The Stability and Growth Pact
Time to Rebuild!*

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Abstract

Within this paper we specify a symmetric two country model for the euro area to evaluate monetary and fiscal policy interaction with decentralized fiscal authorities. Obviously this calls for rules which neatly balance the chances and perils. Thereby we show that stringent rules are a prequisitive for a harmonious functioning of a monetary union. Nevertheless given the ability of fiscal policy to effectively stabilize the economic cycle we show that the current rules in reign are of little use. We close the paper by making some suggestions along which the Stability and Growth Pact might be reformed.

Keywords: Economic and Monetary Union, Fiscal Policy, Fiscal Rules, Stability and Growth Pact

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1 Introduction

With the launch of the third stage EMU the member countries have embarqued to unknown territory to tighten the political vision of a common European future. Once more the economic momentum served as a vehicle to link irreversibly the fate of the member countries as it was from the outset of the union after WWII. As a consequence the twelve member states had to rethink and rebuild a new common European macroeconomic architecture that enshrined the views on monetary and fiscal policy interaction in the euro area. Unfortunately, the grandfathers of the Stability and Growth Pact (SGP) were not ignited by the challenge to restructure but mostly guided by cautioness, or put differently the new architecture- The Stability and Growth Pact- is a child of German “Angst”. Given the current problems and shortcomings of the SGP it is time to rethink and rebuild.

The unique feature of a currency area is given by the fact that the different macroeconomic agents, the ECB, national governments and labour unions focus on different levels of target variables. The common central bank whose policy we assume to be conducted according to the notion of inflation targeting (Svensson 1999) focuses on union wide aggregates. It sets nominal interest rates for the currency area consistent with its inflation target while equally having a concern for economic activity. This means in particular that the interest rate policy of the ECB will be indifferent against mean preserving distributions of macroeconomic outcomes across member states. In contrast governments basically focus on national aggregates. In a monetary union that is subject to asymmetric shocks fiscal policy serves as a firewall to block idiosyncratic shocks from spreading to other member countries. Of course fiscal policy might equally be itself the source of destabilisation as incentives for free-rider behaviour are present (Dixit and Lambertini 2001). Therefore a monetary union calls for a renaissance of fiscal stabilization policy[1]. Obviously this calls for rules which neatly balance the chances and perils that are nested in monetary and fiscal policy interaction in a currency union with decentralised fiscal authorities.

The paper is structured as follows: In a first step we aim to identify a small scale symmetric two country macromodel for the euro area that realistically describes the data.

[1] In a closed large economy it is somewhat a consensus that active demand management should be conducted by the central bank as these have heavily improved over the last decades when it comes to stabilize economic fluctuations. John B. Taylor (2000) comes to the following conclusion: "In the current context of the U.S economy, it seems best to let fiscal policy have its main countercyclical impact through the automatic stabilizers. U.S. monetary policy has been doing a good job in the recent decades at keeping aggregate demand close to its potential GDP, partly because this is consistent with the Fed's inflation objective and partly because it is viewed as a good policy in its own light. "

Thereby we specify an open economy Quarterly New Keynesian Macromodel that is augmented by fiscal policy. Analytically we calibrate the model along the lines as proposed by (Mayer 2003). To specify a model we need to identify the monetary and fiscal policy rules that describe the current macroeconomic paradigm in reign in Europe. Thereby we stress the view taken by the European Commission on fiscal policy rules and the view taken by the ECB- given its high status of legal independence- on monetary policy rules.

Once we have calibrated the model we perform a battery of tests. In particular we want to evaluate the impact of symmetric and asymmetric fiscal spending shocks to underline the need for rules as fiscal policy instrumentalised by myopic politicians inflicts substantial damage on the rest of the union. This holds in particular as the ECB will only take care on idiosyncratic events insofar as they have an impact on the overall European averages. In a second step we analyse how effective fiscal policy is in stabilising economic cycles by computing the impact of varying degrees of automatic stabilizers on the correlation structure of the model. In particular we will evaluate whether fiscal policy can reduce the persistence nested in the output gap and the inflation rate. On the other hand we would like to state our mistrust that the rules as laid down in the SGP. The implicit assumption of the SGP that "high deficits lead to high inflation rates" has generated a malfunctioning alarming system. The 3% deficit criterion impairs the ability of fiscal policy to effectively stabilize the cycle. We finish the paper by giving some proposals along which we think the SGP should be reformed.

2 Specifying a Symmetric Two Country Model for the Euro Area

In this section we will shortly highlight the current macroeconomic interaction in the euro-area as enshrined in the reaty of Maastricht and the SGP in order to identify a realistic model for the euro area. As we will see the current macroeconomic paradigm in reign in Europe was highly shaped by the view that one needs stringent fiscal policy rules to safeguard the de-facto independence of the ECB[2]. The European Council feared that an unsustainable fiscal policy at the national level defined as one that breaks well defined rules causes negative spill over effects in the form of higher inflation rates and real interest rates for the rest of the union, and

[2] The European Council stated: "The European Council underlines the importance of safeguarding sound government finances as a means to strengthening the conditions for price stability and for strong sustainable growth conducive to employment creation. It is also necessary to ensure that national budgetary policies support stability oriented monetary policies. "(European Council 2003)

in the worst case scenario ultimately calls for a bail out as a consequence of unsustainable debt/GDP ratios. In conclusion one can say that the current SGP was strongly shaped by the view that wet nosed governments could ultimately inflate Europe. In the following section we put the focus on identifying monetary and fiscal policy rules that were designed to prevent such developments.

2.1 The Current Setting of the ECB

Despite its official strategy (see (ECB 2004)) it is common practice to specify the objective function of the ECB by the following loss function, although it is typically related to a regime of inflation targeting.

$$L_t = \left[\sum_{t=0}^{\infty} \beta^t \left\{\pi_t^2 + \lambda y_t^2 + \nu \Delta i_t^2\right\}\right]^3 \tag{1}$$

According to equation (1) the ECB tries to reduce aggregate price dispersion across the currency area while equally having a concern for stabilising economic activity. The preference parameter λ depicts the weight monetary policy attaches to stabilise the output gap versus stabilising the inflation rate. Additionally Woodford has shown that equation (1) can be derived as a quadratic approximation to a households expected utility problem in a New Keynesian Macro Model (Woodford 2003). In order to achieve its targets the ECB sets the interest rate in response to exogenous disturbances and consistent with the structural equations of the model so that the loss function $L_{ECB,t}$ is minimised. Note that the ECB only targets at area wide averages, whereas it does not take care on the dispersion of goal variables across member states. In other words the ECB does not consider the spread as a problem as long as it is mean preserving. Additionally we assume that the ECB implements its desired target rate only gradually. Interest rate smoothing can be rationalized by a broad range of arguments. Among them are for instance that the ECB does not want to disrupt financial markets. Additionally gradualism can be a direct result of uncertainties to which a monetary policy maker is exposed (Brainard uncertainty, model uncertainty, data uncertainty ((Martin and Salmon Chris 1999))). From a theoretic perspective interest rate smoothing is a device of making use of private sector expectations of further interest rate steps in the same direction in a forward looking environment ((Lansing and Bharat 2001)).

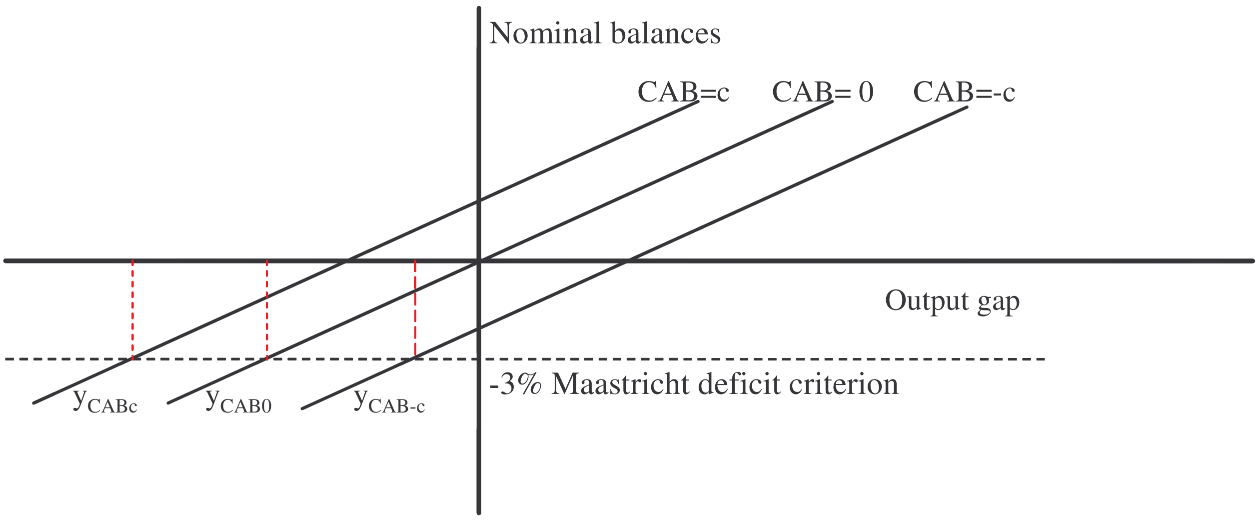
2.2 The Current Setting of Fiscal Policy

The institutional design of the European monetary union was heavily shaped by the „Delors Report“ that called for stringent rules for national fiscal policies as a prequisitive for an efficient functioning of monetary policy (Bofinger 2003). In particular the German side was anxious that individual member states could conduct an unsustainable fiscal policy that would trigger a chain reaction of higher average inflation and nominal interest rates for the rest of the union. Therefore the grandfathers of the SGP intended to design fiscal rules for national policymakers that prevented fiscal authorities itself from being a major source of economic disturbance. This was laid down in particular by the following two interrelated rules which are intended to serve as a firewall against myopic fiscal policymakers:

- The ratio of the current nominal balance to GDP should not exceed the 3%-line unless the economy is hit by a large shock.
- The debt /GDP ratio should be in the medium run close to or below 60%.

According to the Commission the CAB should be balanced over the cycle. Nevertheless this does of course not rule out that the CAB is used in a discretionary manner. As automatic stabilisers and discretionary fiscal policy are freely allowed to operate the definition of a sustainable fiscal policy combines at least from the perspective of the Commission long run sustainability with short run flexibility ((EEAG 2003).

Figure 1: The actual budget balance as a function of the output gap



Based on EEAG (2003), p.54.

[3] Note that throuuoght our exposition we will make use of the fact that after scaling the intertemporal loss function by $(1-\delta)$ the intertemporal loss function approaches the weighted average of the unconditional variances of the individual goal variables: $\lim_{\delta \longrightarrow 1}(1-\delta)L_t = Var[\pi_t]+\lambda Var[y_t]+\nu Var[\Delta i_t]$.

If the CAB is zero on average automatic stabilisers can freely operate and the likelihood that the 3%-deficit criterion will be broken is low (see Figure 1). Only if the economy is hit by a large shock so that $y<y_{CAB}$ the monitoring procedure will be triggered. Nevertheless if the CAB is for instance on average –c% small shocks are likely to run fiscal policy into troubled waters as normal output fluctuations trigger the monitoring procedure[4]. Obviously a fiscal policy stance that exhibits a negative nominal balance even if the output gap is zero increases the likelihood to break the 3%-deficit criterion in the vague of shocks.

In order to incorporate fiscal policy into our small scale macromodel we follow (Taylor 2000) who has proposed for reasons of plausibility that US fiscal policy can be described by the following relationship:

$$g_{1,t} = -\chi y_{1,t} + \overline{g}_1 + \varepsilon_{1,t}^{f} \qquad (2)$$

With $-\chi_1 y_{1,t}$ measuring the reaction of fiscal policy to the state of the cycle. The constant $\overline{g}_1$ depicts the structural fiscal balance over the sample period; $\varepsilon_{1,t}^{f}$ denotes a fiscal spending shock. For the sample period 1983-1999 Taylor has estimated χ to be -0.37% and the constant was estimated to be 0.31. Hence Taylor makes the prediction that a decline in output by 1% induces an increase in government financial balances by 0.37 percent. In a similar approach Van Arle et al (2002) have proposed a parameter of $\chi = 0.5$ for the euro area. To make realistic inferences in a quarterly model we follow (Ballabriga and Martinez-Mongay C. 2002) and additionally introduce inertia in fiscal spending decisions:

$$g_{1,t} = \overline{g}_1 + -\chi y_{1,t} + \lambda g_{1,t-1} + \varepsilon_{1,t}^{f} \qquad (3)$$

Obviously this simple specification of fiscal policy does not disentangle whether the cyclical stance is automatic (automatic stabilizers) or intentional (discretionary policy). But as it is our aim to measure the overall impact of fiscal policy on the cycle this cannot come as a drawback. Throughout the paper we will not take debt smoothing as an independent goal of fiscal policy into account. (Ballabriga and Martinez-Mongay C. 2002) have shown that the output gap is equally influenced by the level of debt. (Auerbach Alan J. 2002) comes to a similar finding for the USA as he reports that fiscal policy seems to respond systematically to both: cyclical factors and the fiscal balance during recent decades.

[4] For an overview on the deficit proceedure see ECB (2003) Monthly Bulletin. Box 7, page 58.

2.3 An open Economy New Keynesian Macro Model as a Vehicle to Model EMU

The vehicle we use to model the euro area is an open economy hybrid New Keynesian Macro Model. It consists of the following building blocs:

- An open economy hybrid Phillips curve that directly incorporates foreign inflation.
- An open economy hybrid IS-curve that is augmented by fiscal policy and the real exchange rate as a measure of intra-European competitiveness.

We will shortly discuss each bloc in term.

2.3.1 An Augmented Hybrid New Keynesian IS-Curve: Euler Equation

The first building bloc of a New Keynesian Macro Model is the IS-equation. It gives a description of the demand side of the economy. The New Keynesian IS-curve is a relationship that relates the output gap negatively to the expected real interest rate. At a quarterly frequency it can simply be stated as:

$$y_{1,t} = \varpi_y E_{1,t-1} \sum\nolimits_{s=1}^{n} \beta_{i,ys} y_{1,t+s} + \left(1-\varpi_y\right) \sum\nolimits_{j=1}^{m} \beta_{yj} y_{1,t-j} - \beta_r \varpi_r \left[\bar{i}_{t-1} - E_{1,t-1}\bar{\pi}_{1,t+3}\right] + \eta_{1,t} \quad (4)$$

Hence it is assumed that today's output gap evolves as a weighted average of yesterdays and tomorrows output gap as well as on the current and future stance of monetary policy. The charm of this approach stems from the fact that it can be derived from microeconomic foundations. Let us assume that the behaviour of a representative household can be mapped by the following separable power utility function as proposed by (Fuhrer 2001):

$$E_t \sum_{j=0}^{\infty} \beta^j \left[\lambda_t \frac{\sigma}{\sigma-1} \left(\frac{C_{t+j}}{C_{t+j+1}^h} \right)^{\frac{\sigma}{\sigma-1}} + bL_{t+j} + \frac{\gamma}{1-\varepsilon} \left(\frac{M_{t+j}}{P_{t+j}} \right)^{1-\varepsilon} \right]^{5} \quad (5)$$

Subject to the following budget constraint:

$$C_{t+j} + \frac{M_{t+j}}{P_{t+j}} + \frac{B_{t+j+1}}{P_{t+j}} = w_{t+j} N_{t+j} + R_{t+j-1} \frac{B_{t+j}}{P_{t+j}} + \frac{M_{t+j-1}}{P_{t+j}} \quad (6)$$

Households draw their total income from their labour income and their predetermined money and bond holdings which they carry over to the next period. They allocate their wealth

[5] Withh: habit formation, σ: Risk Aversion and $(1/\sigma)$= intertemporal elasticity of substitution, ε: inverse of the elasticity of money holdings, γ: steady-state-money holding, λ: shock to he households preferences

on money and bond holdings as alternative assets and their desired level of consumption. The households intertemporal optimisation problem is given by maximising its utility subject to his budget constraint. The household chooses depending on the model specification $B_{\tau+1}(h,f)$, $C_{\tau}(h,f)$, $M_{\tau}(h,f)$ (see for instance (Canzoneri, Cumby, and Diba 2002)). The utility function implies (external) habit persistence. This means that the household is not only interested in the level of consumption $C_t, C_{t+1}, C_{t+2}, \ldots$, but also in the ratio of tomorrows consumption in relation to some (external) habit stock. This assumption automatically introduces inertia into the first order condition for consumption as not only tomorrow, but also yesterday matters. Maximizing the intertemporal utility function with respect to the constraint implies that the following combined first order condition (for consumption and bond holdings) has to hold:

$$E_t\left[\beta\psi_{t+1}\frac{P_t}{P_{t+1}}R_t\right]=E_t\left[\psi_t\right] \tag{7}$$

The basic intuition for this equation is quite simple. It states that the marginal utility of consumption today and tomorrow should be equal in equilibrium. As we have complete contingent claim markets you have the possibility to carry your purchasing power in the form of bonds through time (Cochrane H. 2003). If you buy $1/P_t$ units of assets today they pay-off a stochastic return of $\frac{P_{t+1}R_t}{P_t}$ tomorrow[6].

In order to capture the international linkages we augment the IS-equation by the following features:

$$\Delta q_t = \left(\bar{\pi}_{-i} - \bar{\pi}_i\right) \tag{8}$$

$$ex^d = \varsigma y_{-i} \tag{9}$$

$$g_{1,t} = \bar{g}_1 - \chi y_{1,t} + \lambda g_{1,t-1} + u^s_{1,t} \tag{10}$$

Relationship (10) is the change in the real exchange rate as a measure for intra-European competitiveness. If foreign inflation rates are higher than domestic ones in disequilibrium domestic products become more attractive and hence the output gap will be

[6] One important mechanism from the perspective of monetary policymakers is that higher expected real interest rates today imply that consumption should grow $\left(C_{t+1}/C_t\right)>1$. This assumption is from an empirical perspective somewhat problematic as recently mentioned. Hence the intertemporal Euler equation predicts that the substitution effect is dominant and people consume less today and more tomorrow if the interest rate is expected to grow. Literature that documents the problems when trying to take the Euler equation to the data is for instance: (Matthew B.Canzoneri, Robert E.Cumby, and Behzad T.Diba 2002), (Goodhart and Hofman Boris 2003). Nevertheless we will use the Euler equation in its standard specification as a workhorse to model the demand side of the economy.

pushed above its potential until the new equilibrium is reached. With ex[d] (see equation (9)) we measure the excess demand that results if a foreign country has a boom in output, so that exports and hence economic activity start to accelerate. Equation (10) is the fiscal policy rule. Combining these equations we arrive at the following open economy IS-relationship:

$$y_{1,t} = \varpi_y E_{1,t-1} \sum_{s=1}^{n} \beta_{i,ys} y_{1,t+s} + \left(1-\varpi_y\right) \sum_{j=1}^{m} \beta_{yj} y_{1,t-j}$$
$$- \beta_r \varpi_r \left[\bar{i}_{t-1} - E_{1,t-1}\bar{\pi}_{1,t+3}\right] + \phi g_{1,t} + \iota \Delta \bar{q}_{1,t-1} + \varphi y_{2,t} + \eta_{1,t} \quad (11)$$

2.3.2 An Augmented Hybrid Phillips Curve

The supply side of the economy is described by an augmented New Keynesian Phillips Curve. It gives a description of the supply side of the economy. In its focus, following (Calvo 1983) is a monopolistically competitive firm in the intermediate good sector that faces restrictions on its ability to set prices and wages in a flexible manner (see (Erceg, Henderson D., and Levin A.T. 2000)). In each period only a fraction of firms are called upon to act to set prices optimally. While resetting the price firms take in particular into account the probability of being stuck with the new reset price for j periods. Following (Amato and Laubach 2001) all other firms that were not called upon to reset their prices follow a rule of thumb and simply index prices by last periods inflation rate. Accordingly the law of motion can be stated as (see for instance (Smets Frank and Wouters Ralf 2003)):

$$\left(P_t\right)^{-1/\lambda_{p,t}} = \xi_p \left(P_{t-1} \left(\frac{P_{t-1}}{P_{t-2}} \right)^{\gamma_p} \right)^{-1/\lambda_{p,t}} + \left(1-\xi_p\right)\left(\tilde{p}_t^j\right)^{-1/\lambda_{p,t}} \quad (12)$$

,where $\tilde{p}_t^j$ denotes the optimal reset price. The parameter λ_{pt} denotes the time varying mark-ups in the good markets that can be interpreted as cost push shocks.

Given its period profit function the monopolistically competitive firm maximises expected profits using a discount factor which is consistent with the pricing kernel for nominal returns used by its shareholders (see equation **Fehler! Verweisquelle konnte nicht gefunden werden.**). Following (Calvo 1983) only a fraction of firms receives each period the price change signal. The resulting first order condition is given by:

$$E_t \sum_{i=0}^{\infty} \beta^i \lambda_{t+i} y_{t+i}^j \left(\frac{\tilde{p}_t^j}{P_t} \left(\frac{P_{t-1+i} / P_{t-1}}{P_{t+i} / P_t} \right)^{\gamma_p} - \left(1+\lambda_{p,t+i}\right) mc_{t+i} \right) = 0 \quad (13)$$

Box 1: Open Economy New Keynesian Macro Model for a Monetary Union:

Central bank is guided by the following period loss function:

$$L_t = \hat{\pi}_t^2 + \lambda \hat{y}_t^2 + \nu \Delta i_t^2$$

The area wide aggregates:

$$\hat{\pi}_t = \varpi_1 \pi_{1,t} + \varpi_2 \pi_{2,t} \quad \sum_{i=1}^{2} \varpi_i = 1$$

$$\hat{y}_t = \varpi_1 \hat{y}_{1,t} + \varpi_2 \hat{y}_{2,t} \quad \sum_{i=1}^{2} \varpi_i = 1$$

Augmented hybrid New Keynesian Phillips curve:

$$\pi_{1,t} = \varpi_\pi E_{1,t-1} \overline{\pi}_{1,t+k} + (1-\varpi_\pi) \sum_{j=1}^{s} \beta_{\pi j} \pi_{1,t-j} + \sum_{i=1}^{n} \beta_{yi} y_{1,t-i} + \xi \overline{\pi}_{2,t} + \varepsilon_{1,t}$$

$$\pi_{2,t} = \varpi_\pi E_{2,t-1} \overline{\pi}_{2,t+k} + (1-\varpi_\pi) \sum_{j=1}^{s} \beta_{\pi j} \pi_{2,t-j} + \sum_{i=1}^{n} \beta_{yi} y_{2,t-i} + \xi \overline{\pi}_{1,t} + \varepsilon_{2,t}$$

Augmented hybrid New Keynesian IS-curve:

$$y_{1,t} = \varpi_y E_{1,t-1} \sum_{s=1}^{n} \beta_{i,ys} y_{1,t+s} + \left(1-\varpi_y\right) \sum_{j=1}^{m} \beta_{yj} y_{1,t-j} - \beta_r \varpi_r \left[\overline{i}_{t-1} - E_{1,t-1} \overline{\pi}_{1,t+3} \right]$$
$$+ \phi g_{1,t} + \iota \overline{q}_{1,t-1} + \varphi \overline{y}_{2,t} + \eta_{1,t}$$

$$y_{2,t} = \varpi_y E_{2,t-1} \sum_{s=1}^{n} \beta_{2,ys} y_{2,t+s} + \left(1-\varpi_y\right) \sum_{j=1}^{m} \beta_{yj} y_{2,t-j} - \beta_r \varpi_r \left[\overline{i}_{t-1} - E_{t-1} \overline{\pi}_{2,t+3} \right]$$
$$+ \phi g_{2,t} + \iota \overline{q}_{2,t-1} + \varphi \overline{y}_{1,t} + \eta_{2,t}$$

Fiscal policy rule

$$g_{1,t} = \phi\left(-\chi\left(\overline{y}_{1,t-1}\right)\right) + \lambda g_{1,t-1} + \varepsilon_{1,t}^f$$

$$g_{2,t} = \phi\left(-\chi\left(\overline{y}_{2,t-1}\right)\right) + \lambda g_{2,t-1} + \varepsilon_{2,t}^f$$

Change of the real exchange rate

$$\Delta \overline{q}_{1,t} = \left(\overline{\pi}_{2,t} - \overline{\pi}_{1,t}\right)$$

$$\Delta \overline{q}_{2,t} = \left(\overline{\pi}_{1,t} - \overline{\pi}_{2,t}\right)$$

where $\tilde{p}_t^j$ is the optimal price of those firms that are called upon to select their optimal reset price. Log-linearization of the dynamic law of motion (see equation (12)) yields the following reduced form hybrid Phillips curve ((Uhlig 1999) (Smets Frank and Wouters Ralf 2003))

$$\pi_{i,t} = \varpi_\pi E_{i,t-1}\bar{\pi}_{i,t+k} + (1-\varpi_\pi)\sum_{j=1}^{s}\beta_{\pi j}\pi_{i,t-j} + \sum_{i=1}^{n}\beta_{yi}y_{i,t-i} + \xi\bar{\pi}_{-i,t} + \varepsilon_{i,t} \quad (14)$$

[7]

In order to describe the inflation dynamics in a monetary union we augment the hybrid Phillips curve by the inflation rate that prevails in the rest of the union $\bar{\pi}_{-i,t}$. The basic idea for this open economy version of a Phillips curve is as follows. When foreign inflation rates start to pick up then domestic inflation rates will equally accelerate, as parts of the products that consumers purchase come from abroad. Summarizing the previous paragraph we can state our small scale macromodel for the euro area as follows (see Box 1):

4 Calibration of a Euro Area Model by Matching Moments

In the following section we use a calibration scheme that simultaneously calibrates the preference vector of monetary policy as well as the degree of forward-lookingness in the Phillips curve and the IS-relationship along the lines as proposed by (Mayer 2003). For the remaining parameters we retrieve estimates along the lines as proposed by (Rudebusch 2000) and Van Arle at al (2003).

4.1 Calibration Scheme

Let us make (as untested apriority) the assumption that a New Keynesian Macro Model describes the true data generating process at a quarterly frequency. Taking this apriority we calibrate the model by choosing $\psi = \begin{bmatrix} 1 & \lambda & \nu & \mu_\pi & \mu_y \end{bmatrix}$ in order to minimize the following distance criterion

$$\underset{\psi}{Min}\left(W'\theta\right) \quad (15)$$

[7] Of course from a theoretical point of view one should take the deviation of marginal costs from its steady state values. Nevertheless given a CES production technology their will be a linear relationship between deviations from marginal cost from its steady state value and the output gap. Therefore we opt to take the output gap as

based on matching moments. Each criterion consists of the absolute squared percentage difference between the individual variances and autocorrelations of each variable (the inflation rate, the output gap, the interest rate and the respective differences) implied by $\psi = \begin{bmatrix} 1 & \lambda & \nu & \mu_\pi & \mu_y & \end{bmatrix}$ minus the corresponding empirically observed values in the historical data 1983:1-2002:4 (see Appendix A3). The backward looking inflation polynomial in the Phillips curve $\alpha_{\pi i}$, the impact of economic activity on inflation α_y, the interest rate sensitivity of economic activity in the IS-curve β_r, and the autoregressive part in the output gap equation β_{yi} was estimated along the lines as proposed by (Rudebusch 2000). We used the following specifications: π_t was specified as the quarterly inflation rate in the GDP chain-weighted price index p_t seasonally adjusted and calculated at an annual rate $4(\ln P_t - \ln P_{t-1})$; $\bar{\pi}_t$ is the four quarter moving average constructed as $(1/4)\sum_{i=0}^{3}\pi_{t-j}$; $\bar{i}_t$ is the four quarter average interest rate, hence $\frac{1}{4}\sum_{i=0}^{3} i_{t-j}$; y_t is the output gap constructed as the percentage deviation of the output Y_t from trend output Y_t^*, where Y_t^* was specified as the HP-filtered output gap with smoothing factor set equal to 1400. All variables were demeaned prior to estimation. Note in particular that the specification as proposed by (Rudebusch 2000) implies that the sum over the inflation polynomial ($\sum_{i=1}^{4}\beta_{\pi i} = 1$) is equal to one, so that the long run neutrality of money holds. This means in steady state ($\pi^T = \pi_{t-1}^T = \pi_{t-2}^T = \pi_{t-3}^T = \dots$) it holds that:

$$y = \frac{\left(1 - [\beta_{\pi 1} + \beta_{\pi 2} + \beta_{\pi 3} + \beta_{\pi 4}]\right)}{\alpha}\pi^T \tag{16}$$

Obviously the property of long run neutrality is violated as long as $[\beta_{\pi 1} + \beta_{\pi 2} + \beta_{\pi 3} + \beta_{\pi 4}] = \beta \neq 1$. Higher inflation targets π^T could boost output permanently, which would violate the long run neutrality of money[8]. Thus, it is desirable to set the slope coefficient equal to one β=1, which translates into $\frac{1-\beta}{\alpha} = 0$. This is from an economic point of view somewhat problematic as β should be interpreted as a discount factor of households.

measure of economic activity. The output gap was specified as an HP filter, hence we did not endeavour to measure the deviation of the output gap from its flex-price equilibrium.

[8] Note however that some might argue that changes in the equilibrium inflation rate induce new steady states, so that the argument is somewhat flawed.

4.2 Evaluating the Identified Model

In the following section we will evaluate the outcomes of the proposed calibration scheme. As indicated by Table 1 the identified vector $\psi = [1 \quad 3.4 \quad 5.95 \quad 0.5 \quad 0.2 \quad]$ captures the correct signs of the autocorrelation functions over all relevant variables..

Table 1 Time Series Properties: Simulated and Actual Data: (1970:1-2002:4)

RANK ψ_i	LEVELS				ONE-QUATER-CHANGES			
	STANDARD DEVIATION	AC(1)	AC(2)	AC(3)	STANDARD DEVIATION	AC(1)	AC(2)	AC(3)
				Inflation				
Data	**1.37**	**0.862**	**0.811**	**0.823**	**1.54**	**-0.364**	**-0.304**	**0.076**
Fitted	1.319	0.6527	0.4813	0.3925	1.0994	-0.2533	-0.1189	
$\lambda = 0$	0.881	0.2527	0.033	0.0812	1.0771	-0.353	-0.1793	
$\lambda = 1/2$	0.8923	0.2784	0.0713	0.1163	1.072	-0.3565	-0.1747	
$\lambda = 1$	0.9033	0.3008	0.1035	0.1457	1.0682	-0.3589	-0.1713	
$\lambda = 2$	0.9238	0.3378	0.1552	0.193	1.0631	-0.3621	-0.1665	
				Output Gap				
Data	**0.86**	**0.836**	**0.677**	**0.527**	**0.47**	**0.027**	**-0.031**	**0.023**
Fitted	0.7496	0.7184			1.4924			
$\lambda = 0$	0.5409	0.3082			1.0582			
$\lambda = 1/2$	0.5328	0.3072			1.0577			
$\lambda = 1$	0.5272	0.3071			1.0181			
$\lambda = 2$	0.5199	0.307			1.0063			
				Interest Rate				
Data	**2.94**	**0.958**	**0.903**	**0.841**	**0.485**	**0.466**	**0.154**	**0.054**
Fitted	0.9673	0.453	0.151	0.019	0.4708	0.2741	-0.0998	
$\lambda = 0$	0.4227	0.453	0.151	0.019	0.1561	0.4935	0.1571	
$\lambda = 1/2$	0.4234	0.453	0.151	0.019	0.1542	0.4431	0.1407	
$\lambda = 1$	0.4298	0.453	0.151	0.019	0.157	0.3906	0.1125	
$\lambda = 2$	0.4498	0.453	0.151	0.019	0.1691	0.2947	0.0496	

Additionally we have plotted as a control group four other vector combinations which are commonly used in literature as a cross cheque (see for instance (Coenen Günter 2003))[9]. Table 1 indicates that the identified vector does a better job in capturing in particular the levels of all variables. This holds for both, the standard deviations as well as for the autocorrelations. Nevertheless within our impulse response analysis we will equally plot (λ=0; $\nu = 2$) to show the dependence of our results on the identified combination ψ. All other combinations generate impulse response functions that lie in between these two.

In order to evaluate the uniqueness and determinacy of the rational expectations equilibrium we evaluate the closed loop dynamics. In particular we test whether:

$$X_{t+1} = A_0^{-1}\left[A_1 - B_1 F\right] X_t$$

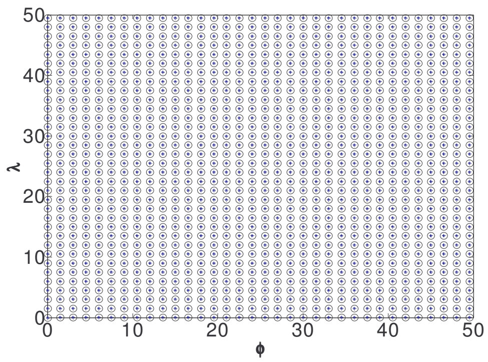
satisfies the proposition of Blanchard et al.(1980) that states that the number of non-predetermined variables should be equal to the number of unstable eigenvalues (see Figure 2) As can be seen the model is remarkably robust against changes in the preference vector of monetary policy. For a vast range of parameter constellations $\left[\lambda \quad \nu\right] \in \left[0 \quad 50\right]$ uniqueness and stability holds. On contrary the model seems to display indeterminacy for combinations of high degrees of forward-lookingness in the Phillips curve and the IS-equation. This scenario occurs if we have low degrees of habit persistence in the IS-equation and a high share of Calvo price setters in the Phillips curve. Additionally indeterminacy seems to be an issue for combinations of very active fiscal (high degree of automatic stabilization) paired with varies degrees of activism on the side of monetary policy (varying degrees of output stabilization).

[9] The forward-looking polynomials have been specified according to estimates as provided by (Smets Frank and Wouters Ralf 2003). They present an estimate of the consumption habit in the euro area which is equal to $h = 0.551$. This translates into a coefficient of 0.64 for the degree of forward lookingness in the intertemporal IS-equation. For the share of Calvo price setters they estimate γ_p=0.91 which translates into an estimate of the degree of forward lookingness in the Phillips curve which is equal to 0.52.

Figure 2 Regions Of Determinacy

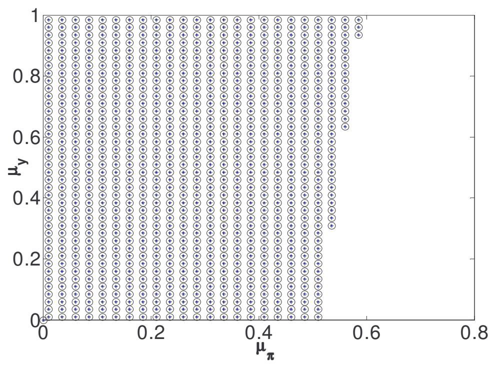
(a)

VARYING DEGREES OF PREFERENCES



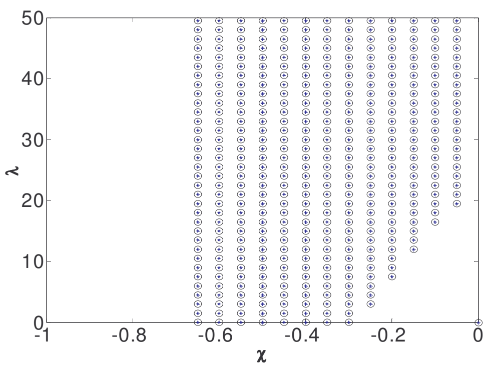
(b)

VARYING DEGREES OF FORWARD-LOOKINGNESS



(c)

VARYING DEGREES OF ACTIVE OUTPUT STABILIZATION



The simulations were performed under the baseline calibration: $\psi = [1 \quad 3.4 \quad 5.95 \quad 0.5 \quad 0.2 \quad]$.

5 On The Need for Stringent Fiscal Policy Rules in a Monetary Union

In the proceeding section we have identified a symmetric two country model for the euro area that generates a stable and unique rational expectations equilibrium. Based on this model we will now provide the basic rationale for stringent rules in a currency area. In order to understand how fiscal policy functions in a monetary union and why there is a need for stringent rules we evaluate the impulse response functions with respect to symmetric and asymmetric fiscal spending shocks.

As can be seen from **Figure 3** a symmetric fiscal spending shock induces persistent deviations of the inflation rate from the inflation target of the central bank. Due to the boost in fiscal spending economic activity starts to accelerate and output is above its potential. As monetary policy aims at stabilising inflation as well as the output gap the central bank will increase short term interest rates which depresses economic activity. Quite naturally the impulse response pattern is similar to that one would observe in the case of a demand shock. In sum the impulse response function depict that fiscal spending shocks can induce persistent swings in all key variables.

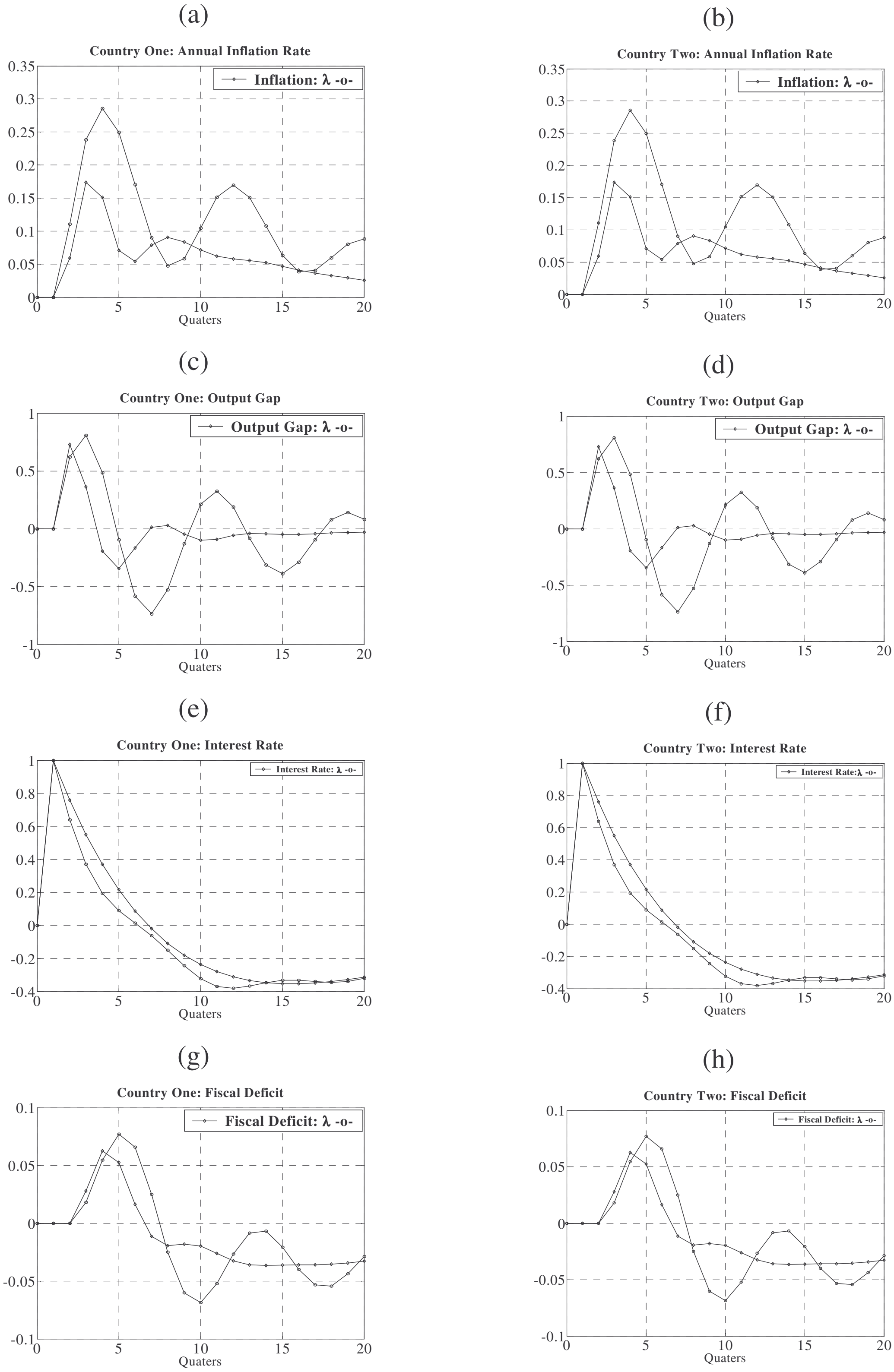
Quite obviously as known from VAR-analysis persistence is a very common theme and not specific to a monetary union. Potential conflicts are nested in asymmetric spending shocks as they potentially generate dispersion across currency areas.

Therefore the need for rules prevails for the case of asymmetric fiscal spending shocks. Let us assume that fiscal authorities in country one trigger an unexpected fiscal expansion. The impulse response functions illustrate that a central bank that is indifferent against mean preserving spreads can hardly operate conveniently in such an environment. The key problem for the ECB prevails in the graphs (a)/(b)/(c)/(d). The persistent deviations in all target variables is remarkable. The spending shock in country one boosts its own inflation rate as well as the output gap. The ECB only reacts modestly compared to a symmetric spending shock as the short term nominal rate is only raised round about half of the size one could observe for a symmetric shock. The ECB faces the fundamental problem that economic activity in country one is fuelled by the domestic spending shock whereas country exhibits cyclical swings, as the ECB increases short term interest rates. Thus the ECB can not punish individual member states by rising average real interest rates which clearly shows that stringent rules are a necessary prequisitive for the well functioning of a monetary union, to prevent free rider behaviour and negative spill over effects for other member states. The depression in economic activity in country two is somewhat dampened as our model following (Van Arle, Garretsen Harry, and Huart Florence 2003) allows for direct demand spill over effects. Additionally we can already see that automatic stabilizers in country two prevent swings in the output gap from becoming more persistent. Hence the impulse response functions show that automatic stabilisers serve as a useful instrument to cushion the consequences of an unsustainable policy in other member states.

This simple illustration clearly indicates that there is an urgent to safeguard the ECB by stringent fiscal rules. In the case of asymmetric fiscal spending shocks fiscal authorities can be a source of destabilisation. The link between fiscal deficits and high inflation rates that were of great concern to the grandfathers of the SGP is clearly present.

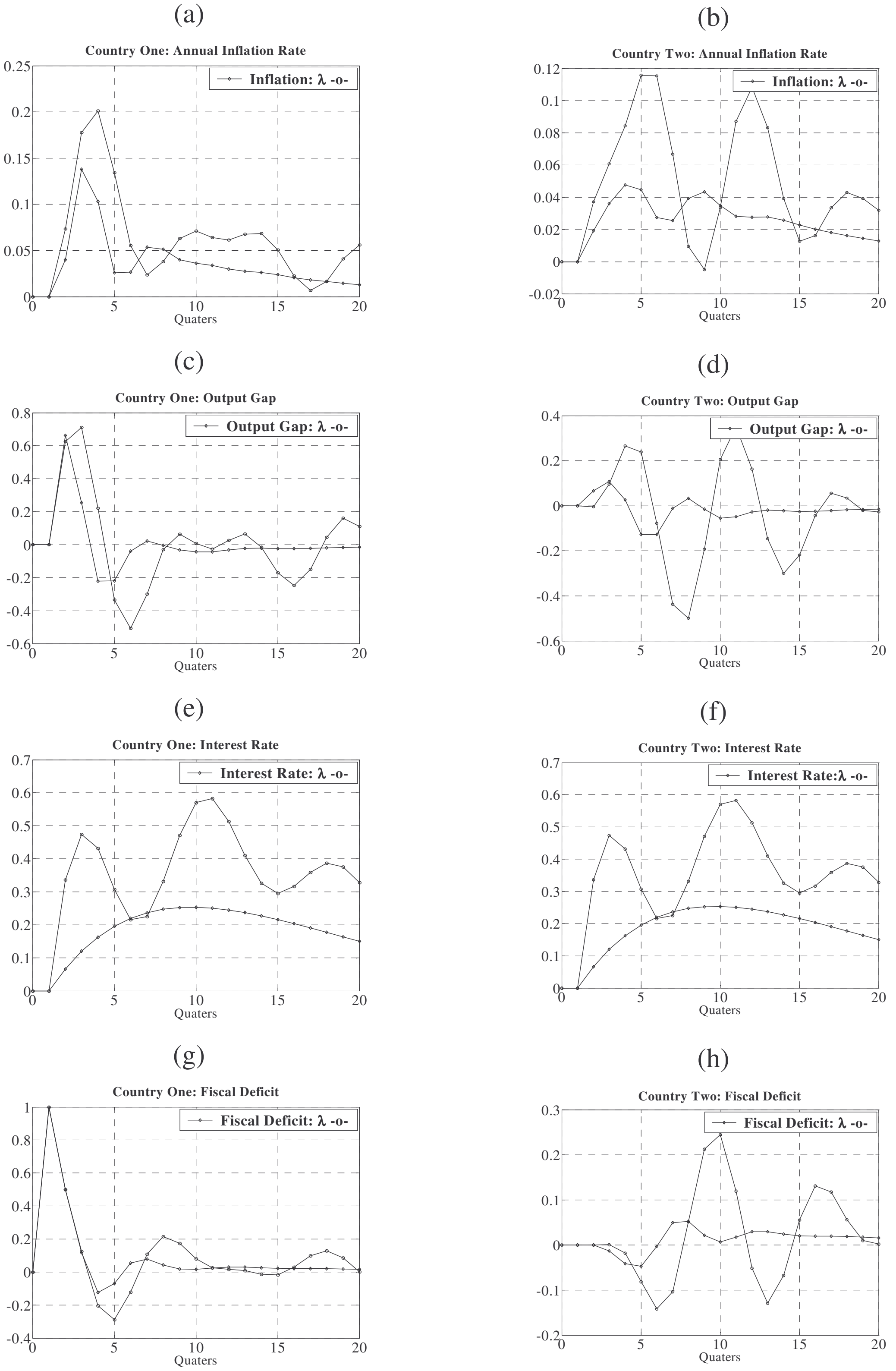
The two causal mechanisms in our model that govern the divergence in real conditions are the wedges in the real exchange rate and the wedge in the intra-european competitiveness. Ceteris paribus the real rate effects will be more pronounced in relatively closed economies whereas with an increasing degree of openness the real exchange rate effect is likely to decrease in importance.

Figure 3: Symmetric Fiscal Spending Shock*:



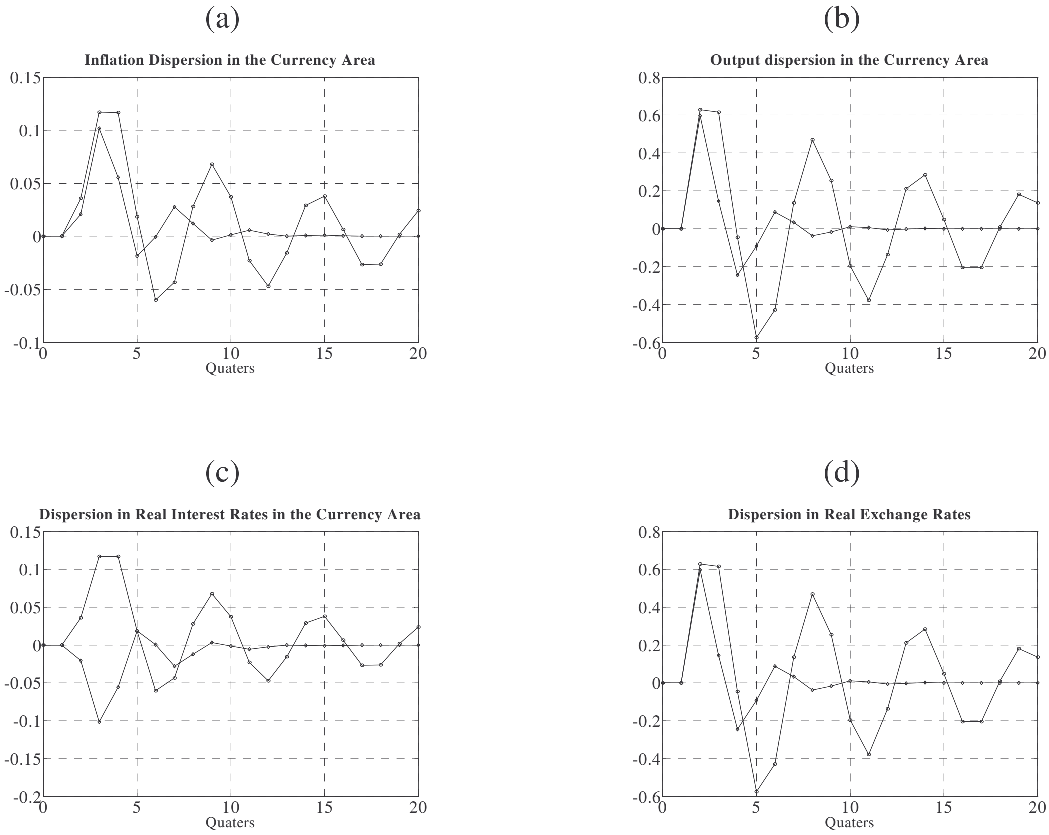
*The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

Figure 4 Asymmetric Fiscal Spending Shock



*The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

Figure 5 :Measuring some indicators for dispersion



*The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

6 On the Deficiencies of the SGP

In the previous section we have stressed the need for stringent policy rules that combine long run sustainability with short run flexibility. Unfortunately the current SGP is inappropriate to achieve this task. The main construction error of the SGP is its underlying assumption that countries with high deficits have high inflation rates. As shown in (Bofinger 2003) by regression analysis this is generally not true for the euro area. This fundamental construction error implies that the SGP has at least two series deficiencies which we will discuss in term. In particular it potentially impairs the ability of fiscal policy to effectively stabilise the cycle. Additionally the 3% deficit criterion has created a malfunctioning alarm-system which needs to be reformed.

6.1 The impact of automatic stabilizers on the correlation structure

In this section we analyse how powerful fiscal policy is. To get a deeper understanding we evaluate the mechanics of the model. In particular we will take a look at the sensitivity of the variances and autocorrelations with respect to changes in the stance of fiscal policy as measured by $|\chi|$ (see equation (17)). Remember throughout our model we have assumed that fiscal policy is conducted according to the following rule:

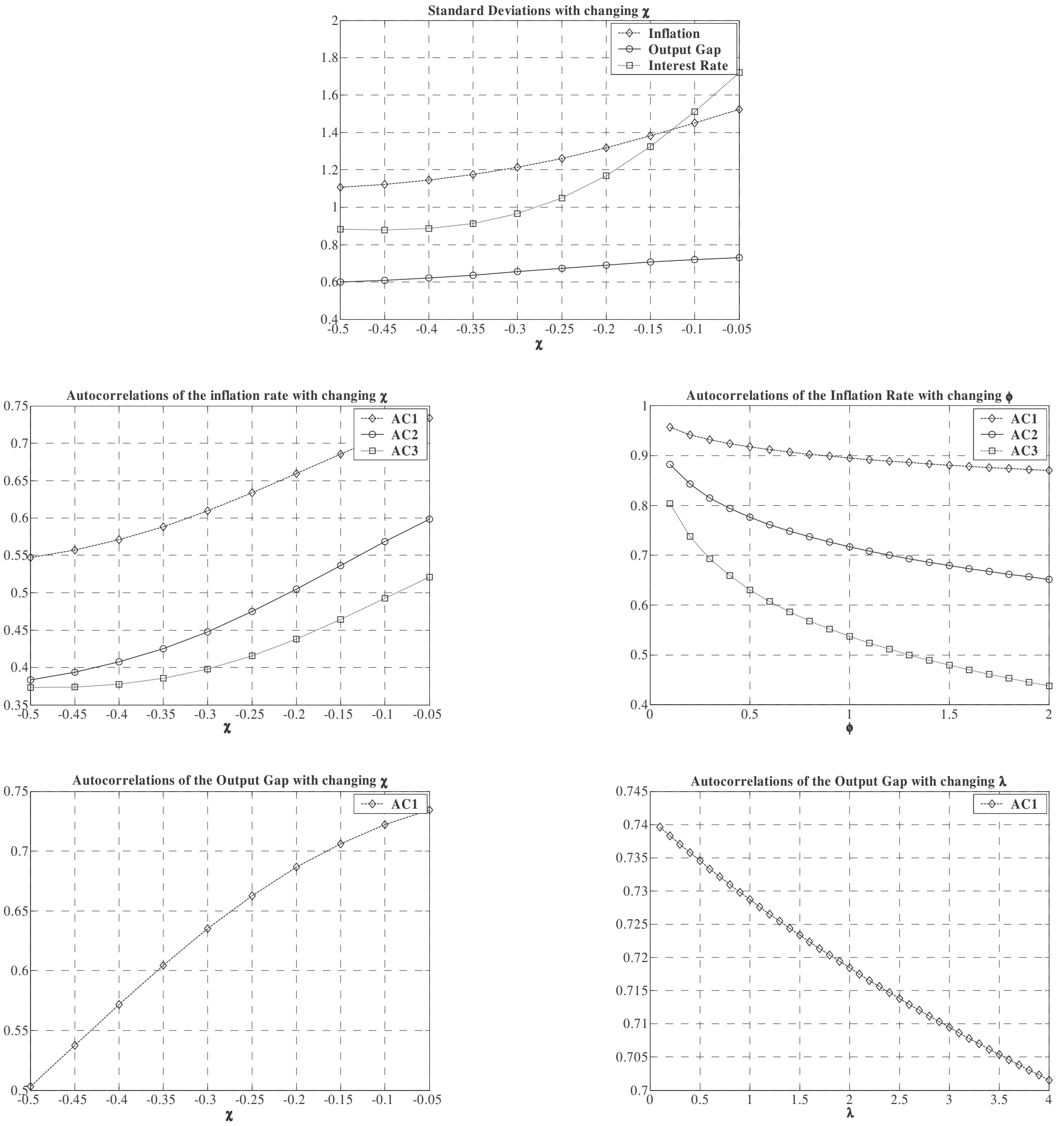
$$g_{1,t} = \overline{g}_1 - \chi y_{1,t} + \lambda g_{1,t-1} + \varepsilon_{1,t}^f \quad (17)$$

In order to evaluate the power of fiscal policy we analyse the impact of fiscal policy on the standard deviation of the inflation rate, the output gap and the interest rate if fiscal policy engages more actively in dampening cycles (increasing $|\chi|$).

Figure 6 shows that a symmetric increase in fiscal activity (increasing $|\chi|$) leads to a drop in the standard deviations of the aggregate inflation rate, the output gap and the interest rate itself in both countries. Not surprisingly the variance in the output gap drops as fiscal policy becomes more active, as it smoothes out the impact of demand shocks (Figure 6). As positive side effect a more stable output gap translates into less persistent fluctuations of the inflation rate. Hence a more active fiscal policy does not only succeed in stabilising output but also serves as an instrument to bring the inflation rate closer to a white noise process.

In order to compare the stabilisation properties of fiscal and monetary policy Figure 6 depicts the ability to reduce the persistence of the inflation rate and the output gap respectively. Quite remarkably fiscal policy –guided by a simple rule- is very effective in stabilising the output gap as the persistence sharply drops in response to a more active fiscal stance (increasing $|\chi|$). The ability to reduce inertia in output is comparatively better than the one of monetary policy. Hence if one abstracts from the effects of distorting taxes a passive fiscal policy can only hardly be rationalised from a stabilisation perspective given the sound evidence on the ability of fiscal policy to stabilise economic activity.

Figure 6 Standard Deviations



*The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

The preceding two sections clearly present evidence that a currency area needs fiscal policy rules in order to prevent individual member states from free rider behaviour. On the other hand fiscal policy is potentially a powerful tool from a stabilisation perspective. Therefore we conclude that a tying hands policy that would prevent fiscal policy from being used actively to fight cycles can hardly be rationalised. Such a trade-off constellation clearly calls for stringent rules that liberate the potential benefits while equally dawn the potential harms. This was of course exactly what the grandfathers of the SGP had in mind when trying to combine short run flexibility (operate within 3%-deficits) with long run sustainability (debt/GDP< 60%), but unfortunately as we will illustrate in the next section the rules designed were flawed from the outset as they are based on the faulty assumption that high inflation rates mirror high deficits.

6.2 Deficiency 1: The 3% Deficit Criterion Impairs the Ability of Fiscal Policy to Stabilise Economic Activity!

The current SGP assumes that 'sound budgetary positions' are the dominant strategy to safeguard price stability. Therefore the 3% deficit criterion limits the ability of short run flexibility as the SGP assumes that excessive deficits might cause inflation and unsustainable debt dynamics in the long run. Based on the following simulations:

$$X_t = MX_{t-1} + v_t \quad (18)$$

$$X_{1t} = \left\{\pi_{i,t}, \pi_{i,t-1}, \pi_{i,t-2}, \pi_{i,t-3}, y_{i,t}, y_{i,t-1}, g_{i,t-1}, i_{i,t-1}, i_{i,t-2}, i_{i,t-3}, \pi_{-i,t}, \pi_{-i,t-1}, \pi_{-i,t-2}, \pi_{-i,t-3}, y_{-i,t}, y_{-i,t-1}, g_{-i,t}\right\}'$$

$$v_{1t} = \left\{\varepsilon_{i,t}, 0, 0, 0, \eta_{i,t}, 0, \varepsilon^f_{i,t}, 0, 0, 0, \varepsilon_{-i,t}, 0, 0, 0, \eta_{-i,t}, 0, \varepsilon^f_{-i,t}\right\}'$$

we either assume asymmetric supply or demand that hit country one.

Table 2: Switch from an active fiscal stance $\chi = 0.3$ to a passive $\chi = 0$ on

Country I	
Ratio ($Y_{\chi=0.3}/Y_{\chi=0}$)	
Symmetric Shock	
Output gap	
0.81	F=1.51, 1%
Inflation Rate	
0.58	F=2.97, 1%
Symmetric Supply Shock	
Output Gap	
0.83	F=1.46, 1%
Inflation Rate	
0.66	F=2.30, 1%
Symmetric Demand Shock	
Output Gap	
0.74	F=1.89, 1%
Inflation Rate	
0.16	F= 39.02, 1%
Symmetric Fiscal Shock	
Output Gap	
0.99	F=1.02; 10%
Inflation Rate	
0.29	F=11.59; 1%

Table 2 shows the beneficial impact of automatic stabilisers. The ratios indicate the relationship of the aggregate variable with and without automatic stabilisation. As indicated the ratios are all well below one which clearly signals the beneficial impact of automatic stabilisation. Additionally the results show that within the New Keynesian framework output stabilisation is a valuable device to keep the inflation rate on track, as it helps to smooth out the impact on demand shocks as well as the consequences of fiscal spending shocks itself.

6.3 Deficiency 2: A Defective Alarming System

In this section we will show that the SGP is a defective alarming system, that is likely to trigger the monitoring procedure even if fiscal policy is conducted in a sustainable fashion. To state the case the starting point is the following reduced form:

$$X_t = MX_{t-1} + v_t \tag{19}$$

$$X_{1t} = \left\{\pi_{i,t}, \pi_{i,t-1}, \pi_{i,t-2}, \pi_{i,t-3}, y_{i,t}, y_{i,t-1}, g_{i,t}, i_{i,t-1}, i_{i,t-2}, i_{i,t-3}, \pi_{-i,t}, \pi_{-i,t-1}, \pi_{-i,t-2}, \pi_{-i,t-3}, y_{-i,t}, y_{-i,t-1}, g_{-i,t}\right\}'$$

$$v_{1t} = \left\{\varepsilon_{i,t}, 0, 0, 0, \eta_{i,t}, 0, \varepsilon_{it}^{f}, 0, 0, 0, \varepsilon_{-i,t}, 0, 0, 0, \eta_{-i,t}, 0, \varepsilon_{-it}^{f}\right\}'$$

Fiscal policy is conducted according to the notion:

$$g_{1,t} = -\chi y_t + \overline{g}_1 + \lambda g_{1,t-1} + \varepsilon_{1,t}^{f} \tag{20}$$

To make realistic inferences we have calibrated $\overline{g}_1 = -1.8\%$ which is approximately the average from (1996 - 2005) and is also equal to the structural balance projected for 2005 for the euro area on average by the OECD. Clearly a structural balance equal to -1.8% would not be in line with the strict view the Commission takes but it would well be consistent with the 60% (debt/GDP) ratio in the long run (see (De Grauwe 2000)). Therefore we model by assumption a sustainable fiscal stance. The 3%-deficit criterion can only be breached within our simulation if the fiscal stance parameter is driven by large demand, supply or fiscal spending shocks itself. In the following we want to illustrate with the help of a simulation that the alarm system nested in the SGP is not reliable.

To make realistic inferences within our small scale macro model we have taken care of the fact that the structural supply and demand shocks hitting the individual member countries are correlated (see Angeloni et al. 1999). We have made a Choleski-Decomposition of the variance covariance matrix in order to express the reduced form shocks as a linear combination of the underlying structural disturbances to which the economy is subject so that

$$\Sigma = P'\Omega P, \tag{21}$$

where Ω is the reduced form variance covariance matrix. Based on this reduced form we have simulated the model over a hypothetical period of 100000 quarters[10]. Figure 4 shows the results of the simulation. Hence the Maastricht criteria are too strict as in none of the identified outcomes the long run sustainability is endangered as we have modelled by definition a sustainable fiscal stance. Therefore as long as the violation of the 3%-deficit criterion stems from the size of exogenous shocks and not from a fiscal policy that is conducted in an unsustainable fashion the violation of the Maastricht criteria is a necessary precondition to let automatic stabilisers freely operate. Of course it is equally possible that fiscal spending shocks itself might be responsible for "excessive deficits" (e.g. a natural disaster like in Germany's flooding events 2002). But as long as these shocks are symmetrically distributed they are unproblematic.

Table 3 Simulation: Percentage of Quarters when g is below 3%

CALIBRATION	PROB. FOR INDIVIDUAL COUNTRY I	PROB. THAT AT LEAST ONE OUT OF 12	WAS INFLATION ABOVE 2%
Fitted	0.0499	0.4859	0.11
Hughes, Hallet McAdam (2003)	0.0800	0.66	

Based on these analysis we have found that the unconditional probability for an individual member country to be driven above the 3% deficit criterion by a large shock is approximately between 2.5%-5%. This in itself might seem an acceptable probability. Nevertheless the currency area consists of twelve member states. Let us for the sake of simplicity assume that the member countries are of equal size and that the unconditional probabilities are uncorrelated. Then we see that the probability of triggering the alarming mechanism on error dramatically increases well above 25% to 66% which does not seem to be sustainable from a political perspective. Hence with the help of the proceeding analysis we wanted to indicate that the current setting implied by the 3%-deficit criterion is unreliable as a warning system to identify an unsustainable fiscal stance. The assumed causal relationship between high

[10] Note that their is quite some discussion whether the very introduction of a currency area has altered the correlation structure of shocks. Karman et al (2003) argue that there is evidence from bivariate VAR-analysis that shocks effecting the demand and supply side of the economies in Europe have converged to a degree of correlation of round about 0.5 for both types of shocks respectively. Within our simulation we have chosen lower correlations which were reported by Angeloni et al (1999). The correlation of fiscal spending shocks was set

inflation rates driven by fiscal policy and the fiscal balance is everything but exhaustive. Additionally one should keep in mind that historically a direct relationship between the fiscal balance and the inflation rate was only given if fiscal policy could borrow directly from the central bank. But this is explicitly ruled out by Art. 102 as the ECB is prohibited to borrow funds to fiscal authorities.

Therefore we strongly propose to reform the three percent deficit criterion. In particular we think that triggering of the monitoring procedure should be conditioned on additional macroeconomic data. In particular we would like to propose to test whether the actual inflation rate is above 3%. The logic is quite simple. Only if the inflation rate and the deficit criterion are violated fiscal policy might undermine the credibility of the central bank in the medium to long run. In other scenarios high deficits are likely to simply mirrow weak economic growth. Under such settings fiscal spending cuts are procyclical. Conditioning the monitoring procedure on the criterion whether the inflation rate was in the target range of the ECB dramatically reduces the risk of triggering the 3% deficit criterion on error.

8 Some Propositions

In the previous sections we have outlined that the current institutional setting impairs the ability of the euro area members to use fiscal policy as an effective stabilisation tool. What one effectively needs to understand is that limiting the functioning of fiscal policy effectively adds more fluctuations on other parts of the economy (e.g., the output gap). Quite clearly today's rules in reign were shaped by the views on the functioning of the economy we as economists had at the outset of the 1990's. This view was still heavily shaped by myopic politicians that aimed at cheating the public. In that respect (Paul De Grauwe (Financial Times, 25 July 2002)) stated:

"The stability pact is a vote of no confidence by the European authorities in the strength of the democratic institutions in the member countries. It is quite surprising that EU-countries have allowed this to happen, and that they have agreed to be subjected to control by European institutions that even the International Monetary Fund does not impose on banana republics."

equal to null. Bruneau et al (1999) report modest negative correlations of -0.11 prior to the introduction of the monetary union.

Generally the relationship between the cyclical stance of fiscal policy and the level of indebtness is not yet well understood. In particular the question which needs to be addressed is to which extend can the CAB be negative on average but still consistent with a long run sustainable debt/GDP ratio. Today's answer seems to be zero which is clearly at odds with for instance the golden rule that states that long term public investments that generates yields over many periods to come should be financed by debt. Nevertheless there seems to be some evidence that a high level of existing debt seems to induce a procyclical movements in the fiscal stance during downturns (OECD 2002).

Since fiscal policy rules are essential for the functioning of a monetary union, the analysis of this paper calls for a reform of the SGP. While the current framework with its focus on inflation is clearly too one-dimensional, it could be relatively easy supplemented with an additional dimension which takes care of the mix between the common monetary policy and national fiscal policies. Again, this paper can only give some general suggestions. Since the ECB has a very strong interest in preventing excessive inflation at the national level, it would be useful to base the assessment of fiscal policy on forecasts for the national rate and their compatibility with the ECB's inflation target.

As long as the majority of forecasts shows that a country's inflation rate will remain *within* the ECB's target range of "below 2%", there would be presumption that the overall policy mix of national fiscal policy and the national real interest rate is adequate. In this situation, a fiscal deficit exceeding the 3% threshold would not pose a problem for the common monetary policy. Of course, it would be necessary to make an additional assessment whether this fiscal policy stance could threaten the overall solidity of a country's public finances. E.g., in the present situation of Germany such a risk could be clearly excluded.

- If the majority of forecasts shows an inflation rate that exceeds the ECB's target range by a certain margin (e.g. one percentage point), there is a presumption that policy mix is inadequate. If in this situation the deficit exceeds 3 %, there is a strong indication that the national fiscal policy is not compatible with an adequate policy mix and an excessive deficit procedure would be warranted.
- If the forecasts show that the national rate will exceed the ECB's inflation target by a wider margin (e.g. two percentage points), one can think of imposing sanctions for fiscal policy even if the deficit is below three percent or even if it is in a much better position. The main advantage of this inflation targeting framework, which would of course need much discussion in detail, is that it provides the flexibility that national fiscal policy needs in a monetary union in order to cope with idiosyncratic shocks. At

the same time, it would set more stringent fiscal limits for high inflation countries than envisaged in SGP.

In sum, the main flaw of the SGP is its neglect of the interplay of national fiscal policy *and* national monetary conditions in a monetary union. Although, as the example of Portugal shows, an "excessive deficit" can be caused by fiscal laxness, it can also be due to a self-aggravating process of below average growth, subdued nominal wage increases, below average inflation and an above average real interest rate. Thus, the SGP's one dimensional focus on the deficit-inflation nexus can be totally misleading. A strict application of the SGP can have the consequence that a country is forced to abandon its only macroeconomic stabiliser and even to pursue a procyclical fiscal policy. The current attempt of a government to reduce the structural deficit in a period of economic stagnation and increasing unemployment is a case in point. Together with above average real interest rates such a policy mix entails a high risk of deflation and of a further widening of monetary conditions within EMU. As monetary policy would become very difficult under such conditions, the ECB should also have a strong interest in avoiding such risks. Since fiscal policy rules are necessary in a monetary union, the SGP should be supplemented in a way that it sanctions fiscal policies only if a country's overall macroeconomic policy stance is inflationary, i.e. if forecasts show that its inflation rate will exceed the ECB's target rate by one or more percentage points. Such an "inflation targeting" approach would not only provide a better policy mix in countries with weak growth, since the 3 % threshold would not be binding. It would also improve the policy mix in above inflation countries since one could think of sanctions whenever the fiscal policy stance contributes to inflation beyond the ECB's target range.

Appendix

A.1 The General Model Setup

Closely following (Söderlind 1999) we can rewrite our basic equation in state space form as follows. In a first step we insert the fiscal spending equation and the real exchange rate ino the IS-relationship. Then we lead our model one period ahead and solve for the rational expectations variables $E_t\pi_{t+4}$ and $\mathrm{E}_t\, y_{t+2}$ with the highest time index. Then for country i the Phillips curve and the IS equation c an be stated as follows:

$$\begin{aligned}\frac{\omega_\pi}{4}E_t\pi_{i,t+4} &= \left(1-\frac{\omega_\pi}{4}\right)E_t\pi_{i,t+1}-\frac{\omega_\pi}{4}E_t\pi_{i,t+2}-\frac{\omega_\pi}{4}E_{t+3}\pi_{i,t+3}\\ &-(1-\omega_\pi)\left[\alpha_{\pi1}\pi_{i,t}+\alpha_{\pi2}\pi_{i,t-1}+\alpha_{\pi3}\pi_{i,t-3}+\alpha_{\pi4}\pi_{i,t-4}\right]-\alpha_y y_{i,t}\\ &-\xi\left(\frac{1}{4}\left(\pi_{-i,t}+\pi_{-i,t}+\pi_{-i,t}+\pi_{-i,t}\right)\right)\end{aligned}$$

$$\begin{aligned}\omega_y E_t y_{i,t+2}+\frac{\beta_r\omega_r}{4}E_t\pi_{i,t+4} &= E_t y_{i,t+1}-\left(1-\omega_y\right)\left[\beta_{y1}y_{i,t}+\beta_{y2}y_{i,t-1}\right]\\ &+\beta_{\mathrm{r}}\omega_r\left[i_t-\frac{1}{4}E_t\left(\pi_{i,t+1}+\pi_{i,t+2}+\pi_{i,t+3}\right)\right]\\ &-\iota\left(\frac{1}{4}\left(\pi_{-i,t}+\pi_{-i,t-1}+\pi_{-i,t-2}+\pi_{-i,t-3}-\pi_{i,t}-\pi_{i,t-1}-\pi_{i,t-2}-\pi_{i,t-3}\right)\right)\\ &-\phi\left(\frac{-\chi}{2}\left(y_{i,t}-y_{i,t-1}\right)+\zeta g_{i,t-1}\right)\\ &-\mathrm{ex}^{\mathrm{d}}\end{aligned}$$

Hence we can rewrite the general model in state space form as:

$$A_0\begin{bmatrix}X_{1t+1}\\ E_t X_{2t+1}\end{bmatrix}=A\begin{bmatrix}X_{1t}\\ X_{2t}\end{bmatrix}+Bi_t+\begin{bmatrix}\varepsilon_{t+1}\\ 0_{n2x1}\end{bmatrix}$$

$$X_{1t}=\left\{\pi_{i,t},\pi_{i,t-1},\pi_{i,t-2},\pi_{i,t-3},y_{i,t},y_{i,t-1},g_{i,t},i_{i,t-1},i_{i,t-2},i_{i,t-3},\pi_{-i,t},\pi_{-i,t-1},\pi_{-i,t-2},\pi_{-i,t-3},y_{-i,t},y_{-i,t-1},g_{-i,t}\right\}'$$

$$X_{2t}=\left\{E_t\pi_{i,t+3},E_t\pi_{i,t+2},E_t\pi_{i,t+1},E_t y_{i,t+1},E_t\pi_{-i,t+3},E_t\pi_{-i,t+2},E_t\pi_{-i,t+1},E_t y_{-i,t+1}\right\}'$$

$$v_{1t}=\left\{\varepsilon_{i,t},0,0,0,\eta_{i,t},0,\varepsilon_{it}^f,0,0,0,\varepsilon_{-i,t},0,0,0,\eta_{-i,t},0,\varepsilon_{-it}^f\right\}'$$

Where X_{1t} is a 17×1 vector of predetermined state variables X_{2t} is a 8×1 vector of forward looking variables and v_{1t} is a vector of shocks. Following Söderlind et al. (2002) we have made use of the fact that $\pi_{t+1} = E_t\pi_{t+1} + \varepsilon_{t+1}$ and that $y_{t+1} = E_t y_{t+1} + \eta_{t+1}$.

$$A_0 = \begin{bmatrix}
1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&\frac{\mu_\pi}{4}&0&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&\frac{\beta_r\mu_r}{4}&0&0&\mu_y&0&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&\frac{\mu_\pi}{4}&0&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&1&0\\
0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&0&\frac{\beta_r\mu_r}{4}&0&0&\mu_y
\end{bmatrix}$$

Note that due to the specific structure of the matrix A_0 it holds that $A_0^{-1}v_t = v_t$.

$$A_1 = \begin{bmatrix}
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & -\frac{\chi}{2} & -\frac{\chi}{2} & \zeta & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \frac{-\chi}{2} & \frac{-\chi}{2} & \zeta & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-(1-\mu_\pi)\alpha_{\pi_1} & -(1-\mu_\pi)\alpha_{\pi_2} & -(1-\mu_\pi)\alpha_{\pi_3} & -(1-\mu_\pi)\alpha_{\pi_4} & -\alpha_{\pi_5} & 0 & 0 & 0 & 0 & 0 & \frac{-\iota}{4} & \frac{-\iota}{4} & \frac{-\iota}{4} & \frac{-\iota}{4} & 0 & 0 & 0 & -\frac{\mu_\pi}{4} & -\frac{\mu_\pi}{4} & \left(1-\frac{\mu_\pi}{4}\right) & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
\frac{-\beta_r(1-\mu_r)}{4}+\frac{\tau}{4} & \frac{-\beta_r(1-\mu_r)}{4}+\frac{\tau}{4} & \frac{-\beta_r(1-\mu_r)}{4}+\frac{\tau}{4} & \frac{-\beta_r(1-\mu_r)}{4}+\frac{\tau}{4} & -\beta_{y1}(1-\mu_r)+\left(\phi\left(\frac{\chi}{2}\right)\right) & -\beta_{y1}(1-\mu_r)+\left(\phi\left(\frac{\chi}{2}\right)\right) & -\phi\zeta & \frac{\beta_r(1-\mu_\pi)}{4} & \frac{\beta_r(1-\mu_\pi)}{4} & 0 & \frac{-\iota}{4} & \frac{-\iota}{4} & \frac{-\iota}{4} & \frac{-\iota}{4} & \frac{-\varphi}{2} & \frac{-\varphi}{2} & 0 & -\frac{\beta_r\mu_r}{4} & -\frac{\beta_r\mu_r}{4} & -\frac{\beta_r\mu_r}{4} & 1 & 0 & 0 & 0 & 0 \\
\frac{-\iota}{4} & \frac{-\iota}{4} & \frac{-\iota}{4} & \frac{-\iota}{4} & 0 & 0 & 0 & 0 & 0 & 0 & -(1-\mu_\pi)\alpha_{\pi_1} & -(1-\mu_\pi)\alpha_{\pi_2} & -(1-\mu_\pi)\alpha_{\pi_3} & -(1-\mu_\pi)\alpha_{\pi_4} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -\frac{\mu_\pi}{4} & -\frac{\mu_\pi}{4} & \left(1-\frac{\mu_\pi}{4}\right) & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\
\frac{-\iota}{4} & \frac{-\iota}{4} & \frac{-\iota}{4} & \frac{-\iota}{4} & 0 & 0 & 0 & \frac{\beta_r(1-\mu_\pi)}{4} & \frac{\beta_r(1-\mu_\pi)}{4} & \frac{\beta_r(1-\mu_\pi)}{4} & \frac{-\beta_r(1-\mu_r)}{4}+\frac{\tau}{4} & \frac{-\beta_r(1-\mu_r)}{4}+\frac{\tau}{4} & \frac{-\beta_r(1-\mu_r)}{4}+\frac{\tau}{4} & \frac{-\beta_r(1-\mu_r)}{4}+\frac{\tau}{4} & \beta_{y1}(1-\mu_r)-\left(\phi\left(\frac{\chi}{2}\right)\right) & \beta_{y1}(1-\mu_r)-\left(\phi\left(\frac{\chi}{2}\right)\right) & -\phi\zeta & 0 & 0 & 0 & 0 & -\frac{\beta_r\mu_r}{4} & -\frac{\beta_r\mu_r}{4} & -\frac{\beta_r\mu_r}{4} & 1
\end{bmatrix}$$

$$B_1 = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta_r\mu_r + \beta_r(1-\mu_r)/4 & 0 & 0 & 0 & \beta_r\mu_r + \beta_r(1-\mu_r)/4 \end{bmatrix}'$$

A.2 Defining the Measurement Equation

Let us define a vector Y_t as target variables in which the ECB is interested. We assume that the common central bank is only interested in aggregate variables:

$$Y_t = [\pi_t \quad \overline{\pi}_t \quad \pi_{t-1} \quad \pi_{t-2} \quad \pi_{t-3} \quad y_t \quad y_{t-1} \quad i_t \quad i_{t-1} \quad i_{t-2} \quad i_{t-3} \quad \Delta i_t \quad \Delta i_{t-1} \quad \Delta i_{t-2} \quad \Delta\pi_t \quad \Delta\pi_{t-1} \quad \Delta\pi_{t-2} \quad \Delta y_t]$$

We can define the target variables as a function of the state variables and the interest rate.

$$Y_t = \left(C_{X1} \quad C_{X2}\right) X_t + C_i i_t$$

$$\left(C_{X1} \quad C_{X2}\right) = \begin{bmatrix}
0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0.125 & 0.125 & 0.125 & 0.125 & 0 & 0 & 0 & 0 & 0 & 0 & 0.125 & 0.125 & 0.125 & 0.125 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & -1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0.5 & -0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & -0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0.5 & -0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & -0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0.5 & -0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & -0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0.5 & -0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.5 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}$$

$$C_i = [0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 1 \quad 0 \quad 0 \quad 0 \quad 1 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0 \quad 0]'$$

A.3 The Proposed Calibration Scheme

We calibrate simultaneously the vector $\psi = \left[1, \lambda, \nu, \mu_\pi, \mu_y\right]$ with:

- μ_π the degree of forward lookingness in the Phillips curve.
- μ_y the degree of forward lookingness in the IS-curve.
- λ weight monetary policy puts on output stabilisation relative to stabilising the inflation rate.
- υ weight the central bank puts on interest rate smoothing relative to inflation rate stabilisation.

To minimise the following distance criterion:

$$\underset{\psi}{Min}\left(W'\theta\right)$$

Criterion 1: $$Crit1 = (1/4)\begin{bmatrix} abs((stdv(\pi) - stdv(\pi_{87-02}))/stdv(\pi_{87-02})) \\ +abs((AC1(\pi) - AC1(\pi_{87-02}))/AC1(\pi_{87-02})) \\ +abs((AC2(\pi) - AC2(\pi_{87-02}))/AC2(\pi_{87-02})) \\ +abs((AC3(\pi) - AC3(\pi_{87-02}))/AC3(\pi_{87-02})) \end{bmatrix}^2$$

Criterion 2: $$Crit2 = (1/2)\begin{bmatrix} abs((sdtv(y) - stdv(y)_{87-02})/stdv(y)_{87-02}) \\ +abs((AC1(y) - AC1(y)_{87-02}))/stdv(y)_{87-02}) \end{bmatrix}^2$$

Criterion 3: $$Crit3 = (1/4)\begin{bmatrix} \left(abs(stdv(i) - stdv(i)_{87-02} / stdv(i)_{87-02}\right) \\ +\left(abs(AC1(i) - AC1(i)_{87-02}) / AC1(i)_{87-02}\right) \\ +\left(abs(AC2(i) - AC2(i)_{87-02}) / AC2(i)_{87-02}\right) \\ +\left(abs(AC3(i) - AC3(i)_{87-02}) / AC3(i)_{87-02}\right) \end{bmatrix}^2$$

Criterion 4: $$Crit4 = (1/3)\begin{bmatrix} abs\left(stdv(d(\pi)) - stdv(d(\pi)_{87-02}) / stdv(d(\pi)_{87-02})\right) \\ abs(AC1(d(\pi)) - AC1(d(\pi_{87-02}) / AC1(d(\pi)_{87-02})) \\ abs(AC2(d(\pi)) - AC2(d(\pi_{87-02}) / AC2(d(\pi)_{87-02})) \end{bmatrix}^2$$

Criterion 5: $$Crit5 = \left[abs((sdtv(d(y)) - stdv(d(y))_{87-02}) / stdv(d(y))_{87-02})\right]^2$$

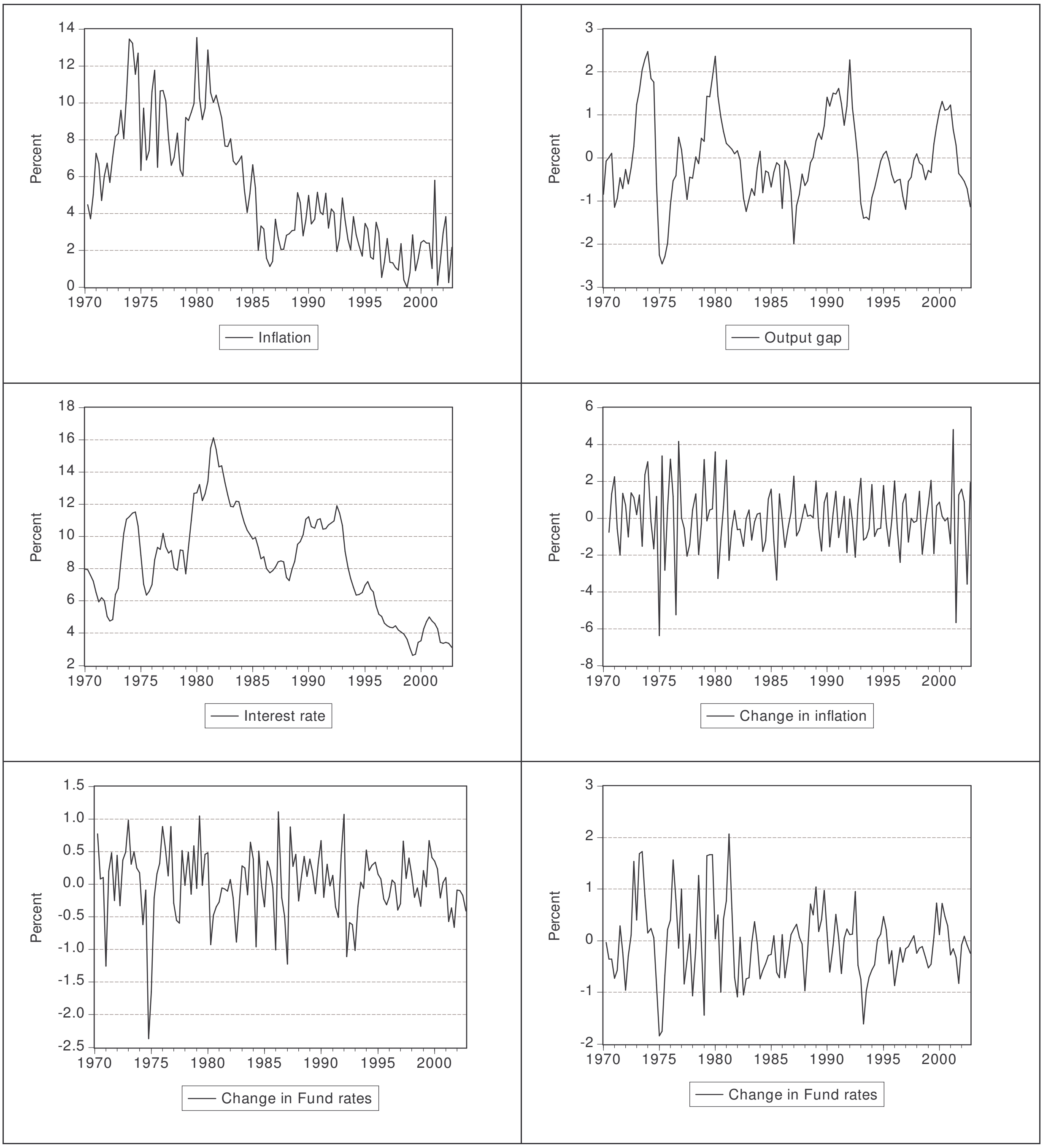
Criterion 6: $$Crit6 = (1/3)\begin{bmatrix} \left(abs(stdv(d(i)) - stdv(d(i))_{87-02} / stdv(d(i))_{87-02}\right) \\ +\left(abs(AC1(d(i)) - AC1(d(i))_{87-02}) / AC1(d(i))_{87-02}\right) \\ +\left(abs(AC2(d(i)) - AC2(d(i))_{87-02}) / AC2(d(i))_{87-02}\right) \end{bmatrix}^2$$

We have proposed an equal weightening of all constructed six criteria.

The constructed criterion is given by:

$$Kriterium = \sum_{i=1}^{6} Crit_i$$

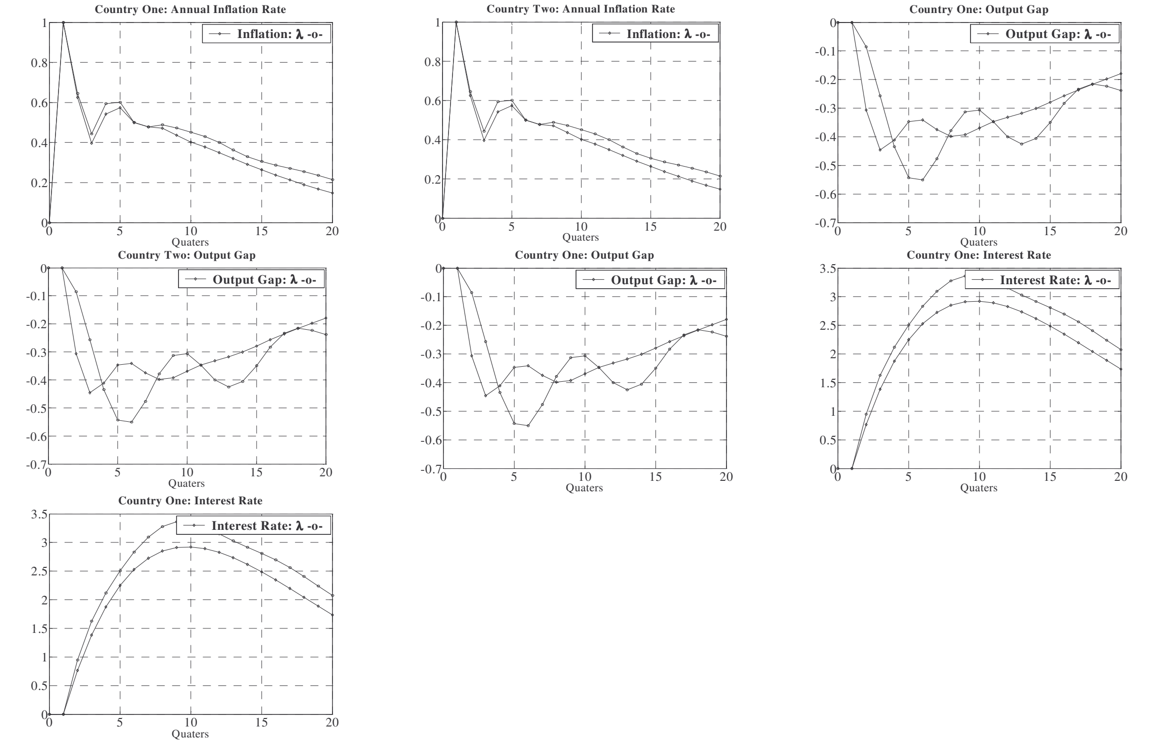
A.4 Stylized Time Series Properties: Levels and Differences



Data was taken from (Fagan, Hanry Jerome, and Mestre Ricardo 2001)

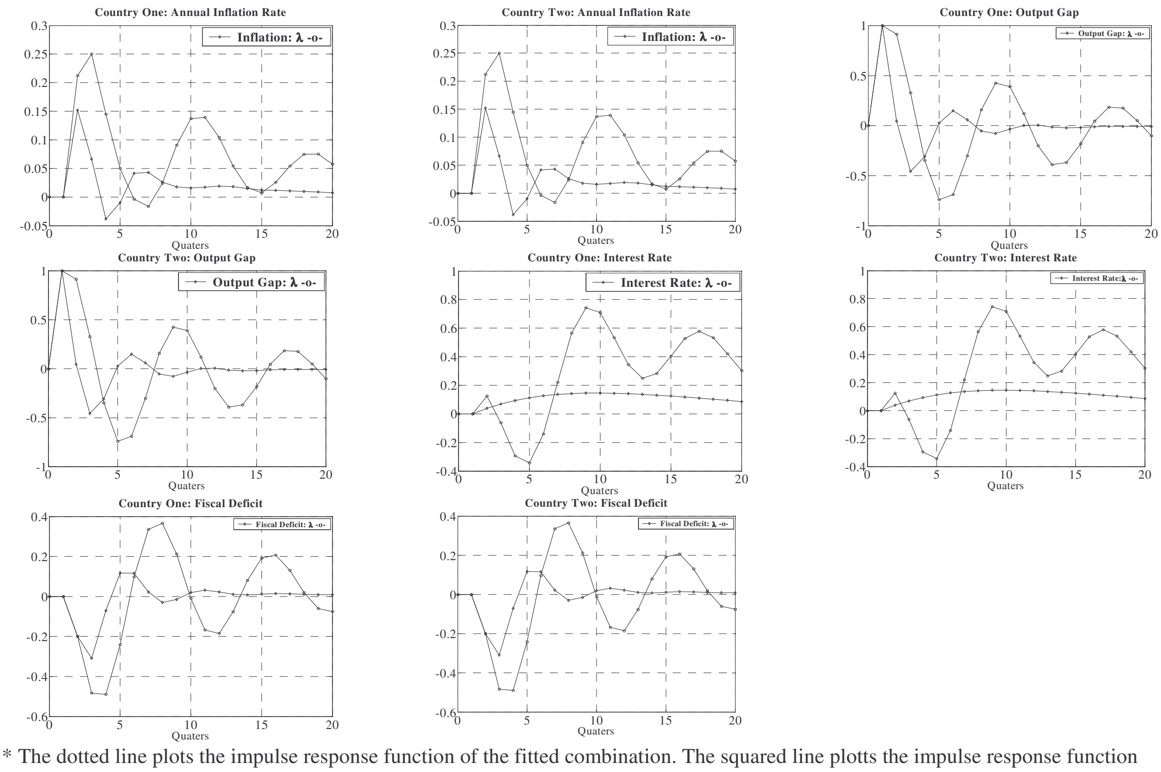
A.5 Impulse Response Functions

Symmetric Supply Shock Hitting the Currency Area



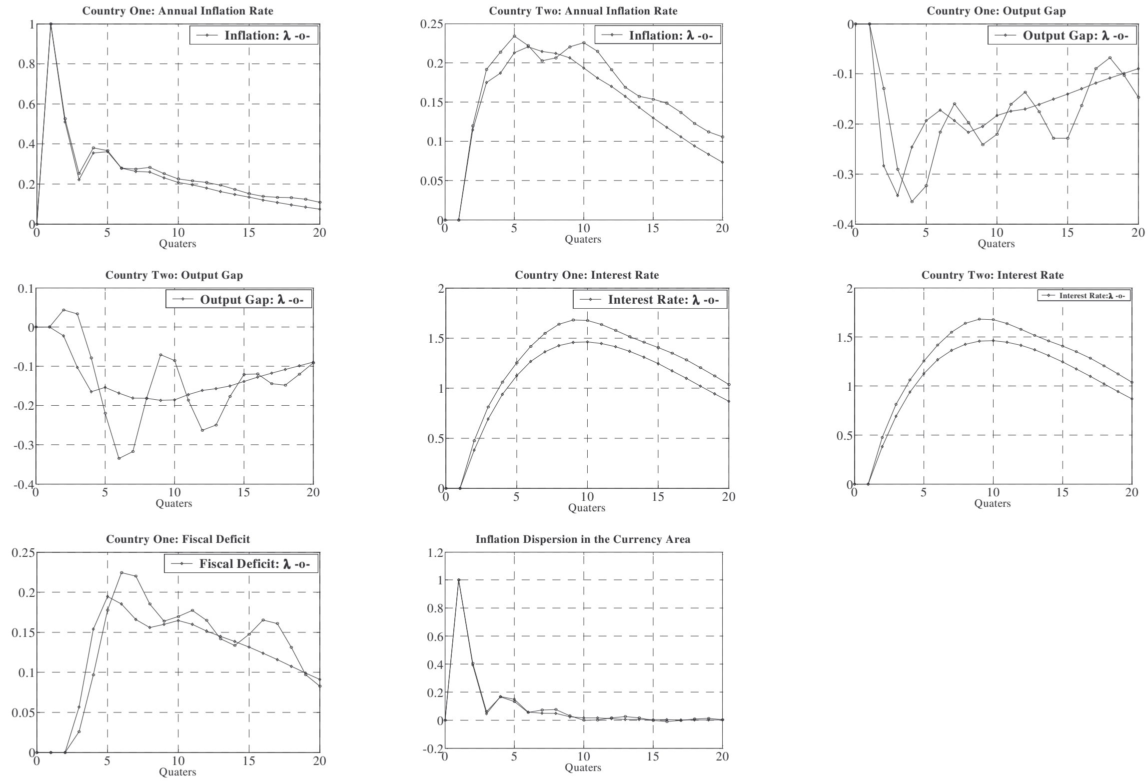
* The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

Symmetric Demand Shock Hitting the Currency Area



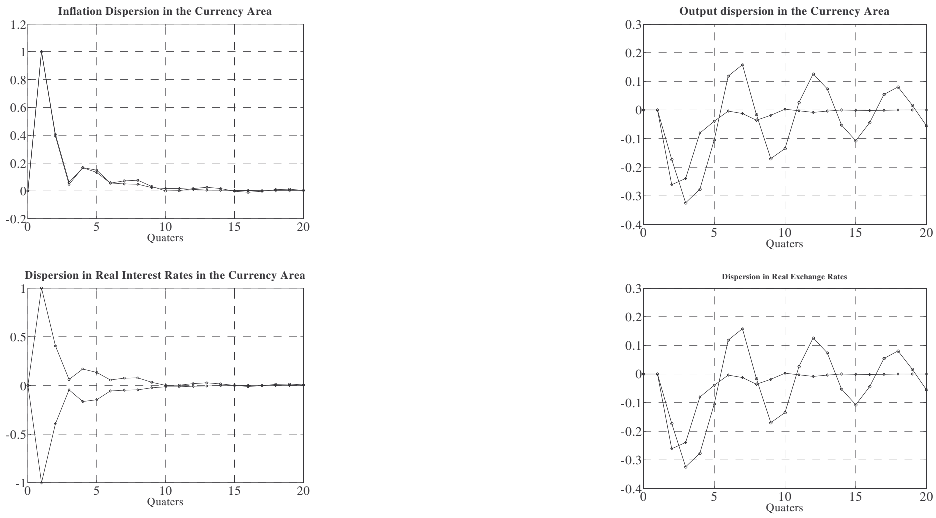
* The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

Asymmetric Supply Shock Hitting the Currency Area*



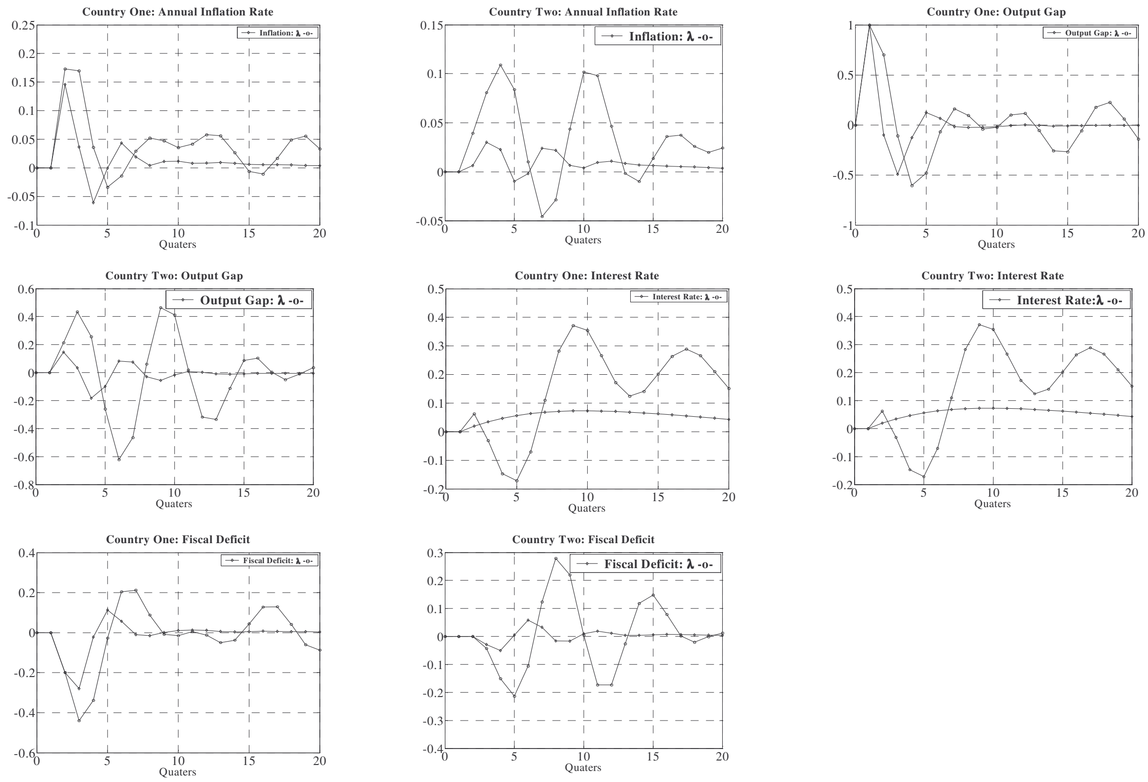
The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

Asymmetric Supply Shock: Dispersion Indicators



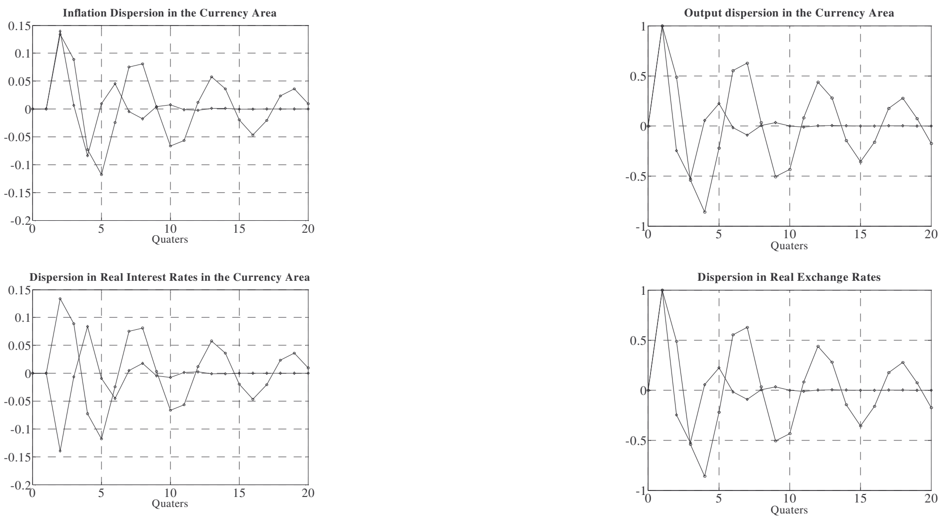
The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

Assymmetric Demand Shock Hitting the Currency Area



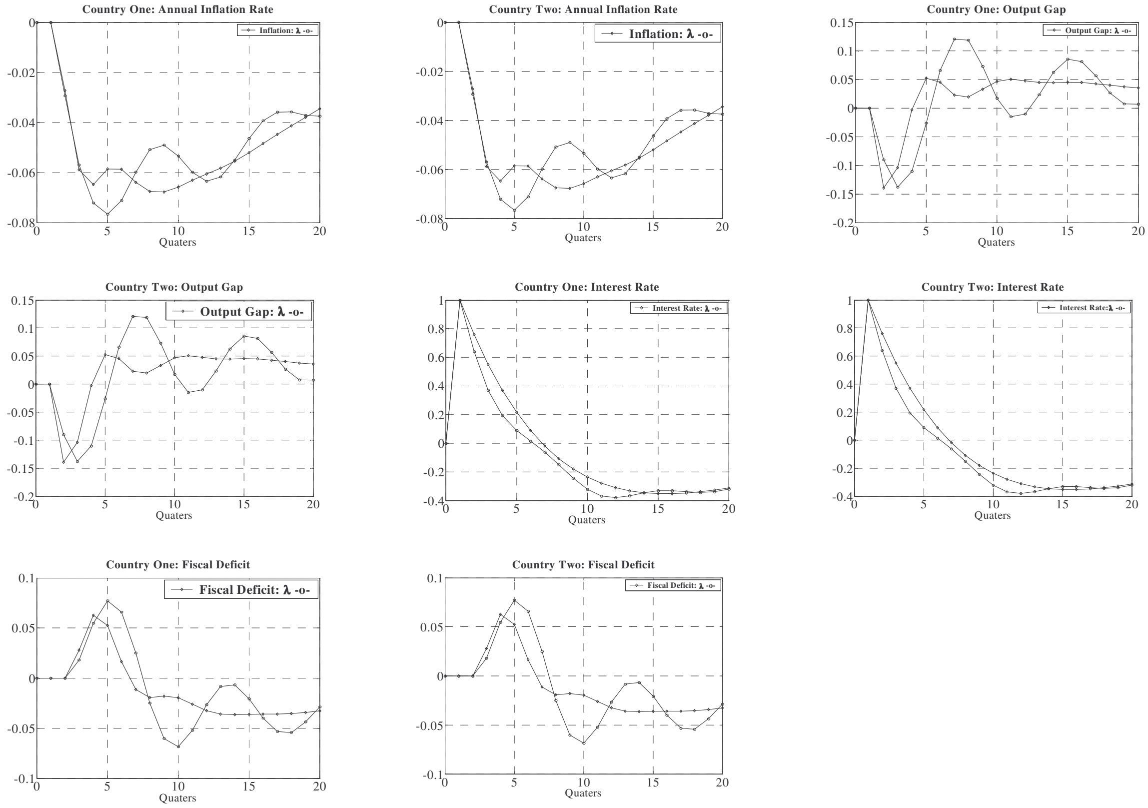
* The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between..

Asymmetric Demand Shock: Dispersion Indicators



The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

Interest Rate Shock Hitting the Currency Area



* The dotted line plots the impulse response function of the fitted combination. The squared line plotts the impulse response function attatched to (λ =0; $\nu = 2$). All other evaluated combinations lie in between.

Baseline Calibration

BASELINE CALIBRATION: ANNUAL VALUES	
Parameters	**Values**
PHILLIPS CURVE	
$\alpha_{\pi 1}$	0.330618
$\alpha_{\pi 2}$	0.067335
$\alpha_{\pi 3}$	0.314959
$\alpha_{\pi 4}$	0.409031
α_{y}	0.210195
ξ	0.1
ϖ_{π}	0.5
IS-Equation	
β_{y1}	1.032538
β_{y2}	-0.215810
β_{r}	-0.160634
ρ	0.5
δ	0.25
ι	-0.3
ϖ_{y}	0.2
Monetary Policy	
λ	3.95
ϑ	5.95
Fiscal Policy rule	
χ	-0.3
θ	0
$\overline{g}_1$	1.8
Demand Externalities	$\rho = 0.5$
Elasticity of change in the exchange rate	$\delta = 0.25$
Imported inflation	$\xi = 0.1$

Values were taken from: {Van Arle, Garretsen Harry, et al. 2003 249 /id}

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