

The Use of the Euro as a National Currency Substitute*

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Abstract

The subject of this paper is the use of the euro as a national currency substitute, a process known in the economic literature as euroisation. The advantages and disadvantages of this process are briefly discussed. The paper presents a theoretical model of a currency crisis in an economy with a currency board arrangement. Because of the possibility of a devaluation of the local currency and of involvement of the ECB in costly bail-out operations, it is concluded that the European Central Bank should support rather than oppose euroisation, at least in countries in which the euro is a reserve currency.

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1 Introduction

The subject of this paper is the use of the euro as a national currency substitute. This differs from membership of a country in the European Monetary Union (EMU), since national representatives will not participate in the governing council of the European Central Bank (ECB) and are not able to conduct or influence its monetary policy. Much research has been conducted on the use of the US Dollar as a national currency substitute, or dollarisation, as this process is called. The new European currency, the euro, also aims to become an international currency and its usage outside the borders of the EMU will surely increase its chances of doing so.

A distinction must be made between official and unofficial euroisation and between unilateral euroisation and euroisation performed with the agreement of the European institutions: unofficial euroisation refers to the accretion of deposits in euro in national commercial banks and in circulation whereas, official euroisation means that the euro is declared as (the only) official legal tender and is the only currency in circulation. Euroisation could be performed unilaterally, without the prior approval of any institutions of the European Union, as for example has happened in Kosovo or Montenegro, or, alternatively, after a mutual agreement between the ECB and a country. Recently proposals that the euro be adopted unilaterally have become even more insistent (see Nuti (2000), Gros (2001) and Rostowski (2001)) particularly in those Central and Eastern European countries which have already given up a significant part of their monetary policy independence and introduced a currency board regime - Estonia, Lithuania and Bulgaria (see Sulling (2000), and Habib (2001)). The European institutions in general, but especially the European Central Bank (ECB), strongly object to these demands (see appendix and Noyer (2001)). The reasons given for their objections, however, are mainly legal. Apart from this the ECB, although without acknowledging it, may be afraid that it could be forced to pump liquidity into the markets and that the money supply could go out of control.

The results of this paper suggest that the ECB instead of opposing euroisation, should support it in countries which presently have a currency board arrangement. Section two presents briefly the advantages and disadvantages of euroisation. Section three introduces the concept of a currency board arrangement, which is the institutional framework of the theoretical model presented in section four. Section five summarizes the results.

2 Costs and Benefits of Euroisation

2.1 Advantages of adopting the euro

The proponents of euroisation argue that adopting the euro as a national currency would bring sound monetary policy as well as monetary stability to Central and Eastern Europe. The risk of devaluation of the national currency

would disappear, which would lower the premia over national interest rates and lead to cheaper borrowing and higher investment. The increase in credibility in monetary policy would lower the risk premium over national interest rates which would, in turn, stimulate economic growth and welfare. The danger of exchange rate crises would disappear (see Nuti (2000) and Coricelli (2001); see also Berg and Borensztein (2000)). Furthermore, there would be lower transaction costs, thus stimulating international trade and economic integration.

A further advantage of euroisation is that it could solve the time inconsistency problem. In a famous article, Barro and Gordon (1983) show that the inability of policy-makers to commit themselves to a low inflation policy can increase excessive inflation: if expected inflation is low, so that the marginal costs of increasing inflation are low, the authorities will have an incentive to pursue an expansionary policy to push output (temporarily) above its normal level. However, the public's knowledge that the government has such incentives will mean that the public will not expect low inflation. The result is increased inflation without an increase in output. A possible solution of this problem is given by Giavazzi and Pagano (1988). According to them, fixing the exchange rate to a currency issued by a dominant central bank will lead to the desired credibility through an "import" of the monetary policy of the dominant central bank and a reduction in inflation expectations. Clearly, the dominant central bank must itself have solved the time inconsistency problem.

Simply fixing the exchange rate, on the other hand, will not help, since the public knows that this fix can easily be abandoned. Moreover, interest rates will contain a premium reflecting the risk of devaluation. Higher domestic interest rates in a system of fixed exchange rates can sooner or later cause risks leading to the abandonment of the regime. Therefore a more appropriate solution for the dynamic inconsistency problem is a currency board arrangement (CBA) or a currency substitution (The Economist (1994)). In both cases the exchange rate fix is determined by law and its abandonment is difficult.

According to some economists, however, the CBA fails to give a reasonable solution to the time inconsistency problem. Zaragaza (1995) argues that this is the case because countries which have introduced currency board arrangements already possess a lack of credibility due to "frequently broken commitments in the past".

Euroisation has an advantage over traditional fixed exchange rate regimes - it is more "irreversible". Although in theory a country can decide to reintroduce its own currency, in practice the chances of this happening are very low. Therefore, countries which perform such a regime are much less vulnerable to speculative attacks and currency crises than countries with normal exchange rates or currency boards.

2.2 Disadvantages

- Loss of Seignorage

Although euroisation is more advantageous than CBAs, it is also connected

with higher costs. These arise from the complete loss of seignorage in the case of euroisation. In the case of currency boards there are revenues from issuing money, which are still lower than in the case of monetary sovereignty. This is because currency boards hold foreign reserves of 100 per cent of the monetary base, albeit at a low interest rate because by law they have to be invested securely.

In every independent country with its own currency the revenues coming from the difference between the face value of bank notes and their printing cost flow into the national budget. If a country abolishes its national currency and adopts a foreign medium of exchange, it also relinquishes an important source of income which then goes to the country whose currency is used. As pointed out by Dietz (2001), seignorage costs accrue to the public whereas revenues from seignorage accrue to the national bank and through it to the local government. The net cost for the economy as a whole is zero¹. If, on the other hand, the country abolishes its national currency the net effect will be negative, whereas the net effect for the country whose currency is used is positive.

Furthermore in the context of "loss of seignorage" one should also consider the amount of reserves necessary to purchase the initial money stock of euro (see Schobert and Gros (2001); Tuma, Z. and T. Holub (2001)). These purchases should be enough to cover the whole monetary base as well as some additional reserves which are necessary to cover the eventual increase in money demand, coming from the uncertainty connected with the introduction of the new currency. This means that the country should possess enough international reserves to cover the purchase. If the reserves are insufficient and need to be borrowed the credibility of the regime will be undermined.

What would the numeric value of the loss of seignorage be? The *stock of seignorage* loss can easily be calculated as the monetary base in circulation, probably with an additional amount of reserves to meet an unexpected increase in money demand. If there are not sufficient reserves to meet this increase in money demand, an economic crisis could result, due to very restrictive "monetary policy", in the sense of money shortage (see Gabrisch (2001)).

It is more difficult to calculate the loss of *flow of seignorage*, which comes from the increase in the monetary base. There are different approaches in the economic literature to how this seignorage should be calculated. According to the so-called monetary seignorage approach (see Schobert and Gros (2001)) the seignorage is estimated by multiplying the growth rate of the monetary base with the real monetary base in the previous period:

$$S_t = \beta m_{t-1} \text{ where } m_{t-1} = \frac{M_{t-1}}{P_t},$$

where S_t denotes the seignorage in period t , and β denotes the growth rate of the monetary base M_t , which contains the bank notes as well as the reserves of the commercial banks held in the central bank and is deflated by the prices P_t .

¹This statement, however, is not in line with Friedman's optimal quantity of money. According to the Nobel price holder, since too little money is held, there is a "small triangle cost" in the economy and the net cost is not zero.

This way of calculating seignorage is related to the idea that national authorities print money in order to finance governmental expenditures. Therefore, it is widely used in countries with hyperinflation. A second way of estimating the seignorage losses is when the opportunity cost concept is used (ibid). The idea here is that the activities of the central bank also bear interest which will be foregone if the central bank does not hold liabilities to finance them. Hence measuring the foregone interest rate income on the central bank's activities also provides a measure of seignorage loss.

Various studies have tried to measure seignorage cost for some Central and Eastern European countries. Schobert and Gros (2001) try to measure the loss of seignorage in two types of countries: the runners-up in the transition process, the countries of former Yugoslavia and other less advanced Central and Eastern European countries and the forerunners, i.e. the Czech Republik, Hungary and Poland. In the case of the runners-up the theory is confirmed that with increase of the ratio of cash to broad money the collected seignorage also increases. Moreover, a high ratio of foreign exchange deposits also lowers the seignorage collected by the national authorities. In none of the three more advanced countries do seignorage revenues exceed 2% of GDP; in fact, if the opportunity cost concept is applied, they do not exceed 0.9% of GDP. In the selected less advanced countries seignorage varies between 0.3% of GDP in Macedonia to 4.6% in Belarus. Monetary seignorage in Bulgaria varies between -1.11% in 1991 to 11.27% of GDP in 1997 (see Hristov (2000)). The high figure in 1997 can be explained with the hyperinflation which reached a level of over 578% (period average) during that year.

Would the ECB agree to share the additional seignorage which it would receive from the euroised countries? Given the current position of the ECB on euroisation (see appendix), this is unlikely. It would be more likely to react as did the American Federal Reserve Bank (Fed), when Argentina attempted to persuade it to sign a seignorage sharing agreement. The Americans refused - the "Americans know all too well the value of their product" (see Euromoney (1999)). Since, however, the ECB's desire is to make the euro an international currency, it has to encourage its usage abroad, also by offering such sharing agreements.

- Loss of Lender of Last Resort Function and Optimal Currency Area (OCA) Aspects

A further problem for a country which has relinquished its national currency and has adopted the euro is the loss of central bank functions. The critics claim that the absence of lender of last resort activities of the central bank will mean significant costs for the whole banking sector (see, for example, Larrain and Velasco (2001)). These activities are necessary to prevent the occurrence of banking panics, which can occur when a run on a bank with liquidity problems becomes contagious thus threatening the solvency of otherwise sound banks. Since the national central bank will cease to issue national currency and hence will not have resource to unlimited amounts of funds, it will no longer be able to

carry out this function. It should also be mentioned that dollarisation and/or euroisation eliminates the currency risk, but does not eliminate completely the risk of default and of capital reversals and financial crisis (see Habib, 2001). When adopting a foreign currency the country should also consider the optimal currency area criteria, especially the two main negative effects connected with the monetary integration - the loss of the exchange rate instrument to deal with differences among countries, and the loss of the possibility of conducting an independent monetary policy.

2.3 Gains and Losses for the EMU

Why are the European Institutions so reluctant for the Central and Eastern European countries to adopt the euro as a national currency substitute? The ECB may fear that it will be obliged to provide liquidity in a country which faces a banking and/or balance of payment crisis and that the money supply in the countries of the EMU might get out of control. Although the ECB is not obliged to provide liquidity, it may fear an implicit obligation.

In the case of Estonia, Anne Sulling (2000) proposes a mutual agreement between the national authorities and the ECB. In this mutual agreement the euroised country could declare that it does not expect any kind of financial support from the ECB and would pursue the currency substitution at its own risk. The problem with such an agreement, however, is that it might not be credible. It could cause moral hazard, in the sense that market participants might, anticipating that the ECB will provide liquidity, change their behaviour thus causing a crisis.

Furthermore, the ECB and the other European institutions oppose unilateral euroisation since it has not been envisaged in the Treaty of Maastricht. These are however, legal rather than economic reasons.

2.4 Is there a rationale for flexibility before joining EMU?

According to some critics of the early adoption of the euro as a national currency, countries might wish to have flexible exchange rates because of the real appreciation of their currencies and the loss of competitiveness which would occur if the CEEC maintained their fixed exchange rate until accession. A further reason cited by the critics of early euroisation is that the alternative regime, flexible exchange rates, would permit testing of the equilibrium exchange rate. To this criticism an easy answer could be given: although real appreciation might indeed occur, it can be explained by the Balassa-Samuelson (B-S) effect and therefore it will not be connected with loss of competitiveness (see Podkaminer (2001)). The B-S effect arises because the growth of productivity is normally higher in the tradable sector than in the non-tradable sector. Wage increases in the sector of tradeables are transmitted to the non-tradable sector, which in turn leads to price increases in this sector of the economy. Hence, the

exchange rate appreciates if measured in terms of real consumer prices² but not if measured in unit labour costs. Another reason for the real appreciation of the CEECs' currencies is related to productivity growth. In the transition country the growth rate of productivity is higher than in the countries which form part of the EMU, since, given the much higher level of productivity in the latter countries, the former have a lot of room to catch up. Therefore Coricelli (2001) argues that exchange rate flexibility cannot be justified only because of real appreciation. The same holds for purposes of testing the equilibrium exchange rate.

Coricelli (*ibid.*) claims that if all Eastern and Central European countries which apply for membership in the EU adopt the euro simultaneously, this will bring even higher benefits. The whole of Europe will be more stable and euroisation will be a further push for the euro to become an international currency. This will happen because the currencies of these countries will "give strength" to the euro since they tend to appreciate due to the Balassa-Samuelson effect.

3 Currency Board Arrangements

This section provides some explanations of currency board arrangements (CBA) because this institutional framework is used in the theoretical model in the following section. A typical (orthodox) currency board has no discretionary power over the determination of money supply nor therefore over the conduct of independent monetary policy. It is a rule for creation of monetary base in accordance with the foreign exchange reserves of a country. It guarantees that after launching the arrangement, the domestic currency will be neither devalued nor revalued.

A typical currency board can neither determine the monetary base nor influence the whole money supply. The latter is determined by market forces only. Because the currency board country guarantees access to foreign reserves money supply is quite responsive to changes in the money demand. The foreign currency can be acquired through two sources - the current account of the balance of payments and its capital account. Hanke and Schuler (1993) after making certain plausible assumptions show, how the process of money supply works in a currency board system. Assuming that the capital account remains unchanged, the authors show the link between the change of the balance of payments and the change of money supply. A current account surplus leads to an increase of the commercial bank reserves and hence to an increase of loan provided (assuming a given reserves-to-deposit ratio). This alone will lead to a decrease in the interest rates and increase in income. When the public has a higher disposable income, it will both save more and spend more and the aggregate demand will go up. With an increase in demand domestic prices will also go up and therefore restore equilibrium through increased imports of foreign goods.

²For the impact of the Balassa-Samuelson effect on the Maastricht convergence criteria see the appendix.

The automatic adjustment mechanism described above is very similar to the mechanism during the Gold Standard. It is also similar to such mechanisms in any fixed exchange rate system apart from the fact that it is automatic and there is no discretion. By contrast, the monetary authority in a fixed exchange rate regime could sterilize the contractional effects of capital outflows through open market operations, which is not possible in a currency board system.

Money growth in the currency board country approximates that in the reserve country. The "price" is the loss of monetary sovereignty. There is a further problem connected with credibility and currency board regimes, as in the case of euroisation, arising from the lack of lender of last resort under such a monetary arrangement. If capital outflows are high, the large increase in interest rates may cause significant problems for the banking system. Small banks in particular may not be able to withstand high interest rates and may fail. Since the monetary authority in a currency board is not able to act as a lender of last resort or to conduct open market operations to provide liquidity, a single bank failure may enforce a run on other banks and threaten the whole banking system. This might also weaken the credibility of a currency board.

Moreover, CBAs cannot prevent banking and financial crises. This is due to the fact that in such a regime, although the monetary base is covered with foreign reserves, the broader measures of the money supply are left uncovered. Hence the public still doubts the system and the CBA does not enjoy full credibility.

Several countries have recently introduced currency board regimes, among them Estonia (1992), Lithuania (1994) and Bulgaria (1997). In all three economies, although certain problems have been observed in the first two, the experience has been rather positive so far.

4 Currency Boards and Multiple Equilibria

4.1 Motivation for the model

Since this paper presents a model of a self-fulfilling currency crisis, the following subsection surveys the recent literature on currency and banking crises.

One view of the occurrence of currency crisis predicts that if a government runs an unsustainable economic program, then a crisis is bound to happen. A "classical" model of this view is provided by Krugman (1979). The author predicts the balance of payments crisis upon the assumption that the fiscal stance is inconsistent with exchange rate policy. In this model, reserves are steadily lost from time 0 to T when the foreign reserves reach a certain level $\bar{R}$. After this point of time there is a run against the domestic currency and the stock of foreign reserves falls to zero (unless the national authority decides to give up the exchange rate fix). A remarkable feature of Krugman's model is the sudden loss of reserves at time T, although individuals have perfect foresight and nobody is taken by surprise. Therefore the model has the feature of the so-called speculative attack.

A currency crisis can be accompanied by a bank crisis. This is discussed by Velasco (1987) and Mishkin (1996). According to Velasco, bank runs lead to the abolition of the fixed exchange rate if the peg is inconsistent with the excessive money creation stemming from the need to bail out the domestic commercial banks. The national authorities can even prefer to devalue the currency when faced with a bank run, if the cost of defending the peg is too high.

Mishkin on the other hand, has the opposite argumentation. He claims that it is not the banking crisis which causes currency crisis, but, rather, it is the currency crisis which causes the banking crisis. A sharp devaluation of the exchange rate could have disruptive effects on the bank's balance sheets. An external shock, such as an increase in the foreign interest rate or a terms of trade shock, could trigger a devaluation.

Another type of crisis is the so-called self-fulfilling speculative crisis. If investors believe that the country is unworthy, no credits will be prolonged, there will be no new funds forthcoming, and indeed the country may experience a currency crisis.

Velasco (1996) looks at currency crises from the viewpoint of credibility. He extends the logic of the Barro-Gordon framework to a dynamic context, in which the level of government debt determines the payoff available to the government. There is still a trade-off between credibility and flexibility but the stock of inherited debt is the most important factor when determining whether it is better to pre-commit to the fix or to retain flexibility. The author finds a possibility for the existence of multiple equilibria and self-fulfilling currency runs, though they are connected only with high levels of government debt.

Multiple equilibria are also considered in Calvo (1988). A confidence crisis (defined as critical change of expectations about the behaviour of the policy-makers) increases the chances that a regime shift will indeed happen. Moreover, the game between the private sector and the national authorities can lead to multiple equilibria. However, certain policy decisions of the national authorities can prevent bad equilibria from happening. Bad equilibria are connected with monetization or repudiation.

Giavazzi and Pagano (1990) model a small open economy with a fixed exchange rate and free capital mobility, where the stock of government debt is large and is rolled over every period. Such an economy is vulnerable to confidence crises. These are brought about by exogenous changes in expectations about the future value of the exchange rate that are self-fulfilling. In the paper of Giavazzi and Pagano a crisis occurs when agents expect a devaluation to occur in the next period. Such a change of expectations raises the interest rates through the uncovered interest rate parity condition. This generates an additional fiscal burden. The treasury finances the extra burden either by monetizing it at the Central bank or by issuing a new debt with more unfavourable conditions. The private sector, not knowing what kind of government it is facing, assigns a positive probability of devaluation, which may occur because of the depletion of the foreign reserves of the central bank if the government monetizes (part of) the debt. To waive the possibility of the occurrence of bad equilibria, as proposed in Giavazzi and Pagano, national authorities can change the maturity structure

of their debt. The authors prove that there exists a critical maturity structure beyond which no self-fulfilling confidence crisis can arise (for a given amount of reserves).

4.2 Introduction to the model

The present model builds on the work of Giavazzi and Pagano (1990). It explains why the European Central Bank (ECB) should give up its opposition to euroisation, at least for countries which have adopted a currency board regime. It shows the possibility of devaluation of the currency of economies with a currency board arrangement even though they might have followed a cautious policy (and, moreover, the existence of a fixed exchange rate which is consistent with the monetary policy).

In the case of a currency crisis the ECB would find itself in a dilemma. On one hand it might wish to provide liquidity to Eastern European authorities and change the equilibrium outcome from bad to good. It might wish to do so in order to save its own banking sector, which, being involved in Eastern Europe will have suffered losses after the devaluation. However, providing credits to the Eastern European authorities increases liquidity to the markets and may increase inflation in the EMU, while not providing credits to the Eastern European authorities may lead to a banking crisis in Western Europe. Hence a dilemma does exist. ECB may not wish to see itself in such a situation! Therefore it should give up its opposition to euroisation and allow the authorities in Eastern European countries with Currency Boards to introduce the Euro. This will eliminate the possibility for devaluation and costly bail-outs.

In a small open economy with a currency board regime and free capital mobility the stock of the governmental debt is large and it rolled over every period. Such an economy is vulnerable to confidence crises. Because of a change of expectations (driven by sunspot-type beliefs) interest rates rise and probability of devaluation increases. This places an additional fiscal burden to the local authorities. The treasury tries to finance the extra burden by increasing its effort in collecting taxes. The private sector, not knowing what kind of government it is facing (with respect to its efforts on tax collecting), assigns a positive probability of devaluation, which may occur because foreign reserves of the currency board might be not sufficient to cover the fall in money demand. The crisis has a self-fulfilling character since the investors know that the higher the refinancing needs of the authorities at each moment, the higher the probability that the confidence crisis will end up with devaluation. The existence of multiple equilibria will be shown, both with positive and zero probability of devaluation.

In the model three agents exist: the private sector, the authorities and the ECB. The role of the latter is given by its preferences - it dislikes and combats inflation. It can act as a lender of last resort and provide liquidity to the market.

An open economy with free capital mobility and a fixed exchange rate of a currency board type is assumed. The prices in the economy are constant so that nominal variables take real values.

4.3 The private sector

The private sector can be characterised by the state of its expectations concerning devaluation. It may expect a normal state (N) during which the exchange rate fix is credible; alternatively it may anticipate a confidence crisis (C). It is assumed that crises are serially uncorrelated events, meaning that in each period state C has an equal probability of occurrence, independently of whether it has occurred in the previous period.

$$2states : \begin{array}{l} \text{Normal (N)} \\ \text{Confidence Crisis (C)} \end{array}$$

In a confidence crisis (C) the probability of devaluation is Π . Therefore in a confidence crisis we have:

$$\begin{array}{l} \text{devaluation with prob. } \Pi \\ \text{no devaluation with prob. } 1 - \Pi \end{array}$$

Since we have an open economy with free capital mobility the uncovered interest rate condition will ensure that in the normal state (N) the return on a one-period bond issued by the national authorities will equal

$$1 + r^*,$$

where r^* is the world interest rate. During the state of a crisis (C), it is the expected return that matters. Hence, assuming risk neutrality, the expected return of a bond during a period of a confidence crisis is

$$1 + r^* = (1 + \rho)(1 - \Pi) + \frac{(1 + \rho)}{1 + x} \Pi,$$

with ρ the nominal interest rate and x the size of devaluation. Solving for ρ one obtains $\rho = \frac{1+r^*}{1-\Pi\beta} - 1 \approx r^* + \Pi\beta$ (β is defined as $\frac{x}{1+x}$). Hence the interest rate during the period of crisis is

$$r^* + \Pi\beta. \tag{1}$$

During a confidence crisis, the interest rate increases, the money demand falls and foreign reserves decrease. The authorities can either defend the peg or abandon the exchange rate arrangement and devalue the currency. They may rely explicitly or implicitly on borrowing from the ECB.

4.4 The national authorities

Local government rolls over the debt until it faces a confidence crisis. During the state of crisis it is more expensive for the government to roll over its debt because of the increased interest rate. In order for the gap in the government budget to be closed the authorities improve tax collection (increase their effort in obtaining tax revenues).

We assume that the government revenues take the following form:

$$GR = \tau Y + T, \quad (2)$$

where τ is the tax rate, Y is the output and T is the stabilisation effort. The revenues stem from two sources: they depend on economic conditions through automatic taxation τY and on the stabilisation effort by the government (on collecting taxes). Furthermore output Y takes the following form:

$$Y = Y_0 - b\Pi\beta, \quad (3)$$

where $b > 0$, and x is the size of devaluation. Y_0 can be interpreted as potential output, which could be achieved if there was no confidence crisis (and hence if probability of devaluation $\Pi = 0$). In the period of crisis, output falls to Y by $b\Pi\beta$. Obviously taxation depends on income and income depends on economic activity. The reverse relationship between output and $\Pi\beta$ can intuitively be explained through the interest rate. The higher the probability and the size of devaluation ($b\Pi\beta$), the higher the interest rates and the lower the output Y . Furthermore, high interest rates may cause trouble in the banking systems of the economy, which in turn can provoke loss of output.

Assuming that the successful efforts of the government on collecting taxes T cannot exceed $\tau b\Pi\beta$ (the government cannot collect more revenues than in the no crisis case $T \leq \tau b\Pi\beta$) we can write

$$T = \alpha\tau b\Pi\beta, \quad (4)$$

where α is the type of government in the opinion of the private sector. Since the latter does not know a priori what kind of authorities it faces, α has a probability distribution ($0 \leq \alpha \leq \alpha_{\max} \leq 1$). The local authorities could be either weak (low value of α), performing low efforts in collecting revenues, or tough (high value of α), performing high efforts in collecting revenues. Combining eq. (2), eq. (3) and eq. (4) one obtains that governmental revenues are equal to $GR = \tau Y_0 - \tau b\Pi\beta + \alpha\tau b\Pi\beta$ or

$$GR = \tau Y_0 - (1 - \alpha)\tau b\Pi\beta.$$

It is assumed that the tax rate τ is constant, in further research, however, it can be modelled to vary. During normal states (N) the government's budget is balanced, whereas during a confidence crisis (C) the authorities find themselves in a situation where the newly issued debt is not sufficient to close the gap between government spending and revenues. Because of this, the national

authorities collect revenues which depend on their stabilisation effort. In order to cope with the budget deficit in the state of crisis, if the increased tax revenues are not sufficient, the authorities lower their expenditures.

The following paragraphs explain the balance sheet of the currency board arrangement (CBA). The essence of this arrangement is that money supply equals the amount of foreign reserves available (R). The government cannot monetize its budget deficit. During the state of confidence crisis, C, the money supply, M^N equals R . In equilibrium money supply equals money demand. We assume an exponential money demand, with σ being the interest rate elasticity. During the normal state money demand is

$$M^N = Ae^{-\sigma r^*},$$

whereas during the state of a confidence crisis it is

$$M^C = Ae^{-\sigma(r^* + \Pi\beta)},$$

whereas $(r^* + \Pi\beta)$ is the interest rate in the state of confidence crisis (see eq. (1)). Hence, the fall of money demand in a state of a confidence crisis compared with the normal state is

$$\Delta M = M^N - M^C = R(1 - e^{-\sigma\Pi\beta}). \quad (5)$$

A condition for the state of confidence crisis to end with devaluation is

$$\Delta M > (R - \bar{R}) + ECBor + \alpha\tau b\Pi\beta. \quad (6)$$

The economic intuition behind this equation is that if the fall in money demand is higher than reserves $(R - \bar{R})$ of the CBA and the credits provided by the ECB ($ECBor$) together with the reserves provided by the fiscal effort ($\alpha\tau b\Pi\beta$), the exchange rate regime will collapse. R denotes the reserves of the currency board, whereas $\bar{R}$ denotes an assumed lower bound of these reserves, beyond which any further fall in R would raise the interest rate and would threaten the banking sector. $\bar{R}$ can take any value between 0 and R . However, if R falls below $\bar{R}$ the model no longer applies and devaluation occurs immediately with all its consequences. It should be noted that the stabilisation effort $\alpha\tau b\Pi\beta$ appears on the right-hand side of eq. (6). Intuitively as tax revenues increase (higher effort), the disposable income of the private sector declines, which leads to less spending and fewer imports. We assume that the whole effect of the higher stabilisation effort is transmitted to spending and imports. Even in this case multiple equilibria will be shown. The current account of the balance of payments improves through an increase in the foreign reserves. A further point to be mentioned is that the money borrowed from the ECB is not used to balance the governmental budget but goes directly to the currency board.

4.5 Multiple equilibria and devaluation

The following subsection proves the existence of multiple equilibria for the case when the borrowing from the ECB is zero (we set the variable $ECBor = 0$ in

equality 6). Assuming that the ECB does not intervene, both a solution with zero probability of devaluation Π and a solution with a positive probability of devaluation exists. In this context the model provides multiple equilibria - a "good" one with no crisis and a "bad" solution with a devaluation crisis. In the latter case the ECB, in order to save its banking sector, might wish or be forced to intervene by providing liquidity and thus change the equilibrium outcome from bad to good.

Combining eq. (5) with eq. (6) and setting $ECBor = 0$ (no ECB intervention) one receives:

$$R(1 - e^{-\sigma\beta\Pi}) > R - \bar{R} + \alpha\tau\beta b\Pi. \quad (7)$$

For a given Π , we denote the probability of the above inequality by $G(\Pi)$. Then it holds that

$$G(\Pi) = \begin{cases} 0 & \text{for } \Pi \in [0, \min(\bar{\Pi}, 1)] \\ P(\alpha g(\Pi) < 1) & \text{for } \Pi \in (\min(\bar{\Pi}, 1), \min(\Pi^*, 1)] \\ 1 & \text{for } \Pi \in (\min(\Pi^*, 1), 1] \end{cases},$$

where

$$g(\Pi) = \frac{\tau\beta b\Pi}{R - R e^{-\sigma\beta\Pi}},$$

$\bar{\Pi} = \frac{1}{\sigma\beta} \ln \frac{R}{\bar{R}}$ is the zero of the denominator of $g(\Pi)$, and

$\Pi^* = \min \left\{ g^{-1} \left(\frac{1}{\alpha_{\max}} \right) \right\}$ in the interesting cases, with $\alpha_{\max}$ the upper bound of the support of the belief on α , and $\Pi^* = \infty$ otherwise (for ex. if $\left\{ g^{-1} \left(\frac{1}{\alpha_{\max}} \right) \right\}$ is empty).

Before deriving the expression for G , let's examine some of its implications. A rational expectations equilibrium is a fixed point of G , i.e. it satisfies $G(\Pi) = \Pi$. Obviously $\Pi = 0$ is always an equilibrium.

If $\bar{\Pi} \geq 1$, $G(\Pi) = 0$ holds for all $\Pi \in [0, 1]$. Then $\Pi = 0$ is the only equilibrium. The intuition is that the fall in money demand is too small to endanger the foreign reserves of the local authorities.

Alternatively, the case $\Pi^* \leq 1$ implies $G(1) = 1$, meaning that now an almost sure devaluation is also an equilibrium. Even the most optimistic improvement in the current account is not sufficient to offset the loss of reserves triggered by the lower money demand.

Equilibria in which devaluation occurs with positive probability smaller than 1 can also exist. Under the additional assumption that the belief on α is represented by a continuous distribution function, $\Pi^* \leq 1$ is a sufficient (but not necessary) condition for their existence. Indeed, consider $G(\Pi)$ on the interval $(\bar{\Pi}, \Pi^*]$ ($\bar{\Pi} < \Pi^*$ is shown in the derivation of G). Since for $\Pi > \bar{\Pi}$ it holds that $g(\Pi) > 0$, one can write

$$G(\Pi) = P(\alpha g(\Pi) < 1) = F_{\alpha} \left(\frac{1}{g(\Pi)} \right),$$

which is a continuous function as a composition of two continuous functions. Then

$$\lim_{\Pi \downarrow \bar{\Pi}} G(\Pi) = F_{\alpha} \left(\lim_{\Pi \downarrow \bar{\Pi}} \frac{1}{g(\Pi)} \right) = F_{\alpha} \left(\frac{1}{\infty} \right) = F_{\alpha}(0) = 0 = G(\bar{\Pi})$$

by the assumption on the support of the belief on α , and

$$\lim_{\Pi \uparrow \Pi^*} G(\Pi) = F_{\alpha} \left(\frac{1}{g(\Pi^*)} \right) = F_{\alpha}(\alpha_{\max}) = 1,$$

again by the same assumption. By the intermediate value theorem, $G([\bar{\Pi}, \Pi^*]) = [0, 1]$, so that G necessarily has a fixed point in this interval.

So far two cases have been considered: one with a single equilibrium (no devaluation), and one with 3 equilibria (no devaluation, almost sure devaluation and uncertain devaluation). A third case is one with only 2 equilibria, no devaluation and uncertain devaluation, and it can (but need not) occur when $\bar{\Pi} < 1$ but $\Pi^* > 0$.

The following paragraph derives the expression for G . For $\Pi \leq \bar{\Pi}$ it holds that $R(1 - e^{-\sigma\beta\Pi}) \leq 0$ and therefore the condition for devaluation (7) cannot be fulfilled, since a non-positive number cannot exceed a positive one. Hence $G(\Pi) = 0$ for $\Pi \leq \bar{\Pi}$.

Let $\Pi > \bar{\Pi}$. Then (7) can be rewritten as

$$\alpha g(\Pi) < 1,$$

and hence $G(\Pi) = F_{\alpha} \left(\frac{1}{g(\Pi)} \right)$. When $\frac{1}{g(\Pi)} > \alpha_{\max}$, $G(\Pi) = 1$. The function g has a U-shape on $(\bar{\Pi}, \infty)$, and if its minimum is lower than $\frac{1}{\alpha_{\max}}$, there are two values of Π for which $g(\Pi) = \frac{1}{\alpha_{\max}}$. We denote by Π^* the smaller one, and if the bigger one is above one, the desired expression for G follows. Whenever a step in the above definition of Π^* fails, we take $\Pi^* = \infty$.

4.6 Graphical Representations and a Numerical Example

Figure 1 shows the function $G(\Pi)$ in the case of a uniform distribution on $[0, \alpha_{\max}]$. In figure 2 the G locus neither intersects with nor touches the 45 degree line, and hence a solution with positive Π does not exist. In this case only $\Pi = 0$ is an equilibrium.

The exact location of the G locus depends on the parameters $b, \beta, \sigma, \tau, R, \bar{R}$. The following paragraphs display a sensitivity analysis for different values of the parameters. Figure 3 displays the graph of function $G(\Pi)$ for different values of the interest rate elasticity σ . Increasing σ leads to decreasing probability of devaluation.

The graph of the function $G(\Pi)$ is very sensitive to the parameter $\bar{R}$. Small changes in the assumed lower bound of reserves leads to high changes in probability of devaluation as shown on 4. An increase of $\bar{R}$ from 85% to 90% leads

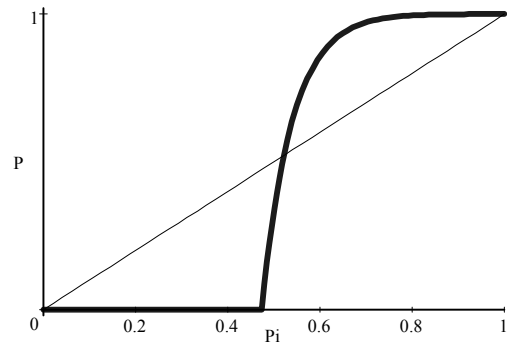


Figure 1: Graphical solution

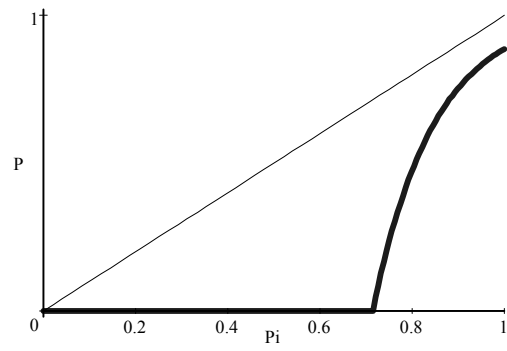


Figure 2: Example of a unique solution

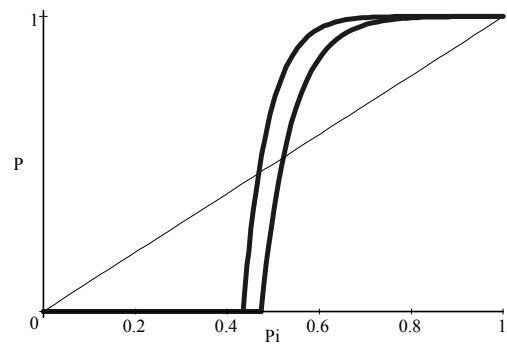


Figure 3: Changes in the interest rate elasticity

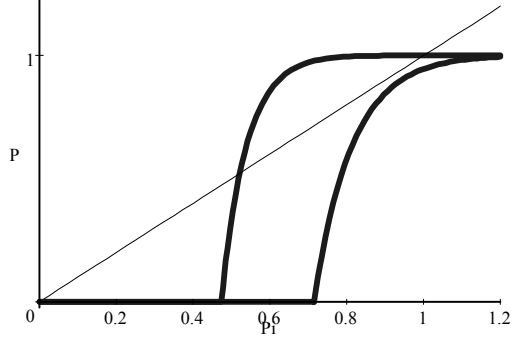


Figure 4: Changes in the parameter $\bar{R}$

in the example displayed below to the inexistence of a positive probability of devaluation.

Assuming that $F(\alpha)$ is a normal distribution, a numerical example can be given. The equilibrium condition changes to

$$\Pi = \frac{1}{\alpha_{\max} g(\Pi)}. \quad (8)$$

Setting the parameters to

$$\tau = 0.3$$

$$\beta = \frac{1}{5}$$

$$b = 10$$

$$R = 10$$

$$\bar{R} = 9.0$$

$$\alpha_{\max} = 1$$

$$\sigma = 1$$

allows us to find a numerical example.

For values of the argument lower than or equal to $\bar{\Pi} = \ln(\frac{R}{\bar{R}})^{-\sigma\beta} = 0.523$ the function $G(\Pi)$ equals 0.

Solving the equation $g(\Pi) = \frac{1}{\alpha_{\max}}$ one obtains the value of $\Pi^* = 0.801$. For values of the argument greater than or equal to $\Pi^* = 0.801$ the function is 1. For these values of the parameters $\bar{\Pi} = 0.473$. For values of the argument less than or equal to $\bar{\Pi} = 0.473$ the function is 0.

Between Π^* and $\bar{\Pi}$ the function $G(\Pi)$ is strictly increasing and crosses the 45 degree line once at $\Pi = 0.686$. Last, but not least $\Pi = 0$ and $\Pi = 1$ are also solutions.

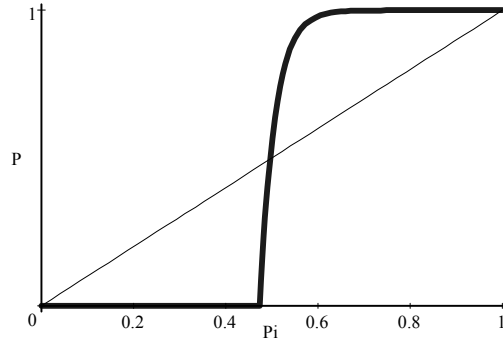


Figure 5: Numerical example

5 Conclusions

The paper considered a model of currency crisis in an economy with a currency board arrangement. It was shown that multiple equilibria of currency devaluation exist. In such a case the European Central Bank would be involved in a costly bail-out (either of foreign governments or of its own financial system). For this reason ECB should not oppose the process of euroisation in such countries.

In the present model, the preferences of the ECB were known. In further research, the type of these preferences can be modelled, which together with the expectations of the private sector on the type of government and on the fact of whether the European Central bank will intervene or not, will give the model further strength.

A The official Position of the EU authorities on euroisation

Unfortunately the positive view of Romano Prodi,³ President of the European Commission (EC), about the use of the euro outside the EMU has still not changed the official view of the Commission itself for the use of the euro as a national currency substitute in Central and Eastern Europe. The official position of the EC and of the Council of the European Communities was expressed at the 2301 Council meeting (ECOFIN) on 7th November 2000 in Brussels.:

"...it should be made clear that any unilateral adoption of the single currency by means of "euroisation" would run counter to the underlying reasoning of EMU in the Treaty which foresees the eventual adoption of the euro as the endpoint of a structured convergence process within a multilateral framework. Therefore, unilateral "euroisation" would not be a way to circumvent the stages foreseen by the Treaty for the adoption of the euro."

With respect to this, three stages in the transition process have been identified (see Noyer (2001)). In the first stage, the so-called pre-accession stage, it is up to the individual countries to decide what kind of exchange rate policy to follow. The only requirements upon accession is the adoption of the "acquis communautaire" and satisfaction of the Copenhagen Criteria. These criteria state the conditions which must be met by Eastern European countries wishing to join the European Union. The economic part requires "functioning market economy as well as its capacity to cope with competitive pressures and market forces within the Union". The criteria are complemented by the requirement that the accession candidates adopt the "acquis communautaire" in general and legislation on the EMU in particular.

During the second stage, which will begin after the accession into the European Union and will end with the adoption of the euro as a national currency, countries will have to join the ERM II (Noyer, (ibid)). It is questionable whether it is necessary for countries to take part in the ERM II before adopting the euro. Coricelli (2001) argues that the exchange rate mechanism is not an option for transition countries. Expectations of inability to enter the euro zone may create self-fulfilling and speculative attacks on weaker currencies. The crisis in the European Monetary System in 1992 is an example par excellence of what could happen to the transition countries from Eastern Europe if they decide (or are forced) to participate in the ERM II. The experience in Greece before January 2001 when it formed part of the ERM II is also conclusive. The country experienced huge movements in its exchange rate starting from an initial depreciation and ending with revaluation before admission to EMU. Such exchange rate swings will definitely not have a positive impact on the transition countries.

At the Seminar on Currency Boards in the Context of EU accession held in Brussels on November, 25th 1999 and organized by the European Commission, the latter expressed its view that *"After accession, the exchange rate policy is a*

³Expressed in a speech at the European University Institute in Florence, Italy on May, 9th 2001.

matter of a common concern but this does not rule out currency boards. Therefore, new member states could keep them in place." At the same conference, the view of the European Commission on euroisation was also expressed: *"Euroisation or possibly early adoption of the euro in the pre-accession phase, is unacceptable as an exit strategy for a CBA. This is because candidate countries, when applying for EU membership have accepted the acquis, which means abiding by the rules laid down in the treaty for the adoption of the euro."*

In the third stage, after having participated in the ERM II for a period of two years, countries should adopt the euro, provided they also fulfill the monetary and budgetary convergence criteria of the Maastricht Treaty. The ECB's view in adopting the euro is summarized by the "coronation" theory (Habib (2001)), according to which the adoption of the euro is supposed to be the final reward after a long and painful process of nominal adjustment. There exist a problem, however, related to the inflation criteria. This arises from the fact that in fast growing economies, like those of the transition CEE countries, higher inflation rates can be expected. These, however, are not connected with a loss of competitiveness. Nevertheless, if not taken into consideration by "modified" Maastricht criteria, the process of nominal convergence could play a negative role and slow down the real convergence (see Bratowski and Rostowski (2001)).

The position of other international institutions like the IMF is also of interest. The international monetary fund still does not have an official position on euroisation. Its view, however, on whether a currency board should be maintained during the second phase is positive (J. Kahkonen⁴, IMF, personal communication)

"The IMF view on whether well-functioning currency boards should be accepted as a viable option to join the euro zone is affirmative .. but the IMF has not taken a stand on adopting the euro before EU accession—an option the EU opposes for institutional reasons."

⁴Mr. Kahkonen is a former representative of IMF to Bulgaria.

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