

# HOW TO RESTORE SUSTAINABILITY OF THE EURO?<sup>1</sup>

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We specify an open-economy version of a two-region New Keynesian model for EMU and demonstrate that the result on the unsustainability of the euro with ever-mounting inflation differentials by Wickens (2007) does not hold in general. Strong fiscal consolidation and far-reaching successful structural reforms are needed to reach sustainability in terms of competitiveness and reduced public debt over the medium run. However, the current deflationary adjustment involves a major polarisation within the euro area. Debt relief within the union and internal devaluation in the debtor country may essentially alleviate the adjustment burden and shift it from the problem countries to the strong countries. An internal revaluation in the strong countries can markedly help the situation in the weak countries in the short run if the interest rate remains unchanged.

*Keywords:* EMU, Euro, Sustainability, Fiscal policy, Competitiveness.

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The financial and economic crisis which started in 2008 has delivered a major blow to the global economic system. As is typical in a deep recession, the crisis has also caused tensions between countries operating in a fixed exchange rate system, like the EMU, with diverging economic developments and imbalances within it.

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Already before the crisis, Wickens (2007) observed that the euro had not been stable in the sense that the price levels, *i.e.*, the real exchange rates of the participating countries of the euro area had been on diverging paths during the first decade of the euro. The high inflation countries at the outset did not experience lower inflation hence, but quite on the contrary, they diverged in terms of price levels and competitiveness. He then made the claim that this will be the case in the future as well. Sustainability can only be reached if there are fiscal transfers from the high-inflation countries to the low-inflation countries, which would be unlikely to happen. This unsustainability holds irrespective of the fact that the ECB has a perfect success in its task and capacity to contain inflation in the euro area as an aggregate in the sequel as well.

In this paper, we first intend to tackle this same question using a stylized new-Keynesian macro model (NKM) for two member countries of the euro area, with a slightly more elaborated specification than that used by Wickens (2007). However, our conclusions are far more comforting than his. We argue that his core result does not hold in general. The model has a determinate solution both for the euro area as a whole and its member countries. Also, if there is an inherited divergence in price levels, linked to a loss of competitiveness in a member country, the internal adjustment within EMU is sufficient to eliminate this imbalance, even without a policy reaction by the ECB.

It has already been shown earlier in the literature of the NKM models that the model for a single infinitesimally small member country of a closed monetary union is stable, see Galí and Monacelli (2005).<sup>2</sup> The intuition behind this notion is the fact that the output in the monetary union is pinned down by the relative price level within the union which acts as a substitute for the Taylor rule in a single open economy under flexible exchange rates. Below we come to the same conclusion in our formulation of the relative price level in an open economy EMU.

Wickens (2007) only considered stability with respect to price levels, while we subsequently enlarge the analysis to consider stability in terms of both price levels and fiscal policy and public

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2. Note that this section is missing from their article publication of the same paper in Galí and Monacelli (2008).

debt. The model is reformulated by giving up the assumption of homogeneous financial markets in the euro area and replacing it with segmented markets with diverging sovereign risk premia in interest rates.

We can discern two meanings of the term sustainability. First, we have the case where the NKM model has or does not have a determinate, bounded unique solution. Secondly, we should consider, whether it makes sense for a weak country to remain as a member of the euro area, so that from a policy point of view this is beneficial for both the weak and strong euro area countries. The exchange rate has both a dimension of macroeconomic stability and microeconomic efficiency (see e.g. Alho, 2011 on the latter). The current crisis, manifesting in the financial markets, is basically due to macroeconomic imbalances in terms of idiosyncratic deviations in competitiveness, output and public deficit. Therefore, we have to base the consideration of the sustainability of the euro on whether the emerged imbalances in the euro area in terms of competitiveness and debt ratios will be eliminated within a reasonable time span of, say, the next five to ten years, and what this requires in terms of economic policies.

One core feature in the current crisis management is the magnitude of the burden sharing, so that the problem countries get some assistance from the strong countries in their adjustment process. This has also created a conflict within the currency union as some actors and the public in the strong countries hold that that there has already been enough transfer of funds to the problem countries, while the problem countries urge for more help. Here we come to illustrate this situation with respect to some policies, but, needless to say, without a definitive result on how far this goal should be accomplished in the present crisis, as is also done in the report by the council of the Institute for New Economic Thinking (2012). We contain ourselves to analyse how the various policies work and are shaped in this respect.

We analyse the sustainability of the euro from the following policy angles to alleviate the current divergences:

- (i) Fiscal austerity in the problem country with a high debt and a large public sector deficit, and loss of competitiveness.

- (ii) EU bailout programmes extending subsidised credit to the problem country.
- (iii) Debt restructuring and debt relief in the problem country.
- (iv) Structural reforms, *i.e.*, cutting mark ups in the economy of the problem country.
- (v) Internal (fiscal) devaluation, *i.e.* lowering the export prices of the problem country through cost cuts and raising the home market price of the imported goods by VAT type of changes.
- (vi) Inflationary policies (revaluation) like cost rises in the strong EMU country which reduces the existing gap in competitiveness between the EMU countries.

As a final scenario we could think about a full breakdown of the EMU. This case has not, however, been evaluated in the paper.

We study the mutual interrelationship between the ECB and national fiscal policies. However, our approach differs markedly from the recent literature on monetary unions where optimal monetary and fiscal policies are studied, see e.g. Galí and Monacelli (2008), Ferrero (2008) and Orjasniemi (2010), where optimal fiscal policies could be linked to respond to idiosyncratic shocks. Instead we try to capture a situation, like the current one, where a policy error has been made and imbalances within the euro area have emerged, and policies are basically pursued to stabilise future public debt and competitiveness developments with simple budgetary rules. Numerically, we illustrate a case like that currently in some EU member states where a rapid pace is required in the elimination of the public deficit, assisted by an EU rescue package. If there is no or only a weak fiscal consolidation, this may entail an unsustainable situation for the euro area in the sense that the imbalances would not be eliminated, or that the mounting public indebtedness would not be prevented within a reasonable horizon.

However, in the future, a rise in the interest rate set by the ECB could cast a doubt on managing the interest burden of accumulating public debt and the success of fiscal consolidation. We also illustrate that the adjustment, although successful, to the current divergence in competitiveness and public debt will lead to a major polarisation within EMU in the sense that the problem countries lose and the rest can gain, although the latter fairly little, in terms

of output during the medium-run adjustment period. And as a next item, we infer that far-reaching successful structural reforms are needed to quickly balance the public debt ratio in the problem EMU country. Then we turn to consider policies where the adjustment burden is shifted to the creditor EMU country so that we first analyse debt restructuring and a possible debt relief, and as a last item internal devaluation, called fiscal devaluation (revaluation) in the problem (strong) country. The general conclusion is that these policies work in quite an effective manner in boosting the economy of the weak EMU country and stabilise the divergences in adjustment within the Monetary Union. However, the effects of a reverse cost push in the strong EMU country crucially depend on the reaction of monetary policy. We assume that the ECB first commits to a fixed low interest rate and then gradually returns to obey a Taylor rule. Under such a policy, a revaluation in the strong country lowers the expected real interest rate and changes the gap in competitiveness and thus has an expansionary effect, especially on the weak country in the short run. However, over time, the effect turns negative for the strong country and neutral also for the weak country. On the other hand, if the ECB reacts immediately to a rise in the inflation rate, the effects are recessionary on both countries and thereby on the whole union.

In general, we find that existing idiosyncratic losses and gains in competitiveness bear a major overhang for the Monetary Union. Much more vigorous policies are needed under such conditions in comparison to those under no initial divergence in competitiveness. We also conclude that the measures aiming at balancing the indebtedness process can only be observed over time, which leads to uncertainty as to policy effectiveness in the short run.

The rest of the paper proceeds as follows. In the next section we build the two-region model for the EMU, and in Section 2 consider theoretically stability of the euro area NKM model. In Section 3 we calibrate the model numerically. In Section 4 we widen the analysis to fiscal policy and public debt, with subsections on the fiscal austerity, debt restructuring and bailout packages, structural reforms and fiscal devaluation (revaluation) in the problem (strong) country. Section 5 concludes.

## 1. The model

We specify the following stylized New Keynesian macro model for the euro area, consisting of two countries, following Wickens (2007), but deviating from it in some key respects. The IS curve, based on aggregate demand, is in period  $t$  the following, for both member countries,  $i, j = 1, 2, i \neq j$ ,

$$q_{i,t} = -\beta(r_t - E_t \pi_{i,t+1} - \theta) + \gamma E_t q_{i,t+1} + (1 - \gamma) q_{i,t-1} + \lambda(p_{j,t} - p_{i,t}) + \phi(s_t + p_t^* - p_{i,t}) + \delta q_{j,t} + \chi z_{i,t} + \varepsilon_{i,t}, \quad (1)$$

where  $q$  is the output gap in log,  $r$  the common interest rate set by the ECB,  $\pi$  is the inflation rate,  $E_t$  is the expectation operator on information in period  $t$ ,  $\theta$  is the equilibrium real rate of interest given by the time preference,  $p$  is the price level in log,  $p^*$  the global price level outside the euro area,  $s$  is the log of the effective exchange rate of the euro, units of foreign currency per unit of euro,  $z$  and  $\varepsilon$  the demand impulses stemming from the domestic fiscal policy and the world markets, respectively. In general, a superscript star denotes a global variable. All parameters in (1) are positive. The first two terms on the right-hand side refer to contributions by consumption behaviour and investment to aggregate demand, and the next three terms refer to net exports. So, we depict the influence of the expected real rate of interest, the expected output gap in the next period, the influence of the competitiveness of the country concerned, both within the euro area and in relation to the rest of the world, and the external demand both within the euro area and the world economy outside it. In the Appendix we present a more exact derivation of the IS curve, especially the case how it is specified in connection with fiscal policies in Section 4.

The supply curve, the inflation rate, measured through a CPI, is determined by the following relationship, depicting also a Calvo pricing mechanism for domestically produced goods,

$$\pi_{i,t} = \xi_1 E_t \pi_{i,t+1} + \xi_2 \pi_{j,t} + \xi_3 (s_t - s_0 + \pi_t^*) + \alpha q_{i,t} + u_{i,t}, \quad (2)$$

$$\xi_1 + \xi_2 + \xi_3 = 1,$$

where the subscript 0 denotes an initial value of a variable determined outside the model. The justification of this specification for the supply curve is that the domestic price level is made of goods

supplied by the domestic producers, and by imports from the euro area partner and from the global markets (the three first terms on the right-hand side of (2)). In addition, we depict the influence of the output gap on inflation in a standard manner. The supply ( $u_{it}$ ) shocks in (2) are serially uncorrelated, but observed in the beginning of the period, before the policy by the ECB is decided.<sup>3</sup>

We deviate from Wickens (2007) who took the external value of the euro as fixed and derive its determination as an endogenous item through the portfolio balance. The demand (superscript  $D$ ) for the euro assets denoted by  $B$  (government bonds), the stock  $B^S$  of which is momentarily given, is determined by investors in the euro area and those in the rest of the world, so that in equilibrium we have,

$$B_t^S = B_{i,t}^D + B_{j,t}^D + s_t B_t^{D*} . \quad (3)$$

Here we assume that the euro area bonds are perfect substitutes for each other so that within the euro area financial markets are homogeneous, but see, however, below in Section 4. Each demand component  $k$  is determined by the given wealth  $\bar{W}_k$  and positively by the expected yield differential between the euro area and the rest of the world,

$$B_{k,t}^D = a_k \bar{W}_{k,t} g(r_t - (r_t^* + Es_{t+1} - s_t)), \quad (4)$$

$$g' > 0, g(0) = 1, 0 < a_k < 1 .$$

A similar equation holds for the demand for the external assets, which can be skipped through the portfolio balance identity. For simplicity, we assume that the investors in the market have a fixed de/revaluation expectation of the future exchange rate of the euro so that  $Es_{t+1} - s_t$  is given by the initial gap in the inflation rates, *i.e.*, it is equal to  $\Omega - \pi_0^*$ , where  $\Omega$  is the inflation target by the ECB. From (3) and (4) we can derive the reaction that a rise in the euro area interest rate leads to an inflow of capital from abroad and to a revaluation of the external value of the euro, and thereby to disinflation within the euro area through this link as well, see (2),

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3. We have somewhat incorrectly specified that the price variable in the competitiveness term in (1) is the gap in the total price levels, not that in the domestically produced goods. This deviation can, however, be corrected when specifying the parameters of the equation.

$$s_t = s_0 - \psi(r_t - r_0), \psi > 0 \quad . \quad (5)$$

In the standard manner, we assume that the two EMU countries in the model are initially symmetric and of equal size. This means that all the reaction parameters in the above country model are identical for countries  $i$  and  $j$ .

The ECB takes the aggregate euro area indicators, denoted by a bar, as a basis for its policy. These are in the symmetric case,

$$\bar{q} = \frac{q_i + q_j}{2}, \bar{\pi} = \frac{\pi_i + \pi_j}{2} \quad . \quad (6)$$

The model for the aggregate euro area is then given by the following behavioural equations,

$$(1 - \delta)\bar{q}_t = -\beta(r_t - E_t\bar{\pi}_{t+1} - \theta) + \gamma E_t\bar{q}_{t+1} + (1 - \gamma)\bar{q}_{t-1} + \phi(s_t + p_t^* - \bar{p}_t) + \bar{z}_t + \bar{\varepsilon}_t \quad (7)$$

$$(1 - \xi_2)\bar{\pi}_t = \xi_1 E_t\bar{\pi}_{t+1} + \xi_3(s_t - s_0 + \pi_t^*) + \alpha\bar{q}_t + \bar{u}_t \quad (8)$$

From the supply curve (8) we find that when the purchasing power parity (PPP) holds, *i.e.*, the expected inflation rate is equal to the global inflation measured in euro then the expected euro area output gap is zero given that there are no supply shocks in the euro area. Similarly, we find that if this holds in each member country as well, then the expected value of the output gap is zero,  $E q_{i,t} = E q_{j,t} = 0$ , and output is at the natural level in each country. From (8) we infer, using the above result concerning expected change in the exchange rate that, in equilibrium,

$$E\bar{\pi}_t = \Omega + \frac{\alpha}{1 - \xi_1 - \xi_2} E\bar{q}_t + \frac{1}{1 - \xi_1 - \xi_2} \bar{u}_t \quad . \quad (9)$$

We should still make a note on the nature of our model with respect to the interpretation of the price levels. Our approach is a macroeconomic one, not one describing growth and convergence. Therefore, when we speak of price levels we should not identify them to the existing price level differentials in a PPP sense within Europe so that the price levels are lower in Southern Europe in comparison to the Northern Europe due to lower real income and productivity levels in the former. But we should rather identify them as price levels in relation to productivity levels, and interpret them in terms of competitiveness differentials.

## 2. Sustainability of the euro: the basic result on determinacy

We could start, as Wickens (2007) did, from a discretionary formulation of the monetary policy by the ECB. However, this effort is not in effect needed, and in order to be able to argue about the conclusion of Wickens, we first state the basic outcome of the policy-making. It is well known that the central bank fully offsets the effects of aggregate demand shocks (if the interest rate is not free to move due to the zero lower bound). This means that in the absence of the supply shocks the expected (for the next period) and the current period output gap is zero. As mentioned above, this holds in the steady state long-run equilibrium.

We could then insert, similarly as Wickens (2007) did, the ECB policy into the IS curves (1) for both countries  $i$  and  $j$  and subtract the IS curves for  $i$  and  $j$  from each other. Using the identity  $E\pi_{i,t+1} = Ep_{i,t+1} - p_{i,t}$ , the following dynamic equation can be readily derived for differentials of logs of price levels,

$$p_{it} - p_{jt} = \frac{\beta}{\beta + 2\lambda + \phi} (Ep_{i,t+1} - Ep_{j,t+1}) + \frac{1}{\beta + 2\lambda + \phi} ((z_{it} - z_{jt}) + (\varepsilon_{it} - \varepsilon_{jt})) \quad (10)$$

This is a determinate difference equation with a unique bounded solution based on the future path of the fiscal and demand shock differentials, in contrast to that stated by Wickens (2007), as the coefficient of the forward-looking variable is smaller than unity, see King and Watson (1998) and Sargent (1989, 216), Lubik and Schorfheide (2004) and Galí (2010) for a general treatment of the NKM model. This requires that the fiscal impulses and the demand shocks do not diverge from each other more rapidly than with the exponential order of  $(\beta + 2\lambda + \phi) / \beta$ . Meeting this, if there is an initial idiosyncratic shock to the price levels, they converge over time. This takes place in conjunction with the fact that the euro area as a whole stays well in a stable way within the goals adopted by the ECB, see below. The terms involving competitiveness are essential as to this outcome.

However, this is not how Wickens (2007) treats this equation (10) and Minford and Srinivasan (2010) consider the NKM model in a similar way to him. Both start from a shock to the initial price

level or the price differential in (10) and then trace the future path of the price differential. Both then use Eq. (10) or the like in the NKM model in effect as a backward-looking equation to trace the future path. Wickens (2007) argues that the ECB can do nothing to prevent this divergence in price level deviations to mount over time. But we argue that this interpretation of the NKM model is not correct.

Galí and Monacelli (2005) argue that within a closed monetary union consisting of infinitesimally small member countries, a member country's terms of trade within the union has a unique stationary solution, by deriving a forward and backward looking difference equation for the terms of trade. From this result they then derive the equilibrium levels of domestic prices and output. But, we can add to this that this relative stability is reached within a monetary union for all kinds of monetary policy rules by the ECB. Let us next follow their line of argumentation, which starts from the inflation equation. We can first derive the following equation in our case for the price differential within the monetary union,

$$(1 + \xi_2)(\Delta p_t - \Delta p_{t-1}) = \xi_1(E_t \Delta p_{t+1} - \Delta p_t) + \alpha \Delta q_t + \Delta u_t, \quad (11)$$

where  $\Delta$  is the difference between countries  $i$  and  $j$ . Let us then take the goods market equilibrium, see the Appendix, analogously as Galí and Monacelli did. Now we can approximately state the following equation for the output difference, as a function of the differential in competitiveness and in the fiscal impulse,

$$\Delta q_t = \zeta \Delta z_t - (1 - \zeta) \delta \Delta p_t, \quad (12)$$

where  $\zeta$  is the share of the fiscal impact in output, assumed to be 0.2, and  $\delta$  is the elasticity of substitution between the goods produced in the home and foreign country, assumed to be two in the calculations below. Inserting this into (11) we can derive the following second-order difference equation

$$(1 + \xi_1 + \xi_2 + \alpha(1 - \zeta)\delta)\Delta p_t = (1 + \xi_2)\Delta p_{t-1} + \xi_1 E_t(\Delta p_{t+1}) + v_t, \quad (13)$$

where  $v$  is a combination of the difference in the fiscal impulses and the supply shocks. The roots of the difference equation (13) are hard to handle analytically. However, a numerical evaluation

of the grid (with  $\alpha$  being 0.3), where  $0 < \xi_1 + \xi_2 < 1$ ,  $\xi_1 > \xi_2$ , gives the result that one of the roots  $\mu_1$  is quite tightly centered on the value of 0.6-0.7, *i.e.* less than unity in absolute value, while the other root is clearly higher than unity. We can now derive the following solution to this difference equation, analogously as in Galí and Monacelli (2005, 16) and Sargent (1987, 395),

$$\Delta p_t = \mu_1 \Delta p_{t-1} + \frac{\mu_1}{1 + \xi_2} \sum_{k=0}^{\infty} \left( \frac{\xi_1}{1 + \xi_2} \mu_1 \right)^k E_t(v_{t+k}). \quad (14)$$

This is a unique stationary solution for the equation (13), converging to price parity similarly as above.

Turn then to the monetary policy rule. Below we shall analyse rules of the Taylor type of the following kind,

$$r_t = r_0 + \omega_1 \bar{q}_t + \omega_2 (\bar{\pi}_t - \Omega), \text{ where } \omega_i > 0. \quad (15)$$

Let us next turn to consider the determinateness of the aggregate euro area, the model of which was presented above in Equations. (7) and (8). In the prototype case of a closed economy the NKM model as such, *i.e.* without the monetary policy reaction, is not determinate, see Galí (2010). The model can be made as determinate if  $\omega_2 > 1$ , see e.g. Woodford (2003) and Galí (2010). However, in our specification of the open economy model for the euro area we come to the conclusion that it is stable under a wider range of policy rules, under the set of parameters adopted below in Section 4.

We have now come to the conclusion that both the models for the aggregate euro area and the difference between the EMU countries are stable. We can then infer that the individual EMU countries have a determinate solution as a linear combination, being either a sum or a difference of these two models, too, given that the shock processes do not diverge too fast from each other. Given the equilibrium path for the terms of trade within the monetary union, we can then trace back out the equilibrium prices and output.

Galí and Monacelli (2005) (and in their other papers, too) derive the result that the open economy NKM model is isomorphic with the closed economy model. This specification leads, however, to the case where there is no return back to parity in price levels

and competitiveness and differences in this sense stick to the initial gap in them. It seems that the key role of competitiveness vanishes in an equilibrium case from the IS curve. Therefore, we have wanted to specify the model so that it applies in a disequilibrium situation as we have now a case where competitiveness is a key factor in determining the output.

### 3. Numerical analysis of sustainability within the euro area after an idiosyncratic shock in inflation and competitiveness

We illustrate the above two-region EMU model with simulations using a numerical specification. We choose the following fairly standard or plausible values for the parameters (see the Appendix): the inflation target  $\Omega$  is 2% p.a., the same holds for the global inflation rate  $\pi^*$ ,  $\lambda = 0.2$ ,  $\beta = 0.3$ ,  $\gamma = 0.3$ ,  $\alpha = 0.3$ ,  $\delta = 0.1$ ,  $\theta = 0.02$ ,  $\psi = 6$ ,  $\phi = 0.2$ ,  $\xi_1 = 0.5$ ,  $\xi_2 = 0.3$  and  $\xi_3 = 0.2$ . The elasticity of substitution between imported goods and home goods is taken to be fairly small, two, which leads to the value of the  $\phi$  parameter, see on this also the Appendix. The openness of the euro area to global trade is taken to be 10%. The reaction parameter  $\psi$  in Equation (5) is based on the evidence between the relation of the euro-dollar rate and the respective interest differential, depicted in Commission (2008, 10). The long-run equilibrium of the model is that the interest rate set by the ECB is 4% p.a., and inflation is on its target of 2% p.a. in both countries. The standard Taylor rule in (15) has the parameters  $\omega_1 = 0.5$ ,  $\omega_2 = 1.5$ , but see on this Section 4.

In this section, we carry out the simulations of the model, specified for a quarterly time unit<sup>4</sup>, over the period from 2010, second quarter, to 2040 under the assumption that initial shocks to level (stock) variables take place in 2010Q1. This temporal specification does not mean that we aim in this section to trace the current situation in the euro area, but rather want to demonstrate how the equilibrium can be restored after an initial shock. So, i.a., we assume in this section that initially output is on its trend in both countries and that the interest rate is on its equilibrium value, *i.e.*, 4% p.a. In this Section we omit the fiscal impulses. We impose

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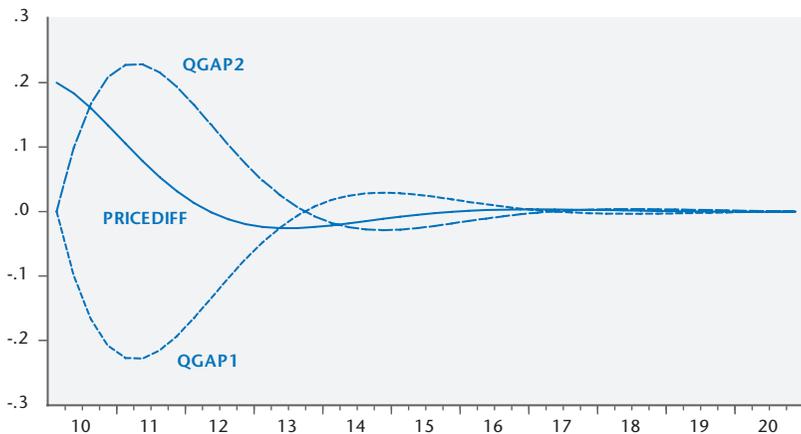
4. This means adjusting the annual interest and inflation rates to match the quarterly dimension of the model.

terminal conditions to the model so that the forward-looking variables reach in the long run constant levels.

Assume that, similarly as in reality, referred to in the Introduction, country 1 has run into an imbalance in its initial price level and in competitiveness of the magnitude of 10 per cent (in logs) in the initial situation (in 2010 Quarter 1). Similarly, this is reflected in that the country 2 has reached a competitiveness gain of the same magnitude. The outcome for the price level differential and the output gaps is now the following, see Figure 1.

Adjustment within the euro area eliminates the initial gap in competitiveness. We see that adjustment brings in a substantial polarisation within EMU in terms of output reaction. In the EMU country which has lost its competitiveness, the loss in output in the deflationary process is very severe, while the country with a gain with respect to competitiveness benefits from this. The speed and magnitude of these reactions are astounding which casts doubt on the relevance of the model from an empirical point of view. This feature is basically dependent on the expected output term in the IS curve. If that term does not appear the size of adjustment is much smaller, but at the same time much more sluggish back towards equilibrium.

**Figure 1. The price differential and the output gaps (QGAP) after an asymmetric positive price level shock (10 percentage points) in country 1 in 2010Q1**



In this case there is no reaction by the ECB if the initial output gaps are zero, if the initial interest rate is on its equilibrium level (4%) and if the global inflation rate is the same as the target adopted by the ECB. This is then the case of a perfect idiosyncratic shock within EMU. However, even without a policy reaction the euro area reaches stability, although this can involve a very marked polarisation within the EMU.

The general conclusion is that this kind of idiosyncratic disparities will be eliminated over the long run within EMU, rather than that they are persistent.

#### 4. Sustainability with respect to public deficit and debt

Recently, another angle as to the stability of the euro has emerged, namely the robustness of the Monetary Union with respect to a diverging situation in public borrowing and debt. Currently, the EMU has had to face the debt crisis of Greece and other so-called PIIGS countries with a large public sector deficit, many of them over 10% of GDP, and a high debt exceeding 100% of GDP, with a marked trade imbalance.

In the initial stage of the EMU more than a decade ago, concern was often raised that the financial markets do not deliver enough sanctions with respect to those countries pursuing lax policy in their public finances. The interest rate differentials were quite small irrespective of the diverging public indebtedness in the member countries. The present global economic crisis has changed all this. The interest premiums between good and bad borrowers have widened markedly and now the tune has changed from tranquillity to an alarmed consideration of a Euro area country even running into some kind of insolvency, reinforced by excessive market reactions in the interest rates.

The fiscal sustainability has been considered in a NKM model, i.a., by Leith and Wren-Lewis (2007) in an optimising framework with several instruments of fiscal policy identified in it, see also Galí and Monacelli (2008), Ferrero (2008) and Orjasniemi (2010). Here our approach deviates from these optimal policy analyses in a fundamental way. We assume that an imbalance has emerged as currently, and the goal of policy-making is to overcome it, notably in public sector indebtedness and competitiveness.

We limit ourselves to consider sustainability with respect to an emerged fiscal imbalance in one EMU country so that we identify the effect of fiscal policy as a demand impulse in the IS curve in Eq. (1) and through a sovereign risk factor.<sup>5</sup> We consider how the public deficit should be reduced and its link to the stability of the euro. We have analysed the sustainability of the euro from the policy points mentioned in the Introduction. By sustainability we now mean that the public sector indebtedness can be kept under control, ultimately measured by whether the no-Ponzi game assumption will or will not be met as to public sector indebtedness.

#### 4.1. Modifications to the model

The debt dynamics are,

$$D_{i,t} = (1 + \bar{r}_{i,t} - \pi_{i,t})D_{i,t-1} + z_{it}Q_{i,t-1}, \quad (16)$$

where  $D$  is the real public debt (in book value),  $\bar{r}$  is the average interest rate on public debt,  $z_i$  is now primary deficit in country  $i$  in relation to GDP, and  $Q$  is the level of GDP. The actual level of output evolves as follows,

$$\log Q_{i,t} = \log Q_{i,t}^{POT} + q_{i,t}, \quad (17)$$

where  $Q^{POT}$  is the potential output growing at the rate of the trend growth of the labour-augmenting productivity process, see below Section 4.3.

Let us now take as a starting point the current debt crisis in EMU, started in 2010 by the situation in Greece, and the policies adopted to overcome the instability caused by it to the euro. We assume that the fiscal policy rule consists of the components of automatic stabilisers and discretion, where the latter now means a stipulated gradual cut in the initial primary deficit along the announced path in one of the member countries, the problem country  $i = 1$ . Thus we have,

$$z_{1t} = -h_1 q_{1,t} + [(1 - h_2)^t z_{1,0} - h_3], \quad 0 < h_1, h_2 < 1, \quad (18)$$

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5. See, however, below where we allow for an effect on inflation by the fiscal austerity leading to hikes in taxation.

where the first component captures the automatic stabilizers and the second the structural budget deficit in the problem EMU country 1. In the other strong EMU country 2, only the automatic stabilizers are at play. Above in the previous section we have assumed that the external value of the euro only reacts to the interest rate set by the ECB and the financial markets in the euro area are homogeneous. This is clearly not consistent with the facts of the 2010-2012 euro debt crisis. We assume now that the financial markets in the euro area are segmented so that the bonds of countries 1 and 2 are no longer perfect substitutes for each other as they were above in (3). So, their risk premia deviate according to the extent of the respective government borrowing, see below. The interest rate on the government debt of the problem country rises as the fears of insolvency of the country spread in the market. Second, this also leads to an outflow of capital from the euro area. We should note that the first impact, in itself, leads according to our specification above in (5) to a stronger euro. In order to reach the possibility of a weakening euro, the latter negative impact should be stronger than the first impact. Let us therefore revise the determination of the external value of the euro to take place through the following open interest parity arbitrage condition, incorporating a combined risk premium,

$$\frac{(1+r^*)Es_{t+1}}{s_t} = 1 + \frac{r_{1,t} + r_{2,t}}{2} + m_0 - m_1 \left( \frac{D_{1,t}}{Q_{1,t}} + \frac{D_{2,t}}{Q_{2,t}} \right), \quad m_i > 0, \quad (19)$$

where  $r^*$  is the foreign interest rate and the rates  $r_i$  and  $r_j$  now refer to the short-run market rates. This equation can be derived from a portfolio balance model between domestic and foreign assets, where the parameter  $m_1$  reflects the attitude toward risk aversion and the risk (variance) of the exchange rate, and GDP marks the size of the portfolio. Now, given the exchange rate expectations, the higher the debt ratio is in the euro area, the more the euro depreciates. Let us assume simply that  $Es_{t+1} = s_{t-1} + \Omega - \pi^*$ , similarly as above.

A notable feature of the debt crisis is the markedly widened interest rate differentials in the euro area between the good and bad borrowers. We can introduce the following specification for this risk premium,

$$r_{1,t} = r_t + \Delta_1 + \kappa\mu f\left(\frac{D_{1,t}}{Q_{1,t}}\right), f' > 0, f'' > 0. \quad (20)$$

Here the second term captures the interest differential vis-à-vis the interest rate set by the ECB and the last term captures the expected capital loss related to government bonds of country 1. The parameter  $1 - \kappa$  depicts the expected amount of the debt to be paid by the borrower country in the case of its debt default, and  $\mu$ , multiplied with the convex function  $f$  of the debt ratio, captures the probability of the default by the country 1.

One outcome of the crisis in 2010-2012 has been that funds have been channelled to other euro area countries so that the interest rates in Germany and elsewhere with a limited budget deficit, like Finland, have been pushed downward. We take this effect simply into account so that for the country 2, modifying Laubach (2009),

$$r_{2,t} = r_t + \eta_2 \left(\frac{D_{2,t}}{Q_{2,t}} - \bar{d}\right) - \eta_1 \left(\frac{D_{1,t}}{Q_{1,t}} - \bar{d}\right), 0 < \eta_1 < \eta_2. \quad (21)$$

Here  $\bar{d}$  is the EMU reference value for the public debt ratio, *i.e.*, 60 per cent. We insert  $r_i$  and  $r_j$  into the IS curve in Equation (1) instead of  $r$ .

The euro rescue package reached in May 2010 consists of loans extended to Greece by the other euro area countries at rates lower than the current market interest rates, and similarly for Ireland in November 2010, Portugal in May 2011 and Spain in July 2012. This transfer has the effect that the domestic fiscal impulse in the country 2 is smaller than without this measure by the amount of the interest subsidy extended to the problem country. An equivalent effect, *mutatis mutandis*, applies to the country 1. This transfer effect will be taken into account in Section 4.3.

Based on this reasoning we specify in Equation (20) that  $f(d_t) = 0.5d_t + 0.5d_t^2 - d_{12}$ , where  $d$  is the debt ratio in country 1 being 100% initially and  $d_{12}$  is the size of the debt of country 1 which country 2 is ready to finance or guarantee. This implies that in the initial stage the probability of default is zero if the euro partner is ready to finance the total debt outstanding. However, over time this probability may become positive, if the country concerned will run into a higher level of debt as will be the case in reality, see below. It is quite unlikely whether the guarantee of the

rest of the euro area countries will be extended to cover such a situation as well. It is true that this formulation for the  $f$ -function is ad hoc, but in any case the future evolution of the interest spreads in the euro area is quite uncertain at the moment. Let us further tentatively assume that  $\kappa = 0.5$ ,  $\mu = 0.01$ , and initially  $d_{12} = 0.5$ . The last item comes to play a role in Section 4.3.

Let us finally introduce the capital stock and the labour market explicitly in the model. In the spirit of the Keynesian analysis in an open economy, the labour market in effect operates as a residual of the model here in the following sense. Let us first specify the output gap in a log-linear manner as a function of the constant returns to scale production function,

$$q_{it} = \kappa k_{it} + (1 - \kappa)(a_{it} + l_{it}), \quad 0 < \kappa < 1, \quad (22)$$

where  $k$  is the capital stock,  $a$  is labour-augmenting technical change and  $l$  is the labour input, all as log deviations from the equilibrium. In effect, we use this equation to derive the labour input, once the output and the capital stock have been determined. The capital stock is defined on the basis of the investment function in the Appendix, and the country-wise interest rates,

$$i_{it} = q_{it} - \tau(r_{it} - E\pi_{i,t+1}) . \quad (23)$$

The capital stock evolves as,

$$k_{i,t} = \vartheta i_{i,t} + (1 - \vartheta)k_{i,t-1}, \quad (24)$$

where  $\vartheta$  is the share of investment in equilibrium in relation to the capital stock. The demand for labour now determines the wage rate from the marginal productivity condition,

$$w_{it} = (1 - \sigma)^{-1}(q_{it} - l_{it}) + a_{it} + p_{it} - mu_{it} , \quad (25)$$

where  $(1 - \sigma)^{-1}$  is the elasticity of substitution between capital and labour and  $mu$  is the mark up-term in the pricing decisions of the firms. In the numerical solutions, we use a fairly typical value of 0.7 for the elasticity of substitution and 0.2 for the mark-up factor.

#### 4.2. Simulations on the sustainability of the euro in a debt crisis: fiscal austerity

We now turn to the simulations. With the previous specifications, we will try to trace a situation like the current one in the euro area, at least more than we did in Section 3.

The above specification is not able to describe the current situation in the euro area so that the interest rates would correspond to those realised currently in the financial market in the European debt crisis. However, to avoid being too far from the reality, we assume below that the short-run interest rate  $r_1$  of the problem country 1 is 2.5 percentage points above the short-term rate set by the ECB throughout, added by the premium described in the previous section in Equation (20). We further assume that a country has to finance its debts with loans with the maturity of ten years, and that the starting values for the average interest rates on debt in Equation (16) are 3% for country 1 and 2% for country 2. The future evolution of the interest rate is quite crucial for the sustainability of the fiscal austerity in country 1, see below.

To further increase realism, we assume that both countries have initially (in 2010) a negative output gap of 4 per cent and face an autocorrelated adverse aggregate demand shock  $\varepsilon$  from world markets which vanishes by 10% per quarter, and that there is in addition a recessionary shock in late 2011 and early 2012 of one percentage point mimicking the current cycle. The size of the initial shock is calibrated in such a way that the aggregate demand initially equalizes output with the stipulated gap. To depict the current situation, we also define that initially country 1 has lost its competitiveness by 10 per cent vis-à-vis the average in the euro area and the rest of the world, while country 2 has reached a gain of the same magnitude. We simulate the model basically over the period starting in 2010Q2. Some policies will take place later on in the manner described below.

We now specify the rule in (18) to be the following for country 1,

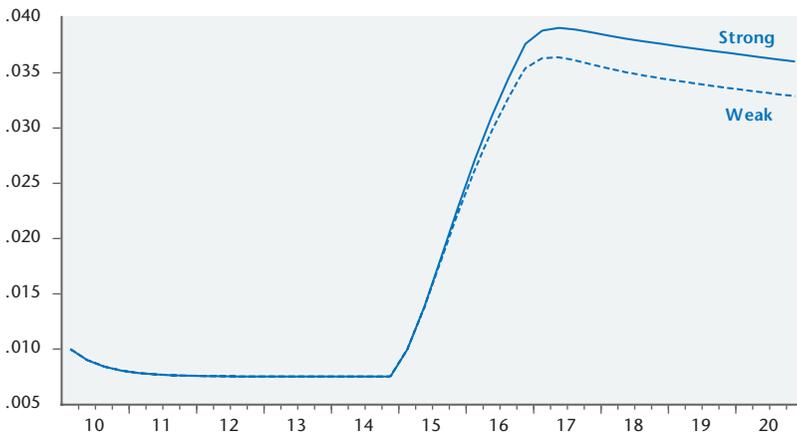
$$z_{1,t} = -0.5q_{1,t} + 0.09(1 - 0.6)^t - 0.01 . \quad (26)$$

We call a fiscal consolidation according to the rule (26) a *strong* one, and the case where in Equation (18)  $h_2 = 0.1$  and  $h_3 = 0$ , a *weak* one. The magnitude of the automatic stabilizer in (26) is standard,

but the fiscal consolidation is arbitrarily fixed, although it is harsh enough to bring in a rapid reduction in the public deficit and, in the end, a ceiling for the public debt—although a very high one—see Figure 3 below. By fixing the  $h_2$  parameter to this value, we assume that the high debt country cuts its public deficit in relation to GDP initially by more than 3 percentage points per year in its austerity programme, which is broadly consistent with the present desired situation in the PIIGS countries. It is true that in (26) we explicitly miss the link between the debt ratio and the degree of fiscal consolidation, raised to an important position by Schabert and van Wijnbergen (2011). In country 2 only automatic stabilisers are in operation. We assume that the potential output grows by 2% p.a. in both countries, but see on this Section 4.4. The initial debt ratios are taken to be 100% for country 1 and 50% for country 2. The IS curve is now modified as in Equation (37) in the Appendix. The strong scenario (26) defines the baseline.

During the crisis the standard monetary policy rules have not been at play. This is partly dictated by the zero lower boundary of the nominal interest rate. The interest rate policy by the ECB is assumed to be a combination of two rules so that it is first fixed to a rule of keeping the rate at 1% up to the end of 2014 and thereafter it gradually returns in two years to the modified Taylor rule, see Figure 2 (see Equation (38) in the Appendix for details). It is true

Figure 2. The interest rate policy by the ECB in the two scenarios



that this fairly rigid set up omits the link between the monetary policy and fiscal consolidation in the euro area in the initial stage. If we assume that the ECB obeys a Taylor rule throughout, some, but not all, of the results below will change.

From Figure 3 we see that fiscal austerity can have a perverse effect in the short and medium run as to the debt ratio, although the size of this difference is not very big. So, there is a temporary, but not permanent, self-defeating fiscal austerity. Even though the public deficit is cut markedly, the debt ratio in country 1 rises temporarily more rapidly in the case of a strong adjustment than in a weak case as output is squeezed in the short run. In any case the debt ratio rises to a very high level in the problem country 1.

Above in Section 2, we initially identified sustainability of the euro in terms of a determinate solution for the euro area and the member countries. From a policy point of view this may be quite far from the reality. Let us therefore examine in the sense of Bergman (2001), whether the evolution of the future public debt meets the no-Ponzi—game assumption. According to this analysis, we estimate a regression of the following kind,

$$D_t = e_0 + e_1 D_{t-4} + v_t. \quad (27)$$

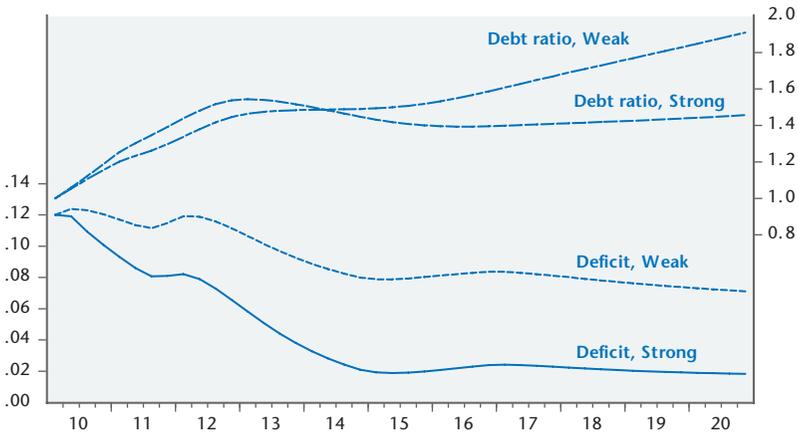
If the parameter  $e_1$  is higher than unity plus the discount rate, indicating explosive debt dynamics, then the no-Ponzi game condition is not satisfied. In our simulations estimation of this equation for the period 2011-2031 produces the outcome that under a strong fiscal policy the parameter  $e_1$  gets the value 0.966 (with t-value 70) and under a weak consolidation it gets the value 1.048 (with t-value 368). This implies that the weak consolidation policies are likely to lead to a situation of being near insolvent in terms of debt dynamics.

If the problem country 1 could finance throughout its public debt with a fixed interest rate, say 4% p.a., the public debt in it would be on a sustainable path under a strong fiscal consolidation ( $e_1$  would then be clearly less than unity), see the Table. In this sense we see that the interest rate policy by the ECB, the fiscal policy and the sustainability of the euro are closely linked together. A likely future rise in the interest rate set by the ECB towards the equilibrium value can jeopardise the sustainability of

the euro through its spillover effect on the interest burden of the public debt in the problem EMU country.

The country 1 reaches under a strong fiscal austerity in 2016 the limit of 0.5% of GDP in terms structural budget balance stipulated by the Fiscal Compact of spring 2012.

**Figure 3. The public deficit and debt in a high debt, low competitiveness EMU country (1) under an adverse demand and supply shock and varying degree of fiscal austerity, in relation to GDP (deficit on the left scale, debt on the right) (for explanations, see the text above)**



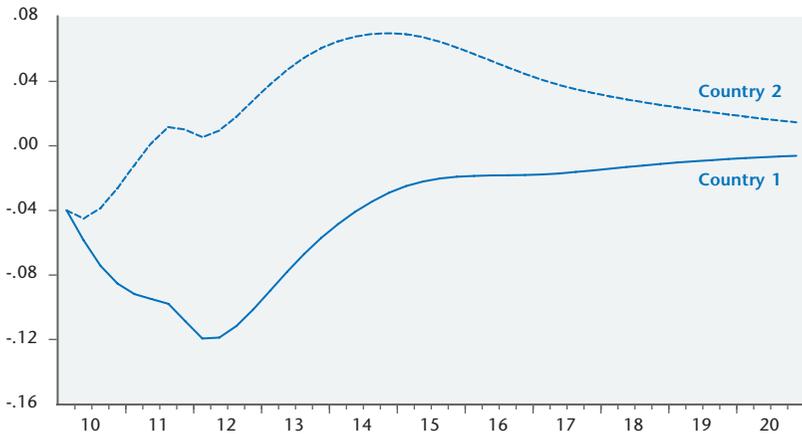
We see that the diverse impacts of various cases will be felt over the long run, but over the medium run the outlook is quite independent of the interest rate assumptions, similarly as predicted in the Greece country report by the OECD (2011). Over the long run, the interest burden and the fiscal consolidation will make their effects felt clearly on the sustainability criterion in Equation (27). The problem in actual policy making lies in the fact that it is very difficult to commit to this kind of policy restraint in a credible way from the point of view of the financial market agents, which recognise various uncertainties and have normally a much shorter time horizon in their decisions.

Fixing the interest rate by the ECB to 1% throughout the simulation period would drive down quite soon the debt ratio under a strong fiscal austerity, but this would take place at the cost of jeopardising the inflation control, which would rise over time to 6% p.a.

Table. Alternative simulations on the link between the interest rate and the fiscal policy in the problem country 1 (under strong fiscal consolidation)

Interest rate $r_1$ for new government debt in country 1	Output gap in 2015, %	Primary balance (surplus, i.e. $-z_1$ ) in 2015, % of GDP	Debt ratio in 2015, %	Debt ratio in 2030, %	Value of $e_1$ in Eq. (27) over the period 2010-2031
as in Equation (20)	-2.2	-0.2	140	181	1.030
4% p.a. throughout	-2.1	-0.1	138	115	0.740

Figure 4. The output gaps in the two EMU countries under a strong fiscal consolidation in country 1 (for explanations, see the text above)

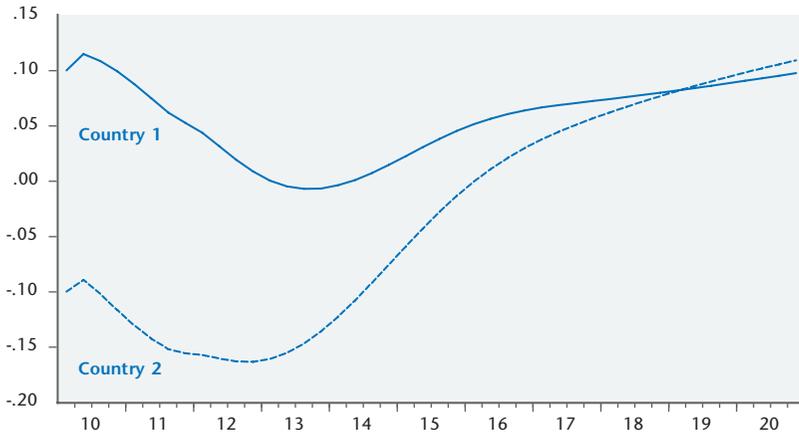


It is anyway interesting and important to see from Figure 4 that the adjustment in the strong EMU country 2 involves an overshooting so that output gap changes sign before converging to the equilibrium where output is equal to the potential GDP. It can be argued that the NKM model shows a fairly vigorous pattern of adjustment back to parity which is not very likely to happen in reality. Therefore, we should interpret the results as only illustrative rather than predictions of future developments. We see that the adjustment implies roughly a 10 percentage point reduction in the nominal wages in the problem country 1, see Figure 5. It is also interesting to note that the wage adjustment in the strong country back to equilibrium is sluggish during the first few years.

Let us then return to compare the situation under a *strong* fiscal adjustment assumed so far compared to the *weak* case, see Figure 6.

We infer that the strong country 2 gains in terms of output after a couple of years from a harsh adjustment to the euro debt crisis. However, the difference for country 2 is quite small so that we can state that the adjustment burden is fully borne by the problem country alone. On the other hand, the country 1 causing the debt crisis loses sharply and increasingly during the first two years, but then the situation is reversed and it turns towards neutrality and a small gain. Thus, there is a marked polarization within EMU as a result of the debt crisis.

**Figure 5. The evolution of the nominal wage rates under a strong fiscal consolidation in country 1**

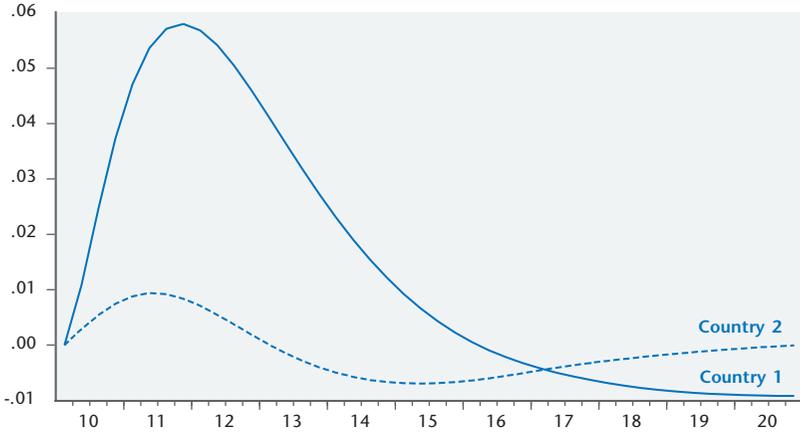


By varying the policy rule in Equation (18) so that the parameter  $h_2$  is raised, we can infer that the pain linked to a strong adjustment is higher, but the more rapidly the reduction in the budget deficit takes place in country 1, the more rapidly it will start to gain from its austere policies. Of course, the measure used here omits many aspects, economic and political, linked to a successful elimination of emerged imbalances within EMU. Altogether, we could argue that a successful consolidation and price adjustment are a condition for a country to be able to permanently reap the microeconomic gains delivered by the participation into the single currency.

We can also depict a difference with respect to the external value of the euro and the average inflation rate. It seems to be the case that over the long run a weak fiscal adjustment to some extent

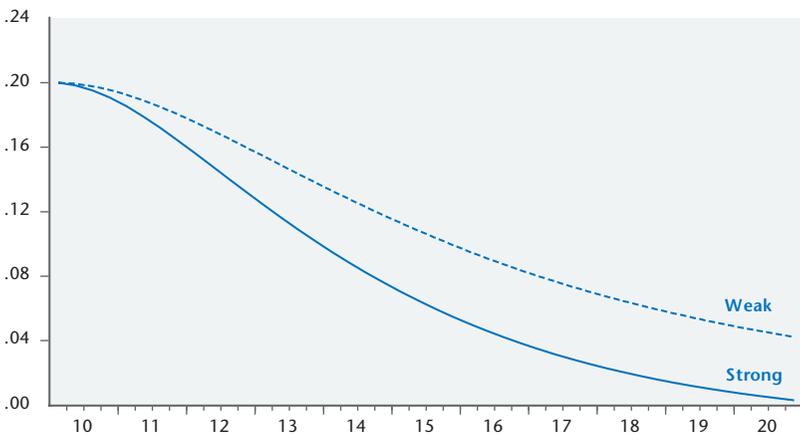
jeopardizes the inflation control in the euro area. Thus the average inflation rate would be on a gradually accelerating trend up to 2015, and weak consolidation can markedly slow down the price level adjustment after initial idiosyncratic disparities to competitiveness. We illustrate this in Figure 7 below.

**Figure 6. The difference in the output gaps (output less potential) between the cases of weak and strong fiscal austerity\***



\* In this comparison in the weak consolidation case the parameters are as follows in Eq. (18)  $h_1 = -0.5$ ,  $h_2 = 0.1$ ,  $h_3 = 0$ . The strong consolidation is that stipulated in Eq. (26). The curves denote the difference  $q(\text{weak}) - q(\text{strong})$ .

**Figure 7. The price level differential ( $p_1 - p_2$ , in logs) under a strong and weak fiscal consolidation (for explanations, see the text above)**



The interest rate policy by the ECB is not sufficient alone to hold public sector indebtedness under control. There is thus a limited interaction between monetary and fiscal policy in EMU, as the latter is necessarily needed to manage the current situation of the debt crisis. Of course, the interest rate policy also plays a role, but it is limited in the sense that it cannot alone stabilise output under a demand shock due to the lower boundary for nominal interest rates. In this sense our result reinforces the conventional wisdom, analysed by Kirsanova, Leith and Wren-Lewis (2009), that monetary policy can be targeted to output stabilisation and fiscal policy to contain public sector finances. But our results sharpen this outcome in the sense that the fiscal policy adjustment is necessarily needed to assist the ECB in its task of reaching a sustainable non-explosive outcome for the euro area.

In the package of new EU legislation, launched in autumn 2010, and recently approved as the so-called six pack, aiming to enhance the sustainability of the euro area, a new concept by the EU Commission was launched. In addition to the fundamental concept of Excessive Deficit Procedure of the Stability and Growth Pact a new one, namely Excessive Imbalance Procedure, was introduced. It tackles other types of imbalances in the overall economic developments than just the budget deficit and public debt. The Euro Plus agreement agreed in March 2011 calls for additional adjustment to restore imbalances in competitiveness. The above model shows that fiscal stabilisation can markedly speed up the convergence in price levels (competitiveness), and is in broad terms a sufficient condition for this, see Figure 7. However, the path back to parity may be quite sluggish. The smaller the parameter  $h_2$  is in Equation (18), the slower the price levels converge back to parity. This would suggest that the role of other policies to maintain overall stability could also be of importance.

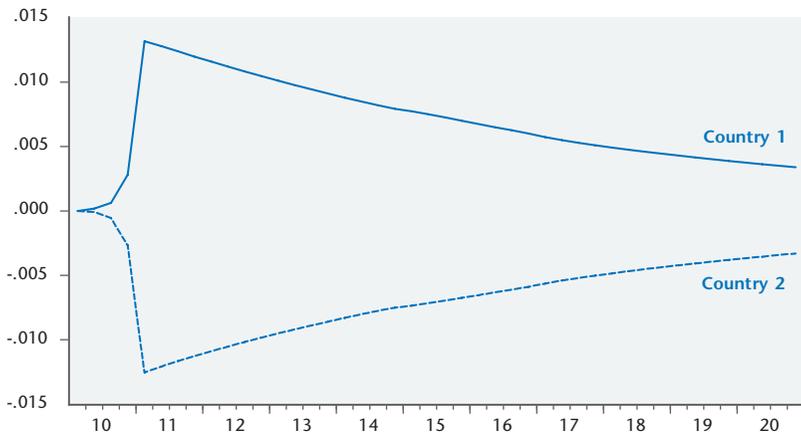
#### 4.3. Sustainability through debt relief?

One central issue in the crisis of Greece has been a possible debt default which has been tried to be avoided through organised debt relief by combining fiscal austerity and debt restructuring with lower than market interest rates. Let us next consider this possibility. Imagine that in the first quarter of 2011 a debt default takes place so that a half of the debt of the country 1 will be wiped out

and the consequent capital loss will be borne by the country 2. Assume further that in Equation (20) in the interest differential the term  $d_{12}$  is one half, because the country 2 is ready to finance a part of the debt burden through debt restructuring. The interest rate on new debt in country 1 will be lower due to this mechanism. In order to capture this situation, we have to modify also the IS curve so that the capital gain related to a lower debt burden will give rise to a higher level of spending so that a part of the gain, say 10%, will be consumed in country 1 in a year. The government finances also change due to this transfer as the country 2 is assumed to finance the part of the debt depicted by  $d_{12}$  of the country 1 at the lower rate  $r_2$ . Similar effects, *mutatis mutandis*, concern country 2.

We see from Figure 8 that, as specified, the burden is shared by the two countries symmetrically. However, the effect of this effect is quite limited, around 1% of GDP, and vanishes gradually. This policy leads to a slowing down of the reduction in the existing gap in competitiveness.

Figure 8. The effect of debt restructuring on the output gaps



#### 4.4. Sustainability through structural reforms?

The above results are quite gloomy in the sense that the high debt country runs into ever mounting debts in this decade even though the evolution of the debt may not be as such inconsistent with the no-Ponzi game criteria. Let us therefore still find out

under which kind of structural reforms to be adopted by the high-debt country it could stabilize and turn its debt ratio into decline.

We derive from a CES production function in (22) and the dependence of the potential output on the capital stock  $K$ ,  $\rho = \rho(Q^{POT}, K)$  where  $\rho$  is elasticity, and from the optimal investment equation, the following expression,

$$d \log K^{POT} = d \log Q^{POT} - \frac{1}{1 - \sigma} \left[ \frac{d \log(1 + mu)}{+ d \log(r - \pi + d)} \right], \quad (28)$$

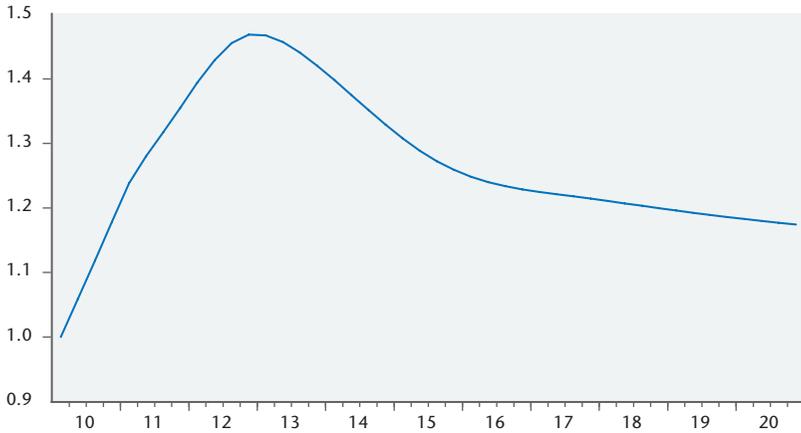
where  $mu$  is the mark up factor in the goods market and  $(1 - \sigma)^{-1}$  is the elasticity of substitution and  $d$  is the rate of depreciation. We now have the expression for a change in the potential output

$$d \log(Q_i^{POT}) = - \frac{\rho}{(1 - \sigma)(1 - \rho)} \left[ \frac{d \log(1 + mu_i)}{+ d \log(r_i - \pi_i + d_i)} \right]. \quad (29)$$

The mark up factor has two kinds of effects. First, as in (28), it has an effect on the potential output. Secondly, it has an opposite effect on the inflation rate in (2). We now see that the problem country 1 needs to carry out reforms to such a magnitude that their impact outweighs their recessionary impact through the rise in the real financing costs.

Assume in a schematic way that the potential output of the problem country 1 concerned grows permanently by 2 percentage points p.a. more than earlier, which is a very big amount, and assume further that it initially cuts the annual inflation rate by 0.25 percentage points and thereby has an effect on the equilibrium price level. Let us further assume that the fiscal policy rule in Equation (18) is fixed to the strong value. The outcome is the following, see Figure 9. If there were no initial loss of competitiveness in country 1, an acceleration of the potential growth rate by 0.5 percentage points p.a. would be enough to reach a similar leveling off and slight reduction in the debt ratio. This again shows the large impact of the inherited loss of competitiveness as to the sustainability of the euro.

**Figure 9. The debt ratio in country 1 under structural reforms, in combination with a strong fiscal consolidation (see the text for explanations)**



#### 4.5. Stability through internal devaluation and revaluation?

The key challenge facing the euro area, on the basis of what has been found out in the previous sections, is divergence in competitiveness. Therefore, it would be interesting to find out what could be achieved by measures influencing directly the competitive position of an EMU country in trouble. Accordingly, the term of fiscal devaluation has been launched, which means that domestic costs of exporters are cut through lowering the payroll tax of the employers, financing this through raising the tax on import prices by a hike in the VAT rate. Although our model is quite concise and deficient in this respect, we can try to mimic something of this kind of policies by inserting (a) a negative shock to the price level  $P_1$  of country 1 in the markets of both countries, as a kind of an export subsidy, (b) a corresponding rise in the price level of country 2 in the market of country 1, and (c) a corresponding shift in the competitiveness term of country 1 vis-à-vis the third countries.

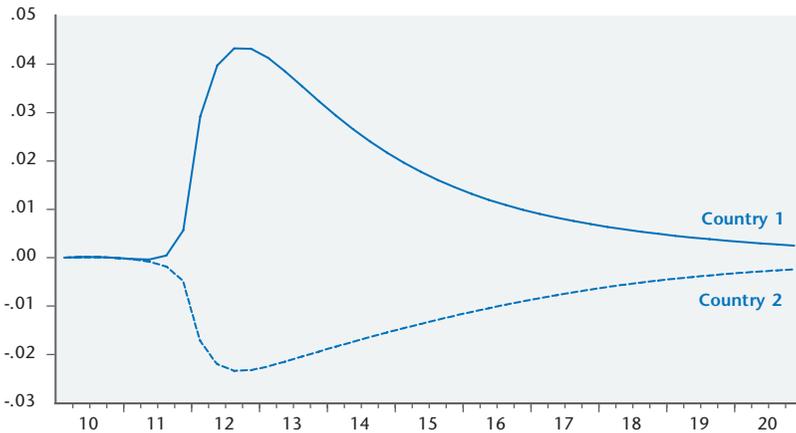
As an illustration, we assume that the export and import competing enhancement in competitiveness of country 1 is 5% from 2012Q1 onward. As foreign trade is typically a quarter of GDP, and consumption a half, this means that the consumer price level rises by around 2.5%-points, and the overall gain to the

competitive position of country 1 is 7.5% vis-à-vis the country 2 and the rest of the world.

We assume in the baseline a strong fiscal consolidation in the meaning defined above in Section 4.2. The result for the output gap is now the following, see Figure 10. The impact is quite vigorous so that a 7.5% internal devaluation leads already quite in the short term to a 4%-points gain in output in country 1.

It has a major negative effect on the country 2, and is to some extent a beggar thy neighbour policy, although the euro area as a whole gains in terms of output, see Figure 10. As this policy boosts output in country 1, and does not initially have an impact on the budget deficit, it also has a major positive effect on the debt ratio. The strong growth is also a result of a rapid convergence back to equilibrium incorporated in the model.

**Figure 10.** The effect of fiscal devaluation on the output gaps in countries 1 and 2

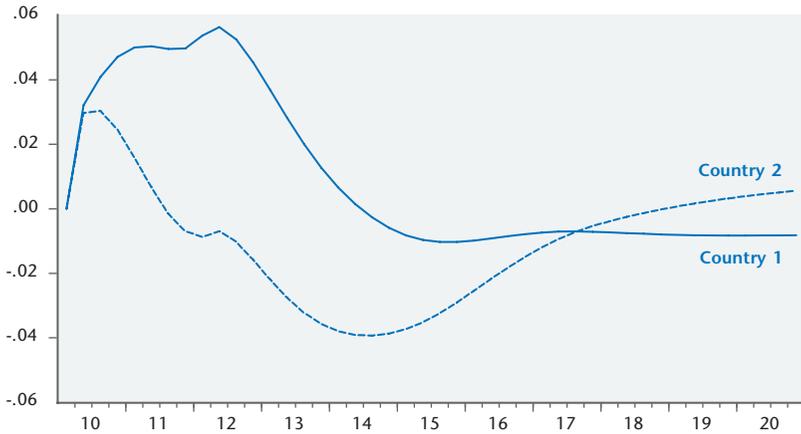


The core of the current EU policies is to prevent divergences in competitiveness from emerging and eliminating rapidly those emerged in this respect. It has been sometimes recently argued that the surplus countries, like Germany, should pursue inflationary policies driving down its competitiveness and thereby creating boost to the problem deficit countries in EMU. One justification for this effect is that the euro area is quite closed vis-à-vis the rest of the world and thereby it could be quite an effective policy to neutralise, or at least reduce, the existing gaps in competitiveness.

Let there be a temporary shock of 2.5%-points to the annual inflation rate in country 2 (in 2012Q1).

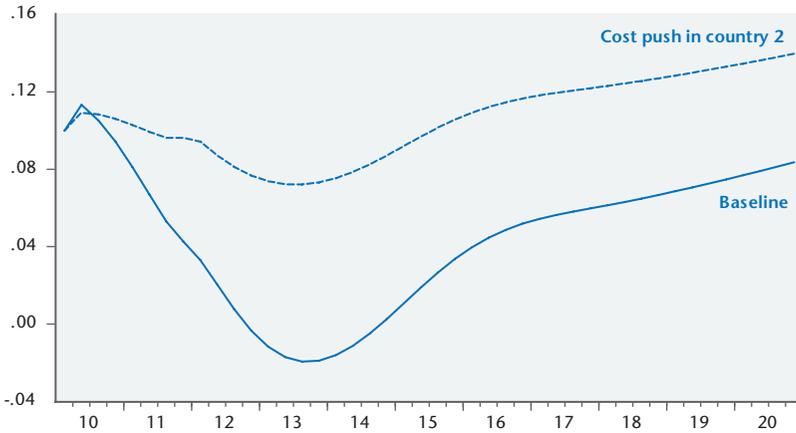
An internal cost push shock in country 2 is a successful alternative from the point of view of country 1 which gains in terms of output, and the disparity within the euro area would diminish, see Figure 11.

**Figure 11. The effect of a cost push (internal revaluation) in the strong EMU country 2 on the output gaps**



The outcome of this policy crucially depends on the reaction of the monetary policy. If the interest rate does not react in the beginning, but only in lagged manner as assumed here, the expected real rate of interest goes down and initially both countries will gain. After that there is a loss for the revaluing country. Both countries turn in the end to neutrality. A revaluation in the strong country also decreases the needed reaction of deflationary adjustment in wages and prices in the weak country, as is plausible, see Figure 12.

Figure 12. Wage developments in the weak country 1 under an internal revaluation in the strong country



## 5. Concluding remarks

We have analysed the case of EMU adjustment to an imbalance in inflationary shocks and competitiveness. We argue that internal adjustment within the euro area is able to restore over time sustainability of the EMU also with respect to idiosyncratic shocks. We reject the unsustainability result by Wickens (2007, 2010) and show that it does not hold within EMU in general. True, we did not address the issue of whether the EMU as such is conducive to such imbalances to emerge. So, we consider the reaction to a period of mounting imbalances, like in 1999-2007, rather than the reasons behind it. Thus, we do not ask the causes of the crisis, but try to find a remedy for it. We also find that, even though the EMU would stay sustainable, the adjustment patterns with respect to the emerged imbalances entail a major polarisation within the Monetary Union which is likely to lead to political tensions.

Above, we have basically taken two approaches to the issue of sustainability: a technical one concerning the existence of a determinate solution for the euro area model and a policy point of view playing a bigger role in reality. As to the fiscal consolidation, we inferred that it takes a lot of time and the debt ratio in the problem country may rise to a very high level.<sup>6</sup> This may make it implausible that the debtor country could reassure the financial markets

of its solvency. This would call for a more stringent fiscal adjustment rule in the country concerned. The problem with the adjustment is that a strict fiscal policy leads to a cut in output, which leads to a higher debt ratio. This would call for an enlargement of the NKM model to describe the behaviour of the private sector under fiscal consolidation in the sense that a lower scenario of the public debt developments can have a boosting effect on private consumer behaviour through an expected reduction in taxation. On the other hand, we could expect that the public debt ratios rise also permanently because in private sector portfolios private assets are substituted for those of the public sector in the crisis. We leave these issues for future consideration.

The mounting debt ratios in the problem countries cast a doubt on whether the EMU can successfully manage its current crisis. In the spring of 2012 fears and speculation emerged that Greece would have to leave the euro area. What this would imply for the monetary policy and stability of the banking sector falls outside the realm of the present paper.

We inferred that far-reaching and successful structural reforms are sufficient to restore the sustainability of the euro in terms of containing the public sector indebtedness, as it seems that in the case of rising future interest rates by the ECB austerity in the public finances may not be sufficient to achieve this alone. Fiscal devaluation is quite an effective tool in stabilising the EMU and in reducing the otherwise marked disparities in adjustment to the debt crisis within the Monetary Union.

It is difficult to definitely argue how much and how rapid a macroeconomic adjustment is in reality needed in order to restore euro and overcome the present crisis. We have illustrated some of the ways to reach a better balance in the euro area. It is, however, true that many aspects like the stability in the financial markets are not at all well captured in macroeconomic modelling like the NKM model. The relevance of our approach stems from the fact that a better balance in the real and nominal overall economy is also conducive to a better balance in the financial markets. However, the financial markets react to macroeconomic developments with

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6. We did not here assume any asset privatisation in the problem country assumed in OECD (2011).

a lead and do not properly discount future developments. Therefore, it is difficult to assure the markets in the short term of future stringent adjustment as these policies typically take quite some time to be successfully put into effect.

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### Appendix. Derivation of the IS curve and specification of the interest rate rule

We start from the goods market equilibrium, written in terms of log deviations from the steady state

$$q_{it} = w_C c_{it} + w_I i_{it} + w_X x_{it} - w_M m_{it} + z_{it} + \varepsilon_{it}, \quad (30)$$

where  $q$  is the output gap,  $c$  is consumption expenditure,  $i$  investment,  $x$  exports and  $m$  imports (measured in terms of the domestic price level),  $z$  the fiscal impulse and the  $w_i$ 's are the equilibrium shares of respective variables in relation to output. From an intertemporal optimisation we derive the consumption expenditure

$$c_{i,t} = E_t c_{i,t+1} - \frac{1}{\nu} (r_{i,t} - E_t \pi_{i,t+1} - \theta), \quad (31)$$

where  $\nu$  is the intertemporal elasticity of substitution and  $\theta$  depicts the time preference. Based on the cost minimisation by firms we can write the following investment equation

$$i_{i,t} = q_{i,t} - \tau (r_{i,t} - E_t \pi_{i,t+1}) \quad . \quad (32)$$

The export equation is based on the import demand function of the importer country, so that typically for the country  $k$ ,

$$x_{kt} = q_t^* + \delta \text{comp}_{kt} \quad \text{and} \quad m_{kt} = q_{kt} - \delta \text{comp}_{kt} \quad , \quad (33)$$

where  $\text{comp}$  is the competitiveness of the country  $k$ , *i.e.* the real exchange rate and  $\delta$  is the relevant elasticity of substitution. We divide exports and imports to those of the EMU country with the EMU partner and rest of the world, with shares of  $w_{k,EMU}$  and  $w_{k,REST}$ ,  $k = X, M$ , summing to unity.

Let us next insert first (31), (32) and (33) into (30) and write it, in a standard manner, for the next period  $t+1$  and take expectations on both sides, and subtract this equation from Equation (30). Let us approximate that investment is in the long run roughly a constant share of the capital stock being in a constant relation to aggregate output, so that the expected investment term on the right-hand side can be written to be the same as the expected output gap. These steps give first the following equation, (we omit

here the separation of the exports and imports into those within and outside of EMU),

$$\begin{aligned}
 (1 + w_M - w_I)q_{i,t} &= (1 + w_M - w_I)E_t q_{i,t+1} + \\
 (-w_C \frac{1}{V} - \tau)(r_{i,t} - E_t \pi_{i,t+1}) - w_X (E_t q_{i,t+1}^* - q_t^*) & \quad (34) \\
 -(w_X + w_M)\delta(E_t \text{comp}_{i,t+1} - \text{comp}_{i,t}) - (E_t z_{i,t+1} - z_{i,t}). &
 \end{aligned}$$

Let us next assume that competitiveness obeys the following type of return to normality adjustment, based on price and wage setting reacting to the existing gap in competitiveness and expected output. If competitiveness is bad, there is less room for price and wage rises, and competitiveness returns to normality. Similarly, if the current output gap is positive, the wage rises are more moderate. So, competitiveness adjusts as follows,

$$E_t \text{comp}_{i,t+1} - \text{comp}_{i,t} = -l_1 (\text{comp}_{i,t} - \text{comp}_i^E) - l_2 q_{i,t}, \quad (35)$$

where the parameters are positive and the superscript *E* denotes the equilibrium. Let us further assume that the expected change in the fiscal impulse depends negatively on the existing impulse,

$$E_t z_{i,t+1} - z_{i,t} = -\chi z_{i,t}, \quad (36)$$

where  $\chi$  is positive. This implies that there is a solvency rule operating in public finances. Similarly, we assume that the change in the expected foreign output gap obeys a return back to parity.

We further want to allow for that typically we cannot realistically specify that production would be a jump variable. So, a part of the agents are backward looking and liquidity constrained, while a part of them are forward looking in the manner described above, see Fuhrer and Rudebusch (2004). There are also costs in adjusting production to meet the demand. This enlargement means that we introduce into the model the lagged output gap and divide the impact of the expected output to this term and the lagged output gap. Then, altogether, we can get the following IS curve, being a mixture of forward and backward looking curves (see also Debrun and Kapoor, 2010),

$$\begin{aligned}
 q_{i,t} &= \gamma_1 E_t q_{i,t+1} + \gamma_2 q_{i,t-1} - \beta(r_{i,t} - E_t \pi_{i,t+1}) + \lambda^* q_t^* + \lambda q_{j,t} + \\
 \delta^* \text{comp}_{i,t} + \phi(p_{j,t} - p_{i,t}) + \chi z_{i,t}. & \quad (37)
 \end{aligned}$$

This is the basis of our specification of the modified IS curve in the section 4 from the basic one in Equation (1) above. Calibration takes place so that the short run fiscal multiplier of  $z$  is around 0.7. The lag structure is specified so that the fiscal impulse vanishes in around three years. These conditions stipulate the parameter  $\chi$  to be 0.5 and  $\gamma_1 = 0.3$  and  $\gamma_2 = 0.6$ .

We assume that the EMU is a small open region in the sense that it does not have an impact on the global economy, so that the global output gap  $q^*$  obeys the developments influenced by a demand shock mentioned above in Section 4.2.

Let us still specify the interest rate rule by the ECB assumed in the paper in Section 4. We specify for the target interest rate  $r^T$  and the actual rate  $r$  the following,

$$\begin{aligned} r_t^T &= r_0 + \text{raux}_t(\theta + \omega_1 \bar{q}_t + \omega_2 (\bar{\pi}_t - \pi^*)) \\ r_t &= v_1 r_t^T + v_2 r_{t-1}, \end{aligned} \quad (38)$$

where  $r_0$  is 1% and the function  $\text{raux}$  is zero up to the year 2015, and then rises in two years to unity and stays there. The parameters  $\omega_1$  and  $\omega_2$  are 0.5, and  $v_1$  is 0.3 and  $v_2$  0.6.