EUROFRAME conference, Kiel 8.6.2012

HOW TO RESTORE SUSTAINABILITY OF THE EURO? *

Preliminary 21.5.2012

Kari E.O. Alho

ETLA, Research Institute of the Finnish Economy

Abstract. We reassess the result of unsustainability of the euro with respect to inflation differentials claimed by Wickens (2007) by specifying an open-economy version of a two-region New Keynesian model for EMU and demonstrate that the result by Wickens does not hold in general. We are able to derive a result that the basic model is determinate for a wide range of policy rules so that the sustainability of the euro area and the member countries is reached over time with respect to supply and demand shocks and emerged imbalances in price levels and competitiveness. A similar conclusion has been presented by Galí and Monacelli (2005) in a closed monetary union. We then enlarge the numerical analysis to consider EMU and sustainability in the case, prevailing currently, where a high debt country should both restore its competitiveness and reduce its fiscal deficit, and the policies required from the single monetary policy and the national fiscal policies. Strong fiscal consolidation and far-reaching successful structural reforms are needed to reach sustainability in the sense that emerged imbalances in competitiveness and price levels and the threat of ever mounting debt levels could be eliminated over the medium run. We also illustrate how the current deflationary adjustment involves a major polarisation in economic developments within the euro area. We also consider sustainability through debt relief within the union and internal devaluation in the debtor country. The conclusion is that these measures may essentially alleviate the adjustment burden and shift it within the EMU from the problem countries to the strong countries. However, debt relief slows down the adjustment process as to elimination of competitiveness disparities within the union. Internal devaluation in the weak countries works, but revaluation in the strong countries does not, as quite an effective tool in alleviating the adjustment involving fiscal austerity within the monetary union.

Key words. EMU, euro, sustainability, fiscal policy, competitiveness

JEL classification. E43, E52, E62

---

* This is a revised and enlarged version of the paper published as No. 1259 in the Discussion Paper series of ETLA. The paper is associated with the report Alho, Kotilainen and Nikula (2010). I thank Ville Kaitila, Markku Kotilainen and Niku Määttänen from ETLA as well as the participants of the XXXIII Annual Meeting of the Finnish Economic Association in Oulu for comments to an earlier version of the paper. The usual disclaimer applies.

1 Introduction

The financial and economic crisis which started in 2007 has delivered a major blow to the global economic system. As typically in a deep recession, the crisis has also caused a tension with respect to the countries obeying a fixed exchange rate system, like the EMU, with diverging economic developments and imbalances within it.

Already before the crisis, Wickens (2007) foresaw and made the observation that the euro has not been sustainable in the sense that the price levels, i.e., the real exchange rates of the participating countries of the euro area have been on an unsustainable divergent path during the first decade of the euro. The high inflation countries at the outset have not experienced lower inflation hence, but quite on the contrary, they have diverged in terms of price levels and competitiveness. He also 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 country to the low-inflation country, which is 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 intend to tackle this same question using a stylized new Keynesian macro model (NKM) for the 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 that by him. We argue that his core result does not hold in general with a plausible numerical specification of the model. The model has a determinate solution both for the euro area as a whole and its member countries. We are also able to demonstrate that in the open economy NKM model the euro area as an aggregate and the individual countries have a determinate solution for a wide range of policy rules by the ECB. Also, if there is an inherited divergence in price levels, linked to a loss of competitiveness in a member country, the consequent policy by the ECB is sufficient as to the elimination of this imbalance. In the long run, the initial deviation from parity will vanish, although this can take quite a long time.

It has been already shown earlier in the literature of the NKM models and monetary union that the model for a single infinitesimally small member country of a closed monetary union is stable, see Galí and Monacelli (2005).[1] 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. Gali and Monacelli do not mention that this result of theirs on the determinacy of the model applies for *all* monetary policy rules of the common central bank. 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

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

policy and public debt. The model is reformulated by giving up the assumption of homogeneous financial markets in the euro area and replacing it with segmented markets.

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, if the solution exists, whether it makes sense in the spirit of the sustainability of the public debt so that the emerged imbalances in the euro area in terms of competitiveness differentials and debt ratios will be eliminated within a reasonable time span of, say, the next ten years.

The sustainability of the euro has been studied here from the following angles:

1) The fiscal austerity in the problem country with a high debt and a large public sector deficit, and loss of competitiveness.

2) EU bailout programs extending subsidised credit to the problem country.

3) Debt restructuring and debt relief in the problem country.

4) Structural reforms, i.e. cutting mark ups in the economy of the problem country.

5) 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.

6) Inflationary policies like wage rises in the no-problem strong EMU country which reduces the existing gap in competitiveness between the EMU countries.

As a final scenario we could think about a breakdown altogether 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 markedly differs 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. Here we rather 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 Greece 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, the future likely rise in the interest rate set by the ECB casts a doubt on managing the interest burden of accumulating public debt and the success of fiscal consolidation. We also illustrate that the adjustment, alt-

hough 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 very 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 in the problem country. The general conclusion is that these policies work in quite an effective manner in boosting the economy of the weak problem EMU country and stabilises the divergences in adjustment within the Monetary Union. However, a cost push in the strong EMU country has a recessionary impact on both the countries and thereby on the whole union.

In general, we find that an existing idiosyncratic shock loss and gain in competitiveness bears a major overhang for the Monetary Union. Much more vigorous policies are needed under such conditions in comparison to those under no divergence in competitiveness. We also come to the conclusion that the measures aiming at balancing the indebtedness process in the euro area can only be observed over time, which is apt to lead to uncertainty as to the process in the short run.

The rest of the paper proceeds in such a way that in the next section we build the two-region model for the EMU, and in Section 3 consider optimal discretionary policy and sustainability of the euro. In Section 4 we calibrate the model numerically and carry out the simulations under a standard Taylor rule for the ECB. In Section 5 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 in the problem country. Section 6 concludes.

2 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, $i \neq j$,

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

where q is the output gap in log, r the common interest rate set by the ECB, π is the inflation rate, E is the expectation operator on information in period t, θ 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 ε 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. A similar equation applies to the other EMU partner country j. In the Appendix 1 we present a more exact derivation of the IS curve, especially the case how it is specified in connection with fiscal policies in Section 5.

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,

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

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.

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,

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

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 5. 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,

$$B_{k,t}^D = a_k \bar{W}_{k,t} g(r_t - (r_t^* + Es_{t+1} - s_t)), g' > 0, g(0) = 1, 0 < a_k < 1\,. \tag{4}$$

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 Ω 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),

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

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,

$$\overline{q} = \frac{q_i + q_j}{2}, \overline{\pi} = \frac{\pi_i + \pi_j}{2} \quad . \tag{6}$$

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

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

$$(1-\xi_2)\overline{\pi}_t = \xi_1 E\overline{\pi}_{t+1} + \xi_3(s_t - s_0 + \pi_t^*) + \alpha\overline{q}_t + \overline{u}_t \, . \tag{8}$$

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, $Eq_{i,t} = Eq_{j,t} = 0$, 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,

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

3 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 the rest of the paper we assume that the ECB follows a Taylor type of rule in its policy making, see below Equation (12). However, 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. 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.

Let us then insert, similarly as Wickens (2007) did, the ECB policy into the IS curves (1) for both countries i and j. Let us take expectations of the IS curves, and simplify the system by approximating that the expected output gaps in period t+1 are zero for both countries. Then by subtracting the IS curves for i and j from each other and using the identity $E\pi_{i,t+1} = Ep_{i,t+1} - p_{it}$, the following dynamic equation can be readily derived for differentials of logs of price levels,

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

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 Srinisavan (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.

We now have a large system of four forward-looking difference equations, the analysis of which is quite awkward and, therefore, we have adopted a simpler approach, constructed below.

Let us next turn to a comprehensive analysis of the model for differences between the EMU countries i and j, embedded in the above NKM model. From the output equations (1) and the inflation equations (2) we can derive the following expression for the relative output gaps and inflation differential, denoted by the symbol d, e.g., $dq_t = (q_{it} - q_{jt})/2$,

$$\begin{aligned} (1+\delta)dq_t + (2\lambda + \phi)d\pi_t &= \gamma Edq_{t+1} + \beta Ed\pi_{t+1} + dz_t + d\varepsilon_t \\ -\alpha dq_t + (1 + \xi_1 + \xi_2)d\pi_t &= \xi_1 Ed\pi_{t+1} + du_t \end{aligned} \qquad (11)$$

Let us denote by A_0 the matrix of coefficients of the vector (dq dπ)' on the left-hand side and by A_1 the corresponding matrix on the right-hand side of (11). Then a necessary and sufficient condition for a unique and stable solution for (11) is that both the characteristic roots of the matrix $H = A_0^{-1}A_1$ lie inside the unit circle, see Galí (2010), as there are two forward-looking variables. An analysis of the roots of this matrix in closed form is very awkward in our case, and therefore a numerical analysis is called for. With the numerical values adopted in this paper for the parameters, see Section 4, the values for the roots of the H matrix are real and lie in the interval (0,1), leading to stability. In Appendix 2 we report a limited sensitivity analysis of this outcome.

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

$$r_t = r_0 + \omega_1 \overline{q}_t + \omega_2 (\overline{\pi}_t - \Omega) \text{ , } where\ \omega_i > 0 \text{ .} \tag{12}$$

Let us next turn to consider the determinateness of the aggregate euro area, the model of which was presented above in Eqs. (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). In contrast to the standard NKM model for a closed economy, an analytic evaluation of the latent roots of this matrix H is in our case quite difficult and therefore a numerical analysis is called for. However, in our specification of the open economy model for the aggregate of the euro area we come to the conclusion that it is stable as such and under a wide range of policy rules, under the set of parameters adopted below, see the Appendix 2. This result has been proved by Galí and Monacelli (2005) for a closed monetary union, being valid for any policy rule by the common central bank, given that the model for the aggregate union is stable which requires that $\omega_2 > 1$.

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 now 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.

Galí and Monacelli (2005) (and in 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 to be 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.

4 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 1): the inflation target Ω is 2% p.a., the same holds for the global inflation π^*, $\lambda = 0.2$, $\beta = 0.3$, $\gamma = 0.3$ (see more on this Appendix 1), $\alpha = 0.3$, $\delta = 0.1$, $\theta = 0.02$, $\psi = 6, \phi = 0.2$, $\xi_1 = 0.5$, $\xi_2 = 0.3$ 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 ϕ parameter, see on this also Appendix 1. The openness of the euro area to global trade is taken to be 10%. The reaction parameter ψ in Eq. (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 (12) has the parameters $\omega_1 = 0.5$, $\omega_2 = 1.5$, but see on this Section 5.

In this section, we carry out the simulations of the model, specified for a quarterly time unit[2], over the period from 2010, second quarter, to 2040 under the assumption that initial shocks to level (stock) variables take place in 2010Q1, and the supply shock (flow) during the year 2010Q2 to 2011Q1. 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. We impose terminal conditions to the model so that the forward-looking variables reach in the long run constant levels.

We now get the following outcome for the gap in log price levels $p_1 - p_2$, i.e., terms of trade within the monetary union, and the output gaps q_1 and q_2 after a unit (1 per cent) asymmetric inflationary supply shock in country 1 (i = 1, j = 2) in 2010Q2–2011Q1. We see that after the shocks, the euro area again reaches a parity in price levels, i.e., in competitiveness and the real exchange rates, as envisioned above. Output gaps will also be eliminated over time. Although the equilibrium is eventually restored, convergence to it is quite sluggish with this numerical specification.

The interest rate set by the ECB reacts in the following way, see Fig. 2. The reaction is sharp and initially the policy tightens but then undershoots the steady state situation slowly converging from below upwards to it.

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

Figure 1. The price differential and the output gaps after an inflationary supply shock (1 percentage point) in country 1 in 2010Q2–2011Q1

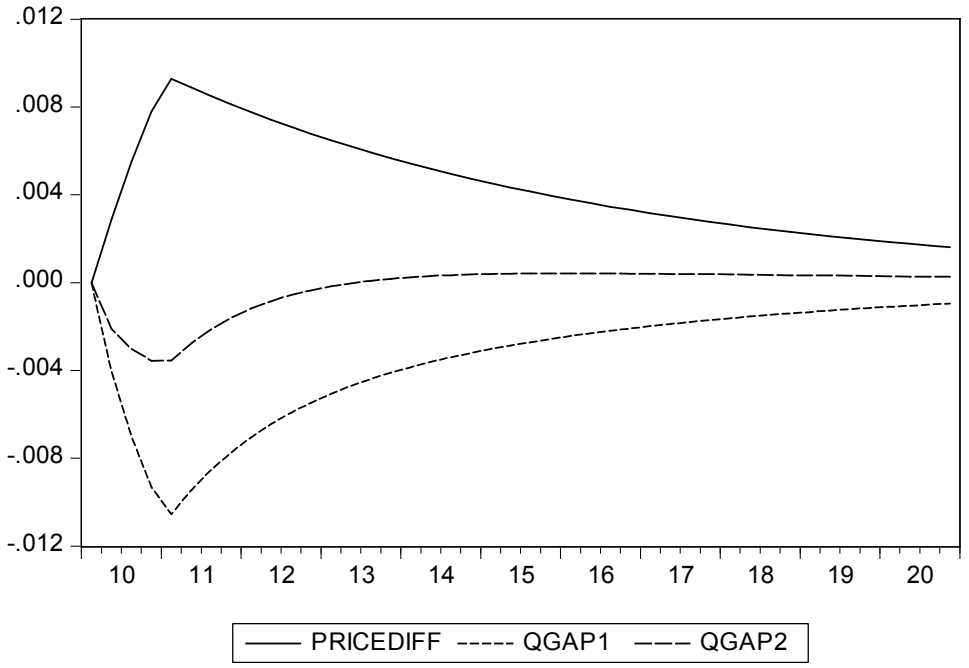
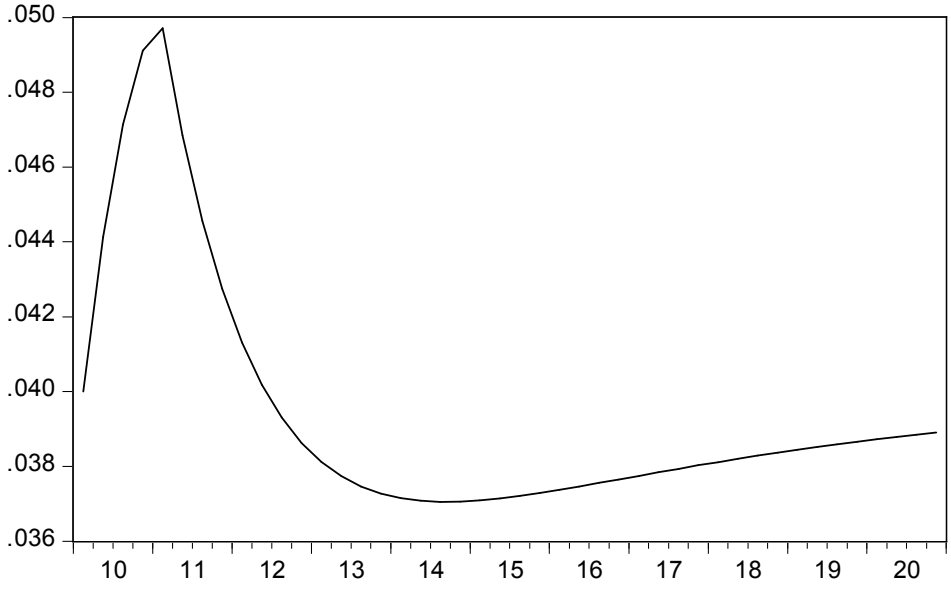


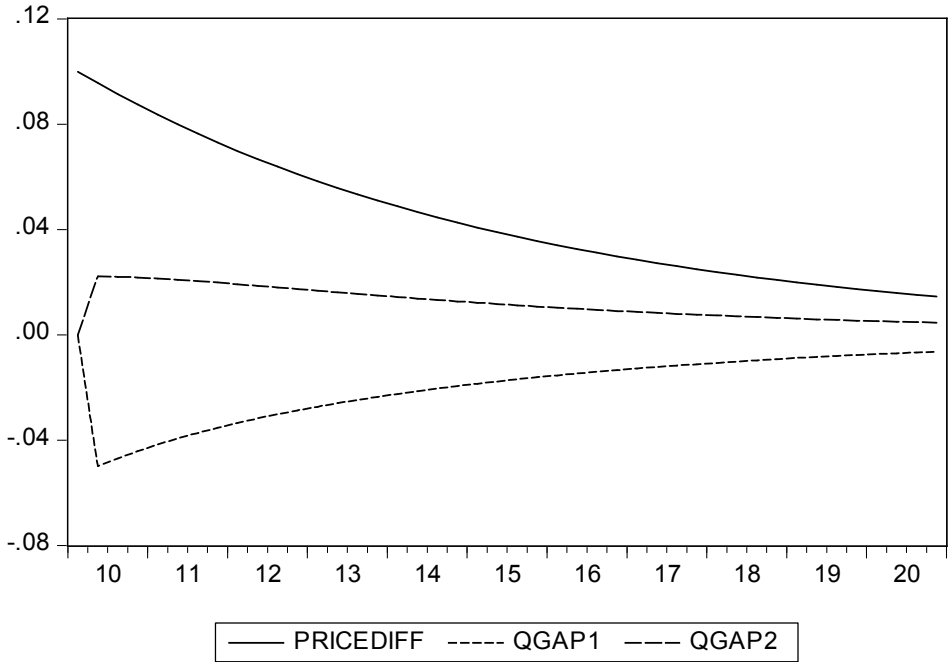
Figure 2. The interest rate policy by the ECB as a reaction to a positive inflation shock in country 1



Next, we demonstrate that the policy reaction by the ECB also has the capacity to eliminate a divergence in the price levels (terms of trade), i.e., in competitiveness within the euro area, once this kind of a loss has emerged due to some reason in one EMU country.

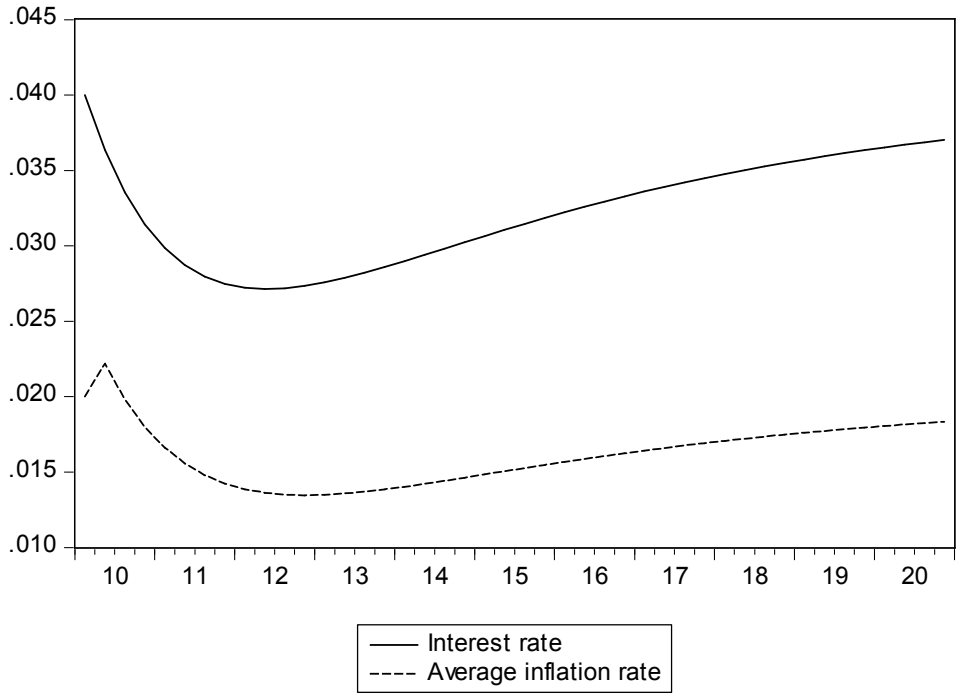
So, we assume that similarly as in reality, referred to in the Introduction, country i = 1 has run into an imbalance in its initial price level and in competitiveness of the magnitude of 10 per cent (in logs) in the initial situation (in 2010 Quarter 1 in the figures) and the ECB follows the Taylor rule in the above sense. The outcome for the price level differential and the output gaps is now the following, see Fig. 3.

Figure 3. The price differential and the output gaps after an asymmetric positive price level shock (10 percentage points) in country 1 in 2010Q1



Adjustment within the euro area eliminates the gap in competitiveness and in both the output gaps. 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 severe, as the output contracts by 4 per cent, while the country in balance with respect to competitiveness gains from the adjustment due to a lower interest rate. The interest rate reaction by the ECB is now the following, see Fig. 4. It is reflationary as the adjustment within the euro area is deflationary, so that the interest rate undershoots the equilibrium interest rate (4% p.a.), initially by more than one percentage point. Now the policy intervention by the ECB is quite long-lasting, although gradually dampening.

Figure 4. The interest rate policy by the ECB as a reaction to a positive price level, i.e., a negative competitiveness shock in country 1



The general conclusion is that this kind of disparities will be eliminated over the long run within EMU.

5 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 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.

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 have been 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.

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 only identify the effect of fiscal policy as a demand impulse in the IS curve in Eq. (1) and consider how the public deficit should be reduced and its link to the stability of the euro.[3] We have analysed the sustainability of the euro from the points mentioned in the Introduction. By sustainability we 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.

5.1 Modifications to the model

The debt dynamics are,

$$D_{i,t} = (1 + \overline{r}_{i,t} - \pi_{i,t}) D_{i,t-1} + z_{it} Q_{i,t-1} \ , \tag{13}$$

where D is the real public debt (in book value), $\overline{r}$ 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,

$$\log Q_{i,t} = \log Q_{i,t}^{POT} + q_{i,t} \ , \tag{14}$$

where Q^{POT} is the potential output growing at the rate of the trend growth of the labour-augmenting productivity process, see below Section 5.3.

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 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, country i = 1. Thus we have,

$$z_{it} = -h_1 q_{i,t} + [(1-h_2)^t z_{i,0} - h_3] \, , \; 0 < h_1, h_2 < 1 \, , \; i = 1 \, , \tag{15}$$

[3] 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 i = 1. In the other strong EMU country j = 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 2010-2011 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 yields 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 risk premium,

$$\frac{(1+r^*)Es_{t+1}}{s_t} = 1 + \frac{r_{1,t} + r_{2,t}}{2} + a_0 - a_1\left(\frac{D_{1,t}}{Q_{1,t}} + \frac{D_{2,t}}{Q_{2,t}}\right),\ a_i > 0\,, \tag{16}$$

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 a_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. In order to reach a determinate solution for Eq. (16), we have to assume that the exchange rate expectations are sluggish. Let us therefore 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 differential,

$$r_{1,t} = r_t + \Delta_1 + \kappa\mu f\left(\frac{D_{1,t}}{Q_{1,t}}\right),\ f' > 0, f'' > 0\ . \tag{17}$$

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 μ, multiplied with the convex function f of the debt ratio, captures the probability of the default by the country i = 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),

$$r_{2,t} = r_t + \eta_2(\frac{D_{2,t}}{Q_{2,t}} - \bar{d}) - \eta_1(\frac{D_{1,t}}{Q_{1,t}} - \bar{d}) \text{ , } 0 < \eta_1 < \eta_2 \text{ .} \quad (18)$$

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 Eq. (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 and Portugal in May 2011. This transfer has the effect that the domestic fiscal impulse in the country j = 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 i = 1. This transfer effect will be taken into account in Section 5.3.

Based on this reasoning we specify in Eq. (17) that $f(d_t) = 0.5d_t + 0.5d_t^2 - d_{12}$, where d is the debt ratio in country i = 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 5.3.

The model comprising also of the fiscal policy block has ten endogenous variables (q_{1t},π_{1t},r_{1t},d_{1t};q_{2t},π_{2t},r_{2t},d_{2t};r_t,s_t), with four forward-looking variables ($Eq_{1,t+1}$,$E\pi_{1,t+1}$, $Eq_{2,t+1}$,$E\pi_{2,t+1}$). We have evaluated the characteristic roots of the H matrix (see above p. 7) in this case and see that for a wide range of policy reactions the model is stable, see Appendix 3.

5.2 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 4.

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 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 i = 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 Eq. (17). 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 Eq. (13) 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 ε 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.

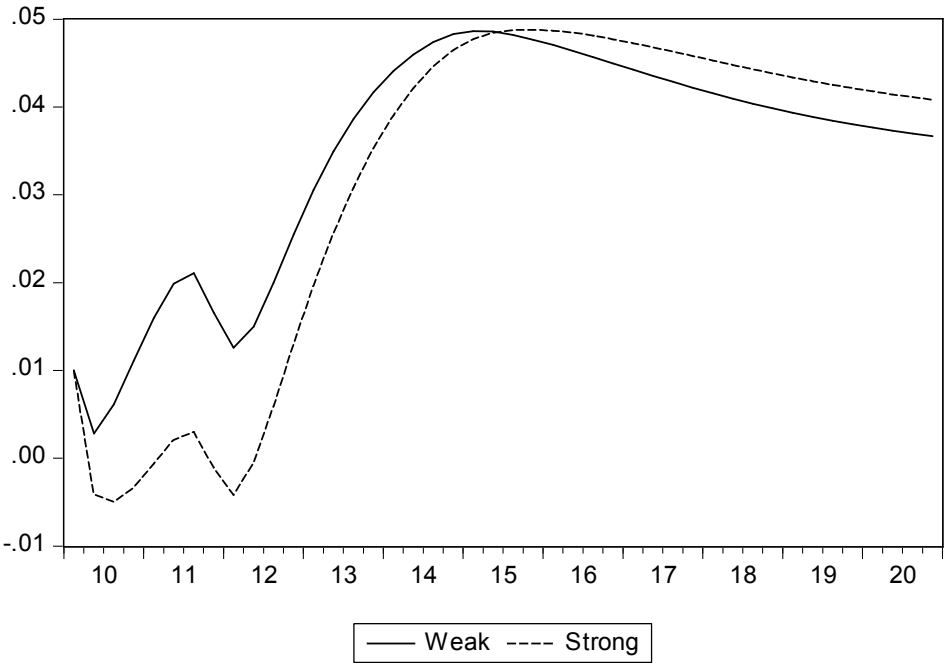
We now specify the rule in (15) to be the following for country i = 1,

$$z_{1,t} = -0.5q_{1,t} + 0.09(1-0.6)^t - 0.01 \ . \tag{19}$$

We call a fiscal consolidation according to the rule (19) a *strong* one, and the case where in Eq. (15) $h_2 = 0.1$ and $h_3 = 0$, a *weak* one. The magnitude of the automatic stabilizer in (19) 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 6 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 (19) 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 j = 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 5.4.

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. Therefore, we have replaced in the interest rate rule in Eq. (12) the reaction parameter ω_2 with value 0.5. The interest rate policy by the ECB is as follows, see Fig. 5. The ECB markedly helps an ambitious fiscal consolidation in the euro area by a lower interest rate.

Figure 5. The interest rate policy by the ECB in the two scenarios



From Fig. 6 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. 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 3, we have 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 debts meets the no-Ponzi -game assumption. According to this analysis, we estimate a regression of the following kind,

$$D_t = c_0 + c_1 D_{t-4} + v_t . \tag{20}$$

If the parameter c_1 is higher than unity plus the discount rate, indicating an 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 c_1 gets the value 1.028 (with t-value 166) and under a weak consolidation it gets the value 1.064 (with t-value 472). 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 (c_1 would then be clearly less than unity), see Table 1. In this sense we see that the interest rate policy by the ECB, the fiscal policy and the sustainability of the euro are crucially linked together. A likely future rise in the interest rate set the ECB towards the equilibrium value can jeopardise the sustainability of the euro through its spillover effect to the interest burden of the public debt in the problem EMU country.

Figure 6. The public deficit and debt in a high debt, low competitiveness EMU country under an adverse demand and supply shock and fiscal austerity, in relation to GDP (deficit on the left scale, debt on the right) (for explanations, see the text above)

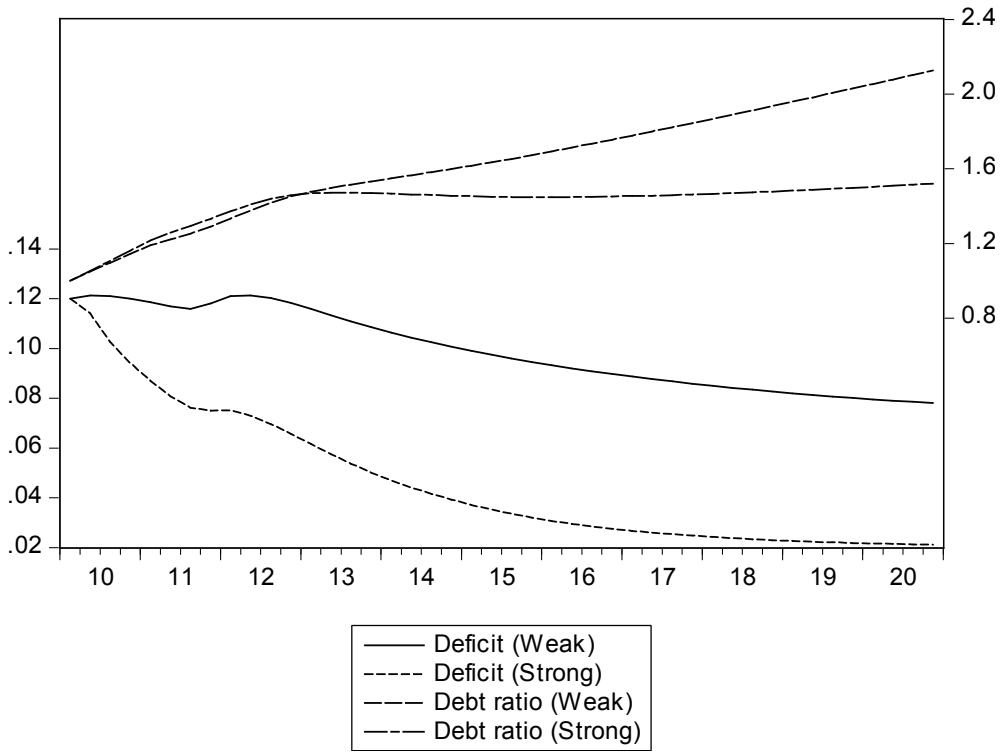
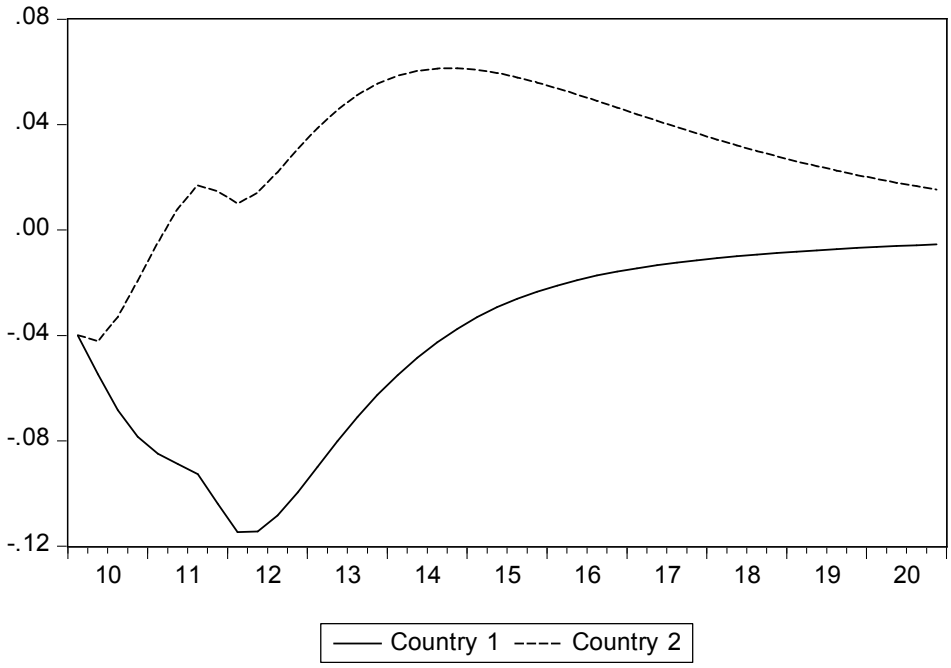


Table 1. Alternative simulations on the link between the interest rate and the fiscal policy in the problem country 1 (under strong fiscal consolidation)

Fiscal policy in country 1 in Eq. (15)	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 c_1 in Eq. (20) over the period 2010-2031
h_1=0.6, h_2= –0.01	as in Eq. (17)	–2.9	–0.6	145	188	1.028
h_1=0.6, h_2= –0.01	4% p.a. throughout	–2.4	–0.3	139	104	0.630

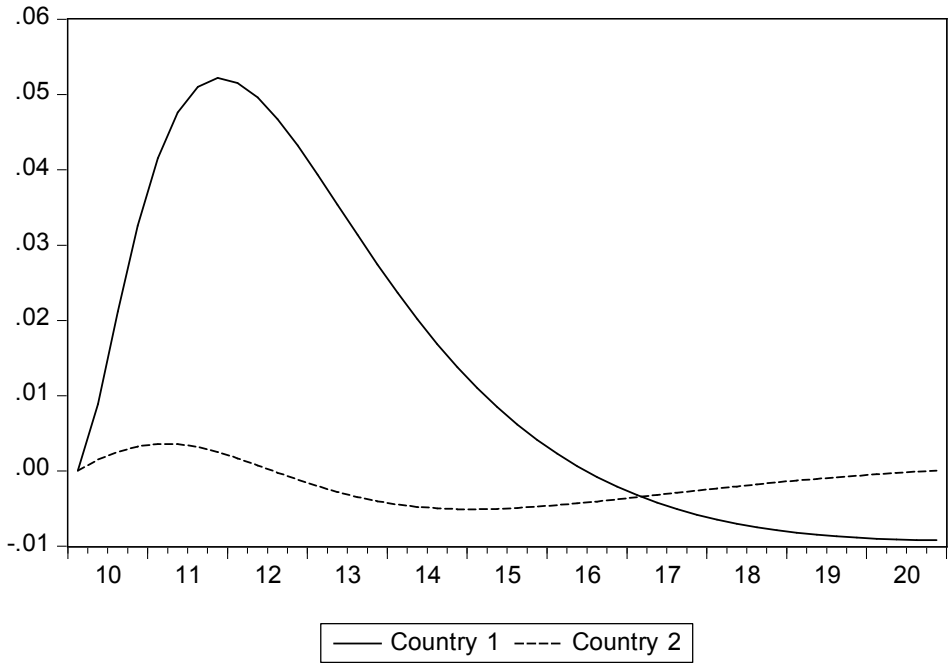
We see that the diverse impacts of various cases will be felt over the long run, but over the medium run the outlook is quite independent of the fiscal assumptions, similarly as predicted in the Greece country report by the OECD (2011). Over the long run, the interest burden and the fiscal consolidation will make their effects felt clearly on the sustainability criterion in Eq. (20). The problem in actual policy making lies in the fact that it is very difficult to commit to this kind of policy determination in a credible way to the financial markets, which recognise various uncertainties and have normally a much shorter time horizon in their decisions.

Figure 7. The output gaps in the two EMU countries under a strong fiscal consolidation in country 1 (for explanations, see the text above)



Let us then compare the situation under a strong fiscal adjustment assumed so far compared to the weak case, see Figure 8. We infer that the no-problem 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 very 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. Thus, there is a marked polarization within EMU as a result of the debt crisis. By varying the policy rule in Eq. (15) 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. So, 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.

Figure 8. The difference in the output gaps (output less potential) between the cases of weak and strong fiscal austerity*



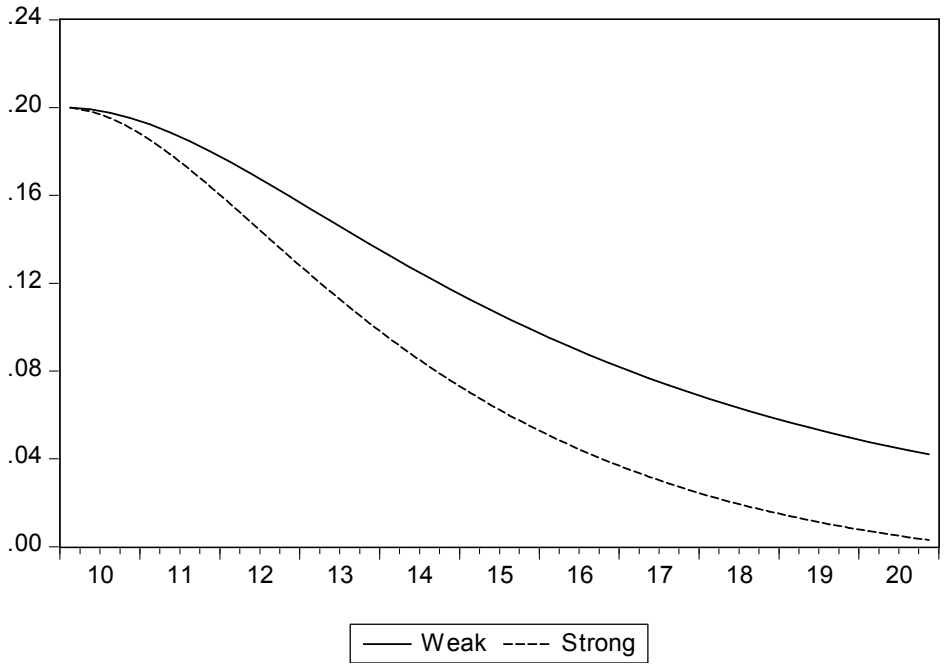
* In this comparison in the weak consolidation case the parameters are as follows in Eq. (15) $h_1 = -0.5$, $h_2 = 0.1$, $h_3 = 0$. The strong consolidation is that stipulated in Eq. (19). The curves denote the difference q(weak)–q(strong).

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 it can markedly slow down the price level adjustment after initial idiosyncratic disparities to competitiveness. We illustrate this in Fig. 9 below.

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 solution 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 Fig. 9. However, the path back to parity may be quite sluggish. The smaller the parameter h_2 is in Eq. (20), 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.

Figure 9. The price level differential (p_1–p_2, in logs) under a strong and weak fiscal consolidation (for explanations, see the text above)



5.3 Sustainability through debt relief?

One central approach in the crisis of Greece has been a possible debt default which have 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 Eq. (17) on page 15 in the interest differential the term d_{12} is one half, because the country 2 is ready to finance the rest 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 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 5%, will be consumed in country 1 in a year. A similar effect, mutatis mutandis, operates in country 2.

We see from Figure 10 that, as specified, the burden is shared by the two countries symmetrically. However, the effect of this effect is quite fairly limited, around 1 % of GDP, and vanishes fairly rapidly. As Figure 11 reveals, this policy leads to a slowing down of the reduction in the existing gap in competitiveness.

Figure 10. The effect of debt restructuring on the output gaps

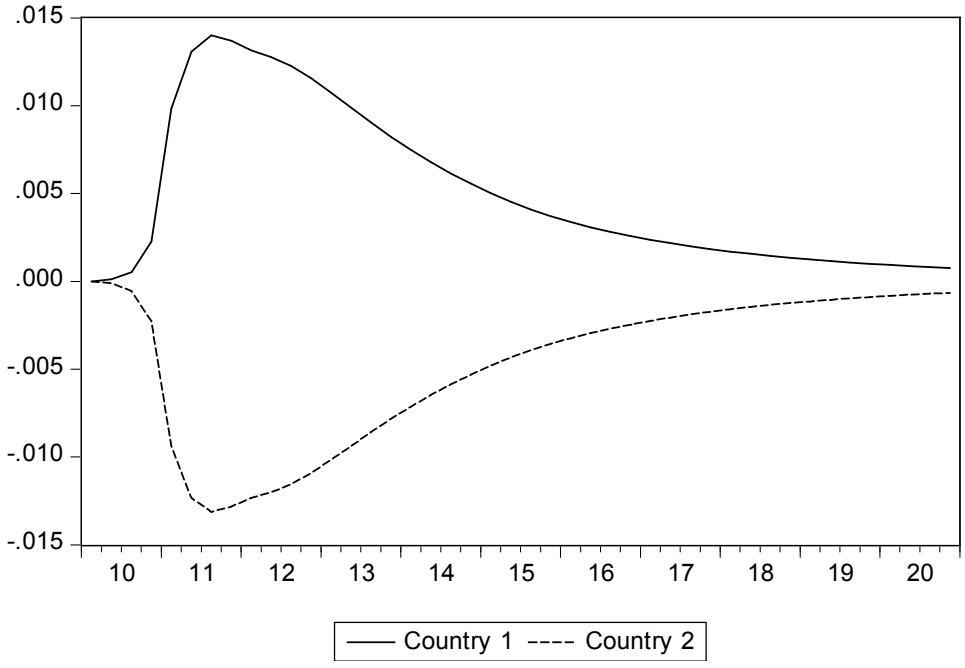
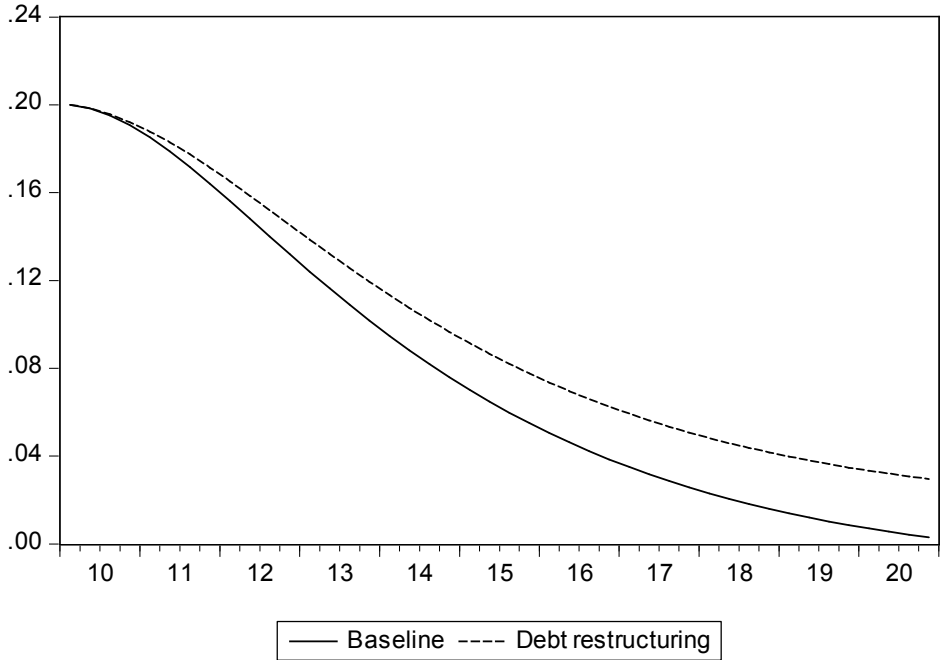


Figure 11. The effect of debt restructuring on the gaps in price levels (country 1 less country 2)



5.4 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 a 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.

By making a digression from the basic model with no explicit role for the capital stock, we define a CES production function the dependence of the potential output on the capital stock K, $\rho = \rho(Q^{POT}, K)$ where ρ is elasticity, and from the optimal investment equation,

$$d\log K^{POT} = d\log Q^{POT} - \frac{1}{1-\sigma}\left[d\log(1+mu) + d\log(r-\pi+d)\right], \qquad (21)$$

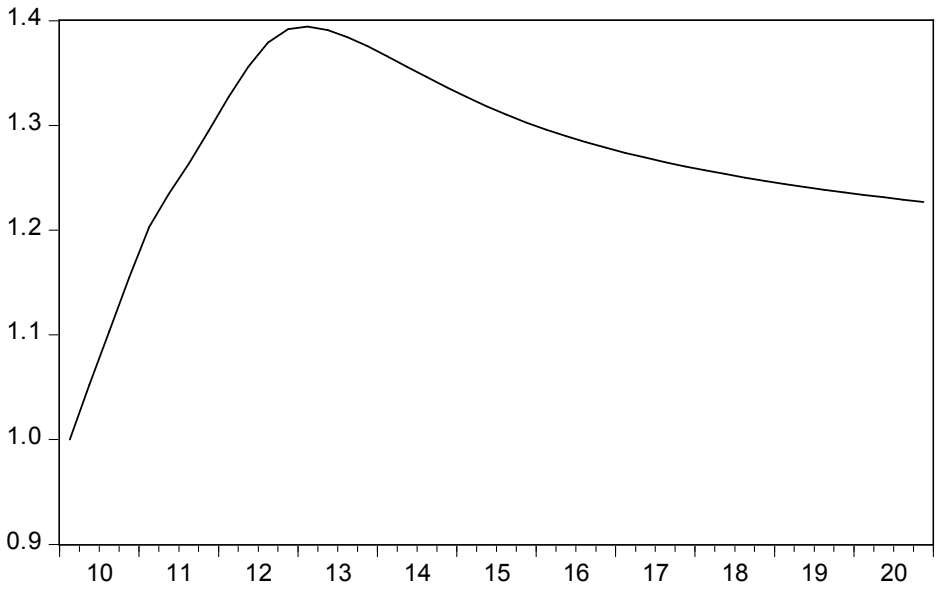
where mu is the mark up factor in the goods market and $(1-\sigma)^{-1}$ is the elasticity of substitution and d is the rate of depreciation. We now have the expression for a change in the potential output

$$d\log(Q_i^{POT}) = -\frac{\rho}{(1-\sigma)(1-\rho)}\left[d\log(1+mu_i) + d\log(r_i - \pi_i + d_i)\right] . \qquad (22)$$

The mark up factor has two kinds of effects. First, as in (22), 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 of 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 huge 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 in the fiscal policy rule in Eq. (15) is fixed to the strong value. The outcome is the following, see Fig. 12. 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 levelling 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 12. The debt ratio in country 1 under structural reforms, in combination with a strong fiscal consolidation



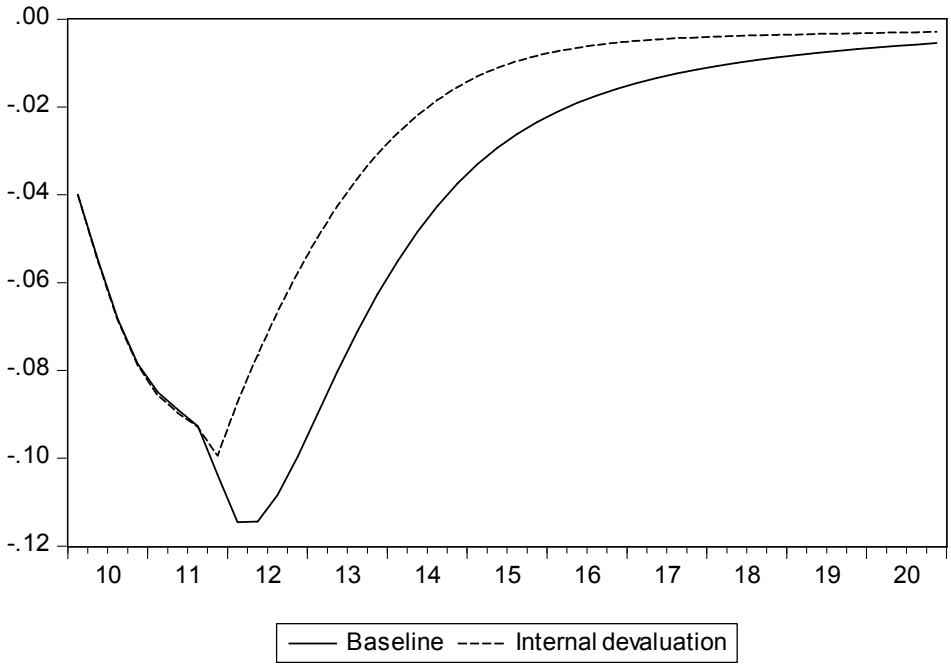
5.5 Stability through internal devaluation and revaluation?

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 by inserting (1) 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, (2) a corresponding rise in the price level of country 2 in the market of country 1, and (3) 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, 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.

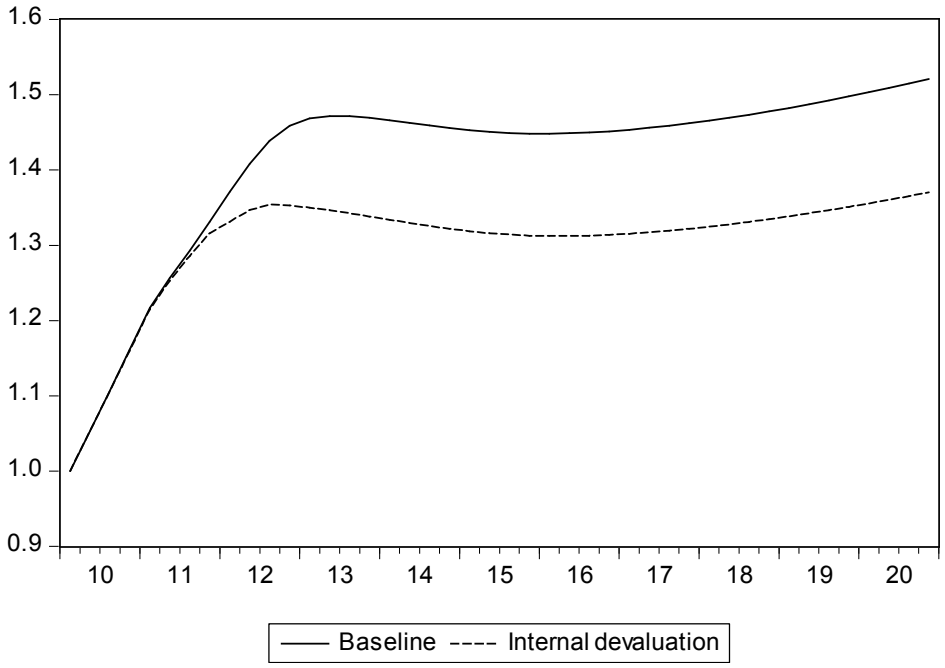
We assume in the baseline a strong fiscal position in the meaning defined above in Section 5.2. The result for the output gap is now the following, see Fig. 13 and Fig. 16. The impact is quite vigorous so that a 7.5% internal devaluation leads already quite in the short term to a 4%-points gain in output in country 1 (see also Fig. 16).

Figure 13. The effects of an internal devaluation in country 1 (for details, see the text above) on the output gap in the problem country 1



It is has a major negative effect on the country j = 2, and is to some extent a beggar thy neighbour policy, although the euro area as a whole gains in terms of output, see Fig. 16. 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, especially on the in a medium run.

Figure 14. The debt ratio in country 1 in the two scenarios



Fiscal devaluation, however, does not drive down the price gap in comparison to the base line, but rather is more inflationary over the long term, see Fig. 15.

Figure 15. The price level gaps in the two scenarios

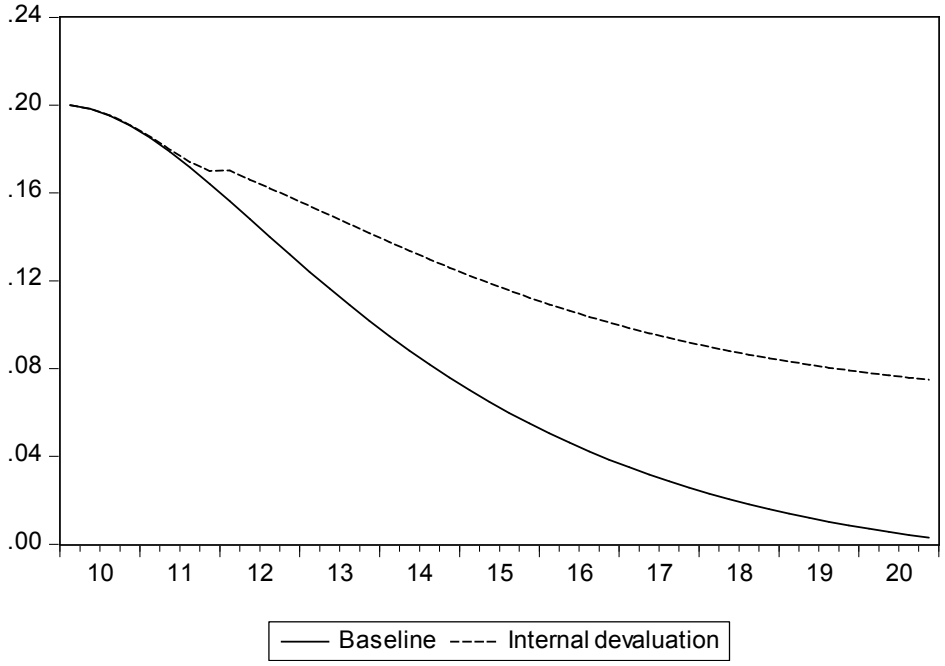
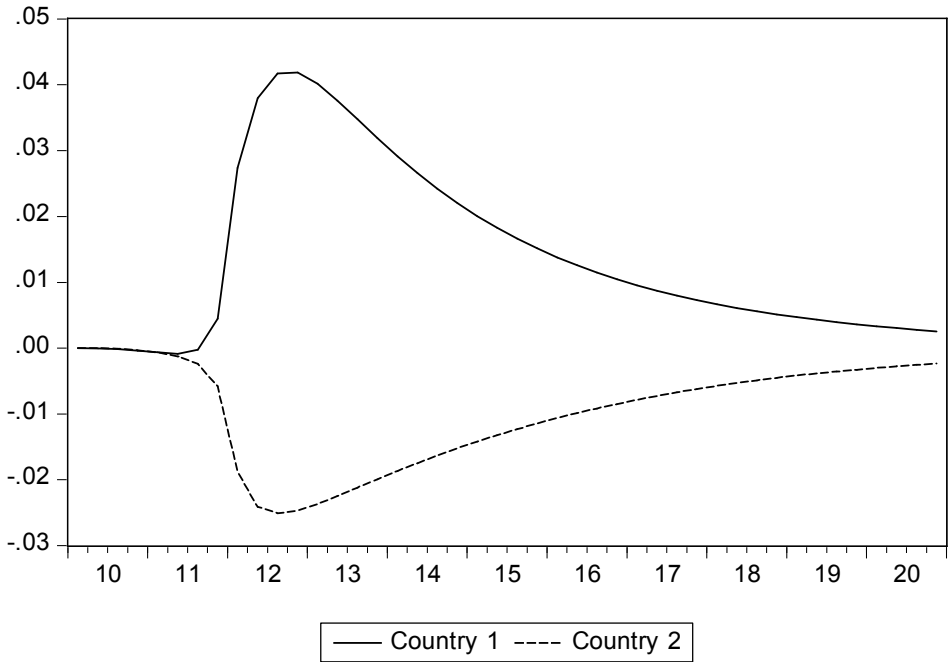


Figure 16. The effect of fiscal devaluation on the output gaps in countries 1 and 2

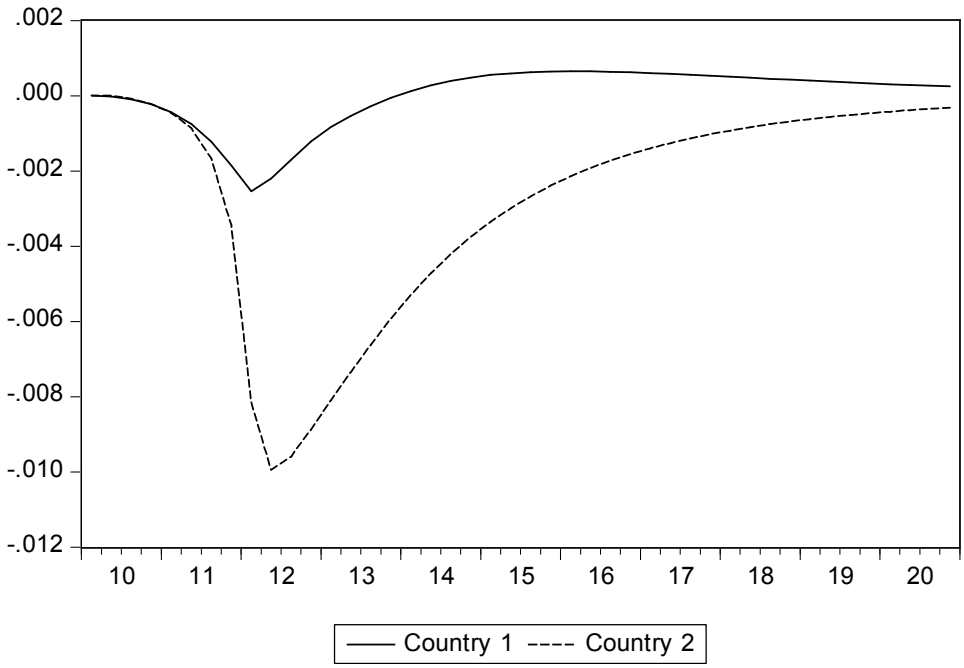


The core of the current EU policies is to prevent divergences in competitiveness from emerging and eliminating rapidly those emerged in this respect. It has been sometimes

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-Q4).

However, an internal cost push shock in country 2 is not a fairly successful alternative from the point of view of country 1, which also loses in terms of output, although the disparity within the euro area would diminish, see Figure 17.

Figure 17. The effects of a cost push (internal revaluation) in the strong EMU country on the output gaps



6 Concluding remarks

We have analysed the case of EMU adjustment to an imbalance in terms of inflationary shocks and competitiveness and argued that the ECB is able to restore, although over time, the sustainability of the EMU also with respect to idiosyncratic shocks. We were able to 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, whether EMU as such is conducive to such imbalances to emerge. 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 likely leading to political tensions in it.

Above, we have basically taken two approaches to the issue of sustainability: a technical one concerning the existence of a determinate solution and a policy point of view playing its role in reality. Especially, as to the fiscal consolidation, we inferred that it takes a lot of time and the debt ratio in the problem country may mount to a very high level.[4] This may make it implausible that the debtor country could reassure the financial markets of its solvency under such a scenario. This would call for a more stringent fiscal rule as to the adjustment in the country concerned. The problem with the adjustment is that 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 by those of the public sector in the conditions of a financial crisis. We leave these issues for a future consideration.

Anyway, 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 it would imply for the monetary policy and stability of the banking sector falls outside the realm of the present paper, and we leave these aspects aside at this stage.

We inferred that far-reaching and successful structural reforms are sufficient to restore the sustainability of the euro in terms 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.

References

Alho, K.E.O., Kotilainen, M. and Nikula, N. (2010): Prospects of the Northern EU Integration (in Finnish), Central Chamber of Commerce, Finland, 2010.

Bergman, M. (2001): "Testing Government Solvency and the No Ponzi Game Condition", Applied Economics Letters, Vol. 8, 27-29.
Commission (2008): EMU@10, Assessing the first 10 years and challenges ahead, Quarterly Report on the Euro Area, Vol. 7, No. 2, European Commission.

[4] We did not here assume any asset privatization in the problem country assumed in OECD (2011).

Debrun, X. and Kapoor, R. (2010): "Fiscal policy and macroeconomic stability: New evidence and policy implications", Nordic Economic Policy Review, No. 1/2010, 35-70.

Galí, J. (2010): "Are Central Banks' Projections Meaningful?", CEPR, Discussion Paper, No. 8027.

Galí, J. and Monacelli, T. (2005): "Optimal Monetary and Fiscal Policy in a Currency Union", CEPR Discussion Paper, No. 5374.

Galí, J. and Monacelli, T. (2008): "Optimal Monetary and Fiscal Policy in a Currency Union", Journal of International Economics, Vol. 76, 116-132.

Ferrero, A. (2008): "Fiscal and Monetary Rules for a Currency Union", Journal of International Economics, Vol. 77, 1-10.

King, R.G. and Watson, M.R. (1998): "The Solution of Singular Linear Difference Systems under Rational Expectations", International Economic Review, Vol. 39, No. 4, 1015-1026.

Kirsanova, T., Leith, C. and Wren-Lewis, S. (2009): "Monetary and Fiscal Policy Interaction: The Current Consensus Assignment in the Light of Recent Developments", The Economic Journal, Vol. 199, No. 541, F482-F496.

Laubach, T. (2009): "New Evidence on the Interest Rate Effects of Budget Deficits and Debt", Journal of the European Economic Association, Vol. 7, Iss. 4, 858-885.

Leith, C. and Wren-Lewis, S. (2007): "Fiscal Sustainability in a New Keynesian Model", Oxford University, Department of Economics, Discussion Paper Series, No. 310.

Lubik, T.A. and Schorfheide, F. (2004): "Testing for Indeterminacy: An Application to U.S. Monetary Policy", American Economic Review, Vol. 94, No. 1, 190-217.

Mavroeidis, S. (2010): "Monetary Policy Rules and Macroeconomic Stability: Some New Evidence", American Economic Review, Vol. 100, No. 1, 491-503.

Minford, P. and Srinivasan, N. (2010): "Determinacy in New Keynesian Models: A Role for Money after All?", CEPR, Discussion Paper, No. 7960.

OECD (2011): Economic Survey of Greece 2011.

Orjasniemi, S. (2010): The Effect of Openness in a Small Open Monetary Union", Bank of Finland, Discussion Papers, No. 18, 2010.

Sargent, T.J. (1989): Macroeconomic Theory, John Wiley.

Schabert, A. and van Wijnbergen, S.J.G. (2011): "Sovereign Default and the Stability of Inflation Targeting", Duisenherg School of Finance – Tinbergen Institute Discussion Paper, TI 11-064/2/ DSF 20.

Wickens, M.R. (2007): "Is the Euro Sustainable?", CEPR Discussion Paper, No. 6337.

Wickens, M.R. (2010): "Is the Euro the Success that Everyone Seems to Think?", Open Economics Review, Vol. 21, 183-185.

Woodford, M. (2003): Interest & Prices – Foundations of a Theory of Monetary Policy, Princeton University Press.

Appendix 1. Derivation of the IS curve

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

$$q_{it} = w_C c_{it} + w_I i_{it} + w_X x_{it} - w_M m_{it} + w_Z z_{it} + \varepsilon_{it}, \tag{23}$$

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

$$c_{i,t} = Ec_{i,t+1} - \frac{1}{\nu}(r_t - E\pi_{i,t+1} - \theta), \tag{24}$$

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

$$i_{i,t} = q_{i,t} - \tau(r_t - E\pi_{i,t+1}). \tag{25}$$

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

$$x_{kt} = q_t^* + \delta comp_{kt} \quad and \quad m_{kt} = q_{kt} - \delta comp_{kt} \tag{26}$$

where comp is the competitiveness of the country k, i.e. the real exchange rate and δ 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 (24), (25) and (26) into (23) and write it, as standard, for the next period t+1 and take expectations on both sides, and subtract this equation from Eq. (23). Let us approximate that investment is in the long run roughly a constant share of the capital stock being a constant share of aggregate output, so that the investment term in the expression on the right-hand side can be written as a change in the output gap less the impact of the expected real interest rate, see (25). These steps give first the following equation, (we omit here the separation of the exports and imports into those within and outside of EMU),

$$(1+w_M-w_I)q_{it} = (1+w_M-w_I)Eq_{i,t+1} + (-w_C\frac{1}{\nu}-\tau)(r_t - E\pi_{i,t+1}) - w_X(Eq^*_{t+1}-q^*_t) \\ -(w_X+w_M)\delta(Ecomp_{t+1}-comp_t) - w_Z(Ez_{t+1}-z_t)\,. \tag{27}$$

Let us next assume that competitiveness obeys the following type of return to normality adjustment, based on wage setting reacting to the existing gap in competitiveness and expected output. If competitiveness is bad, there is less room for 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,

$$Ecomp_{t+1} - comp_t = -\xi(comp_t - comp^E) - \zeta q_t\,, \tag{28}$$

where the parameters ξ and ς 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,

$$Ez_{t+1} - z_t = -\chi z_t\,, \tag{29}$$

where χ 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. There are also costs in adjusting production to meet the demand. This enlargement means that we introduce to 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 Debrun and Kapoor, 2010),

$$q_{i,t} = \beta_1 Eq_{i,t+1} + \beta_2 q_{i,t-1} - \omega(r_t - E\pi_{i,t+1}) + \lambda^* q^*_t + \lambda q_{j,t} + \\ \delta^* comp_{it} + \phi(p_{jt} - p_{it}) + \eta z_{i,t}\,. \tag{30}$$

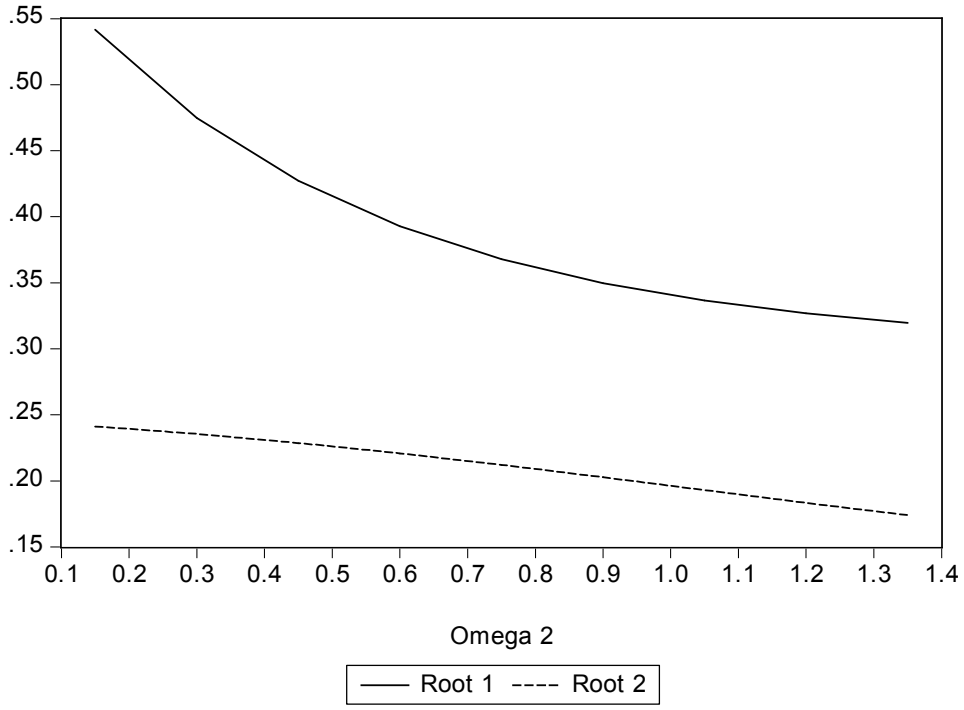
This is the basis of our specification of the modified IS curve in the section 5 from the basic one in Eq. (1) above. Calibration takes place so that the short run fiscal multiplier of z is around 0.7. The lag structure is specified so that the fiscal impulse vanishes in around three years. This stipulates the parameter η to be 0.5 and $\beta_1 = 0.3$ and $\beta_2 = 0.6$.

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 5.2.

Appendix 2. Latent roots of the H matrix on page 7

From the model for the aggregate euro area (Eqs. (7) and (8)) as a function of the parameter ω_2 in Eq. (17) we get the following latent roots for the H matrix on page 8.

Figure A1. The latent roots of the aggregate euro area model as a function the parameter ω_2 (omega2) in Eq. (12)



For the difference model in Eq. (11) we get the following outcomes.

Figure A2. The latent roots of the H matrix on p. 8 of the difference model (11) as a function of the coefficient ϕ (fii), impact of competitiveness on output

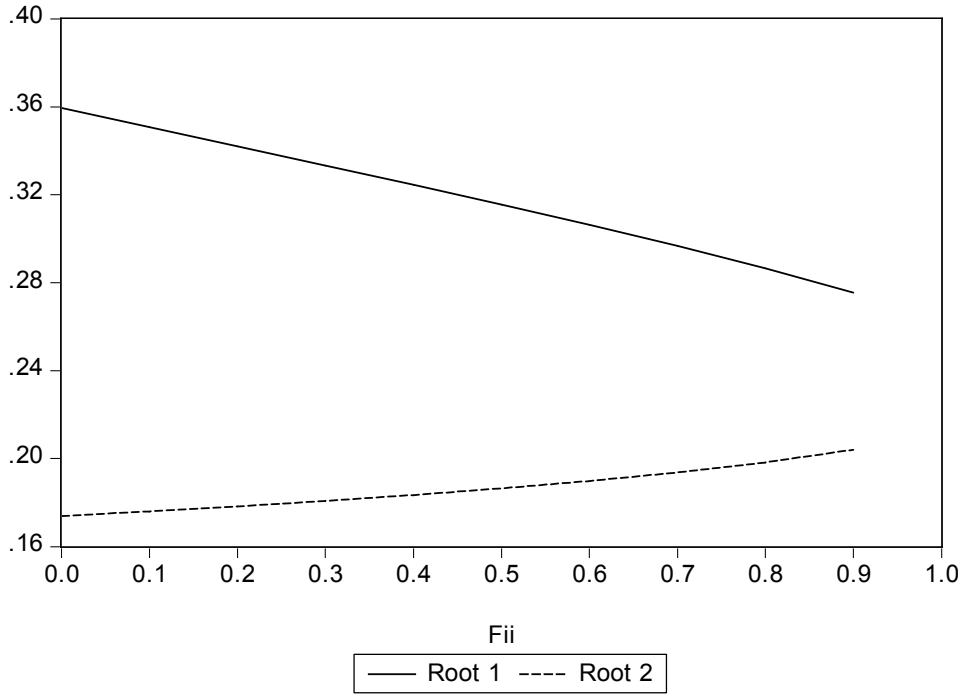
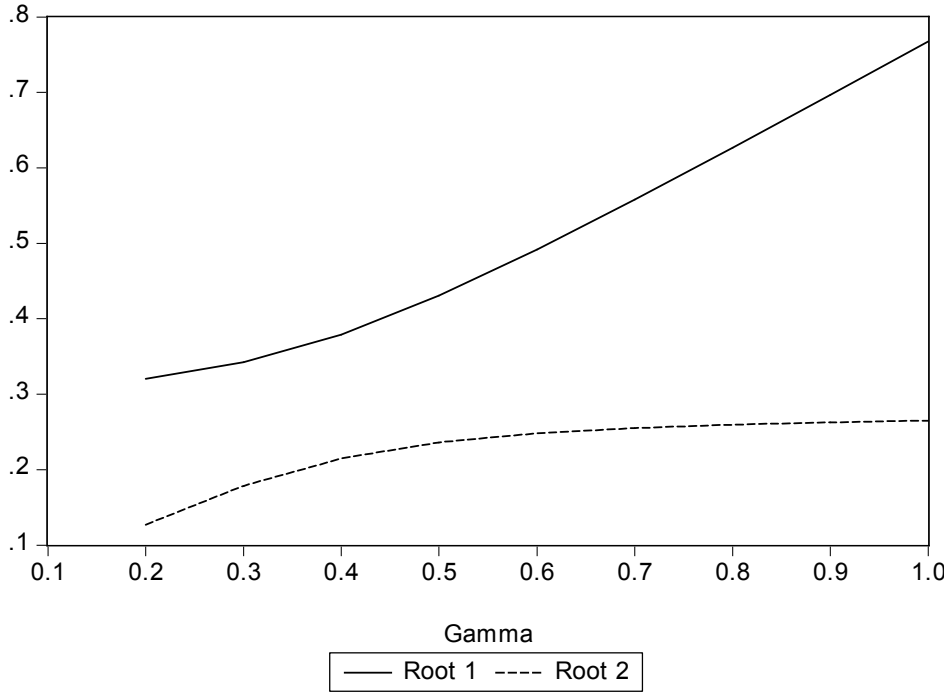


Figure A3. Latent roots of the H matrix on p. 8 of the difference model (11) as a function of the coefficient γ (gamma), impact of expected output on current output



Appendix 3. The characteristic roots of the extended system for fiscal policy analysis in Section 5

The model comprising of the fiscal policy block has ten endogenous variables ($q_{1t},\pi_{1t},r_{1t},d_{1t};q_{2t},\pi_{2t},r_{2t},d_{2t};r_t,s_t$), with four forward-looking variables ($Eq_{1,t+1},E\pi_{1,t+1}$, $Eq_{2,t+1},E\pi_{2,t+1}$).

Of the characteristic roots of the corresponding matrix $H = A_o^{-1}A_1$ (see page 8) are four non-zero and six zero. We have varied the in the monetary policy rule the coefficient of the inflation target in Eq. (12). The largest characteristic root behaves as follows.

Table A1. The characteristic root of the model enlarged with a block of fiscal policy

Weight of inflation (ω_2) in the monetary policy rule in Eq. (12)	**The largest characteristic root in absolute value**
0.25	0.676
0.5	0.644
0.75	0.616
1.0	0.590
1.25	0.566
1.5	0.544

This would suggest that the model is stable for a wide range of parameter values.