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Marketta Järvinen

Exchange rate regimes and nominal convergence in the CEECs

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Marketta Järvinen

Valuuttakurssijärjestelmät ja nimellinen lähentyminen Keski- ja Itä-Euroopan maissa

Tiivistelmä

Paperissa tarkastellaan – Keski- ja Itä-Euroopan maiden tulevan EMU-jäsenyyden valossa – finanssipolitiikan ja inflaation välistä yhteyttä eri valuuttakurssijärjestelmissä. Teoreettisena kehikkona toimii finanssipolitiikkaa painottava inflaatioteoria (fiscal theory of the price level, FTPL). Tulokset osoittavat, että rahaliitossa yhden maan vastuuton finanssipolitiikka nostaa hintatasoa koko rahaliitossa. Toisaalta, uskottavasti kiinnitetty valuuttakurssi vaatii finanssikuria. Toisin sanoen, euron käyttöönottoa edeltävä ERM II -vaihe pakottaa maat harjoittamaan vastuullista finanssipolitiikkaa, mutta euron käyttöönotto mahdollistaisi vastuuttoman finanssipolitiikan. Tämä korostaa finanssipoliittisen koordinaation tarvetta EU:n piirissä. Paperissa suositellaan hakijamaille, joissa finanssipoliittinen kuri on heikko, joustavia valuuttakursseja, kun taas maat, joissa finanssipolitiikka on vastuullista, voivat hyötyä kiinteiden kurssien järjestelmistä näiden parantaessa politiikan uskottavuutta.

Asiasanat: valuuttakurssijärjestelmät, inflaatio, finanssipolitiikkaa painottava inflaatioteoria, siirtymätaloudet

Exchange rate regimes and nominal convergence in the CEECs

Marketta Järvinen*

This version 27 March 2002

Abstract

This paper examines, in the context of future EMU membership of the Central and Eastern European countries (CEECs), the interaction between fiscal policy and the price level in different exchange rate regimes. The theoretical framework is based on the Fiscal Theory of the Price Level (FTPL). The results show that a credibly fixed exchange rate is inconsistent with fiscal irresponsibility, while adopting the common currency enables the conduct of irresponsible policies with the result that a rise in the level of debt by one member country raises the common price level of the whole union.

Keywords: Exchange rate regimes; Inflation; Fiscal theory of the price level; Transition economies

JEL classification: E00; F33; O57

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1. Introduction

Many Central and Eastern European countries (CEECs) are currently preparing for membership in the European Union and Economic and Monetary Union (EMU). Most candidate countries intend to join the exchange rate mechanism (ERM II) immediately upon accession, and as a result the Maastricht convergence criteria are having an increased influence on their economic policymaking. Disinflation has often been considered the most daunting challenge for transition economies, while for the current euro area members the greatest obstacle on the way to the adoption of the euro were the fiscal criteria. The challenges in this area are, however, no less demanding for the candidate countries, perhaps on the contrary.

This paper examines the effects of the exchange rate regime on the interaction between fiscal variables and the price level. A theoretical framework based on the Fiscal Theory of the Price Level (FTPL) is constructed. The model is adapted from Bergin (2000), who examined the FTPL in a monetary union framework. There are two countries in the model, a candidate country and a monetary union (EMU). The model's timeline begins with a first stage, in period t, when the candidate country announces plans to join the ERM II arrangement and the EU in period T (stage 2) and adoption of the euro in T+2 (stage 3). During the first stage, the candidate country may have one of several exchange rate regimes, while in the second stage, the exchange rate is assumed to be credibly fixed within the ERM II arrangement. Monetary policy in EMU is characterized by a price stability target. Fiscal policy of the candidate country can be either "responsible," i.e. the government present value budget constraint is satisfied at all times, or

"irresponsible," where the primary surplus is set at a fixed level. EMU fiscal policy is assumed to be responsible.

The results demonstrate the impact of the exchange rate regime on price level determination. As a rule, when fiscal policy is responsible, fiscal variables do not affect the price level. In a floating regime with inflation targeting, the price level is affected by fiscal policy in the same way as in a monetary union. However, a rise in the debt level of the candidate country only raises that price level in stage 1; in a monetary union, it raises the common price level throughout the union. In other words, an inflation target cannot be achieved without help from the fiscal authorities. If the candidate country conducts a fixed-exchange-rate regime, the price level changes of the candidate country have to match those of the monetary union to maintain the fixed exchange rate. Thus, the candidate country is forced to conduct responsible fiscal policy.

As the household has rational expectations, the knowledge of the upcoming ERM II entry and adoption of the common currency affect the candidate country's current price level. Indeed, we see that the inflation target of the candidate country should match that of the monetary union as soon as future entry is announced and is necessary to prevent arbitrage opportunities at the time of the ERM II peg. Moreover, it appears that the ERM II arrangement, where the exchange rate is credibly fixed, forces the participating countries to conduct responsible fiscal policies. Still, we question whether ERM II in its current form – even with the help of the Maastricht criteria – can attain this. The candidate countries with their relatively low debt levels have clear leeway with the debt criterion. Furthermore, when the candidate countries adopt the common currency, problems arising from irresponsible fiscal policies may endanger the price stability target of the entire

union. This underlines the importance of EU guidelines in the area of fiscal policies.

Section 2 discusses the Fiscal Theory of the Price Level. Section 3 develops the model for the different exchange rate regimes, starting with a monetary union. Section 4 examines the policy implications of the findings and section 5 concludes.

2. The Fiscal Theory of the Price Level

The interaction between fiscal variables and inflation can be examined under the Fiscal Theory of the Price Level (FTPL), which states that the price level, in contrast to the traditional view of the price level being determined solely by monetary policy, is determined by the budgetary policies of the fiscal authority.[1] Naturally, the monetary view recognizes that high inflation can be caused by fiscal policy via seigniorage revenues that are obtained from rapid money growth. These revenues, however, are typically negligible in low-inflation industrial countries.

The FTPL originates from Leeper, Sims and Woodford. Leeper (1991) defines policies as either active, whereby the authority pays no attention to the state of government debt and is free to set its control variable as it sees fit, or passive, whereby the authority responds to government debt shocks, while its behavior is constrained by private optimization and the active authority's actions. Equilibrium policies can be divided into those where future direct lump-sum taxes back debt shocks entirely, i.e. monetary policy is active and fiscal policy is passive, and those where fluctuations in real debt generate current or future money creation, i.e. fiscal policy is active and monetary policy is passive. A unique pricing function requires that at least one authority sets its control variable actively, while an intertemporally balanced government budget requires that at least one authority sets its control variable passively.[2]

Sims (1994) proves that a monetary policy that fixes the money stock may – depending on the transaction technology – be consistent with indeterminacy of the price level – and indeed, with stochastically fluctuating explosive inflation. In contrast, a monetary policy that fixes the nominal interest rate, even if it holds the interest rate constant regardless of the observed rate of inflation or money growth rate, may deliver a uniquely determined price level. The determinacy of the price level under any policy depends on the public's belief as what the policy authority would do under conditions never observed in equilibrium.

Similarly, Woodford (1994) finds that the price level is uniquely determined under a nominal interest rate peg, while constant money growth rates can lead to indeterminacy of the perfect foresight equilibrium and existence of sunspot equilibria. Woodford (1995) identifies two types of policy regimes. A fiscal policy is Ricardian if the primary surpluses adjust to guarantee fiscal solvency for any sequence of prices. In a non-Ricardian policy, the government's intertemporal budget constraint is satisfied for some, but not all, price paths.[3 4] Woodford (1998) further shows that fiscal policy and the price level are connected through the wealth effect of variations in the value of public debt. He finds that if fiscal policy is non-Ricardian, the time path and composition (like maturity and degree of indexation) have consequences for inflation determination.[5] Moreover, Woodford (2001) shows that a commitment by the central bank to conduct monetary policy according to a rule (e.g. Taylor rule) is insufficient to guarantee a stable, low equilibrium inflation rate.[6] Indeed, the combination of a Taylor rule with certain fiscal policies may result in an inflationary or deflationary spiral. Hence, a Taylor rule should be accompanied with targets for the size of government budget deficit.

Buiter (1999), one of FTPL critics, argues that the FTPL has an economic

misspecification when it requires that the government's inter-temporal budget constraint only be satisfied in equilibrium. He also questions the absence of the possibility for government default, as a fiscal regime results in over-determination of the price level without an endogenous default discount factor on government debt. He concludes that the FTPL may lead to harmful policies. Cochrane (2000) counters some of this critique, finding that the intertemporal budget constraint should be taken as a value equation (like a stock valuation equation) instead of as a constraint. Thus, the government is not forced by the budget constraint to raise future taxes in response to an off-equilibrium deflation and a determinate, finite price level can be achieved.

As pointed out by Christiano and Fitzgerald (2000), it is clear that the non-Ricardian assumption is not a good characterization of policy in all times and places. Examples of governments adjusting fiscal policy as debt gets too large are numerous, including the US in the 1980s and 1990s. Other examples provided by Christiano and Fitzgerald include the Maastricht criteria, which are designed to prevent excessive indebtedness, and IMF programs, which often guide countries toward debt reduction.

Indeed, it has been shown that the Maastricht criteria are sufficient to force a country into a Ricardian regime. Canzoneri and Diba (1996) show that limiting the government's total deficit (primary deficit plus interest payments) to 3% of GDP is sufficient. In addition, Woodford (1996) finds that, in the presence of a Maastricht-type debt limit, Ricardian equivalence holds and fiscal shocks have no effect upon real or nominal variables. He notes that the debt limit serves as a pre-condition for the common central bank in a monetary union to be charged with responsibility for maintaining a stable value for the common currency.[7]

The analysis of most studies concentrates on one-country/one-currency frameworks. Dupor (2000) shows that the Sims-Leeper-Woodford results do not hold in a two-countries/two-currencies setting. Indeed, if both countries peg the nominal interest rate on domestic bonds, then the price level and the exchange rate are indeterminate. Canzoneri et al. (1998a, 2000a) examine the implications of the FTPL for the maintenance of various exchange rate regimes.[8] Their key finding is that tighter monetary integration requires greater fiscal discipline. Furthermore, they find that in a monetary union, when one country conducts a fiscal-dominant (i.e. non-Ricardian) regime, then the union as a whole will operate in that fiscal-dominant regime. Similarly, Bergin (2000) finds that the implications of FTPL for a monetary union are that the inflation tax on nominal bonds may be large, even though seigniorage is small and that a rise in debt not backed by future taxes of one member country can raise the price level of the entire union.[9]

The FTPL has not been empirically tested widely. Kocherlakota and Phelan (1999) point out that the only way to know if a government is using a non-Ricardian policy is to know whether the government's budget constraint is satisfied for unobserved prices, which is impossible. Cottarelli et al. (1998) examine inflation performance in transition economies by looking at policymakers' incentives to inflate the economy. Using panel data econometric techniques, they conclude that there is a significant effect of fiscal deficits on inflation, especially in countries where the government securities market is undeveloped. Komulainen and Pirttilä (2000) examine inflation in Bulgaria, Romania and Russia with VAR models, finding that fiscal deficits increased inflation only in Bulgaria, but even there the money aggregates proved more important. In their empirical examination, Canzoneri and al. (2000b,c) find no evidence of a fiscal dominant regime for the US

or the 16 OECD countries, which would indicate prevalence of traditional views of price-level setting.[10]

3. The Model

Bergin (2000) formally solved the effects of irresponsible fiscal policy on the price level in a monetary union context. Bergin's common currency model is here extended to two currencies, and thus to different exchange rate regimes. There are two countries in the model – a candidate country and a monetary union (EMU). The infinitely-lived representative household chooses consumption of the two goods, nominal holdings of money and nominal bond holdings.[11] As in Bergin (2000), the households are assumed to be unable to insure perfectly against asymmetric shocks. The government determines lump-sum taxes and issues nominal government debt. The central bank is independent of the government and issues money through open-market purchases of bonds. The interest income of the central bank is returned to the national government, or in the case of monetary union, is divided among the governments.

A price stability target is the cornerstone of monetary policy in EMU. EMU fiscal policy is assumed to be "responsible", i.e. the government present-value budget constraint is satisfied at all times. The candidate country's monetary policy depends on its exchange rate regime. In general, a fixed regime (e.g. ERM II) is described by an exchange rate target, while a totally flexible regime is characterized by a price stability target. Fiscal policy of the candidate country can be either "responsible" or "irresponsible," where the primary surplus is set at a fixed level.

The model's timeline begins with a first stage, in period t, when the candidate country announces plans to join the ERM II arrangement and the EU in period

T (stage 2) and adoption of the euro in T+2 (stage 3). During the first stage, while the exchange rate is credibly fixed in the ERM II, the candidate country may have one of several exchange rate regimes, while the exchange rate is credibly fixed in the second stage (ERM II). We first solve the model in the monetary union framework in a similar manner to Bergin (2000), then we extend it to different exchange rate regimes. Finally, the solution for the monetary union, stage 3, is imposed on the first stage.

3.1. Monetary union

The infinitely-lived representative household receives a stochastic endowment of the domestic consumption good (y_{1t}) and chooses consumption of the domestic and foreign goods (c^1_{1t}) and (c^2_{1t}), nominal holdings of money (M_{1t}) and nominal bond holdings (B_{1t}) that have a nominal gross return (R_t). Real money balances (m_{1t}) are defined as the nominal money holdings to the common price level (P_t). The household pays lump-sum taxes (τ_{1t}) to the domestic government. Utility is discounted at a rate β. The infinitely-lived household in country 1 maximizes

$$MaxE_0 \sum_{t=0}^{\infty} \beta^t \left[\left(c^1_{1t}\right)^a \left(c^2_{1t}\right)^{1-a} \right]^d (m_{1t})^{1-d} \tag{1}$$

with regard to B_{1t} and m_{1t} subject to the following budget constraint

$$c_{1t} + \frac{M_{1t}}{P_t} + \frac{B_{1t}}{P_t} + \tau_{1t} = \frac{p^1_t}{P_t} y_{1t} + \frac{M_{1t-1}}{P_t} + R_{t-1}\frac{B_{1t-1}}{P_t}, \tag{2}$$

where $M_{1t} \geq 0$, $c_{1t} \geq 0$ and $m_{1t} \equiv \frac{M_{1t}}{P_t}$. The household's holdings of bonds can be either positive or negative. The first order conditions of the household's problem are

$$\left(\frac{m_{1t}}{c_{1t}}\right)^{1-d} = \beta R_t E_t \left[\left(\frac{m_{1t+1}}{c_{1t+1}}\right)^{1-d} \left(\frac{P_t}{P_{t+1}}\right) \right] \tag{3}$$

$$m_{1t} = \left(\frac{1-d}{d}\right)\left(\frac{R_t}{R_t-1}\right)c_{1t}. \tag{4}$$

To solve the price index P_t, we maximize consumption $c_{1t} = \left(c_{1t}^1\right)^a \left(c_{1t}^2\right)^{1-a}$ subject to total expenditure $P_t c_{1t} = p_t^1 c_{1t}^1 + p_t^2 c_{1t}^2 = Z_1$, which produces

$$\left(\frac{a}{1-a}\right)\left(\frac{c_{1t}^2}{c_{1t}^1}\right) = \frac{p_t^1}{p_t^2}, \tag{5}$$

from where it can be calculated that $c_{1t}^1 = a\frac{P_t}{p_t^1}c_{1t}$ and $c_{1t}^2 = (1-a)\frac{P_t}{p_t^2}c_{1t}$. Substituting these back into the consumption equation, we can solve for the price level

$$P_t = \left(p_t^1\right)^a \left(p_t^2\right)^{1-a}. \tag{6}$$

The transversality condition implies that households fully use their lifetime wealth, i.e.

$$\lim_{T\to\infty}\left(\prod_{j=t}^{T-1} R_j^{-1}\right) W_{1T} = 0, \tag{7}$$

where $W_{1t} = R_{t-1}B_{1t-1} + M_{1t-1}$ is the nominal beginning of period household wealth. Thus, the household intertemporal budget constraint can be written as

$$\frac{W_{1t}}{P_t} = \sum_{s=t}^{\infty}\left(\prod_{j=t}^{s-1} r_j^{-1}\right)\left(c_{1s} + \tau_{1s} + \frac{R_s-1}{R_s}m_{1s} - \frac{p_s^1}{P_s}y_{1s}\right), \tag{8}$$

where the real rate of return on bonds is defined as $r_j = \frac{R_t P_t}{P_{t+1}}$. The household's problem is solved analogously for country 2.

Each government determines lump-sum taxes (τ_1) and issues nominal government debt (D_{1t}), which together with the real transfers from the central bank (v_{1t}) finance the constant government purchases ($\overline{g}_1$). The flow government budget constraint in country 1 can be written as

$$\overline{g}_1 + R_{t-1}\left(\frac{D_{1t-1}}{P_t}\right) = \tau_{1t} + v_{1t} + \frac{D_{1t}}{P_t}, \tag{9}$$

where $P_t\overline{g}_1 = p_t^1\overline{g}_1^1 + p_t^2\overline{c}_1^2$. The solvency condition for the government states that the present value of real outstanding government debt goes to zero in the limit, i.e.

$$\lim_{T\to\infty}\left(\prod_{j=t}^{T-1} R_j^{-1}\right) D_{1T} = 0. \tag{10}$$

Therefore, the intertemporal budget constraint for government 1, which requires that the present discounted value of future tax and seigniorage revenues covers expenditures and allows the government to pay back its outstanding debt, is

$$R_{t-1}\left(\frac{D_{1t-1}}{P_t}\right) = \sum_{s=t}^{\infty}\left(\prod_{j=t}^{s-1} r_j^{-1}\right)\left(\tau_{1s} - \overline{g}_1 + v_{1s}\right). \tag{11}$$

The central bank is independent of government, and it issues money (M_t) through open market purchases of bonds (B_{mt}), but does not issue debt itself or levy taxes. The period budget constraint of the common central bank is

$$\frac{B_{mt}}{P_t} + v_{1t} + v_{2t} = R_{t-1}\left(\frac{B_{mt-1}}{P_t}\right) + \frac{M_t - M_{t-1}}{P_t}. \tag{12}$$

The interest income of the central bank is returned to the governments according to exogenously determined division rules ω_1 and ω_2 such that

$$v_{1t} = \omega_1\left[\left(R_{t-1} - 1\right)\frac{B_{mt-1}}{P_t}\right] = \omega_1 v_t; \tag{13}$$

$$v_{2t} = \omega_2 v_t, \tag{14}$$

where $\omega_1 + \omega_2 = 1$. The intertemporal budget constraint of the common central bank can be written as

$$\frac{M_{t-1} - R_{t-1}B_{mt-1}}{P_t} = \sum_{s=t}^{\infty}\left(\prod_{j=t}^{s-1} r_j^{-1}\right)\left(\frac{R_s - 1}{R_s}m_s - v_{1s} - v_{2s}\right). \tag{15}$$

The central bank's monetary policy is assumed to be characterized by a price stability target, where $\frac{P_{t+1}}{P_t} = 1 + \mu$. This implies an interest rate of the form

$R_t = \overline{R} = \frac{P_{t+1}}{\beta P_t} = \frac{1+\mu}{\beta}$. Furthermore, the money supply becomes endogenous with $\frac{M_{t+1}}{M_t} = 1 + \mu$.[12]

The market clearing conditions in the goods, money and bond markets are

$$c_{1t}^1 + c_{2t}^1 + \overline{g}_1^1 + \overline{g}_2^1 = y_{1t} \text{ and } c_{1t}^2 + c_{2t}^2 + \overline{g}_1^2 + \overline{g}_2^2 = y_{2t} \tag{16}$$

$$M_{1t} + M_{2t} = M_t \tag{17}$$

$$B_{1t} + B_{2t} + B_{mt} = D_{1t} + D_{2t}. \tag{18}$$

As in Bergin's (2000) model, there are transitory asymmetric output shocks. These are considered offsetting across countries, so there are no shocks to aggregate output, i.e.

$$\begin{aligned} y_{1s} &= \overline{y}_1 + \varepsilon_s \\ y_{2s} &= \overline{y}_2 + \varepsilon_s \\ \varepsilon_s &\sim N\left(0, \sigma^2\right). \end{aligned} \tag{19}$$

There are 19 necessary conditions for equilibrium. These include for both countries the household intertemporal budget constraint (8), first-order conditions (3), (4) and (5), the exogenous sequence for outputs (19), government flow budget constraint (9) and fiscal policy, the common central bank's budget constraint (12), monetary policy and rebate allocations (13) and (14), as well as the market-clearing conditions for the goods and money markets (16) and (17). It should be noted that neither the government intertemporal budget constraint nor the solvency condition are necessary conditions for equilibrium.

If linearized around a deterministic steady state with $\omega_1 + \omega_2 = 1$, where $\frac{P_{t+1}}{P_t} = 1+\mu$, and similarly for other nominal variables, the household intertemporal budget

constraint can be written as

$$\frac{\widetilde{W}_{1t}}{\overline{P}} - \left(\frac{\overline{W}_1}{\overline{P}}\right)\left(\frac{\widetilde{P}}{\overline{\overline{P}}}\right) = \sum_{s=t}^{\infty} \beta^{s-t}[\{\widetilde{c}_{1s} + \widetilde{\tau}_{1s} + \frac{\overline{R}-1}{\overline{R}}\widetilde{m}_{1s} + \frac{\overline{p}^1}{\overline{\overline{P}}}\widetilde{y}_{1s} \qquad (20)$$
$$- \left[\frac{\widetilde{p}^1_s}{\overline{\overline{P}}} - \left(\frac{\overline{p}^1}{\overline{\overline{P}}}\right)\left(\frac{\widetilde{P}_s}{\overline{\overline{P}}}\right)\right]\overline{y}\} + (1-\beta)\left(\frac{\overline{W}_1}{\overline{P}}\right)\sum_{j=t}^{s-1}\left(\frac{\overline{P}_{j+1}}{\overline{P}}\right)\left(\frac{\widetilde{P}_{j+1}}{\overline{\overline{P}}_{j+1}} - \frac{\widetilde{P}_j}{\overline{\overline{P}}}\right)],$$

where the overbars indicate steady-state values in period t (for steady states that differ from those of period t, the period is noted), and tildes denote deviations from the steady state. Using the linearized first-order conditions (3) and (4), as well as the goods-market-clearing conditions (see the appendix), we solve for current consumption

$$\widetilde{c}_{1t} = d\,(1-\beta)\left[\left(\frac{\overline{W}_1}{\overline{\overline{P}}}\right)\left(\frac{\widetilde{W}_{1t}}{\overline{W}_1} - \frac{\widetilde{P}_t}{\overline{\overline{P}}}\right) + \sum_{s=t}^{\infty}\beta^{s-t}\left(\frac{\overline{p}^1}{\overline{\overline{P}}}\widetilde{y}_{1s} - \widetilde{\tau}_{1s}\right)\right]. \qquad (21)$$

As can be seen from equation (21), changes in consumption are a function of changes in the household's intertemporal wealth, i.e. the initial asset holdings and the present value of output net of taxes. Summing the consumption function with its foreign counterpart, and imposing the goods-market-clearing condition so that joint consumption is constant, produces

$$\frac{\widetilde{P}_t}{\overline{\overline{P}}} = \left(\frac{\overline{W}}{\overline{\overline{P}}}\right)^{-1}\left[\left(\frac{\widetilde{W}_t}{\overline{\overline{P}}}\right) - \sum_{s=t}^{\infty}\beta^{s-t}\left(\widetilde{\tau}_{1s} + \widetilde{\tau}_{2s}\right)\right], \qquad (22)$$

where $W_t = W_{1t} + W_{2t}$ and analogously for steady-state values.

Next, the fiscal rules of both countries, rules for the determination of $\widetilde{\tau}_{1s}$ and $\widetilde{\tau}_{2s}$ respectively, are entered into equation (22). Moreover, it is assumed that the economy starts in a steady state in period t-1. If both countries have a "responsible" fiscal policy, i.e. they choose τ_{1s} and τ_{2s} such that they ensure their own solvency at all times (satisfy equation (11)), then the price level is

unaffected by the fiscal variables. However, if it is assumed that country 1 has an "irresponsible" fiscal policy, where it pegs its taxes at a given level $\tau_{1s} = \overline{\tau}_1$, while the fiscal policy of country 2 is "responsible", it can be shown that (also see appendix)

$$\frac{\widetilde{P}_t}{\overline{P}} = -\left(\frac{\overline{W}_1}{\overline{P}}\right)^{-1} \widetilde{\tau}_{1t}. \tag{23}$$

Bergin interprets equation (23) as follows: If the government in country 1 temporarily cuts taxes in period t, after which they would be held fixed again, equation (23) implies that the price level would rise proportionally to the tax cut, the proportion depending on the initial wealth of country 1. The consumption equation (21) suggests that without a price level rise, household wealth would rise in country 1, while consumption in country 2 would not fall, leading to excess demand in the goods market. Thus, a rise in the price level is needed to lower the real value of wealth to be consistent with goods-market equilibrium. (Bergin 2000, 46-47).

Equation (23) can also be written as (see appendix)

$$\frac{\widetilde{P}_t}{\overline{P}} = \frac{\widetilde{D}_{1t}}{\overline{D}_1}. \tag{24}$$

Equation (24) states that a percentage rise in the debt level of country 1 will equal a percentage rise in the common price level. Therefore, it appears that the central bank cannot achieve its price stability target without help from the fiscal authorities. However, as noted by Bergin (2000), the price stability target can be achieved when one country absorbs the increased debt of the other. Next, Bergin's model is extended to a two-currency setting.

3.2. Two currencies

When there are two currencies and two central banks, the household of country 1 maximizes (1) with regard to B^1_{1t}, B^2_{1t} and m_{1t} subject to the following budget constraint

$$\begin{aligned} & c_{1t} + \frac{M_{1t}}{P_{1t}} + \frac{B^1_{1t}}{P_{1t}} + e_t \frac{B^2_{1t}}{P_{1t}} + \tau_{1t} \\ = & \frac{p^1_{1t}}{P_{1t}} y_{1t} + \frac{M_{1t-1}}{P_{1t}} + R_{1t-1} \frac{B^1_{1t-1}}{P_{1t}} + e_t R_{2t-1} \frac{B^2_{1t-1}}{P_{1t}}, \end{aligned} \tag{25}$$

where $M_{1t} \geq 0$, $c_{1t} \geq 0$, $m_{1t} = \frac{M_{1t}}{P_{1t}}$. The household's holdings of bonds, domestic (B^1_{1t}) and foreign (B^2_{1t}) with nominal gross returns (R_{1t}) for domestic and (R_{2t}) for foreign bonds, can be either positive or negative. The first order condition (3) for country 1 is now written as

$$\begin{aligned} \left(\frac{m_{1t}}{c_{1t}}\right)^{1-d} &= \beta R_{1t} E_t \left[\left(\frac{m_{1t+1}}{c_{1t+1}}\right)^{1-d} \left(\frac{P_{1t}}{P_{1t+1}}\right) \right] \\ \left(\frac{m_{1t}}{c_{1t}}\right)^{1-d} &= \beta R_{2t} E_t \left[\left(\frac{m_{1t+1}}{c_{1t+1}}\right)^{1-d} \left(\frac{P_{1t}}{P_{1t+1}}\right) \left(\frac{e_{t+1}}{e_t}\right) \right], \end{aligned} \tag{26}$$

while condition (4) still applies. Condition (26) implies the uncovered interest rate parity

$$R_{1t} = R_{2t} E_t \left(\frac{e_{t+1}}{e_t}\right). \tag{27}$$

To solve the price index P_{1t}, we again maximize consumption $c_{1t} = \left(c^1_{1t}\right)^a \left(c^2_{1t}\right)^{1-a}$ subject to total expenditure $P_{1t} c_{1t} = p^1_{1t} c^1_{1t} + e_t p^2_{2t} c^2_{1t} = Z_1$, which produces

$$\left(\frac{a}{1-a}\right)\left(\frac{c^2_{1t}}{c^1_{1t}}\right) = \frac{p^1_{1t}}{e_t p^2_{1t}}. \tag{28}$$

From condition (28) and the respective condition for country 2, we get that $c_{1t}^1 = a\frac{P_{1t}}{p_{1t}^1}c_{1t}$, $c_{1t}^2 = a\frac{P_{1t}}{e_t p_{2t}^2}c_{1t}$, $c_{2t}^1 = a\frac{P_{2t}}{\frac{1}{e_t}p_{1t}^1}c_{2t}$ and $c_{2t}^2 = a\frac{P_{2t}}{p_{2t}^2}c_{2t}$. Substituting these into the consumption equations produces the domestic and foreign price levels

$$P_{1t} = \left(p_{1t}^1\right)^a \left(e_t p_{2t}^2\right)^{1-a}, \tag{29}$$

and

$$P_{2t} = \left(\frac{1}{e_t}p_{1t}^1\right)^a \left(p_{2t}^2\right)^{1-a}, \tag{30}$$

respectively. Thus, the exchange rate is defined as

$$\frac{P_{1t}}{P_{2t}} = e_t. \tag{31}$$

Linearizing the exchange rate around the steady state produces

$$\frac{\widetilde{e}_t}{\overline{e}} = \frac{\widetilde{P}_{1t}}{\overline{P}_1} - \frac{\widetilde{P}_{2t}}{\overline{P}_2}. \tag{32}$$

The budget constraint of the central bank in country 1 changes from (12) to

$$\frac{B_{1mt}}{P_{1t}} + v_{1t} = R_{1t-1}\left(\frac{B_{1mt-1}}{P_{1t}}\right) + \frac{M_{1t} - M_{1t-1}}{P_{1t}} \tag{33}$$

with the rebates paid to the domestic government defined as

$$v_{1t} = \left(R_{1t-1} - 1\right)\frac{B_{1mt-1}}{P_{1t}}. \tag{34}$$

The intertemporal budget constraint for the central bank of country 1 is now written as

$$\frac{M_{1t-1} - R_{1t-1}B_{1mt-1}}{P_{1t}} = \sum_{s=t}^{\infty}\left(\prod_{j=t}^{s-1} r_{1j}^{-1}\right)\left(\frac{R_{1s}-1}{R_{1s}}m_{1s} - v_{1s}\right). \tag{35}$$

Analogous conditions apply to the central bank of country 2, while the government budget constraints are unaltered. Furthermore, the goods-market-clearing conditions (16) do not change and the money-market condition (17) disappears with the common central bank, whereas the bond-market condition (18) is divided into

$$B_{1t}^1 + B_{2t}^1 + B_{1mt} = D_{1t} \text{ and } B_{1t}^2 + B_{2t}^2 + B_{2mt} = D_{2t}. \tag{36}$$

There are no changes to other equations. The linearized household intertemporal budget constraint (20), and therefore the solution for the change in consumption (21) for the monetary union solution, still applies, but with household wealth now written as $W_{1t} = R_{1t-1}B^1_{1t-1} + e_t R_{2t-1}B^2_{1t-1} + M_{1t-1}$. We next solve for the price level change for fixed exchange rate regimes, including a regular peg, a currency board and dollarization, and for more flexible exchange rate regimes that incorporate a pure float, a crawling peg, or a managed float.

3.2.1. Fixed exchange rate regimes

ERM II here is considered as an arrangement where the exchange rate is credibly fixed. The solutions for fixed exchange rate regimes naturally also apply to countries that have a fixed rate regime during stage 1. A fixed exchange rate, i.e. $e_t = e_{t+1} = \overline{e}$, implies through equation (32) that the price level changes of the two countries cannot differ, i.e. $\frac{\bar{P}_{1t}}{\bar{P}_1} = \frac{\bar{P}_{2t}}{\bar{P}_2}$. If country 2 (EMU) is engaged in inflation targeting with $\frac{\overline{P}_{2t+1}}{\overline{P}_2} = 1 + \mu_2$, then the steady-state price level change of country 1 (the candidate country) must also be $\frac{\overline{P}_{1t+1}}{\overline{P}_1} = 1 + \mu_2$. Furthermore, the interest rate parity condition (27) implies that, with a credibly fixed exchange rate, the interest rates of the two countries cannot differ, i.e. $R_{1t} = R_{2t} = \frac{1+\mu_2}{\beta}$.

Assuming that fiscal policy is responsible in both countries, the procedure applied in the previous sections produces (see appendix)

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{P}_{2t}}{\overline{P}_2} \Rightarrow \frac{\widetilde{e}_t}{\overline{e}} = 0, \tag{37}$$

which implies that the exchange rate is indeed credibly fixed, when both conduct responsible fiscal policies. If fiscal policy is irresponsible in the candidate country and responsible in EMU, and assuming that the EMU price level is at the steady-

state level, we get

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{e}_t}{\overline{e}} = -\left(\frac{\overline{W}_1}{\overline{P}_1}\right)\widetilde{\tau}_{1t}, \tag{38}$$

which can also be written as

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{e}_t}{\overline{e}} = \left[\overline{R}_2\left(\overline{e}\overline{B}^2_{1t-1} - \overline{B}^1_{2t-1}\right) + \overline{D}_1\right]^{-1}\widetilde{D}_{1t} \tag{39}$$

(see appendix). Both equation (38) and (39) must equal zero for the exchange rate to be credibly fixed. If not, the candidate country may be forced to exit the peg. In other words, irresponsible fiscal policy is inconsistent with a fixed exchange rate.[13] All in all, there appears to be a paradox between the findings for the ERM II and the common currency stages. If the exchange rate is credibly fixed within the ERM II arrangement, the candidate country is essentially barred from having an irresponsible fiscal policy. However, it may engage in an irresponsible fiscal policy once it adopts the common currency!

Tighter forms of a peg include the currency board arrangement (CBA) and dollarization. A currency board has the following basic features: an exchange rate fixed by law; a reserve requirement stipulating that domestic currency is backed by foreign reserves; and a self-correcting balance of payments mechanism in which a payments deficit automatically contracts the money supply, resulting in a contraction of spending (Frankel 1999, 18). Instead of equation (33), the central bank's budget constraint for the CBA country can be written as

$$\overline{e}\frac{B^2_{1mt}}{P_{1t}} + v_{1t} = \overline{e}R_{2t-1}\left(\frac{B^2_{1mt-1}}{P_{1t}}\right) + \frac{M_{1t} - M_{1t-1}}{P_{1t}}, \tag{40}$$

where $v_{1t} = (R_{2t-1} - 1)\overline{e}\frac{B^2_{1mt-1}}{P_{1t}}$. Equation (40) reflects the fact that the domestic money supply has to be backed by foreign reserves, i.e. $\frac{M_{1t}-M_{1t-1}}{P_{1t}} =$

$\overline{e}\frac{B^2_{1mt}-B^2_{1mt-1}}{P_{1t}}$. Consequently, the bond-market equilibrium conditions (35) become

$$B^1_{1t} + B^1_{2t} = D_{1t} \text{ and } B^2_{1t} + B^2_{2t} + B_{1mt} + B_{2mt} = D_{2t}. \tag{41}$$

If both countries conduct responsible fiscal policies, the answer is again equation (37). Assuming that fiscal policy in country 1 would be irresponsible, while country 2 would be at the steady-state price level, again produces equation (38), as well as

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{e}_t}{\overline{e}} = \left[\overline{R}_2\left(\overline{e}\overline{B}^2_{1t-1} - \overline{B}^1_{2t-1} + \overline{e}\overline{B}^2_{1mt-1}\right) + \overline{D}_{1t}\right]^{-1}\widetilde{D}_{1t} \tag{42}$$

(details in appendix). As changes in the exchange rate are impossible, or at least very difficult, in the CBA, equation (42) would have to equal zero. Irresponsible fiscal policies are thus inconsistent with the CBA arrangement. Increasing debt would result in the loss of reserves, which would eventually lead to the abandonment of the CBA. Hence, the CBA implies even tighter fiscal discipline on a country than a regular peg. Indeed, authorities committed to the CBA are likely to also be committed to the responsible fiscal policies required.

Dollarization means replacing a country's own currency fully with the currency of a foreign country, and thus abandoning the issue of domestic currency altogether.[14] The interest rate differential, which consists of a country premium (perceived risk of default) and a small currency premium, diminishes as the latter factor disappears with dollarization and the other one falls. The government budget constraints for both countries are affected. The seigniorage revenues for country 1 disappear and the government budget constraint for the dollarized country is thus written as

$$\overline{g}_1 + R_{1t-1}\left(\frac{D_{1t-1}}{P_{1t}}\right) = \tau_{1t} + \frac{D_{1t}}{P_{1t}}, \tag{43}$$

so that government 2 now benefits from increased seigniorage revenues. If we assume that arbitrage applies, there is only one price level. Moreover, the country risk premium is ignored and the interest rate parity continues to apply, $R_{1t} = R_{2t}$, but we continue to separate bonds by countries. Thus, the bond-market equilibrium conditions are written as

$$B^1_{1t} + B^1_{2t} = D_{1t} \text{ and } B^2_{1t} + B^2_{2t} + B_{2mt} = D_{2t}. \tag{44}$$

and in addition there is a money market condition $M^2_{1t} + M^2_{2t} = M^2_t$. If both countries conduct responsible fiscal policies, then the common price level is not affected by the fiscal variables. However, if the dollarized country conducts an irresponsible fiscal policy, then the percent change in the price level can be defined as (see appendix)

$$\frac{\widetilde{P}_t}{\overline{P}} = \frac{\widetilde{D}_{1t}}{\overline{D}_1}, \tag{45}$$

which is the same as equation (24) for the monetary union case. Hence, a rise in the level of debt of the dollarized country raises the common price level of both countries. From the view point of the other countries using the dollar, dollarization of a country conducting irresponsible fiscal policies, is thus not desirable.

As there is no exchange rate constraint, dollarization does not prevent irresponsible fiscal policies in the same manner as e.g. the currency board.[15] However, irresponsible fiscal policy may force a country to abandon the system eventually as debt simply gets too large. Therefore, even though dollarization does not, as such, impose responsible fiscal policy, it promotes responsible policies by making it very difficult – not to mention costly – to reverse official dollarization. Thus, dollarization in itself, like the CBA, supports the credibility of a commitment to responsible policies. Due to tighter constraints on the central bank, irresponsi-

ble fiscal policy is likely to lead to a crisis faster in a CBA or dollarization than in a regular peg. The price level rise caused by irresponsible fiscal policy in the dollarized country may also affect the exchange rate of the dollar, even though it is assumed that the dollarized country is small relative to the US, or in case of euroization, the euro area.

3.2.2. Floating exchange rate regimes

In a pure float, both central banks are assumed conduct a monetary regime of inflation targeting. The inflation target for the candidate country is determined as $\frac{P_{1t+1}}{P_{1t}} = 1 + \mu_1$, while that of the monetary union is defined as $\frac{P_{2t+1}}{P_{2t}} = 1 + \mu_2$. The relative interest rates are thus $R_{1t} = \frac{1+\mu_1}{\beta}$ and $R_{2t} = \frac{1+\mu_2}{\beta}$. The uncovered interest rate parity implies that the steady state change in the exchange rate can be determined as

$$\frac{\overline{e}_{t+1}}{\overline{e}} = \frac{1+\mu_1}{1+\mu_2}, \tag{46}$$

which implies a trend appreciation or depreciation of the exchange rate, if $\mu_1 \neq \mu_2$.

Assuming that fiscal policy is responsible in both countries gives for the price level change in country 1 (see appendix)

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{P}_{2t}}{\overline{P}_2} \Rightarrow \frac{\widetilde{e}_t}{\overline{e}} = 0. \tag{47}$$

Therefore, if both countries conduct responsible fiscal policies, there are no deviations from the steady-state path of the exchange rate. When the candidate country conducts an irresponsible fiscal policy and assuming that the monetary union is in a steady state, we get (see appendix)

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \frac{\widetilde{e}_t}{\overline{e}} = \left(\overline{e}\overline{R}_2\overline{B}^2_{1t-1} - \overline{R}_1\overline{B}^1_{2t-1} + \overline{D}_1\right)^{-1} \widetilde{D}_{1t}, \tag{48}$$

i.e. the price level of country 1 would rise proportionally to the rise in the level of debt, the proportion depending on the steady-state net foreign interest payments plus the steady-state debt of country 1. The price level rise of country 1 implies a nominal exchange rate depreciation. Thus, a flexible exchange rate absorbs the price level rise and therefore sets no constraints on fiscal policy.

With a crawling peg regime, the central bank of the candidate country targets a specific periodic rate of change for the exchange rate, defined here as $\frac{e_{t+1}}{e_t} = 1+\lambda_1$, while the central bank of the monetary union still has inflation targeting. Thus, in the steady state

$$\left(\frac{\overline{P}_{1t+1}}{\overline{P}_1}\right) = (1+\lambda_1)(1+\mu_2)\,. \tag{49}$$

Moreover, the uncovered interest rate parity implies

$$R_{1t} = \left(\frac{1+\mu_2}{\beta}\right)(1+\lambda_1)\,. \tag{50}$$

The solution is the same as for the pure float with inflation targeting.

In a managed float, the central bank has a certain (often unannounced) target path for the exchange rate. As the other central bank is engaged in inflation targeting, the solution for a managed float is similar to that of a pure float with inflation targeting. Hence, the more flexible regimes are able to absorb the effects of irresponsible fiscal policy. Irresponsible fiscal policy only implies that the central bank may not meet its monetary policy targets.

3.3. Rational expectations

As the public has rational expectations it can be assumed that the knowledge of the upcoming EMU entry already affects its price level. To find out the effects, the

first-order conditions (4) and (26) are here linearized around the common currency steady state

$$\frac{\widetilde{m}_{1t}}{\overline{m}_{EMU}} = \frac{\widetilde{c}_{1t}}{\overline{c}_{EMU}} \tag{51}$$

$$\begin{aligned}(1-d)\left(\frac{\widetilde{m}_{1t}}{\overline{m}_{EMU}} - \frac{\widetilde{c}_{1t}}{\overline{c}_{EMU}}\right) &= (1-d)\left(\frac{\widetilde{m}_{1t+1}}{\overline{m}_{EMU,t+1}} - \frac{\widetilde{c}_{1t+1}}{\overline{c}_{EMU,t+1}}\right) \\ &\quad + \frac{\widetilde{P}_{1t}}{\overline{P}_{EMU}} - \frac{\widetilde{P}_{1t+1}}{\overline{P}_{EMU,t+1}},\end{aligned} \tag{52}$$

where the overbars indicate EMU steady-state values in period t (for steady states that differ from those of period t, the period is noted), and tildes denote deviations from the EMU steady state. Equations (51) and (52) imply that

$$\begin{aligned}\frac{\widetilde{P}_{1t}}{\overline{P}_{EMU}} &= \frac{\widetilde{P}_{t+1}}{\overline{P}_{EMU,t+1}} \Rightarrow \frac{P_{1t} - \overline{P}_{EMU}}{\overline{P}_{EMU}} = \frac{P_{1t+1} - \overline{P}_{EMU,t+1}}{\overline{P}_{EMU,t+1}} \\ &\Rightarrow \frac{P_{1t+1}}{P_{1t}} = \frac{\overline{P}_{EMU,t+1}}{\overline{P}_{EMU}} = 1 + \mu_{EMU}.\end{aligned} \tag{53}$$

Hence, the candidate country's price level jumps at the time of the announcement and continues thereafter at the EMU steady-state level. In other words, candidate countries should align their monetary policies with those of the EMU. For example, an inflation targeting candidate country should set its inflation target similar to that of EMU when it announces its future intention to adopt the common currency. Furthermore, to achieve these targets, they should conduct responsible fiscal policies in accordance with the Maastricht criteria.

4. Policy implications

The analysis in the previous section implies that the price level is affected by irresponsible fiscal policy in all exchange rate regimes. Indeed, there is no exchange rate regime that would in itself impose fiscal policy responsibility. Thus, the choice of the exchange rate regime is closely connected with the general level of commitment of the authorities. The credibility of responsible policies may be enhanced by a commitment to a more fixed exchange rate regime, while more flexible regimes can better absorb the effects of irresponsible policies.

In a monetary union, the price level is affected by fiscal policy as the rise in the debt of just one member country raises the common price level throughout the union. In other words, the inflation target will not be achieved without help from the fiscal authorities. Thus, to guarantee price stability within the euro area, EU guidelines in the area of public finances need to be strengthened.

The Maastricht criteria require fiscal responsibility and price stability from the countries aiming to adopt the euro. Until recently, the choice of exchange rate regime has aroused more concern than the question of fiscal policy in the discussions between the EU and the candidate countries. However, the Maastricht criteria are not officially on the table until the ERM II stage. According to the results in the previous section, ERM II should force the candidate countries to conduct responsible fiscal policies and thus bring price level changes in line with those of the euro area. The central assumption here is that the exchange rate is credibly fixed within the ERM II, which may not be the case considering the current flexible arrangement. Concisely, there appears to be a paradox between the ERM II stage and the final stage of adopting the euro, as irresponsible fiscal

policy is impossible during the ERM II stage but again possible in the final stage.

Presently, there are several exchange rate regimes in place in the candidate countries. In general, fixed exchange rate regimes imply more responsible policies, as exiting the regime is often very costly. In more flexible regimes, responsible policies are not a strict requirement, as the exchange rate can adjust. Here, irresponsible policies only mean that the central bank may not meet its goals. Regimes that are tighter than a standard peg, e.g. currency boards and dollarization (euroization), set even higher demands for fiscal policy to be responsible. Exiting these regimes is extremely difficult. The currency board seems appropriate to function as a substitute for the ERM II arrangement, while the case for euroization is less clear. The EU has nonetheless ruled out the possibility, which is understandable considering the possibility that irresponsible fiscal policy in the candidate country might raise the price level in the monetary union.

As the household has rational expectations, the knowledge of the upcoming ERM II entry and adoption of the common currency affects the candidate country's current price level. Indeed, the candidate country's price level jumps at the time of the announcement and continues after that on the EMU steady-state level. In other words, the candidate countries should align their monetary policies with those of the EMU already when the future entry is announced. This is also necessary to prevent arbitrage opportunities at the time of the ERM II peg.

What exchange rate regime should a euro-area aspirant then choose according to this analysis? From the fiscal policy point of view, a country with irresponsible fiscal policy is better off choosing a more flexible regime, as exiting a fixed regime would certainly not impress the EU at this point. Countries with responsible fiscal policies, on the other hand, may enhance the credibility of their policies by

committing to a fixed regime. Nevertheless, it should not be forgotten that this is only one factor in the determination of the appropriate exchange rate regime.

5. Conclusions

Several Central and Eastern European countries will become euro-area members in the near future. Hence, debate on the appropriate exchange rate regime and nominal convergence will remain major topics. Responsible fiscal, monetary, and exchange rate policies should, however, not be solely viewed as methods to gain euro-area membership, but rather as permanent policies.

The Fiscal Theory of the Price Level, despite severe criticism, seems a proper way to combine these aspects. In fact, while no incontestable proof of the existence of the so-called fiscal dominant regimes has been presented, it may be attributable to several factors. In this paper, it was shown that irresponsible fiscal policies are inconsistent with fixed exchange rate regimes, while in earlier literature, it has been illustrated how irresponsible fiscal policy may lead to a currency crisis. On the other hand, governments appear to adjust their fiscal policy when debt gets too large. Thus, it seems appropriate to conclude, as Christiano and Fitzgerald (2000), that the fiscal dominance assumption is not a good characterization of policy in all times and places. Nevertheless, it may be a useful characterization of actual policies in certain contexts.

The analysis in this paper shows that the price level is affected by irresponsible fiscal policy in all exchange rate regimes, while the price level is unaffected by fiscal variables when policy is responsible. Furthermore, no exchange rate regime in itself is sufficient to impose responsible fiscal policy, the commitment by the authorities to conduct such policies is also needed.

For a monetary union, it was found, like in Bergin (2000), that irresponsible fiscal policy raises the price level of the entire union. Paradoxically, irresponsible fiscal policy will not be possible during the ERM II stage if the exchange rate is credibly fixed within the arrangement. Prior to participation in the ERM II, a general guideline in the determination of the appropriate exchange rate regime is that fixed regimes require responsible fiscal policies, whereas flexible regimes can better adjust to irresponsible policies.

Further research in the area of the fiscal determinants of inflation is clearly needed. One possible topic could be examining empirically the relationship between the fiscal variables and some crisis indicators. The amount of data available for CEECs is constantly increasing, which will facilitate empirical analyses in the future. Another line of research could focus on the relationship between the results from this research and other determinants in the choice of an appropriate exchange rate regime.

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7. Appendix

7.1. Monetary union

The linearized first-order conditions (3), (4) and (5) are

$$\frac{\widetilde{c}_{1t}^2}{\overline{c}_1^2} - \frac{\widetilde{c}_{1t}^1}{\overline{c}_1^1} = \frac{\widetilde{p}_t^1}{\overline{p}^1} - \frac{\widetilde{p}_t^2}{\overline{p}^2} \tag{54}$$

$$(1-d)\left(\frac{\widetilde{m}_{1t}}{\overline{m}_1} - \frac{\widetilde{c}_{1t}}{\overline{c}_1}\right) = (1-d)\left(\frac{\widetilde{m}_{1t+1}}{\overline{m}_{1t+1}} - \frac{\widetilde{c}_{1t+1}}{\overline{c}_{1t+1}}\right) + \frac{\widetilde{P}_t}{\overline{P}_t} - \frac{\widetilde{P}_{t+1}}{\overline{P}_{t+1}} \tag{55}$$

$$\widetilde{m}_{1t} = \left(\frac{1-d}{d}\right)\left(\frac{R_t}{R_t-1}\right)\widetilde{c}_{1t}. \tag{56}$$

From conditions (55) and (56) we get that $\frac{\bar{P}_t}{\overline{P}_t} = \frac{\bar{P}_{t+1}}{\overline{P}_{t+1}}$. Imposing this and condition (56) on equation (20), we can solve for current consumption (equation (21) in the text).

Two results used here (and later on) are the goods markets clearing condition that joint consumption is constant $\widetilde{c}_{1t} + \widetilde{c}_{2t} = 0$ and the condition stating that $\frac{\bar{p}_t^1}{\bar{p}^1} = \frac{\bar{p}_t^2}{\bar{p}^2} = \frac{\bar{P}_t}{\overline{P}}$.

Proof ($\widetilde{c}_{1t} + \widetilde{c}_{2t} = 0$):

$$c_{1t} = \frac{p_t^1}{P_t}c_{1t}^1 + \frac{p_t^2}{P_t}c_{1t}^2 \text{ and } c_{2t} = \frac{p_t^1}{P_t}c_{2t}^1 + \frac{p_t^2}{P_t}c_{2t}^2 \tag{57}$$

$$\begin{aligned}
\widetilde{c}_{1t} + \widetilde{c}_{2t} &= \left[\frac{\widetilde{p}_s^1}{\overline{P}} - \left(\frac{\overline{p}^1}{\overline{P}}\right)\left(\frac{\widetilde{P}_s}{\overline{P}}\right)\right](\overline{c}_1^1 + \overline{c}_2^1) + \frac{\overline{p}^1}{\overline{P}}\left(\widetilde{c}_{1t}^1 + \widetilde{c}_{2t}^1\right) \\
&\quad + \left[\frac{\widetilde{p}_s^2}{\overline{P}} - \left(\frac{\overline{p}^2}{\overline{P}}\right)\left(\frac{\widetilde{P}_s}{\overline{P}}\right)\right](\overline{c}_2^1 + \overline{c}_2^2) + \frac{\overline{p}^2}{\overline{P}}\left(\widetilde{c}_{1t}^2 + \widetilde{c}_{2t}^2\right) \\
&= \left[a\left(\frac{\widetilde{p}_t^1}{\overline{p}^1}\right) + (1-a)\left(\frac{\widetilde{p}_t^2}{\overline{p}^2}\right) - \frac{\widetilde{P}_t}{\overline{P}}\right](\overline{c}_1 + \overline{c}_2) \\
&= 0,
\end{aligned} \tag{58}$$

as linearizing equation (6) produces

$$\frac{\widetilde{P}_t}{\overline{P}} = a\left(\frac{\widetilde{p}_t^1}{\overline{p}^1}\right) + (1-a)\left(\frac{\widetilde{p}_t^2}{\overline{p}^2}\right). \tag{59}$$

Proof ($\frac{\bar{p}_t^1}{\bar{p}^1} = \frac{\bar{p}_t^2}{\bar{p}^2} = \frac{\bar{P}_t}{\bar{P}}$):

Imposing $c_{1t}^1 = a\frac{P_t}{p_t^1}c_{1t}$, $c_{1t}^2 = (1-a)\frac{P_t}{p_t^2}c_{1t}$, $c_{2t}^1 = a\frac{P_t}{p_t^1}c_{2t}$ and $c_{2t}^2 = (1-a)\frac{P_t}{p_t^2}c_{2t}$ on the goods market clearing conditions (16) and linearizing produces

$$a\left[\left(\frac{\widetilde{P}_t}{\overline{P}} - \frac{\widetilde{p}_t^1}{\overline{p}^1}\right)\left(\frac{\overline{P}}{\overline{p}^1}\right)(\overline{c}_1 + \overline{c}_2) + \frac{\overline{P}}{\overline{p}^1}(\widetilde{c}_{1t} + \widetilde{c}_{2t})\right] = 0 \tag{60}$$

and

$$(1-a)\left[\left(\frac{\widetilde{P}_t}{\overline{P}} - \frac{\widetilde{p}_t^2}{\overline{p}^2}\right)\left(\frac{\overline{P}}{\overline{p}^2}\right)(\overline{c}_1 + \overline{c}_2) + \frac{\overline{P}}{\overline{p}^2}(\widetilde{c}_{1t} + \widetilde{c}_{2t})\right] = 0, \tag{61}$$

which imply that

$$\frac{\widetilde{p}_t^1}{\overline{p}^1} = \frac{\widetilde{p}_t^2}{\overline{p}^2} = \frac{\widetilde{P}_t}{\overline{P}}. \tag{62}$$

The fiscal rule for country 1 implies that $E_t \sum_{s=t}^{\infty} \beta^{s-t}(\widetilde{\tau}_{1s}) = \widetilde{\tau}_{1t}$, while for country 2

$$\sum_{s=t}^{\infty} \beta^{s-t}(\widetilde{\tau}_{2s}) = \overline{R}\left[\frac{\widetilde{D}_{2t-1}}{\overline{P}} - \left(\frac{\overline{D}_{2t-1}}{\overline{P}}\right)\left(\frac{\widetilde{P}_t}{\overline{P}}\right)\right] + \sum_{s=t}^{\infty} \beta^{s-t}(\widetilde{v}_{2s}) \tag{63}$$

by definition of fiscal policy in country 2 and the linearized government intertemporal budget constraint (11), where the last term is solved from the linearized central bank intertemporal budget constraint (15)

$$\sum_{s=t}^{\infty} \beta^{s-t}(\widetilde{v}_{2s}) = \omega_2\left[\overline{R}\frac{\widetilde{B}_{mt-1}}{\overline{P}} - \frac{\widetilde{M}_{t-1}}{\overline{P}} + \left(\frac{\overline{M}_{t-1}}{\overline{P}} - \overline{R}\frac{\overline{B}_{mt-1}}{\overline{P}}\right)\left(\frac{\widetilde{P}_t}{\overline{P}}\right)\right]. \tag{64}$$

Substituting these into equation (22) we arrive at equation (23) in the text. To arrive at equation (24), we define

$$\sum_{s=t}^{\infty}\beta^{s-t}\left(\widetilde{\tau}_{1s}\right) = \widetilde{\tau}_{1t}=\overline{R}\left[\frac{\widetilde{D}_{1t-1}}{\overline{P}}-\left(\frac{\overline{D}_{1t-1}}{\overline{P}}\right)\left(\frac{\widetilde{P}_t}{\overline{P}}\right)\right]-\frac{\widetilde{D}_{1t}}{\overline{P}} + \left(\frac{\overline{D}_1}{\overline{P}}\right)\left(\frac{\widetilde{P}_t}{\overline{P}}\right)-\left(\widetilde{v}_{1t}\right) \tag{65}$$

by description of fiscal policy in country 1 and the government linearized flow budget constraint (9), where the rebates are defined according to equation (13).

Verifying that the steady state exists: The household intertemporal budget constraint (8) in the steady state is

$$\frac{\overline{W}_1}{\overline{P}}=\frac{1}{1-\beta}\left(\overline{c}_1+\overline{\tau}_1+\frac{\overline{R}-1}{\overline{R}}\overline{m}_1-\frac{\overline{p}^1}{\overline{P}}\overline{y}_1\right), \tag{66}$$

which together with the steady-state first-order condition (4)

$$\overline{m}_1=\left(\frac{1-d}{d}\right)\left(\frac{\overline{R}}{\overline{R}-1}\right)\overline{c}_1, \tag{67}$$

solves for consumption

$$\overline{c}_1=d\left[\left(1-\beta\right)\frac{\overline{W}_1}{\overline{P}}+\frac{\overline{p}^1}{\overline{P}}\overline{y}_1-\overline{\tau}_1\right]. \tag{68}$$

The steady state government budget constraint for both countries can be written as

$$\overline{\tau}_1=\overline{\tau}_2=\overline{g}_1-\overline{v}_1+\frac{\left(1-\beta\right)}{\beta}\frac{\overline{D}_1}{\overline{P}}, \tag{69}$$

which is the same for the flow budget constraint (9) and the intertemporal budget constraint (11) and thus for responsible and irresponsible policies alike. The central bank rebates are solved from the central bank equations (13) and (15), which gives

$$\overline{v}_1=\omega_1\left[\frac{\overline{R}-1}{\overline{R}}\overline{m}-\left(1-\beta\right)\left(\frac{\overline{M}_{t-1}}{\overline{P}}-\overline{R}\frac{\overline{B}_{mt-1}}{\overline{P}}\right)\right]=\omega_1\overline{v} \tag{70}$$

$$\overline{v}_2 = \omega_2 \overline{v}. \tag{71}$$

Summing the consumption functions of both countries, substituting equations (69), (70) and (71) and imposing the goods-market-clearing conditions (16) gives

$$\begin{aligned} \overline{c}_1 + \overline{c}_2 &= \frac{\overline{p}^1}{\overline{P}} \left(\overline{c}_1^1 + \overline{c}_2^1 \right) + \frac{\overline{p}^2}{\overline{P}} \left(\overline{c}_1^2 + \overline{c}_2^2 \right) \\ &\quad + (1-\beta) \frac{\overline{W}}{\overline{P}} + \frac{(1-\beta)}{\beta} \frac{\overline{B}_m}{\overline{P}} - \frac{(1-\beta)}{\beta} \left(\frac{\overline{D}_1}{\overline{P}} + \frac{\overline{D}_2}{\overline{P}} \right) - \frac{(1-\beta)}{\beta} \frac{\overline{M}}{\overline{P}} \\ &= \frac{\overline{p}^1}{\overline{P}} \left(\overline{c}_1^1 + \overline{c}_2^1 \right) + \frac{\overline{p}^2}{\overline{P}} \left(\overline{c}_1^2 + \overline{c}_2^2 \right). \end{aligned} \tag{72}$$

7.2. Two currencies

Linearized first order conditions (26) for country 1 are

$$\begin{aligned} (1-d) \left(\frac{\widetilde{m}_{1t}}{\overline{m}_1} - \frac{\widetilde{c}_{1t}}{\overline{c}_1} \right) &= (1-d) \left(\frac{\widetilde{m}_{1t+1}}{\overline{m}_{1t+1}} - \frac{\widetilde{c}_{1t+1}}{\overline{c}_{1t+1}} \right) \\ &\quad + \frac{\widetilde{P}_{1t}}{\overline{P}_1} - \frac{\widetilde{P}_{1t+1}}{\overline{P}_{1t+1}} + \frac{\widetilde{e}_{t+1}}{\overline{e}_{t+1}} - \frac{\widetilde{e}_t}{\overline{e}}, \end{aligned} \tag{73}$$

which together with the foreign equation and the definition of the exchange rate gives for all exchange rate regimes that $\frac{\bar{P}_{1t+1}}{\overline{P}_{1t+1}} = \frac{\bar{P}_{1t}}{\overline{P}_1}$.

7.2.1. Fixed exchange rate regimes

Regular peg: The consumption equation (21) still applies, as from the goods market clearing conditions we get that $\frac{\bar{p}^1_{1s}}{\overline{p}^1_1} = \frac{\bar{P}_{1s}}{\overline{P}_1}$ and $\frac{\bar{p}^2_{2s}}{\overline{p}^2_2} = \frac{\bar{P}_{2s}}{\overline{P}_2}$. Assuming that both countries have a responsible fiscal policy - substituting equation (63) and (64), where P_t now refers to each country's own price level, in the consumption equation of both countries - and imposing the goods market clearing condition

$\widetilde{c}_{1t} + \widetilde{c}_{2t} = 0$, produces

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right)\left(\overline{e}\frac{\overline{B}^2_{1t-1}}{\overline{P}_1} - \frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right) = \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{1}{\overline{e}}\frac{\overline{B}^1_{2t-1}}{\overline{P}_2}\right), \tag{74}$$

which gives equation (37) in the text. Assuming that country 1 has an irresponsible fiscal policy and country 2 a responsible fiscal policy, equations (63) and (64) substituted in the consumption equation of country 2 brings, as joint consumption is constant,

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left(\frac{\overline{W}_1}{\overline{P}_1}\right) = \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\overline{R}_2\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{\overline{e}\overline{B}^1_{2t-1}}{\overline{P}_2}\right) - d\widetilde{\tau}_{1t} \tag{75}$$

and substituting further equation (65), where P_t now refers to the price level of country 1, here

$$\begin{aligned} & \left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left[\overline{R}_2\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right) + \frac{\overline{D}_{1t}}{\overline{P}_1}\right] \\ = & \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\overline{R}_2\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right) + d\frac{\widetilde{D}_{1t}}{\overline{P}_1}. \end{aligned} \tag{76}$$

Then assuming that country 2 is in a steady state $\frac{\bar{P}_{2t}}{\overline{P}_2} = 0$, we arrive at equations (38) and (39) in the text.

Currency board: Assuming that both countries have a responsible fiscal policy, substituting equations (63) and (64) in the consumption equations and imposing the goods-market-clearing condition $\widetilde{c}_{1t} + \widetilde{c}_{2t} = 0$, produces

$$\begin{aligned} & \left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right)\left(\overline{e}\frac{\overline{B}^2_{1t-1}}{\overline{P}_1} - \frac{\overline{B}^1_{2t-1}}{\overline{P}_1} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right) \\ = & \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{1}{\overline{e}}\frac{\overline{B}^1_{2t-1}}{\overline{P}_2} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right), \end{aligned} \tag{77}$$

which gives again equation (37) in the text. Assuming that country 1 has an irresponsible and country 2 a responsible fiscal policy, equations (63) and (64) again

substituted in the consumption equation of country 2 brings, as joint consumption is constant,

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left(\frac{\overline{W}_1}{\overline{P}_1}\right) = \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right) \overline{R}_2 \left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{\overline{e}\overline{B}^1_{2t-1}}{\overline{P}_2} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right) - d\widetilde{\tau}_{1t}, \quad (78)$$

which equals equation (38), when it is assumed that $\frac{\bar{P}_{2t}}{\overline{P}_2} = 0$. Substituting further equation (65) in equation (78) gives

$$\begin{aligned} & \left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left[\overline{R}_2 \left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{\overline{B}^1_{2t-1}}{\overline{P}_1} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right) + \frac{\overline{D}_{1t}}{\overline{P}_1}\right] \quad (79) \\ = & \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right) \overline{R}_2 \left(\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \frac{\overline{B}^1_{2t-1}}{\overline{P}_1} + \overline{e}\frac{\overline{B}^2_{1mt-1}}{\overline{P}_1}\right) + d\frac{\widetilde{D}_{1t}}{\overline{P}_1}. \end{aligned}$$

If it is then assumed that $\frac{\bar{P}_{2t}}{\overline{P}_2} = 0$, we get

$$\frac{\widetilde{P}_{1t}}{\overline{P}_1} = \left[\overline{W}_1 - \overline{R}_2\overline{D}_{1t-1} + \overline{D}_1\right]^{-1} \widetilde{D}_{1t}, \quad (80)$$

which is the same as equation (42) in the text.

Dollarization: Households maximize (1) with regard to B^1_{1t}, B^2_{1t} and m_{2t} subject to

$$\begin{aligned} & c_{1t} + \frac{M^2_{1t}}{P_t} + \frac{B^1_{1t}}{P_t} + \frac{B^2_{1t}}{P_t} + \tau_{1t} \quad (81) \\ = & \frac{p^1_t}{P_t} y_{1t} + \frac{M^2_{1t-1}}{P_t} + R_{1t-1}\frac{B^1_{1t-1}}{P_t} + R_{2t-1}\frac{B^2_{1t-1}}{P_t}. \end{aligned}$$

Assuming that country 1 has an irresponsible fiscal policy and country 2 a responsible fiscal policy and substituting equations (63) and (64) in the consumption equation of country 2 gives, as joint consumption is constant,

$$\left(\frac{\widetilde{P}_t}{\overline{P}}\right) = -\overline{R}_2 \left(\frac{\overline{D}_{1t-1}}{\overline{P}}\right) \widetilde{\tau}_{1t}. \quad (82)$$

Further substituting equation (65) here gives equation (45) in the text.

7.2.2. Floating exchange rate regimes

Assuming both countries have a responsible fiscal policy, substituting equations (63) and (64) in the consumption equations and imposing the goods-market-clearing condition $\widetilde{c}_{1t} + \widetilde{c}_{2t} = 0$ produces

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right)\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right) = \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right), \quad (83)$$

which gives equation (47) in the text. Assuming that country 1 has an irresponsible fiscal policy and country 2 a responsible fiscal policy, equations (63) and (64) again substituted in the consumption equation of country 2 brings (as joint consumption is constant)

$$\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left(\frac{\overline{W}_1}{\overline{P}_1}\right) = \left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right) - d\widetilde{\tau}_{1t}, \quad (84)$$

which gives equation (38), assuming that $\frac{\bar{P}_{2t}}{\overline{P}_2} = 0$. Further substituting equation (65) in equation (84) gives

$$\begin{aligned} &\left(\frac{\widetilde{P}_{1t}}{\overline{P}_1}\right) d\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1} + \frac{\overline{D}_{1t}}{\overline{P}_1}\right) \\ = \quad &\left(\frac{\widetilde{P}_{2t}}{\overline{P}_2}\right)\left(\overline{R}_2\frac{\overline{B}^2_{1t-1}}{\overline{P}_2} - \overline{R}_1\frac{\overline{B}^1_{2t-1}}{\overline{P}_1}\right) + d\frac{\widetilde{D}_{1t}}{\overline{P}_1}, \end{aligned} \quad (85)$$

which, assuming that $\frac{\bar{P}_{2t}}{\overline{P}_2} = 0$, yields equation (48) in the text.

Notes

[1]Under the FTPL, the government's present value budget constraint is treated as an equilibrium condition. It states that the real value of existing public sector liabilities must equal the present value of current and future primary surpluses (inclusive of central bank transfers).

[2]Carlstrom and Fuerst (2000) also divide the FTPL into two parts – weak-form FTPL and strong-form FTPL – according to which policymaker moves first. Under the weak-form version, it is assumed that the fiscal authority moves first by committing to a path for primary budget surpluses or deficits, forcing the monetary authority to generate the seigniorage needed to maintain solvency. If both authorities refuse to generate the needed seigniorage, then the nation's debt-to-GDP ratio will grow at an unsustainable rate until one of the authorities alters its behavior. In the strong-form version, fiscal policy determines future inflation but is independent of future monetary growth. Carlstrom and Fuerst argue that this version, as in many monetary models, is possible as the initial price level is not pinned down. Different initial price levels are consistent with different paths for future inflation. Hence, it is assumed that the fiscal budget constraint pins down the initial price level. The strong-form version assumes that both fiscal and monetary policies are given exogenously and that prices adjust to ensure solvency.

[3]Fiscal policy is argued not to have an effect on the price level due to the Ricardian equivalence proposition, which implies that if consumers have rational expectations, fiscal policy should have no effect upon aggregate demand, and hence, no effect upon inflation.

[4]Canzoneri et al. (1998a,b) define policies according to whether fiscal or monetary policy provides the nominal anchor for the economy. In the fiscal dominant regime (FD), primary surpluses are determined independently of the debt level. The path of the money supply and the price level must also satisfy the needs of fiscal solvency (monetary policy has to work through seigniorage to control the price level), whereas in the money dominant regime (MD), primary surpluses respond to the level of debt in a way that assures fiscal solvency, and money and prices can be determined by the supply and demand for money.

[5]Cochrane (2001) finds the maturity structure of the debt matters. Long-term debt may help stabilize inflation in some cases.

[6]Bofinger (2000) claims the ECB relies on a Taylor rule in its internal decision-making.

[7]In an empirical study, Lane and Milesi-Ferretti (2000) find a relationship between debt and the real exchange rate, i.e. debtor countries tend to have depreciated real exchange rates, while creditor countries have appreciated real exchange rates.

[8]Dupor (2000) uses a single government present value budget constraint, while in Canzoneri et al. (1998a, 2000a) each government faces its own PVBC.

[9]Lane and Perotti (2001) also examine the interaction of fiscal policy and the exchange rate regime, asking whether the exchange rate regime makes a difference in the transmission of fiscal policy and what are the effects of the composition of a given movement in fiscal policy. They find for the OECD countries that increases in wage government spending raise the real product wage and decrease profitability

in the traded sector, which effects are larger with flexible exchange rate regimes.

[10]Canzoneri et al. (1998b) develop restrictions that enable differentiation between MD and FD regimes. In a MD regime, the fiscal surplus in period t pays off some period t+1 debt, whereas in a FD regime, there are several possibilities depending on the correlation between the current surplus and future surpluses and discount factors. In case of a no-correlation, the period t+1 debt is not affected by the period t surplus, while in case of positive correlation, period t+1 debt rises. In both cases, the regimes can be differentiated. If the correlation is negative, period t+1 debt will fall in both regimes, resulting in a differentiation problem.

[11]Bergin (2000) uses a single common consumption good.

[12]Bergin (2000) characterizes monetary policy in the first case by a nominal interest rate peg and in the second case by a price stability target, where the central bank does not tolerate deviations from the steady-state price level.

[13]The literature on currency crises supports this result. Krugman (1979) notes that in first-generation currency crises, irresponsible fiscal policy leads to increasing debt and finally to a currency crisis. Daniel (2001) argues that a currency crisis takes place when the fiscal authority lets the present value of primary surpluses, inclusive of seigniorage, differ from the value of government debt at the fixed exchange rate. Corsetti and Mackowiak (2001), in their study on size and timing of devaluations within in the FTPL framework, find that real debt acts as leverage. Devaluations are smaller when nominal liabilities are a larger fraction of the total debt and long-term nominal debt helps the government delay the devaluation.

[14]Specific, this is official dollarization as opposed to unofficial dollarization,

whereby domestic residents at least partly rely on a foreign currency in their domestic transactions. Unofficial dollarization is typically a reaction to high domestic inflation levels.

[15]Indeed, Fatás and Rose (2001) find in their empirical study that dollarization is associated with higher spending, while currency boards are characterized with fiscal restraint.

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