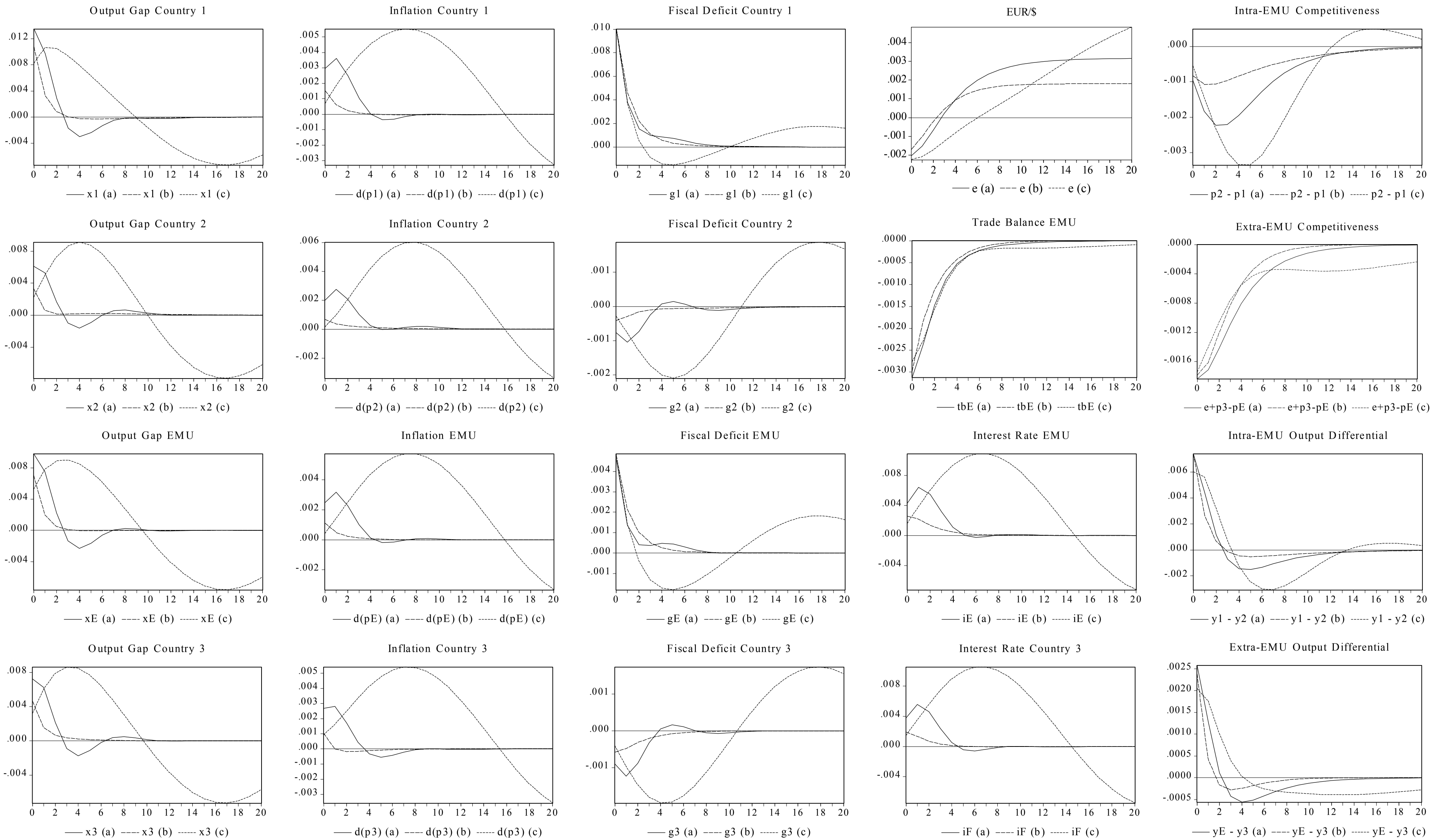

Figure 3

III. A Positive Asymmetric Fiscal Shock in the EMU.

___ (a): $\omega_i, \psi_i = 0.5$ ------ (b): $\omega_i, \psi_i = 0$ …… (c): $\omega_i, \psi_i = 1$

This shock stimulates country 1's economy significantly, in the short-run. Given some degree of deficit smoothing, deficits remain high in the short-run. Mainly because of the inflationary developments in country 1, the ECB implements a restrictive monetary policy. After an initial appreciation, the euro depreciates in the long-run (UIP) because of the restrictive monetary policy. Through the direct output spillovers, the economies of country 2 and 3 are also stimulated as witness significantly positive output gaps and inflation. Restrictive fiscal policies (fiscal surpluses) result there from the automatic stabilizers. In addition, the fiscal shock causes a number of indirect spillovers on country 2 and 3. E.g., the initial appreciation of the euro that is caused, produces a negative (positive) spillover on output in country 2 (3). Country 2 and 3 gain competitiveness vis-à-vis country 1. Also, an inflation reducing (increasing) spillover on country 2 (3) results. Note that the (relatively small) differences in adjustment of country 2 and 3 are entirely due to the differences in monetary policy of the ECB and the FED and the resulting dynamics of the euro exchange rate since otherwise both countries are identical and only subjected to the shock in country 1. In the short-run output of the euro-area exceeds output of country 3 and there is a trade deficit of the euro-area since the effects of higher output and negative competitiveness work in the same direction.

This example shows in a quite clear way that asymmetric shocks in the EMU are likely to produce divergences, despite the presence of some potentially equilibrating mechanisms in the form of output spillovers, the policy response of the ECB and the adjustment of the euro exchange rate. As noted in the previous examples, the magnitude and persistence of the effects is moreover strongly dependent on the degree of forward- and backward looking in the economy. Finally, the example demonstrates once more that also non euro-area country 3 can not insulate itself from the adjustments in the euro-area, notwithstanding the workings of a number of stabilizing mechanisms operating through trade and international finance and the workings of its own stabilization policies.

5. The Role of Macroeconomic Policymaking

Macroeconomic policies play a crucial role in the adjustment to shocks in the model. In this section, we, therefore, want to take a more detailed look at the role of monetary and fiscal policy rules.

IV. A Global Demand Shock with a More Aggressive FED and an Asymmetric SGP

As noted in Section 2 it can be argued that US monetary and fiscal policies acted more aggressively against worsening domestic and global macro-economic conditions after September 2001. In contrast, the euro-area seemed to be characterized by a very cautious monetary policy and fiscal policies that were seriously constrained by the SGP and other factors. In the next example we want to consider such a scenario in the context of our model. We consider a global negative demand shock that occurs at $t = 0$ and dissipates instantaneously, i.e. $u^d_{1,2,3}(0) = -0.01,\ \phi^d_{1,2,3} = 0$. We assume that the FED acts more aggressively than the ECB. In the model there are two possibilities to achieve this, (i) we can give the FED a relatively stronger weight at stabilizing output fluctuations (relative to price stability) than the ECB, $\chi_F > \chi_E$, (ii) we can assign in the monetary policy rule of the FED a lower smoothing parameter than the one of the ECB, $\rho_F < \rho_E$. Here, we use the second interpretation of a more aggressive monetary policy of the ECB as it seems to somewhat closer to policy making in practice and it also fits well into the recent strong interest in the consequences of policy smoothing in theoretical and empirical research. We assume that $\rho_F = 0, \rho_E = 0.5$. In addition, we assume that country 2 is completely restricted by the SGP and has no room of manoeuvre in the sense that its budget deficit is restricted to equal zero, whereas country 1 and 3 retain the baseline flexibility in their fiscal policy rule: $\rho_2 = 1,\ \rho_1 = \rho_3 = 0.5$.

The adjustments are displayed in Figure 4.

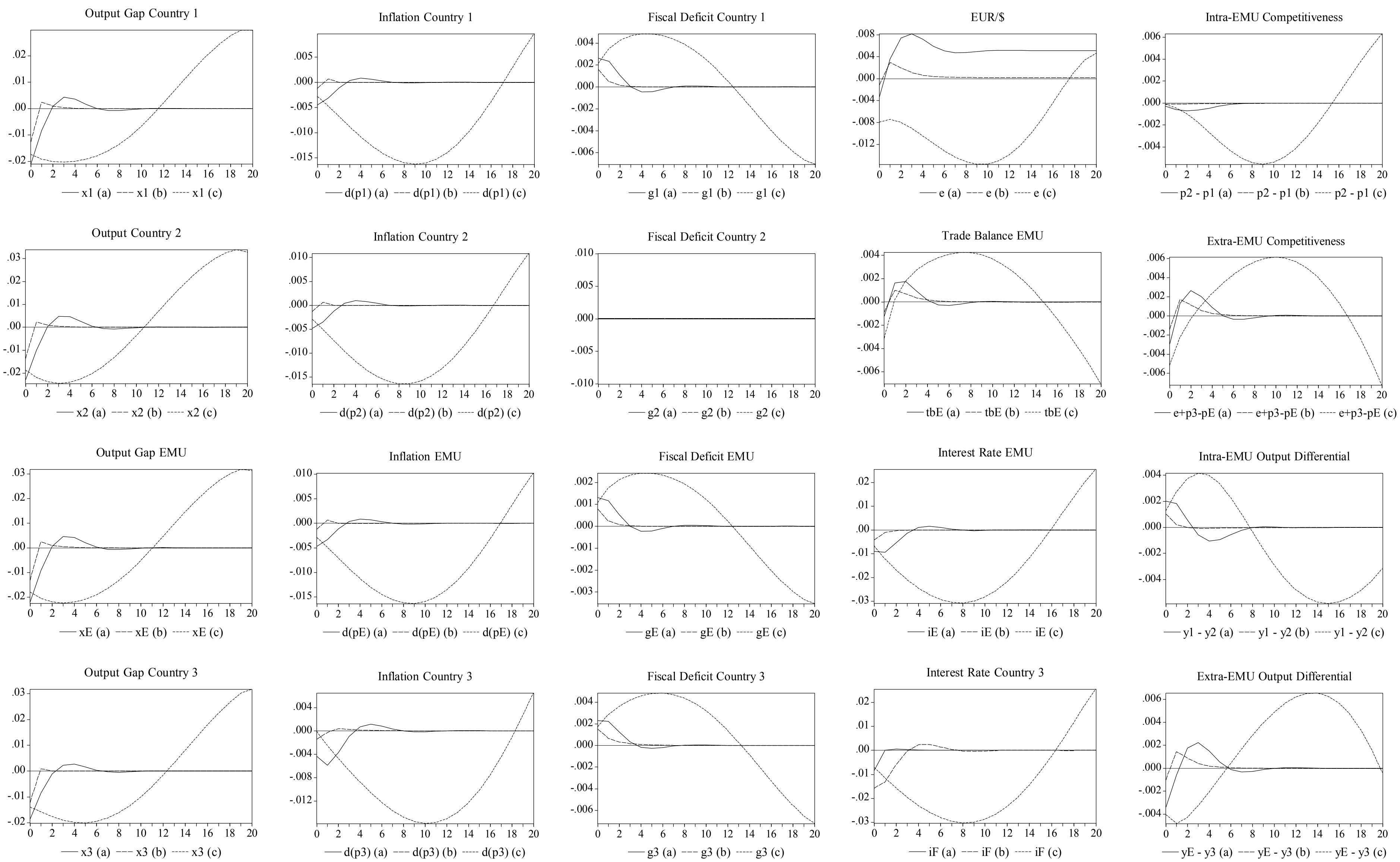

Figure 4

IV. A Negative Symmetric Demand Shock.

___ (a): $\omega_i, \psi_i = 0.5$ ------ (b): $\omega_i, \psi_i = 0$ …… (c): $\omega_i, \psi_i = 1$

Country 3 has the most policy flexibility and it initially displays a lower inflation and output drop and stronger counter-cyclical policy responses than the EMU countries. Country 1 has lower output fluctuations than country 2 which faces a regime of no fiscal flexibility and whose policy flexibility therefore rests solely with the policy adjustments of the ECB.[22] The lack of adjustment in country 2 also witnesses the initial negative intra-EMU competitiveness and income differential variables. In a similar manner, the slower adjustment in the euro-area vis-à-vis the US result in lower competitiveness of the euro-area and an initial negative income differential. These factors also explain the adjustment of the EU trade balance: the lower competitiveness has a negative effect, whereas the negative income differential has a positive effect. Most of the time the second effect appears to dominate the first effect and the trade balance tends to a surplus. In the backward-looking regime, the considerable appreciation of the euro is deflationary for the euro-area and inflationary for the US economy.

V. An Asymmetric Demand Shock in the EMU with Alternative Degrees of Policy Smoothing

The effects of macroeconomic shocks in our model can be partially stabilized by designing adequate monetary and fiscal policies. In this example, we want to look a bit deeper into the effects of alternative stabilization policies. We focus in particular on the role of instrument smoothing in macroeconomic stabilization. We do no longer vary the degree of forward and backward looking in this example and assume in all three regime the baseline setting of hybrid IS and Phillips curves, $\psi_i = \omega_i = 0.5$ and all three countries symmetric. At period *t* = 0, a negative demand shock hits country 1, $u_1^d(0) = -0.01,\ \phi_1^d = 0$. We analyze the adjustment dynamics that are produced under three alternative policy rules settings. Regime (a) has the baseline case of moderate monetary and fiscal policy smoothing: $\rho_{E,F,1,2,3,} = 0.5$. Regime (b) has no instrument smoothing: $\rho_{E,F,1,2,3} = 0$. Regime (c) has complete instrument smoothing: $\rho_{E,F,1,2,3} = 1$. The resulting adjustments are displayed in Figure 5.

[22] These results are a bit difficult to discern from Figure 4 directly but a graphical inspection by the authors revealed these conclusions.

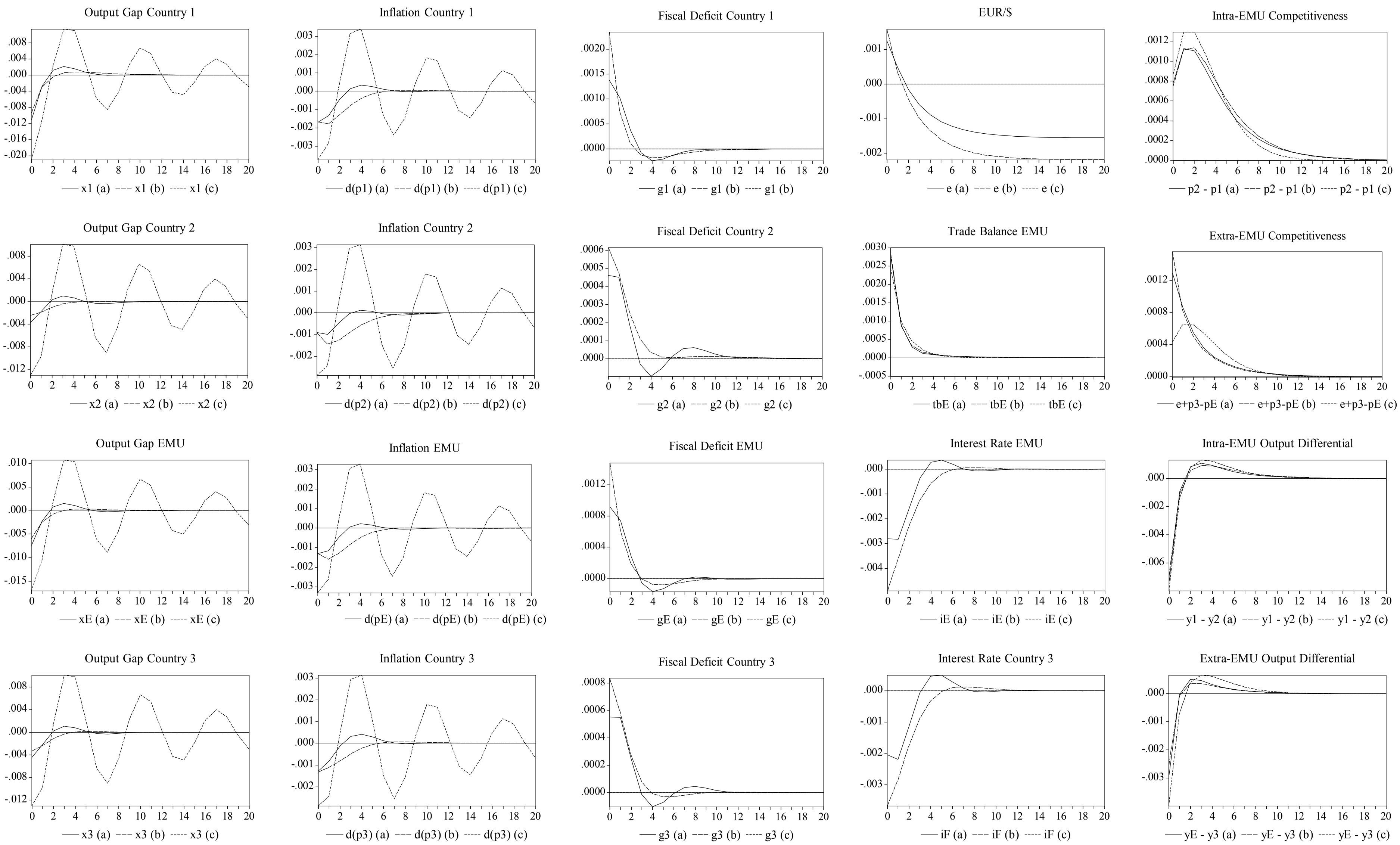

Figure 5

V. A Negative Asymmetric Demand Shock in the EMU.

___ (a): $\rho_i = 0.5$ ------ (b): $\rho_i = 0$ …… (c): $\rho_i = 1$

The adjustments are straightforward: the negative demand shock in country 1 induces a negative output gap, deflation and fiscal deficits there (except in the third case where fiscal policy is inert). These adjustments are partially transferred to country 2 and 3. The initial depreciation of the euro is an additional negative spillover that affects country 3. In the (a) and (b) regimes, higher fiscal deficits and lower interest rates act as stabilizing mechanisms. The complete smoothing regime implies inactive monetary and fiscal stabilization policies: interest rates and fiscal deficits remain unaltered. This is not adequate and his regime displays much larger volatility in real and nominal variables than the moderate and no instrument smoothing cases. Due to the absence of any stabilization policy, the adjustment dynamics are in the form of (damped) oscillations. In the complete smoothing regime also the exchange rate is constant, whereas in the other two regimes the initial depreciation induces an improvement in competitiveness vis-à-vis the US, which reminds again of the shock-absorbing capacity of the euro-dollar exchange rate.[23] Together with the negative output differential of the euro-area and the US, this induces a trade surplus of the euro-area.

This example hints at the lower efficiency of inert monetary and fiscal policies that are not directed at stabilization. The workings of instruments smoothing are, moreover, not wholly symmetric, an increase of ρ_i from 0.5 to 1 has much more impact that an increase from 0 to 0.5.

VI. An International Financial Markets Shock with Alternative Monetary Policy Functions

In official statements, both the ECB and the FED have routinously stressed that in their monetary policy decisions the value of the euro/dollar exchange rate is of no concern and that they principally maintain a policy of "benign neglect" to the exchange rate. Notwithstanding these statements, one could imagine situations and considerations in which the level of the exchange rate or the rate of exchange rate depreciation does play a role to policymakers, in particular when it is feared to endanger the objectives of price and output stability and/or if the fluctuations of the exchange rate are judged to be driven by speculation and out of line with fundamentals.

To illustrate such a scenario, we consider in the hybrid model the effects of an UIP shock under three alternative monetary policy functions of the ECB. In regime (a) we have the baseline with no feedback from the euro exchange rate on monetary policy of the ECB: $\tau_{E,0} = \tau_{E,1} = 0$. Regime (b) considers a direct feedback from the level of the exchange rate on the euro-area interest rate: $\tau_{E,0} = 0.5$ and $\tau_{E,1} = 0$. Regime (c) entails a direct feedback from the rate of depreciation of the euro on the euro-area interest rate: $\tau_{E,0} = -\tau_{E,1} = 0.5$. Regime (b) implies a strong monetary policy reaction as the policymaker seeks to target the level of the exchange rate; in regime (c) it seeks only to target the rate of change of the exchange rate. At period $t = 0$, an UIP shock occurs and we assume zero persistence for simplicity,

[23] In fact, regime (c) may also be interpreted as a regime where also country 3 starts participating in a monetary union with country 1 and 2.

$u^r(0) = 0.01,\ \phi^r = 0$. We analyze the adjustment dynamics that are produced under these three alternative policy rules settings in Figure 6.

There is an interesting aspect to this UIP shock: it has a truly anti-symmetric working. It affects the euro area and US in an opposite manner. The initial appreciation shock to the euro reduces output and inflation (through the competitiveness and pass-through channels, respectively) and increases fiscal deficits in the euro-zone, but it increases output and inflation and reduces fiscal deficits in the US. The effects are driven by the different exchange rate paths and in particular the different interest rate policies of the ECB: with exchange rate targeting strategies we find a substantially stronger reaction of the euro-area interest rate. The size and persistence of these differences and their effects remain limited, altogether, and it may be argued that the scope for exchange rate targeting by the ECB may be rather limited in practice and that the current policy of benign neglect is rather appropriate. In cases of more prolonged shocks or more inertia in macroeconomic adjustment such a conclusion however may be subject to more caution.

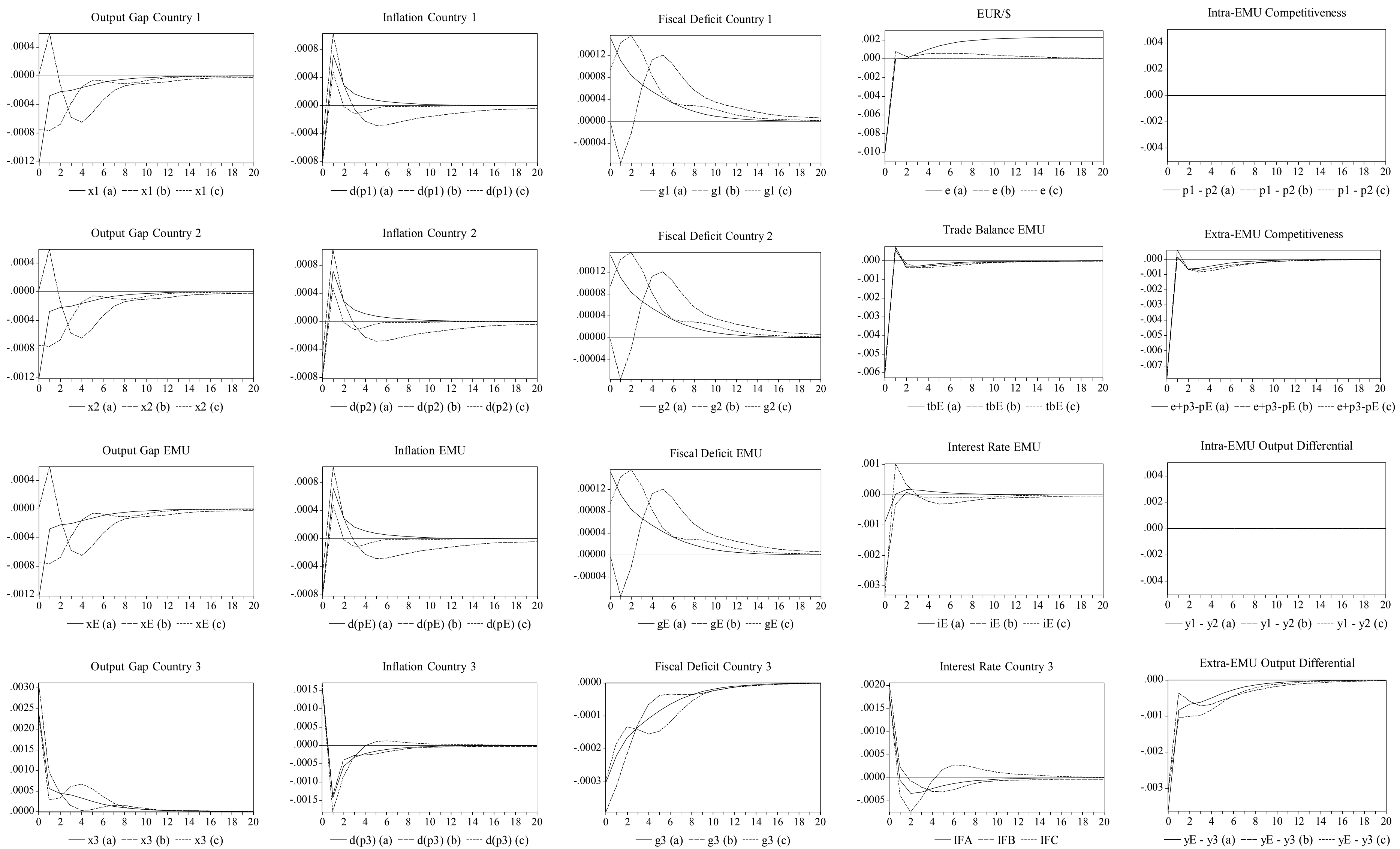

Figure 6

VI. An Exchange Rate Shock with Alternative Monetary Policy Functions of the ECB

___ (a): $\tau_{E,0} = \tau_{E,1} = 0$ ------ (b): $\tau_{E,0} = 0.5,\ \tau_{E,1} = 0$ …… (c): $\tau_{E,0} = -\tau_{E,1} = 0.5$

Some Efficiency Considerations

To assess briefly a number of efficiency aspects, we carried out stochastic simulations of the examples analyzed above, i.e. the respective shocks in these examples are repeated 100 times and the resulting standard deviations calculated. Efficiency can then be assessed by looking at inflation, output and instrument variability. The variability of a variable is measured by its standard deviation (*Std*). Table 2 gives the standard deviation of inflation rates, output gaps, the interest rate and fiscal deficits in the examples I-VI.

A number of insights are summarized in Table 2. With more backward-looking in output and inflation, the variability of output and inflation increases as the economy adjusts in a more inertial manner to macro-economic shocks. Typically, this induces also more variability in policy instruments given a larger scope for stabilization policies (here in the form of macro-economic policy rules). At the same, there is also a larger scope for cross-country spillovers, be they direct or indirect and inside the euro-area or transatlantic. It is also clear that the forward and backward-looking do no operate in a linear way, in the sense that moving from the purely backward regime (c) to the hybrid regime (a) involves different, more drastic, changes than moving from a purely forward looking regime (b) to the hybrid regime.

Example I and II illustrate especially how the euro-area shocks affect country 3, through the transatlantic spillovers. Example III shows how asymmetric shocks hitting one euro-area country will affect other countries through various spillovers. In that case it is also interesting to compare country 2 and 3. While both are faced with the same shock in country 1, the transmissions are different and so are the resulting output, price and instrument variability. The role of the common monetary policy and adjustment of the euro exchange rate are the crucial factors to explain these differences as we had already discussed in the previous section. While very roughly, this comparison may, therefore, be useful in assessing how useful/damaging for country 2 it is to be in a monetary union instead of –like country 3- staying outside. Case IV shows the consequences of more policy activism of the side of the US than in the euro-area in the presence of the same macroeconomic shock, and also the effects of a restriction on fiscal policy flexibility in one euro-area country, e.g. due to the workings of the SGP. It results in lower output variability in country 3 than in the euro-area, but higher instrument variability. Case IV was designed to study alternative degrees of policy activism, from mild (a), strong activism (b) and no activism (c). Regime (c) moreover featured a fixed euro exchange rate so that adjustment through the shock-absorbing capacity of that variable is also precluded. We see that monetary and fiscal policy rules perform a stabilizing function under aggregate demand shock depending on the size of policy parameters. The estimated effects of different exchange rate targeting strategies in case VI, seem also to suggest that the usefulness of these strategies may be questioned. In all cases, these rules induce more variability in output, inflation and instrument if compared with the no exchange rate targeting strategy (a).

Table 2

Efficiency of Alternative Macroeconomic Policy Rules

	$Std(\pi_1)$	$Std(\pi_2)$	$Std(\pi_E)$	$Std(\pi_3)$	$Std(x_1)$	$Std(x_2)$	$Std(x_E)$	$Std(x_3)$	$Std(e)$	$Std(i_E)$	$Std(i_3)$	$Std(g_1)$	$Std(g_2)$	$Std(g_E)$	$Std(g_3)$
I(a)	0.0012	0.0012	0.0012	0.0009	0.0032	0.0032	0.0032	0.0011	0.0039	0.0022	0.0009	0.0006	0.0006	0.0006	0.0002
I(b)	0.0005	0.0005	0.0005	0.0006	0.0020	0.0020	0.0020	0.0009	0.0048	0.0024	0.0004	0.0003	0.0003	0.0003	0.0002
I(c)	0.0021	0.0021	0.0021	0.0020	0.0050	0.0050	0.0050	0.0045	0.0066	0.0053	0.0041	0.0011	0.0011	0.0011	0.0010
II(a)	0.0023	0.0022	0.0022	0.0006	0.0027	0.0023	0.0025	0.0009	0.0053	0.0014	0.0007	0.0005	0.0004	0.0005	0.0002
II(b)	0.0022	0.0021	0.0022	0.0004	0.0013	0.0012	0.0012	0.0005	0.0029	0.0014	0.0003	0.0002	0.0002	0.0002	0.0001
II(c)	0.0049	0.0041	0.0045	0.0024	0.0075	0.0033	0.0051	0.0047	0.0193	0.0062	0.0045	0.0016	0.0008	0.0012	0.0010
III(a)	0.0011	0.0008	0.0010	0.0009	0.0038	0.0018	0.0028	0.0022	0.0016	0.0020	0.0018	0.0023	0.0003	0.0010	0.0004
III(b)	0.0003	0.0002	0.0003	0.0002	0.0024	0.0007	0.0016	0.0010	0.0010	0.0007	0.0005	0.0023	0.0001	0.0011	0.0002
III(c)	0.0029	0.0030	0.0029	0.0029	0.0067	0.0065	0.0065	0.0061	0.0021	0.0061	0.0060	0.0025	0.0015	0.0017	0.0014
IV(a)	0.0013	0.0015	0.0013	0.0019	0.0051	0.0055	0.0053	0.0052	0.0031	0.0030	0.0050	0.0008	0	0.0004	0.0008
IV(b)	0.0005	0.0004	0.0004	0.0005	0.0051	0.0034	0.0042	0.0037	0.0011	0.0013	0.0025	0.0006	0	0.0003	0.0005
IV(c)	0.0048	0.0051	0.0049	0.0040	0.0117	0.0136	0.0126	0.0112	0.0040	0.0108	0.0102	0.0026	0	0.0014	0.0025
V(a)	0.0004	0.0003	0.0003	0.0003	0.0023	0.0008	0.0015	0.0010	0.0007	0.0008	0.0006	0.0003	0.0001	0.0002	0.0002
V(b)	0.0012	0.0010	0.0011	0.0009	0.0046	0.0014	0.0030	0.0019	0.0021	0.0029	0.0022	0.0012	0.0004	0.0007	0.0018
V(c)	0.0011	0.0010	0.0010	0.0010	0.0043	0.0036	0.0039	0.0036	0	0	0	0	0	0	0
VI(a)	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0003	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
VI(b)	0.0002	0.0002	0.0002	0.0003	0.0002	0.0002	0.0002	0.0005	0.0015	0.0004	0.0003	0.0001	0.0001	0.0001	0.0001
VI(c)	0.0002	0.0002	0.0002	0.0007	0.0003	0.0003	0.0003	0.0006	0.0025	0.0009	0.0005	0.0001	0.0001	0.0001	0.0001

Note: displayed are standard deviations of inflation rates, output gaps and instrument variables of stochastic simulations of examples I - VI. (a), (b) and (c) denote the different regimes in place, see also the analysis before.

Conclusions.

Recent macroeconomic research has focused on the working and effects of macroeconomic policy rules. This paper has applied the insights of the recent new-Keynesian literature on monetary as well as fiscal policy rules to the EMU. Using a stylized three-country model of the euro-area and its links with the non euro-area, we have shown by means of simulations that interesting insights about the effects of macroeconomic policy can be obtained from a "policy-rules" based approach to monetary and fiscal policy design. The EMU is an interesting case because it combines monetary policy designed at the supra-national (federal) level with fiscal policy chosen at the national level but subject to restrictions in the form of the SGP.

The analysis has also provided more insight on macroeconomic interactions between the euro-area and non euro-area and on exchange rate formation of the euro. In this, a detailed analysis of the design of monetary and fiscal policies was a crucial element. The analysis contributed by showing how macro-economic fluctuations and macro-economic policies in the euro-area and the US transmit themselves through various channels. In addition, this led to a policy-based explanation of euro-dollar fluctuations. Finally, also more insight has resulted on the determinants and dynamics of the trade balance of the euro-area with the US.

Using numerical simulations, we specifically have analyzed how four aspects play a crucial role in our model (i) the consequences of alternative monetary and fiscal policy rules, (ii) transatlantic spillovers and policy interactions, and the dynamics of the euro and euro-area current account, (iii) the consequences of asymmetries between EMU countries -asymmetries in macroeconomic shocks, macroeconomic structures or policy preferences/rules-, and between the EMU-area and the US, (iv) the role of alternative degrees of backward and forward looking in output and inflation.

Adjustment of the euro exchange rate remains an important shock absorber when the source of the disturbances is outside the euro-area. If the source of disturbances is inside the euro area, however, the induced adjustment of the euro exchange rate does not need to be stabilizing for all EMU countries, in particular not if the euro area is hit by asymmetric shocks and significant asymmetries in economic structures. The euro exchange rate shares this feature with the common interest rate, the policy instrument of the ECB: in case of symmetric shocks and symmetric economic structures it is more easy to implement monetary policies that are (approximately) appropriate for the euro-area countries than in cases with substantial asymmetries.

There are several directions in which this paper may be extended: for making practical policy making it would be highly desirable to have empirical estimates on the size of (policy) output and inflation spillovers in the euro-area and between the euro-area and non euro-area. From a theoretical perspective it would be interesting to compare the ad hoc policy rules with optimal rules under commitment and discretion strategies of optimizing monetary and fiscal policymakers. In such a setting, even an explicit game-theoretic modeling seems useful and advisable, given the various interactions between the various policymakers in the model. As it was not possible to include these additional topics to the current analysis, they were left for future research.

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