

# SEIGNIORAGE:

## AN ARGUMENT FOR A NATIONAL CURRENCY?

FRANZISKA SCHOBERT

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# **Seigniorage:**

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Franziska Schobert<sup>\*</sup>

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## **Abstract**

Seigniorage has often been mentioned as one of the most important and most readily quantifiable arguments for a government not to give up its monopoly in base money. The analysis shows that the measurement of seigniorage may lead to very different results and that it eventually depends on the monetary environment, in which central banks issue and manage base money. For less advanced countries in Central and Eastern Europe seigniorage has only been fiscally significant in high inflationary economies and even then the success in exploiting seigniorage has been limited. Widespread currency substitution has contributed to the results. Governments in these countries which are willing to stabilise prices but which lack credibility to do so, may be increasingly interested in euroisation. More advanced EU-accession countries have received low revenues from having a national currency over the recent years. Seigniorage has arisen as a by-product of other central bank's objectives such as price and exchange rate stability. This caused high sterilisation costs and valuation gains of the central banks asset portfolio have often been the main reason for positive results of seigniorage. In search for a viable monetary regime and in face of further liberalisations of capital markets these countries may look at euroisation as a choice to achieve price stability without exchange rate volatility.

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<sup>\*</sup> University of Frankfurt. E-mail: Schobert@wiwi.uni-frankfurt.de

# **Seigniorage:**

## **An argument for a national currency?**

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### **1. Introduction**

The idea that each nation-state has its own national currency has become increasingly challenged not only from countries forming currency unions, but also from countries considering official substitution of the national currency by a foreign currency. So-called official dollarization has been vitally discussed in Latin America. Some countries – such as Ecuador and El Salvador, have actually implemented it. Likewise, official euroisation has recently been considered in Central and Eastern Europe. The term dollarization or euroisation describes the unilateral adoption of the dollar or the euro through the means of a monetary agreement, which falls short of a full monetary union (i.e. not implying institutions to jointly determine monetary policy). While many have stressed the advantages of such a monetary arrangement compared to a fixed but less credible peg, one of the main arguments against dollarization or euroisation is the loss of seigniorage, the revenues from the monopoly in base money. It is argued that especially in countries with a weak enforcement of tax collection, seigniorage accounts for a considerable share of budget revenues. But how much do governments actually earn from having a national currency? The answer depends on the concept applied for the measurement of seigniorage. And the decision on the concept again depends on the environment, in which central banks issue and manage base money.

Part 2 starts with a comparison of the different concepts of seigniorage. The various processes of base money creation and management in their particular monetary environment eventually determine, which concept should be used. It is also analysed which process of base money creation may reflect a monetisation of budget deficits and why the existence of assets backing base money may be important for a government in an EU-accession country considering euroisation.

In part 3 seigniorage is measured for two groups of countries. The first group comprises the Federal Republic of Yugoslavia (FRY) and other less advanced Central and Eastern European countries. The case of the FRY is especially interesting because the Republic of Montenegro, a part of the FRY, has already chosen to give up the dinar and to introduce the D-Mark as an official currency. A weak institutional framework and difficulties in raising other sources of financing budget deficits are common features and support the measurement of seigniorage by the monetary concept.

The second group consists of more advanced accession countries to the European Union (EU). The institutional framework of their central banks limits the possibilities to exploit seigniorage for fiscal purposes. Additionally, the central banks of these countries are faced

with non-trivial costs and valuation changes when issuing and managing base money. Therefore, a fiscal concept of measuring seigniorage is developed.

## 2. Concepts

There is no single measure of seigniorage, which is generally applicable, its measurement eventually depends on the model and on the policy experiment being considered.<sup>1</sup>

Drazen's statement implies that any measurement of seigniorage depends on a suitable concept and that the choice of the concept depends on the monetary environment, in which central banks issue and manage base money. In the following analysis, it will be argued that the *monetary concept* is most appropriate for countries in which financial markets are underdeveloped and in which the government eventually finances budget deficits at the central bank. The *opportunity cost* concept might be most appropriate, if base money is created by purchases of interest bearing assets or outstanding government bonds without any substantial costs or valuation changes arising and if alternative financing at the capital market is possible. And finally, it is shown, that the *fiscal concept* is the concept that is most widely applicable and that the two other concepts arise as special cases.

### 2.1 Monetary concept

In monetary concepts seigniorage ( $s^m$ ) is measured by the real value of changes in base money.<sup>2</sup>

$$s^m = \frac{\Delta H}{P} = \frac{\Delta H}{H} \cdot \frac{H}{P} = \mathbf{q} \cdot h$$

where H is nominal base money (including currency in circulation and deposits of banks at the central bank), P is the price level,  $\Delta$  are absolute changes and  $\theta$  is the growth rate of nominal balances.

Monetary concepts are closest to the idea of a government financing current payments by taking loans directly at the central bank or what is commonly understood as "using the printing press".

### 2.2 Opportunity cost concept

In opportunity cost concepts seigniorage ( $s^o$ ) is measured as the nominal interest rate  $i$  multiplied by real base money,  $h$ .<sup>3</sup>

$$s^o = i \cdot h$$

<sup>1</sup> Drazen, A. (1985), p. 327.

<sup>2</sup> Cagan (1956), Marty (1967), p. 72 Friedman (1971), pp. 848-850, Fischer, P. (1982), pp. 300-305.

<sup>3</sup> Marty, A. (1978), pp. 437-452, Phelps, E. (1971), pp. 174-178.

This measure takes into account the opportunity costs born by the government. These costs will arise if the government has to finance its expenditure through the issuance of interest-bearing bonds instead of issuing noninterest-bearing currency. By using a nominal interest rate instead of a real interest rate it is assumed that money holders increase nominal balances in face of inflation to keep the real value of base money constant.<sup>4</sup>

Most estimates of seigniorage for developed economies use an opportunity cost concept with a short-term interest rate, e.g. a money market rate.<sup>5</sup> This actually differs from the original idea of the opportunity cost concept which would suggest an interest rate on government bonds. The underlying idea for the choice of the interest rate in these estimates is rather based on the opportunity costs of revenues, which would be foregone if the central bank were not able to issue base money. Choosing a domestic money market rate is appropriate if base money is issued by refinancing operations between the central bank and commercial banks in the domestic money market. Similarly, if base money is created by interventions in the foreign exchange market, the relevant interest rate will be the rate of return on foreign assets. In contrast to the monetary concept which calculates revenues from newly printed balances, the opportunity cost concept takes into account that the central bank receives returns from a stock of assets accumulated by the outstanding quantity of base money.

### 2.3 Fiscal concept

The fiscal concept of seigniorage ( $s^f$ ) focuses on the net revenues the fiscal authorities obtain from central banking operations, which are not only linked to the creation of base money but also to its management.<sup>6</sup> Instead of distributing all revenues to the fiscal authorities, central banks can also withhold part of their earnings and accumulate reserves over time. In this case the central bank receives an additional flow of revenues from the assets backing retained earnings.<sup>7</sup> Although this case may be relevant in practice, the analysis rather looks at revenues, which could be distributed to the fiscal authorities. This is based on the assumption that central banks cannot withhold revenues infinitely and eventually distribute them to the fiscal authorities. The focus of the analysis is actually the measurement of revenues, which are a potential source of fiscal income disregarding the fact that some central banks retain earnings temporarily.

$$s^f = i \cdot (a + b^{cb}) + c + v - k$$

<sup>4</sup> The opportunity cost concept precisely gives  $i/(1+p) \cdot h$ .

<sup>5</sup> See for example Hochreiter et al. (1996), Bini-Smaghi and Gros (2000).<sup>5</sup>

<sup>6</sup> See Klein and Neumann (1990) and Lange (1995) pp. 26-29.

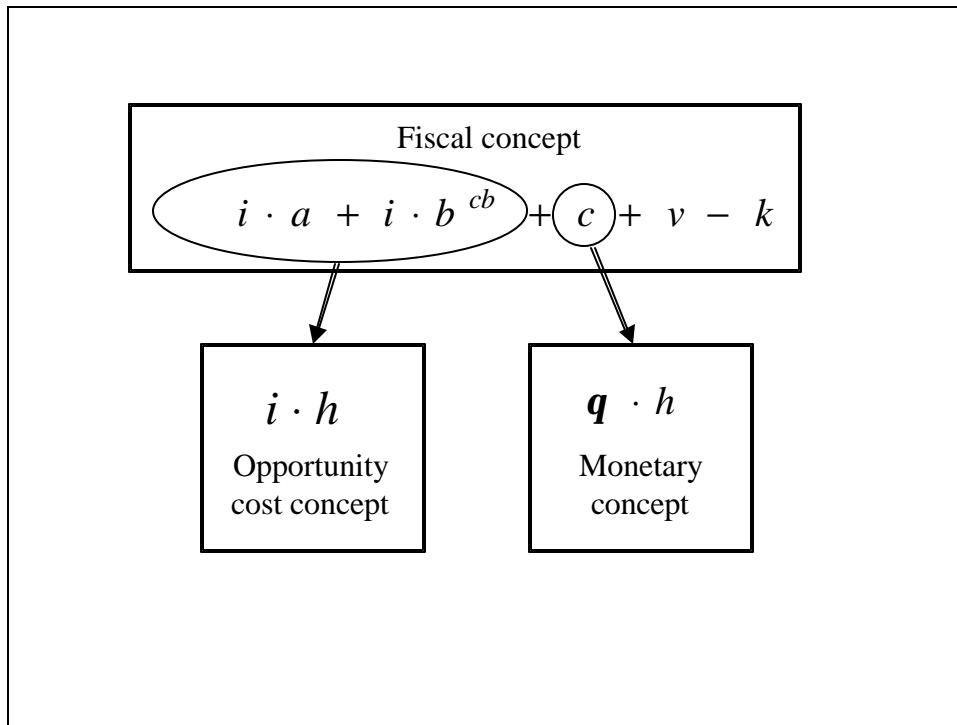
<sup>7</sup> Revaluation reserves can be quite excessive, see Gros and Schobert (1999). Hochreiter et al. (1996) p. 632, have argued to include revaluation reserves, reserve provisions, deferred income and other kinds of retained earnings into the measurement of seigniorage, although statutes of several central banks should prevent excessive capital accumulation, e.g. in Germany the legal reserve is restricted to 5% of banknotes in circulation and other reserves to the Bundesbank's capital.

The term  $i \cdot (a + b^{cb})$  describes the revenue of the portfolio of assets held at the central bank, which comprises assets outside the government sector,  $a$ , and government bonds held at the central bank,  $b^{cb}$ .

The issuance of base money in order to finance current expenditures – “money printing” – is shown by  $c$ . It reflects a claim to the government, which is held against base money issued for the fiscal purpose of financing government consumption.

Costs,  $k$ , arise with the issuance and management of base money. Valuation changes,  $v$ , occur in the asset portfolio accumulated by previous issues of base money and are included in the measurement because they arise with having a monopoly in base money.

Figure 1. Concepts of seigniorage



Disregarding valuation changes and costs is a precondition for transforming the fiscal concept into its two special cases, the monetary concept and the opportunity cost concept. As shown in Figure 1 the monetary concept will arise as a special case of the fiscal concept, if the issuance of base money takes place by direct lending for current expenditures. The fiscal concept will be generally equal to the opportunity cost concept, if base money is either issued by purchasing outstanding government bonds or by acquiring interest bearing-assets outside the government sector. In appendix A1.1 the link between the concepts is shown in detail by deriving them from budget identities and in appendix A.1.3 it is shown, that under special conditions purchases of government bonds may rather be considered as financing of current expenditures. Then, a measurement by the monetary concept may be more applicable than a measurement by the opportunity cost concept.

#### 2.4 Advantages of the fiscal concept

The monetary concept and the opportunity cost concept are only applicable in certain situations of base money creation, in which costs and valuation changes can be disregarded, whereas the fiscal concept should be used, if they matter.

The inclusion of the costs on the one hand is important as having a monopoly in base money is a source of both revenues *and* expenditures. Generally it is assumed that the costs of producing paper money are very low and thus net revenues do not differ significantly from gross revenues. However, this assumption neglects other potentially significant sources of costs of the issuance and management of base money. Whereas costs arising from other responsibilities of the central bank such as banking supervision can be neglected, costs arising from monetary policies and the management of base money need to be considered.

Introducing on the other hand valuation changes into the measurement of seigniorage is necessary if large valuation changes arise and eventually can be distributed to the fiscal authorities. One could argue that valuation changes cancel out over time and that any valuation gains should be held as reserves. Revaluation reserves are a buffer against the risk of adverse market movements and therefore valuation gains should not be distributed to the fiscal authorities. However, the measurement of seigniorage might only matter for a certain period of time in which large valuation changes arise. If the risk of changes in market movements disappears at the end of this period, reserves are not needed any more and valuation gains can be distributed to the fiscal authorities. This is the case of EU-accession countries which will give up their own currencies, when they join the European Monetary Union (EMU) or even earlier, when they consider the unilateral adoption of the euro. Reserves held as a buffer against adverse exchange rate changes to the euro are not needed any more and eventually can be distributed to the fiscal authorities.

The fiscal concept offers another advantage. Compared to the monetary and opportunity cost concept it measures seigniorage from the asset side rather than from the liability side of the central bank. Therefore, it directly looks at the sources of revenues by looking at the items backing base money. These items either represent assets outside the government sector ( $a$ ) such as foreign exchange reserves or inside the government sector ( $b^{cb} + c$ ) such as all forms of claims to the government. As shown in appendix A1.2 and A1.3 only the former can be safely regarded as net assets whereas the latter most likely represents consolidated government indebtedness. In a fiat money system the items backing base money are generally not important. The main objective of the central bank, price stability, is pursued without considering the backing of base money. But if a government considers official euroisation or dollarization, this issue becomes relevant. The difference is technically important for a government considering the unilateral adoption of a foreign currency, because it will need to convert its stock of cash in domestic currency into cash in foreign currency (US dollars or euros). If there are sufficient marketable assets, i.e. foreign reserves, these can readily be sold in exchange for domestic cash. However, if base money is backed by net government indebtedness, which has financed past budget deficits, the government would need to take up

a loan to finance the conversion of cash in domestic currency into cash in foreign currency. The government would eventually swap its noninterest-bearing liabilities (its outstanding cash in domestic currency) into an interest-bearing loan. Does it matter financially for a government, whether it has to take up a loan to finance the changeover to a foreign currency or whether it can convert cash in domestic currency into foreign currency by selling assets? In appendix A2 the case of an economy, which euroises by selling assets (case I) and an economy, which euroises and needs to take up a loan (case II) are analysed. Given the chosen assumptions both cases bear the same costs. In practice and especially when assessing costs over a limited period of time, the financial impact can differ substantially and eventually has to be assessed case by case.

In this respect, the situation of EU-accession countries is a special case, because losses of seigniorage would only arise temporarily, if they euroised. To understand this point it is useful to summarise the special situation of EU-accession countries. A country, which euroises but has the opportunity to join the European Monetary Union at a later stage including its participation in seigniorage sharing, will only suffer from lost seigniorage until it joins the monetary union. As has already been pointed out by Rostowski (2000)<sup>8</sup> the countries would not suffer from any losses on the stock of assets, which formerly were held against base money and which they now have spent to convert base money into euros. According to the statute of the European System of Central Banks, the "monetary income" of a national central bank of a member country will not remain in the hands of the national central bank. The monetary income is the return from those assets the central bank holds to back base money. Monetary income of the central banks of all member states shall be pooled and then shall be allocated to the central banks in proportion to their paid up shares in the capital of the European Central Bank (Art. 32.5). The regulation of seigniorage sharing implies that the link between the size of base money issued by a national central bank (or the assets held against it) and its seigniorage received is broken. Whereas the contribution of a central bank to total monetary income of the Eurosystem will depend on the stock of its base money, the fiscal revenues of the government on it will depend on the capital share, i.e. equally on the country's share in gross domestic product (GDP) and population.

Thus, a euroised EU-accession country does only lose the return on its asset portfolio until it becomes a full member of EMU. As soon as it enters EMU it will be entitled to participate in the sharing of seigniorage though it will not be able to contribute any own monetary income at the beginning, because it has already sold assets held against base money when it became euroised. Therefore, it will not contribute to the common pool of monetary income, but other member countries, which have acquired its assets in exchange of euros, will do so instead.

So what does the backing of base money imply for governments of EU-accession countries considering euroisation? Central banks, which have backed their base money with marketable assets sell them and purchase cash in euro. They temporarily lose the return on the assets until they join EMU and participate in the sharing of seigniorage. In contrast, central banks, which

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<sup>8</sup> Rostowski (2000), pp. 20-21.



have no saleable assets as base money has been created by increasing net government indebtedness, have to carry the costs of the loan in addition to losses of seigniorage. These countries are more likely to be confronted with higher total costs, as the relevant period of time until entry to EMU becomes shorter and/ or as the terms of the loan are more costly. But if they do not euroise but introduce the euro as they join EMU, they will substitute cash in domestic currency into cash in euros without substituting noninterest-bearing liabilities into interest-bearing loans. Under pure fiscal considerations governments may then prefer holding on to their currencies during their accession to EMU.

### **3. The measurement of seigniorage**

In this part seigniorage is measured for two groups of countries over the most recent years in order to assess whether temporary losses of seigniorage would have been fiscally significant. The first group of countries consists of less advanced economies in Central and Eastern Europe, which are either no EU-accession countries at all or still in a very early stage of accession. In contrast the second group of countries includes more advanced EU-accession countries which are most likely to be the first new members of EMU in Central Europe.

#### **3.1. Yugoslavia and other less advanced Central and Eastern European countries**

Montenegro, the smaller of the two remaining republics of Yugoslavia, decided to introduce the D-Mark as the only official currency in November 2000 after having already legalised it as a parallel currency in November 1999. Thus, it can be considered a “euroised” country, though it is not a fully sovereign nation-state. In order to assess the loss of seigniorage as a consequence of the Montenegrin decision, it should first be estimated, how much the Montenegrin share on seigniorage of the Federal Republic of Yugoslavia has been during the 1990s. Seigniorage is measured by the monetary concept, because neither interest bearing assets have been accumulated by creating base money nor has there existed any access to capital markets to finance budget deficits alternatively with interest bearing bonds.

Two caveats have to be kept in mind. First, newly issued bonds are not the only way of eventually balancing the budget. Lost fiscal revenues from seigniorage could also lead to a reduction in government expenditures, an increase in foreign aid or even an increase in illegal sources of revenues. Opportunity costs would then have to be assessed on a wider economic perspective including lost output due to lower government expenditures and consequently less tax revenues. However, a reduction in government expenditures, which have been more harmful than beneficial to the economy, such as subsidising unproductive state companies, or a temporary increase in foreign aid conditional on a quick implementation of stabilisation policies, may not bear this form of opportunity cost at all. And finally, the lack of inflationary financing at the central bank may lead to higher output, because lower and less volatile inflation provides a better economic environment for investments and may even prevent economic activities to be driven into the informal sector.

And second, just measuring seigniorage does not give a complete picture of all sources of financing ultimately enabled by the monopoly in base money. The leaders in Belgrade were

able to finance their expenditures by various other methods apart from taking loans at the central bank, i.e. by receiving subsidised credit from state controlled banks and by having unlimited overdraft facilities on their accounts at the central payments office. These sources of additional monetary financing eventually caused an increased demand of cash which was provided by the central bank, though strict regulations on cash withdrawals at banks may have retarded the leakage of changes in deposit money to cash. So, changes in base money only partially reflect the rise in money and near-money, which have been possible due to the lack of liquidity constraints to credits. But statistical evidence on the full range of means of payments created by these soft credits does not exist.

Seigniorage was not officially shared with the Republic of Montenegro, though some unofficial agreements of seigniorage sharing may have existed between the two republics. Montenegrin seigniorage is estimated by assuming a 5% share of total monetary seigniorage in Yugoslavia (about the Montenegrin share of output and population in the Federal Republic of Yugoslavia).

The results for Montenegro are compared with seigniorage in other less advanced Central and Eastern European countries, including two former Yugoslavian countries, Macedonia and Croatia, and Albania, Belarus, the Ukraine and Romania. Weak institutional frameworks in these countries support the use of the monetary concept as a measure for fiscal revenues from the central bank, although these countries formally either limit or prohibit fiscal financing at the central bank (see table A2 in the appendix). However, most of the laws have been heavily amended in the 2<sup>nd</sup> half of the 1990s and even despite being stipulated by law, the fiscal financing restrictions were not always binding or disguised in other transactions with the central bank. For example in the Ukraine, the government's financing needs were not served by its ability to borrow from the treasury-bill and international markets. Domestic and foreign investors' interest in government bills or bonds remained weak, partly because of the uncertain economic environment, but also due to the government's reluctance to let the yields rise to levels that would have been attractive to market participants. As a result, the central bank purchased a significant amount of treasury bills in the primary market and so it directly financed the budget deficit of the current period (see appendix A1.3 for the effects to the measurement of seigniorage). Likewise, the National Bank of Romania was forced to accommodate large fiscal and quasi-fiscal deficits of loss-making state-owned enterprises in general and of the agriculture sector in particular during various occasions during the 1990s. The most egregious case was the surge in money growth, which peaked in late 1994, when the authorities launched a very large program of subsidised agricultural financing, additionally injected special credits into failed banks and thereby avoided having to resolve them. The central bank eventually served the refinancing needs, which arose with these activities.<sup>9</sup> It will therefore be assumed that the active exploitation of seigniorage beyond the limits set in the laws was still possible in practice and that the government was not willing to finance fiscal

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<sup>9</sup> See, IMF Ukraine country report 1999, p. 57, IMF Romania country report (2000), p. 11 and for additional examples Hochreiter and Kowalski (2000), p. 10, 11.

and quasi-fiscal deficits at the bond market.<sup>10</sup> This opportunity may not have truly existed for the government and consequently, seigniorage is measured by the monetary concept.

In table 1 the results as averages of yearly data are presented. Annual data are contained in table A1 in the appendix. For each country, the ratio of the change in base money to nominal GDP is calculated in the first column. This represents the command over resources, as a ratio to GDP that the government obtained in that period by creating base money. In the second column seigniorage is calculated as a share of total fiscal revenues (including seigniorage).

Montenegrin seigniorage averaged at 1.4% of GDP in 1995 to 1999 comprising about 2.3% of total fiscal revenues. It is relatively low compared to Fischer's results for high inflationary countries. Here seigniorage generally accounted for well above 2% of output and 10% of total fiscal revenues.<sup>11</sup>

The results of other high inflationary countries, such as Albania, Belarus, Ukraine and Romania are mixed. Belarus and Romania also suffered from extraordinarily high inflation but seigniorage still ranges below 10% of fiscal revenues. Only in Albania, seigniorage comprises more than 10% of fiscal revenues. The Ukrainian economy stabilised after the hyperinflation in 1993/1994, though inflation remained in the double digits and still contributed to seigniorage. Nonetheless, revenues from the monopoly in base money have been quite low. For Macedonia and Croatia, two countries with relatively low inflation rates, seigniorage is no important source of revenue.

*Table 1: Seigniorage of selected countries in Central and Eastern Europe (1995-1999)*

	Seigniorage in % of output	Seigniorage in % of total fiscal revenues	Inflation rate	Change in real GDP in %
Montenegro	1.4	2.3	72.0	6.6
Macedonia	0.8	2.5	4.0	1.4
Croatia	1.0	2.3	4.2	3.9
Albania	3.6	17.0	14.8	2.1
Belarus	4.2	9.8	155.8	3.1
Ukraine	2.4	6.3	54.1	-5.6
Romania	2.3	7.3	66.3	-0.7

*Source:* MONET, International Monetary Fund (IMF) country reports and central banks.

Inflation: Dec. to Dec. change of CPI index (RPI for Albania and Croatia), total fiscal revenues: revenues of the consolidated budget (excl. non-tax, capital revenue and grants) and monetary seigniorage; because no consolidated budget figures are available for Montenegro, the figures include "budget revenues of the central government" and "social funds".

Looking at Figures 2 and 3, some of the reasons for the differences in seigniorage can be explained by cash to GDP ratios and the structure of broad money.

<sup>10</sup> Eventually, a more detailed analysis of the special situation in each country would be needed for more refined arguments in favour of the monetary concept.

<sup>11</sup> Fischer (1984), pp. 302-303, the results were generally based on a longer time period.

Figure 2: Cash/ GDP ratios  
(average 1995-1999)

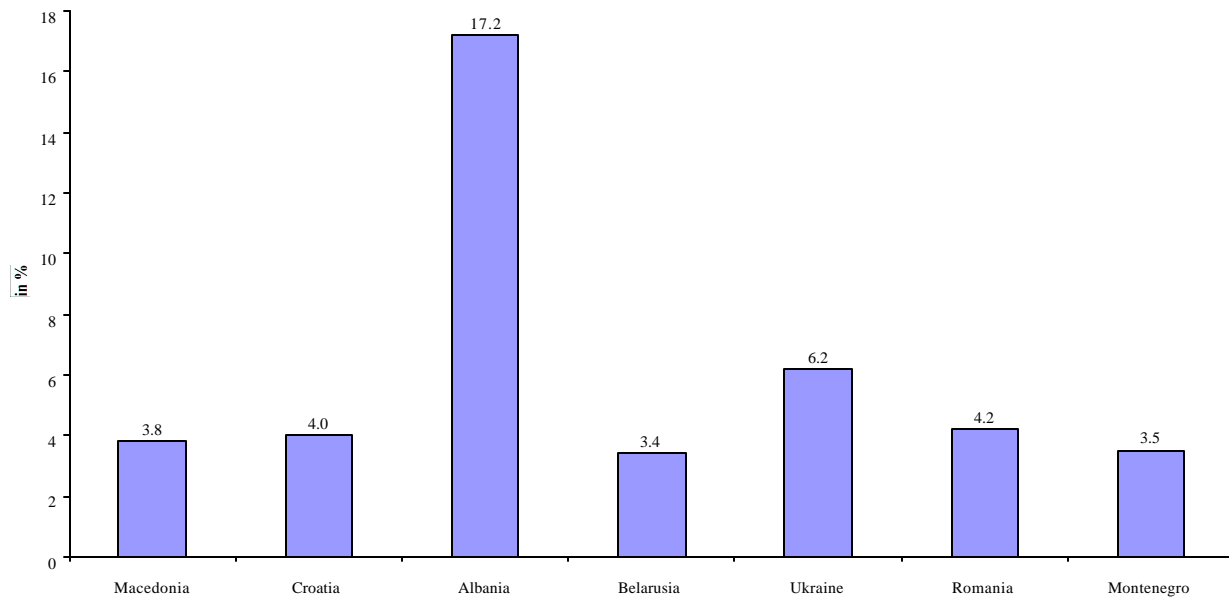
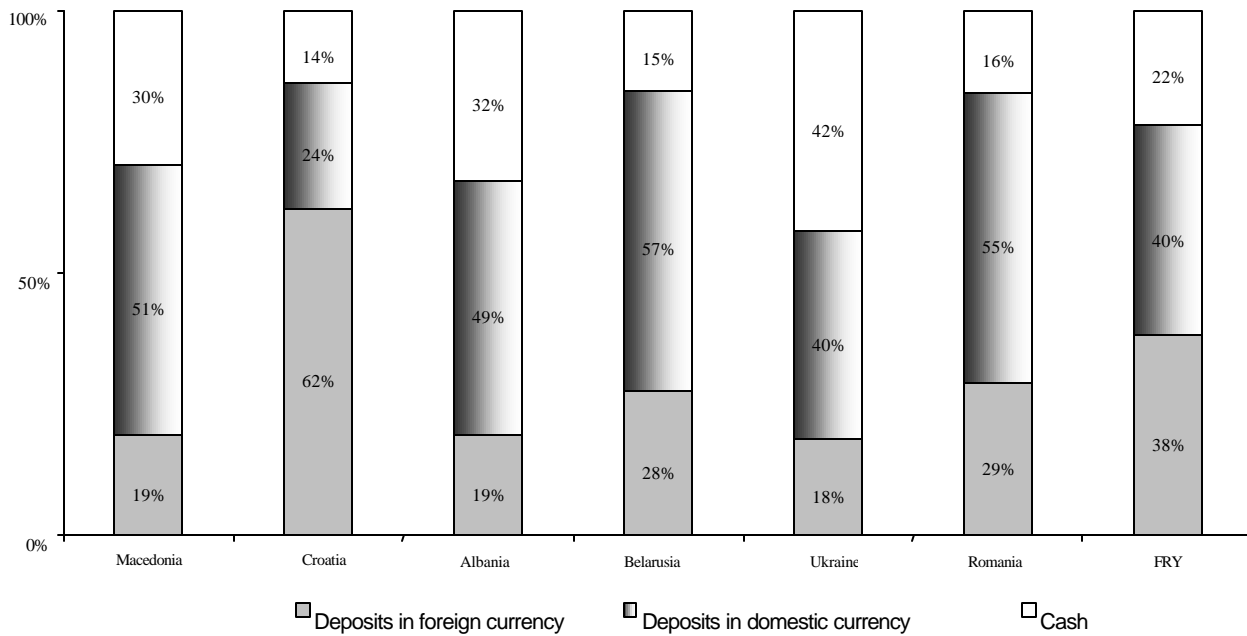


Figure 3: Structure of broad money  
(average 1995-1999)



Source: IMF Country Reports and central banks.

Generally a high ratio of cash to GDP supports high revenues collected from seigniorage. Cash to GDP ratios are very low in all countries apart from Albania, which strikes out with about 17%. Even in developed countries with advanced financial systems offering alternative means of payments than cash, the cash to GDP ratio is usually well above 4%. The economy of these countries has either shifted to other means of payments such as foreign currency and/ or cash holdings in domestic currency were economised.

In figure 3 it is indicated, which other means of payments than domestic currency were used in these countries. The structure of broad money (cash in domestic currency held outside banks and deposits in domestic and foreign currencies) thus illustrates whether deposits in domestic or foreign currency were used as alternative means of payments in these countries. Data on cash in foreign currency are not included, because they are extremely hard to measure, though cash in foreign currency is probably the most important substitute to domestic currency.<sup>12</sup> The ratio of foreign currency deposits to broad money then serves as a proxy for currency substitution. Especially a high ratio of foreign currency deposits indicates that international currencies are already widely used as means of payment in the economy, which should lower the ability to collect seigniorage. The share of foreign currency deposits is already about 38% in the FRY (including Serbia and Montenegro) even though frozen deposits in foreign currencies have been excluded. Private savings in foreign currencies have been confiscated in the early 1990s and contributed to the loss of public confidence in the banking system. Nevertheless, deposits in foreign currencies rose steeply again and reached 60% of broad money at the end of 1999. With about 60% Croatia has the highest ratio of foreign currency deposits over the period 1995-1999. Cash ratios to broad money are usually well below 10% in developed economies, whereas in most countries in this group using deposits at the banking system as alternative means of payments is still at an early stage. Ukraine and Albania have the highest cash ratios. Apparently, the pyramid scheme crisis in Albania in 1996-1997, in which the country descended into anarchy and a near civil war, has led to a loss in confidence in the banking system from which it slowly recovers. Nevertheless, its success in fighting inflation has not reduced the confidence in using cash in domestic currency as evidenced by the high cash to GDP ratio. Additionally, Albania has been an extremely isolated country for most of the postwar period due to rigid dictatorship, which has limited the use of foreign currencies in the economy. In contrast, the FRY also suffers from a loss of confidence in the banking system and private households rarely keep savings at banks. But endemic inflation over most of the postwar period and the openness of Yugoslavia compared to other communist countries have influenced the use of foreign currencies in this economy for decades. As in Croatia currency substitution is very common and reduces the ability of the government to fiscally exploit its monopoly in base money. To some extent this applies to other countries of the group with low cash to GDP ratios, but relatively high ratios of foreign currency

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<sup>12</sup> Most recent studies for Croatia are Feige et al. (2000). The significance of the national currency as a means of payments would be lowered additionally if cash in foreign currency were included.

deposits to broad money indicating a wide use of foreign currencies as substitutes for the national currency.

### **3.2 Seigniorage in advanced EU-accession countries**

#### **3.2.1 Monetary environment and the process of base money creation**

How much do the more advanced Central European countries like the Czech Republic, Estonia, Hungary, Poland and Slovenia fiscally gain from keeping their national currency while they aim to achieve important preconditions for an early EU-accession, i.e. stable exchange rates, a high degree of capital market liberalisation and central banking activities sheltered from government financing?

For these more advanced EU-accession countries with open capital markets a fiscal concept is most suitable for measuring seigniorage. A fiscal concept explicitly accounts for costs and valuation changes arising from the monopoly in base money and both are important in the special environment, in which these central banks issue and manage base money.

Before specifying the suitable concept, the monetary environment and its impact on the process of base money creation and management needs to be analysed. Some of the more advanced EU-accession countries targeted their exchange rates in the period under consideration and at the same time they struggled with high capital inflows putting upward pressure on their pegged exchange rates. This made interventions in the foreign exchange market necessary, which in turn created excessive liquidity in the banking system. Thus to drain part of the liquidity these central banks were forced to use various forms of costly sterilisation instruments.

This special monetary environment is thoroughly described by Nuti (2000) for Poland. The National Bank of Poland was posed in an inescapable dilemma by net capital inflows and the rapid accumulation of foreign reserves. Either it had to allow the domestic monetary expansion brought about by reserve acquisition, possibly at the cost of inflation, or it had to incur hefty costs of sterilisation and the Bank opted for both.<sup>13</sup> The IMF notes, that the Bank of Slovenia often found itself pursuing conflicting objectives: tight monetary conditions aimed at achieving lower inflation tended to lead to an appreciation of the currency, while exchange rate interventions aimed at preserving competitiveness tended to slow disinflation. To keep the balance between objectives, the central bank had to engage in second-round interventions and maintain a strong and continuous presence on the money market.<sup>14</sup> The central banks policy dilemma can be similarly described for the Czech Republic and Hungary. Aiming at price and exchange rate stability is the crucial ingredient of the dilemma, but just pursuing one of the two objectives seemed to be no viable option for these countries. Interestingly, even in Slovenia, which officially

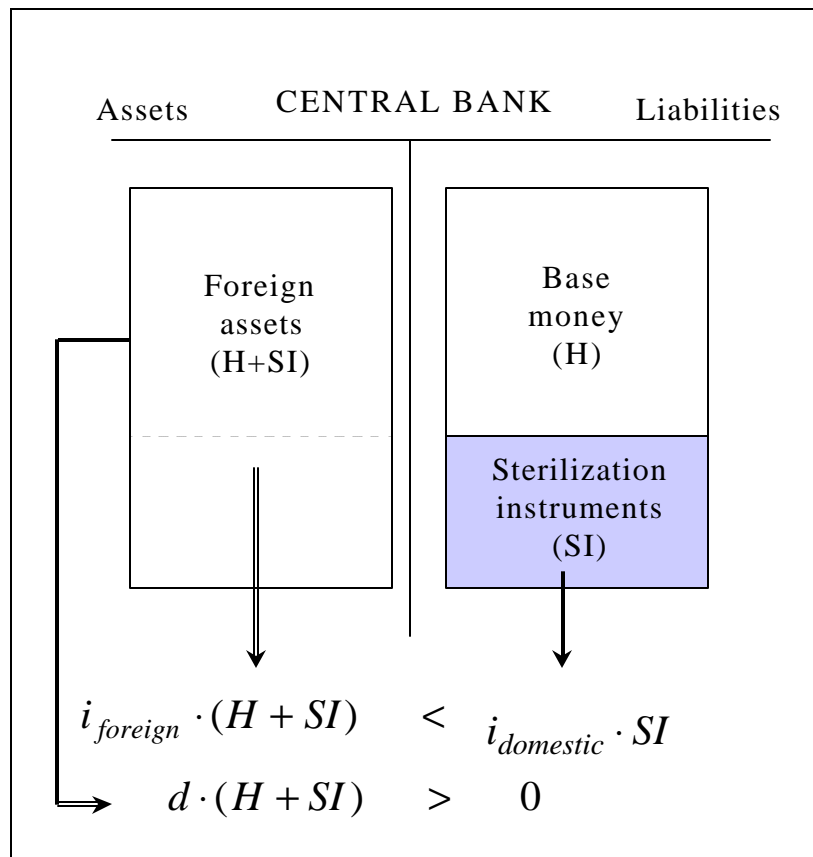
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<sup>13</sup> See Nuti (2000), p. 57.

<sup>14</sup> See IMF Country Report (2000), p. 39.

pursued a managed floating exchange rate regime, or the Czech Republic which moved from an officially pegged exchange rate systems to a managed floating system, the exchange rate objective of central banks in these small and open economies has remained non-trivial so far. Accordingly, the process of base money creation should be reflected in the central banks balance sheet and eventually in their profit and loss account.

Figure 4: Stylised balance sheet



In Figure 4 above, the process is shown in a stylised balance sheet. Its structure of assets and liabilities should reflect the creation and management of base money just described. Foreign assets are accumulated on the asset side and cover not only base money but also sterilisation instruments, which are sold to drain part of the liquidity. The return on foreign assets measured by the generally lower foreign interest rate,  $i_{foreign}$ , and the stock of foreign assets is compared to interest expenses on sterilisation instruments measured by a generally higher domestic interest rate,  $i_{domestic}$ , and the stock of sterilisation instruments. Assuming that the return on foreign assets is lower than the expenses on sterilisation instruments, a country does not necessarily receive *net* revenues on its monopoly in base money. However, the calculation has not considered valuation changes of foreign assets yet. Because the balance sheet is highly leveraged, exchange rate

depreciation cause revaluation gains measured by the depreciation rate,  $d$ , and the sum of base money and sterilisation instruments. If valuation gains outweigh losses on interest income the central bank will still make gains on its monopoly in base money.

Analysing whether this process can be traced on the balance sheets of the five central banks is more difficult in practice. Base money on the liability side is easily identified but the underlying process of base money creation is blurred. Developments of balance sheet items not only include activities related to the issuance and management of base money but also to other activities conducted by the central bank. Therefore, it is not useful to look at the entire balance sheet in order to identify seigniorage. It is more advisable to artificially split central banking operations into activities arising from the “issue department” and from the “banking department” and only to focus on the first group of activities.<sup>15</sup>

A closer look at the balance sheets of the five central banks in Graphs A1 to A5 in the appendix confirms that the process of base money creation and management cannot be easily traced by the overall asset and liability structure of the central bank. Apart from the Bank of Estonia base money generally comprises less than 50% of total liabilities. Not surprisingly, the Bank of Estonia is special, because it is basically a monetary authority conducting the strict rules of the currency board regime. Sterilisation instruments are relatively significant compared to base money at the other central banks. And the share of base money and sterilisation instruments is fully covered by assets denominated in foreign currency over most periods. This gives a first indication of the process underlying base money creation and the choice of the concept.

The issuance and management of the national currency is just one activity among several conducted by the central banks, which include acting as a fiscal agent or supporting a weak banking system. For example, the Czech National Bank was involved in restructuring the banking system by taking over assets and liabilities or guaranteeing liabilities of various banks. The National Bank of Hungary has issued foreign exchange bonds as part of public debt management. Therefore the structure of the assets *and* liabilities side of the National Bank of Hungary has been dominated by foreign exchange. In contrast, while the asset sides of both the National Bank of Poland and the Czech National Bank have also been dominated by foreign exchange, the liability sides are mostly denominated in domestic currency. Thus, their balance sheet structure better reflects the results of interventions in foreign exchange markets arising from managing base money.

So what has driven base money creation at these central banks? Transactions at the balance sheets of the central banks do not give evidence to a significant share of base money created by fiscally

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<sup>15</sup> The definitions go back to the Bank of England Act (1844), which divided the Bank into two departments – the Issue Department which dealt with the Bank’s note issuing function and the Banking Department, which was intended and proposed to behave as an ordinary commercial bank, see Goodhart, (1988), p. 8.



related transactions. In line with the central bank laws (see table A1 in the appendix) claims to the budget have been low or zero at all central banks. As already mentioned, the large share of foreign currency credit to the central government at the National Bank of Hungary is linked to its debt management in which the bank also used to issue international bonds on behalf of the government. Now, the state's foreign borrowing programmes and bond issuances have been transferred to the Treasury and Debt Management Agency as one further step towards a clearer and more transparent separation of monetary and fiscal policies. The amount of government securities held at the central bank is only important at the National Bank of Poland, but here they consist of old government loans, which are now converted into securities. Any movements are mainly the result of ongoing repayments by the government or changes in debt servicing terms.

Some caveats may be kept in mind. Securities and shares held by the Czech National Bank reflect its involvement in the restructuring of the banking system including cash advances to weak banks. The National Bank of Poland has also lent to troubled banks and additionally has extended loans to banks in order to refinance central government investment projects. These balance sheet items at the Czech National Bank and the Bank of Poland are about 10 to 15% of base money. To the extent that losses on these assets will be incurred, the central bank may indirectly finance the government as it prevents higher government expenditures, which would otherwise probably be directly charged to the budget.

Having these caveats in mind, only limited financing of the government or opportunities to indirectly do so can be identified at the central banks over recent years.

Other balance sheet items, which are most closely connected with the issuance of base money are claims to banks and, especially in small open economies with pegged exchange rates, foreign exchange assets. Claims to banks can be regarded as the major counterpart to base money created by monetary policy related transactions. Foreign assets are generally accumulated by interventions, and reflect the creation of base money by autonomous transactions. They dominate the asset side of the five central banks as shown in graph A1-A5 in the appendix.

In graph A6 to A10 in the appendix the development of base money, currency in circulation, foreign assets and claims to banks are shown for the five central banks. At all central banks foreign assets have not only dominated the balance sheet but have also closely risen with base money. Foreign assets have even increased much faster than base money at the National Bank of Poland and to a lesser extent at the National Bank of Hungary whereas claims to banks, the domestic source of base money creation, have decreased. The evolution of the balance sheet items supports the view that the creation of base money was mainly the result of interventions.<sup>16</sup> However, at the Bank of Slovenia the picture is less clear-cut. Though foreign assets dominate

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<sup>16</sup> In 1998 the National Bank of Hungary quite openly states that base money is predominantly created by interventions in the foreign exchange market (Annual Report 1998, p. 126) .

the balance sheet and rise closely with base money, the Bank of Slovenia has actively provided base money to domestic banks by domestic operations. Claims to banks have risen sharply over some periods in contrast to their evolution at the other central banks. However, the Bank of Slovenia has differed from the situation at other central banks. It used the sale of tolar bills as conventional sterilisation instruments and the sale of foreign exchange bills to sterilise capital inflows that have already been realised, but have not been monetised. Thus, foreign exchange bills are primarily used to pursue the central banks exchange rate objective but eventually prevent the sale of more costly sterilisation instruments in domestic currency. The Bank of Slovenia is successful in pursuing this policy, because banks have a strong motive to purchase foreign currency bills, since such instruments can serve as collateral for loans at the central bank and can be temporarily sold bank to the central bank through repos. In fact foreign exchange bills have reached about 13 % of total assets in commercial banks' balance sheets in 1997-1998, which highlights the importance of these instruments for exchange rate interventions, but also for some monetary policy related transactions at the Bank of Slovenia.<sup>17</sup>

Summing up, the balance sheet structure and the evolution of base money, foreign assets and claims to banks support the view described above. The central banks apart from Estonia and to a lesser extent the Bank of Slovenia have issued and managed base money by being placed in a policy dilemma reflected by high interventions and costly sterilisations.

### 3.2.2 The measurement of seigniorage

Because of the special process of base money creation and management causing significant costs and valuation changes, a fiscal concept will be applied. Excess liquidity is issued by interventions in the foreign exchange market and has been sterilised by costly instruments. Consequently, considering all revenues and expenditures connected with the issuance and management of base money, these costs will be included in a suitable concept because they belong to the overall management of base money.<sup>18</sup> The proposed measure of fiscal seigniorage is:

$$S = \sum_{x=1}^X i_x \cdot FA_x - (i_{si} - \sum_{x=1}^X i_x \cdot q_x) \cdot SI + d \cdot (\sum_{x=1}^X FA_x + SI) \quad \text{with} \quad \sum_{x=1}^X FA_x = H$$

The first term, foreign assets (FA) multiplied by the respective interest rates  $i_x$ , comprises interest revenues earned on the existing stock of base money (H). The sum of this part of the portfolio of foreign assets equals the sum of base money (cash in circulation and current accounts of financial institutions). The currency structure of the portfolio of foreign assets is not known and is assumed to be equal to the structure of the currency basket of the exchange rate peg for Poland, Hungary and the Czech Republic, euro for Estonia and for Slovenia, it equals the structure of currencies, as

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<sup>17</sup> IMF country report (2000).

<sup>18</sup> Many thanks to Daniel Gros for pointing out this issue.

stated by the Bank of Slovenia in its comments to its balance sheet at each end of the year. The investment of foreign assets is supposed to be mainly short term, so interest rates  $i_k$  are chosen to be treasury bill rates for the US and three month interbank rates for all other currencies. Thus revenues earned on the stock of base money depend on the structure of foreign assets  $FA_x$  in each currency  $x$  and the respective interest rates  $i_k$  in the anchor countries.

In the second term the costs of sterilisation are shown as the spread between the interest rate paid on sterilisation instruments  $i_i$  and the interest rate on foreign assets. Weights  $q_x$  of foreign interest rates are again chosen by the structure of the foreign assets as described above. If the interest rate on sterilisation instruments is not published, it is equal to the domestic base rate or another comparable short-term domestic rate. It is assumed, that the domestic interest rate must be at least equal to the lowest domestic market rate, because this rate must be at least offered on marketable sterilisation instruments.

The last term measures valuation changes on the total portfolio of foreign assets of the “issue department”. It comprises foreign assets as counterparts to the stock of base money ( $FA = H$ ) and foreign assets as counterparts to sterilisation instruments ( $SI$ ). A positive  $d$  is the actual depreciation rate of the currency against its anchor currencies, a negative  $d$  is accordingly the actual appreciation rate. Because the central banks have large open foreign exchange positions in their “issue department”, valuation gains are received by the rising value of net foreign assets when the domestic currency depreciates against its anchor currencies. In this concept it is assumed that all valuation gains and losses, whether realised or not, are distributed to the fiscal authorities. So different accounting policies of the central banks are ignored in order to make the results comparable as already discussed in part 2. If foreign assets are denominated in euro, the central banks will not need the revaluation reserves any more at the time they join the euro area. And foreign assets denominated in other currencies have become less important as the central bank started to target the euro instead of other anchor currencies. They can be sold as the countries join EMU, because the Eurosystem is already regarded as having excessive foreign exchange reserves. Accordingly, revaluation reserves eventually are distributed to the fiscal authorities.<sup>19</sup>

More details to the data and methods used for the measurement of seigniorage are given in table A8 in the appendix.

In case the central bank remunerates required reserves, as for example in Hungary and Estonia, interest rate expenditures on required reserves  $i_{RR}$  are deducted. Thus, interest revenues on the stock of base money are calculated net of interest expenses due to minimum reserves.

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<sup>19</sup> At the National Bank of Poland and at the Bank of Slovenia revaluation gains, which are not realised yet, are held as reserves. The National Bank of Hungary has changed accounting practices in 1999 and

$$S = \left( \sum_{x=1}^X i_x \cdot FA_x - i_{rr} RR \right) + d \cdot \left( \sum_{x=1}^X FA_x + SI \right) - (i_{si} - \sum_{x=1}^X i_x \cdot q_x) \cdot SI \quad \text{with} \quad \sum_{x=1}^X FA_x = H$$

The proposed fiscal concept is compared with the opportunity cost concept used in other studies of seigniorage,<sup>20</sup> where *i* is chosen as a domestic refinancing rate or other comparable short term interest rate.

$$S = i \cdot H$$

For comparison, seigniorage will be calculated as if the countries had already joined EMU and as if EMU had already existed over the period. The opportunity cost concept is called “implied EMU” and differs from the first opportunity concept in two aspects: Interest rates are either Fidor/ Euribor-rates and base money does not include minimum reserves, because they will be remunerated at market rates under EMU.

All calculations are based on monthly data from the financial statements of the respective central banks.<sup>21</sup>

In table 2 the results are presented as an average for the period 1995-2000. Annual results are given in tables A3-A7 in the appendix.

*Table 2. Seigniorage by concepts (Average 1995-2000)*

In % of GDP	Czech Republic	Estonia	Hungary	Poland	Slovenia
Opportunity cost concept	1.49	0.67	1.99	1.86	0.62
Implied EMU	0.38	0.30	0.24	0.21	0.10
Fiscal concept	0.19	0.37	0.89	0.02	0.47
of which					
+ Net interest revenues	0.43	0.37	0.00	0.36	0.18
- Sterilisation costs	0.60	0.00	0.54	0.59	0.08
+ Valuation changes	0.36	0.00	1.43	0.25	0.38

*Source:* Financial statements of central banks, differences due to rounding.

only distributes realized revaluation gains as well, whereas at the Czech National Bank all revaluation gains are distributed which adds a volatile feature to their stated profits.

<sup>20</sup> Most recently in Hochreiter and Rovelli (1999).

<sup>21</sup> Only averages of yearly data on minimum reserves and on sterilization instruments have been available from the Czech National Bank.

Average seigniorage calculated by the fiscal concept is far lower than seigniorage calculated by the more commonly used opportunity cost concept. Looking at the components of seigniorage measured by the fiscal concept reveals the differences.

Net interest revenues are lower than one would expect by the opportunity cost concept. Mainly responsible are lower returns earned on foreign assets compared to the returns implied by the opportunity cost concept. Due to high inflation gaps to their anchor countries domestic nominal interest rates have been relatively high as well over most of the periods. However these domestic interest rates are not applicable for the fiscal concept but only for the opportunity cost concept.

Additionally, sterilisation costs have averaged at about 0.5-0.6 % of GDP in the Czech Republic, Hungary and Poland. Sterilisation costs have not only been influenced by the volume of outstanding sterilisation instruments, but also by the level of interest rates relative to interest rates in anchor countries. Net interest revenues have not compensated for the losses born by the use of costly sterilisation instruments. Only and not surprisingly again, Estonia has practically zero costs on sterilisation and on valuation changes. The fiscal concept only deviates from the opportunity cost concept because domestic interest rates in Estonia still bear a risk premium over foreign interest rates. And due to its differentiated sterilisation in tolar and foreign exchange bills, the Bank of Slovenia succeeded in limiting sterilisation costs<sup>22</sup>, but total seigniorage remains fiscally unimportant.

The case of Hungary shows that remunerating required reserves might be a hidden sterilisation cost because the net interest revenues have been nil on average. Generally higher reserve requirements offset the costs of sterilisation because part of the liquidity is blocked by minimum reserve accounts bearing below market or no interest rates. So not reducing required reserves or even increasing them will save costly sterilisation operations if they are not remunerated. But this of course is in sharp contrast to more market oriented central banking policies, which these countries should pursue on their way to EU.

Central banks do not explain the use of high minimum reserve requirements as less expensive sterilisation instruments, but they openly admit the link between minimum reserve requirements and sterilisation costs.<sup>23</sup> The Czech National Bank has actually increased reserve requirements

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<sup>22</sup> Sterilisation costs include costs on tolar bills and on foreign currency bills, although the costs on foreign currency bills have even been negative over some periods, because the interest rate on these instruments have been lower than the interest rates on foreign assets held against them. Sterilisation instruments as shown in table A5 only include tolar bills.

<sup>23</sup> For example, as stated in the annual report of the Czech National Bank the decrease of minimum reserves by 2 %-points at the end of July 1998 has increased liquidity in the banking system which would have caused higher sterilization costs, if the decrease of domestic interest rates due to lower inflation had not decreased capital inflows and therefore the need for sterilization instruments.

over some periods, though its true motivation for it remains unclear.<sup>24</sup> However reserve requirements have been adjusted downwards and will approach the ratio of the European Monetary Union (EMU) as countries will accede further to EU.<sup>25</sup> So, even if central banks have postponed more progressive reductions of reserve requirements over previous years, they will have to adjust to lower levels soon and thus will be unable to use reserve requirements as inexpensive sterilisation instruments.

Valuation gains *on average* are only important in case of Hungary, but at all central banks apart of the Bank of Estonia they have heavily influenced the overall positive results.

The concept “Implied EMU” measures seigniorage as if these countries would have been full members of the Monetary Union and if the Monetary Union would have existed over the period observed. Interest rates would have been considerably lower and minimum reserves would have not generated seigniorage anymore. Only small differences arise between the countries, which are mainly due to different behaviours in cash holdings. The calculation has only concentrated on what these countries would have generated as seigniorage in EMU, but not what they would have received. This in turn depends on their capital share at the ECB and can differ substantially in cases, where the share of base money differs from the share in GDP and population in the Eurosystem. Thus for countries, in which cash holdings are relatively low, seigniorage received under full membership of EMU may be much higher than the figures presented under “Implied EMU”.

#### 4. Conclusions

The loss of seigniorage is often argued to be a major disadvantage of official dollarization or euroisation because seigniorage is assumed to be an important source of fiscal revenues. This can mean that it comprises a high share of fiscal revenues or GDP. Additionally, it can mean that seigniorage is an emergency source of revenue which can be activated in case other sources of fiscal revenues do not cover the financial needs of the government.

The first interpretation can be analysed by quantifying actual seigniorage after selecting a suitable fiscal concept. No concept is generally applicable for measuring seigniorage and the choice of the concept eventually depends on the specific environment, in which base money is created. In this respect the fiscal concept is the most general concept for measuring the revenues from the monopoly in base money, which can be distributed to the budget. The monetary and the opportunity cost concept arise as special cases.

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<sup>24</sup> Reserve requirements on primary deposits increased from 8.5% in August 1995 to 11.5% in August 1996 and decreased slowly to 9.5% in May 1997, 7.5% in July 1998, 5% in January 1999 and finally 2% in October 1999. Whether this was motivated by weaknesses of the banking business or by the attempt to reduce sterilisation costs remains unclear.

<sup>25</sup> Reserve requirements in the Eurosystem are 2% on all deposits and are remunerated at market interest rates.

In the second interpretation it is implicitly assumed that the central bank serves the government without being sufficiently independent to withstand its financial needs. In such a weak institutional framework borrowing at the central bank to cover current expenditures takes place in different forms, such as direct lending from the central bank, purchases of bonds which could not be sold at the capital markets or refinancing of loans to state controlled enterprises. Seigniorage is measured by the monetary concept, because the government is eventually not able or willing to finance deficits with marketable bonds as an alternative.

The monetary concept is certainly applicable for Yugoslavia in the 1990s and it has been applied to other less advanced Central and Eastern European countries. If at all, seigniorage has only been fiscally important in high inflationary countries, though fiscal needs have been high. Permanent shifts to other means of payments, i.e. currency substitution, have influenced the relatively low success in collecting seigniorage. Not surprisingly, for less advanced Central and Eastern European countries, that were successful in stabilising prices, seigniorage has no fiscal significance. Accordingly euroisation will be an option for a government of an inflationary economy, which is willing to stabilise prices but which lacks credibility to do so.

Monetary seigniorage, the real value of changes in base money, only measures a part of total revenues enabled by the monopoly in base money. For example, it will only measure the refinancing of a loan, which has been extended at soft conditions to state-controlled enterprises, but not the loan itself. These additional sources of income will be limited to finance fiscal and quasi fiscal deficits in these countries, if they euroise. So as an additional objective, a government, which decides for euroisation, should also be willing to reform its fiscal policies and its financial system. However, these reforms are needed anyway and postponing them should not be a reason to hold on to a national currency.

In case of euroisation governments of less advanced countries in Central and Eastern Europe may additionally have to face costs on loans, which they need to take up to acquire foreign currencies. In contrast to central banks in advanced EU-accession countries, base money is often only partly covered by foreign assets. If the relevant period of time until any potential entry to EMU is expected to be quite long and/ or as the terms of the loan are quite favourable, this additional cost has less weight in the overall assessment.

For more advanced Central and Eastern European countries which are aiming at an early EU-accession and are therefore aiming for a high degree of central bank independence and stable prices seigniorage is not an actively exploited source of fiscal revenue. It rather arises with other activities of the central bank, namely its interventions in the foreign exchange market. Seigniorage in more advanced EU-accession countries has been a by-product of the operations, which were used to achieve their central banks objectives of achieving price and exchange rate stability. It has been relatively low and its overall positive result has often depended on valuation gains. These countries have actually struggled to manage their national currencies in an

environment of high and volatile capital flows unless they only targeted one objective, namely exchange rate stability as in Estonia. Having a monopoly in base money is not only a source of revenues but also a source of expenses for central banks in these countries, because part of the excess liquidity created by foreign exchange interventions was drained by the sale of costly sterilisation instruments. Using less costly sterilisation instruments, such as postponing reductions of high minimum reserve requirements will be limited for the countries, as they move closer to-EU-accession.

Euroisation may become an option from a fiscal point of view as governments of these countries have not earned much from their monopoly in base money. The governments have limited or stopped the sources of fiscal exploitation of the monopoly in base money by stronger institutional frameworks. Additionally, euroisation would only imply temporary losses of seigniorage until their entry to EMU. Any further costs of loans, which other countries would need to take up to substitute cash in domestic currency into cash in foreign currency, do not occur, because base money is already more than covered with marketable foreign assets.

Low and volatile seigniorage mainly resulting from a depreciating exchange rate may become increasingly disturbing for a central bank, because costs of sterilisation and potential valuation *losses* from adverse exchange rate movements can eventually outweigh interest revenues on its asset portfolio. The government may then have an additional reason to reconsider the choice of its monetary regime either towards more *truly* floating regimes or towards euroisation, which offers a way to achieve price stability without any exchange rate volatility in liberalised capital markets.



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## Appendix

Table A1. Seigniorage of selected countries in Eastern Europe

	Seigniorage in % of output	Seigniorage in % of total fiscal revenues	Inflation in %	Real GDP change in %	FCD ratio in %	Cash ratio in %
Montenegro						
1995	1.5	2.7	104.1	14.1	17.6	27.3
1996	2.1	3.5	47.2	27.7	21.6	30.2
1997	2.1	2.9	18.1	6.6	38.7	23.2
1998	0.6	1.0	44.8	-1.5	49.3	17.0
1999	0.6	1.4	146.0	-13.8	63.0	11.9
Av 95-99	1.4	2.3	72.0	6.6	38.0	21.9
Macedonia						
1995	1.1	4.7	15.8	-1.1	16.3	31.8
1996	-0.1	-0.4	2.3	1.2	15.0	35.7
1997	1.0	3.0	2.6	1.4	20.8	30.5
1998	0.3	0.9	-0.1	2.9	22.9	26.5
1999	1.6	4.5	-0.4	2.7	20.5	23.2
Av 95-99	0.8	2.5	4.0	1.4	19.1	29.5
Croatia						
1995	2.1	4.4	3.7	6.8	57.6	13.7
1996	1.9	4.1	3.4	6.0	59.7	17.3
1997	1.3	2.9	3.8	6.5	61.8	14.4
1998	-0.3	-0.6	5.6	2.5	66.4	13.1
1999	0.2	0.5	4.6	-2.1	65.2	10.5
Av 95-99	1.0	2.3	4.2	3.9	62.1	13.8
Albania						
1995	5.1	22.9	6	8.9	18.7	39.0
1996	2.7	14.9	17.4	9.1	21.9	30.9
1997	8.6	38.9	42.1	-7	18.3	36.6
1998	-0.2	-1.4	8.7	-8	16.8	28.5
1999	1.7	9.5	0	7.3	19.5	27.1
Av 95-99	3.6	17.0	14.8	2.1	19.0	32.4

Belarus						
1995	4.2	12.0	244	-10.4	30.7	21.1
1996	2.9	7.2	39	2.8	19.5	18.3
1997	3.7	8.0	63	11.4	21.4	16.7
1998	6.1	12.8	182	8.4	35.7	8.0
1999	4.1	8.8	251	3.4	30.4	12.0
Av 95-99	4.2	9.8	155.8	3.1	27.5	15.2
Ukraine						
1995	3.7	9.6	181.7	-12.2	22.8	49.0
1996	1.6	4.2	39.7	-10	15.5	36.5
1997	2.3	6.1	10.1	-3	11.8	43.1
1998	1.5	4.2	20	-1.7	17.5	37.6
1999	2.7	7.5	19.2	-1.2	24.5	44.1
Av 95-99	2.4	6.3	54.1	-5.6	18.4	42.0
Romania						
1995	2.0	6.5	27.8	7.1	22.6	20.6
1996	2.9	9.8	56.9	3.9	23.4	17.7
1997	1.1	3.9	151.4	-6.1	28.4	14.8
1998	2.4	7.8	40.6	-5.4	32.6	12.5
1999	2.9	8.6	54.8	-3.2	37.6	13.0
Av 95-99	2.3	7.3	66.3	-0.7	28.9	15.7

Inflation: Dec. to Dec. change of CPI index (RPI for Albania and Croatia). FCD ratio: foreign currency deposits in % of broad money (including foreign currency deposits). cash ratio (cash in national currency outside banks in % of broad money (including foreign currency deposits). fiscal revenues: taxes, social contributions, customs duties (excluded in Montenegro)

Table A2. Lending to the government<sup>26</sup>

Country	Limit	Maturity	Legal Act
Albania	5% of the annual average of the Government of the Republic of Albania ordinary revenue for the three preceding financial years and exceptional temporary waiver not exceeding 8% of it Exceptions are possible if government debt arises due to membership in international organisations. Purchases of government bonds in the secondary market are possible. Under certain conditions they do not add up to the overall limit on government debt.	Max. 6 months	Art 30, 31, 32 of the Law on the Bank of Albania
Croatia	5% of the budget for the current year (to be banned in the new law)	Not beyond the end of the fiscal year	Art. 57, 58 Law on the Croatian National Bank (amended version 1994)
Czech Republic	No direct lending to the Republic or its bodies, regional authorities, bodies governed by public law or legal entities under the control of the state, a regional authority or a body governed by public law ( <i>with the exception of banks</i> ) not even through the purchase of bonds from such entities (unless in order to regulate the money market).		Art. 30 (2), 32 Act on the Czech National Bank
Estonia	No direct or indirect granting of credits to the government, no buying of government securities		Law on the Central Bank of the Republic of Estonia
Hungary	2% of the planned budget revenue of the actual year	15 days in a calendar month	Art. 18 (4) of the Act LX of 1991 on the National Bank of Hungary (last amended 1997)
Macedonia	5% of the current budget, but exceptions allowed if the Republic has debt due to regulations of external debt or membership in international organisations	Usually not beyond the end of the fiscal year	Art 46 of the National Bank of the Republic of Macedonia Act
Poland	No direct lending to the government		Art. 220.2 of the Constitution
Romania	7% of the State budget revenues of the previous year	180 days	Art 29(4) The National Bank of Romania Act
Slovenia	5% of the budget of the Republic of the current year and 1/5 of total anticipated budget deficit	Not beyond the end of the fiscal year	Law of the Bank of Slovenia, Art. 61
Ukraine	No direct lending to finance expenses of the State Budget		Art. 54 of the Law of Ukraine on the National Bank of Ukraine
Yugoslavia	10% of the planned yearly budget	Short term	Art. 34 of the Federal Law on the National Bank of Yugoslavia

<sup>26</sup> Based on central bank laws and on Hochreiter, and Kowalski (2000).

Table A3. Seigniorage by concepts in the Czech Republic

in million € (or stated otherwise)	1995	1996	1997	1998	1999	2000
Opportunity cost	740	793	942	893	401	309
<i>in % of GDP</i>	1.95	1.73	2.13	1.73	0.79	0.58
Implied EMU	314	122	109	136	131	226
<i>in % of GDP</i>	0.83	0.27	0.25	0.26	0.26	0.43
Fiscal concept	91	-557	975	-1.132	956	120
<i>in % of GDP</i>	0.24	-1.22	2.21	-2.20	1.88	0.23
of which						
Net interest revenues	135	258	226	254	213	120
<i>in % of GDP</i>	0.36	0.56	0.51	0.49	0.42	0.23
Sterilisation costs	285	493	216	437	195	27
<i>in % of GDP</i>	0.75	1.08	0.49	0.85	0.38	0.05
Valuation gains	241	-322	965	-949	938	27
<i>in % of GDP</i>	0.63	-0.70	2.19	-1.84	1.84	0.05
Base money to GDP in %	18.38	13.8	14.2	12.4	11.7	11.0
Inflation (CPI) in %	9.1	8.8	8.5	10.7	2.1	3.9

Source: Financial statements of the Czech National Bank, statistical office.

Table A4. Seigniorage by concepts in Estonia

in million €(or stated otherwise)	1995	1996	1997	1998	1999	2000
Opportunity cost	15.17	12.12	30.55	61.49	26.38	25.96
<i>in % of GDP</i>	0.58	0.36	0.74	1.31	0.55	0.48
Implied EMU	10.9	9.66	11.03	12.13	10.83	16.13
<i>in % of GDP</i>	0.42	0.29	0.27	0.26	0.23	0.30
Fiscal concept	13.09	11.39	14.68	18.82	14.29	17.06
<i>in % of GDP</i>	0.50	0.34	0.36	0.40	0.30	0.32
of which						
Net interest revenues	13.11	11.4	14.68	18.83	14.29	17.06
<i>in % of GDP</i>	0.50	0.34	0.36	0.40	0.30	0.32
Sterilisation costs	0.02	0.01	0.00	0.01	0.01	0.00
<i>in % of GDP</i>	0.00	0.00	0.00	0.00	0.00	0.00
Base money to GDP in %	9.32	10.27	10.79	11.41	12.24	10.92
Inflation (CPI) in %	28.9	23.1	11.1	8.2	3.3	4

Source: Financial statements of the National Bank of Hungary, statistical office.

Table A5. Seigniorage by concepts in Hungary

in million €(or stated otherwise)	1995	1996	1997	1998	1999	2000
Opportunity cost	829	920	855	760	737	572
<i>in % of GDP</i>	2.16	2.77	2.22	1.93	1.65	1.25
Implied EMU	91	79	86	91	131	138
<i>in % of GDP</i>	0.24	0.24	0.22	0.23	0.21	0.30
Fiscal concept	882	288	82	465	88	262
<i>in % of GDP</i>	2.29	0.87	0.21	1.18	0.20	0.57
of which						
Net interest revenues	1	-40	-39	-0	23	76
<i>in % of GDP</i>	0.00	-0.12	-0.10	0.00	0.05	0.17
Sterilisation costs	15	225	345	369	221	97
<i>in % of GDP</i>	0.04	0.68	0.90	0.94	0.49	0.21
Valuation gains	896	553	466	834	286	283
<i>in % of GDP</i>	2.33	1.67	1.21	2.12	0.64	0.62
Base money to GDP in %	7.8	16.4	10.4	10.2	10.5	10.9
Inflation (CPI) in %	28.2	23.6	18.3	14.3	10.0	9.8

Source: Financial statements of the National Bank of Hungary, statistical office.



*Table A6. Seigniorage by concepts in Poland*

in million € (or stated otherwise)	1995	1996	1997	1998	1999	2000
Opportunity cost	2.252	2.215	2.824	2.433	1.667	2266
<i>in % of GDP</i>	<i>2.48</i>	<i>2.08</i>	<i>2.31</i>	<i>1.81</i>	<i>1.22</i>	<i>1.27</i>
Implied EMU	252	227	228	277	264	401
<i>in % of GDP</i>	<i>0.28</i>	<i>0.21</i>	<i>0.19</i>	<i>0.21</i>	<i>0.15</i>	<i>0.23</i>
Fiscal concept	123	270	-765	-22	1.667	-1.291
<i>in % of GDP</i>	<i>0.14</i>	<i>0.25</i>	<i>-0.63</i>	<i>-0.02</i>	<i>1.13</i>	<i>-0.73</i>
of which						
Net interest revenues	375	376	430	525	485	635.5
<i>(in % of GDP)</i>	<i>0.41</i>	<i>0.35</i>	<i>0.35</i>	<i>0.39</i>	<i>0.33</i>	<i>0.35</i>
Sterilisation costs	260	205	1.359	1.231	614	1089.3
<i>(in % of GDP)</i>	<i>0.29</i>	<i>0.19</i>	<i>1.11</i>	<i>0.92</i>	<i>0.42</i>	<i>0.61</i>
Valuation gains	9	98	163	684	1.795	-836.7
<i>(in % of GDP)</i>	<i>0.01</i>	<i>0.09</i>	<i>0.13</i>	<i>0.51</i>	<i>1.22</i>	<i>-0.47</i>
Base money to GDP in %	9.3	8.2	8.5	9.0	8.9	7.1
Inflation (CPI) in %	27.8	19.9	14.9	11.8	7.3	9.0

*Source:* Financial statements of the National Bank of Poland, statistical office.

Table A7. Seigniorage by concepts in Slovenia

in million €(or stated otherwise)	1995	1996	1997	1998	1999	2000
Opportunity cost	62	65	79	98	95	112
<i>in % of GDP</i>	0.45	0.47	0.57	0.71	0.69	0.81
Implied EMU	15	12	12	17	17	26
<i>in % of GDP</i>	0.11	0.08	0.08	0.10	0.09	0.14
Fiscal concept	31	79	77	2	144	149
<i>in % of GDP</i>	0.22	0.55	0.50	0.01	0.78	0.78
of which						
Net interest revenues	25	22	23	31	32	44
<i>in % of GDP</i>	0.18	0.15	0.14	0.18	0.17	0.23
Sterilisation costs	4	6	34	16	13	7
<i>in % of GDP</i>	0.03	0.04	0.22	0.09	0.07	0.04
Valuation gains	10	63	88	-13	125	113
<i>in % of GDP</i>	0.07	0.44	0.57	-0.07	0.68	0.59
Base money to GDP in %	4.2	5.0	6.0	7.5	9.0	9.7
Inflation (CPI) in %	13.5	9.9	8.4	7.9	6.1	8.9

Source: financial statements of the National Bank of Hungary, statistical office.

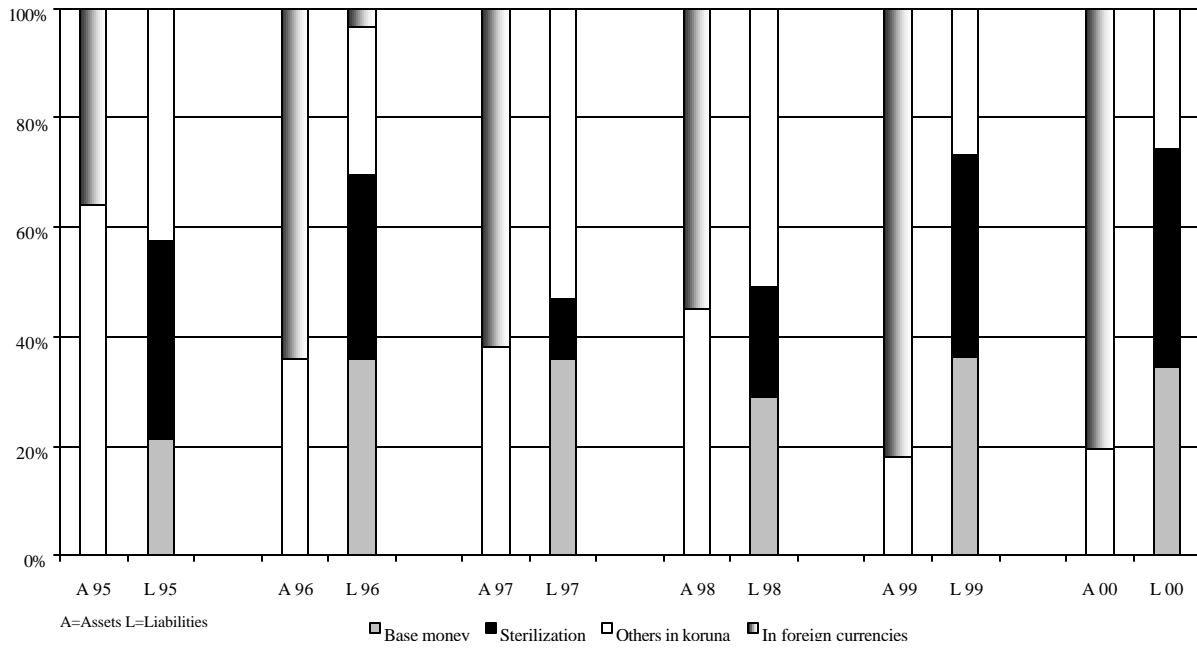
Table A8. Chosen variables and assumptions for the calculation of seigniorage

	Sterilisation instruments	Interest rate on sterilisation instruments and as rate of opportunity cost	Assumed structure of foreign assets	Exchange rate regime
Czech National Bank (CNB)	Other liabilities to domestic banks	Repo rate (2 weeks)**	35% USD, 65% DEM/ EUR	until May 26, 1998: basket peg 35 % USD, 65 % DEM since May 27, 1998: managed float
National Bank of Hungary (NBH)	Repurchase agreements and forint non-callable deposits, NBH domestic bills held by resident credit institutions	Base rate	until end of 1999: 30% USD, 70% DEM/ EUR since 2000: 100 % EUR	crawling peg regime to basket until end of 1996: 30% USD, 70% ECU until end of 1999: 30 % USD, 70% DEM, since 2000: 100% EUR
National Bank of Poland (NBP)	Liabilities to banks from open market operations and others, securities issued by the NBP	Basic refinancing rate	until end of 1998: 45% USD, 35% DEM, 10% GBP, 5% FF, 5% SF) since 1999: 45 USD, 55% EUR	Crawling band regime to basket until end of 1998: 45% USD, 35% DEM, 10% GBP, 5% FF, 5% SF, until April 11, 2000: 45% USD, 55% EUR since April 12, 2000: full floating
Bank of Slovenia	Tolar and foreign exchange bills	Bill rates on sterilisation instrument, Average between lombard and discount rate as rate of opportunity cost	1995: 64% EUR/ 36% USD 1996/97: 70% EUR/ 30% USD 1998: 68% EUR/ 32% USD 1999: 69% EUR/ 31% USD 2000: 74% EUR/ 26% USD	Managed float
Eesti Pank	Securities (CD's)	Overnight lending rate	100% DEM/ EUR	Currency board to DEM/ EUR

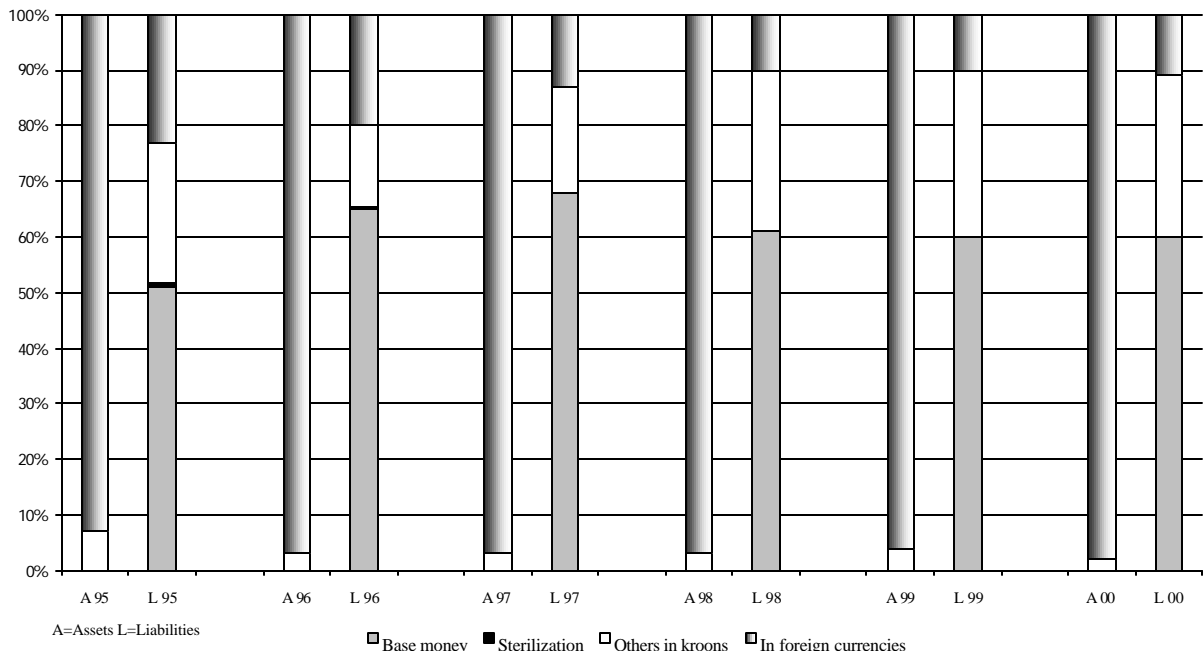
\* (Discount + lombard rate)/2 in 1995 (Jan-Nov), Pribor 2 weeks in 2000.

# Balance sheets of central banks (calculated from monthly averages)

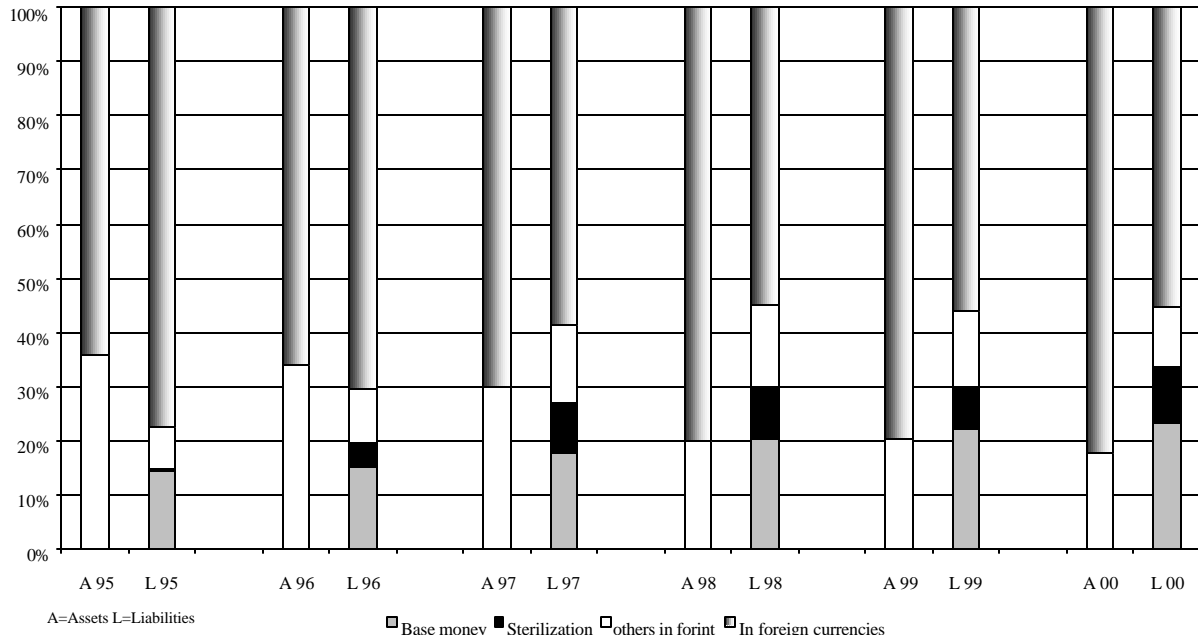
## Graph A1: Czech National Bank



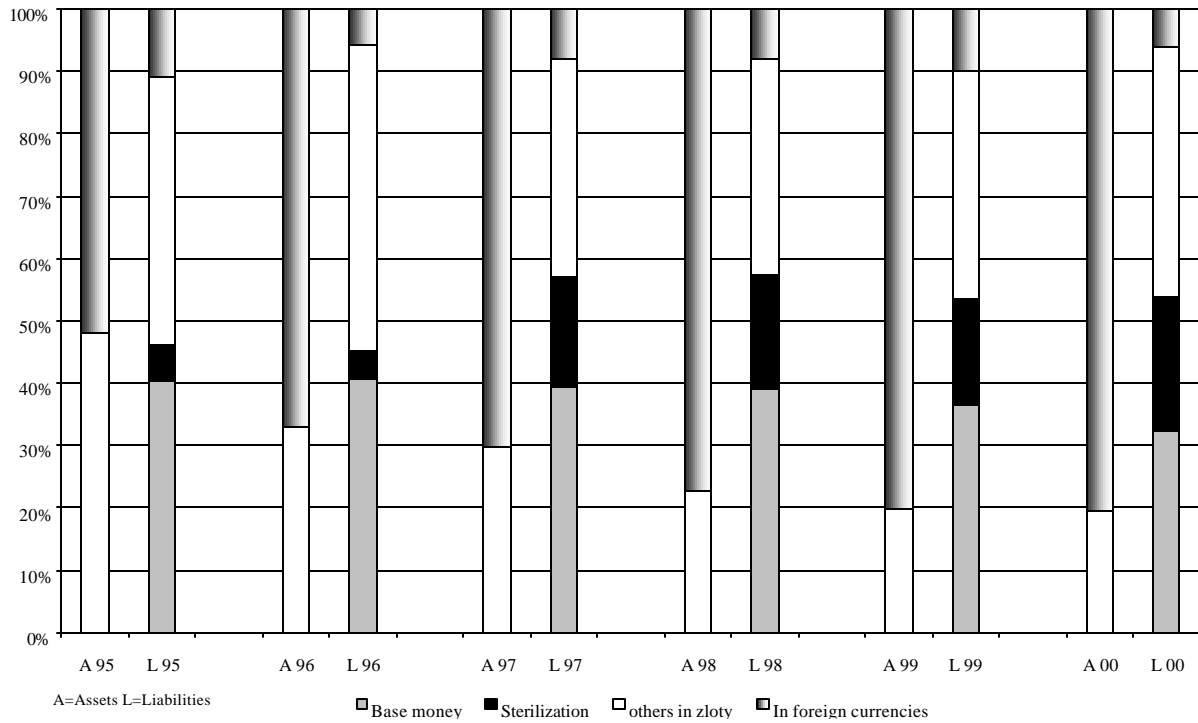
## Graph A2: Bank of Estonia



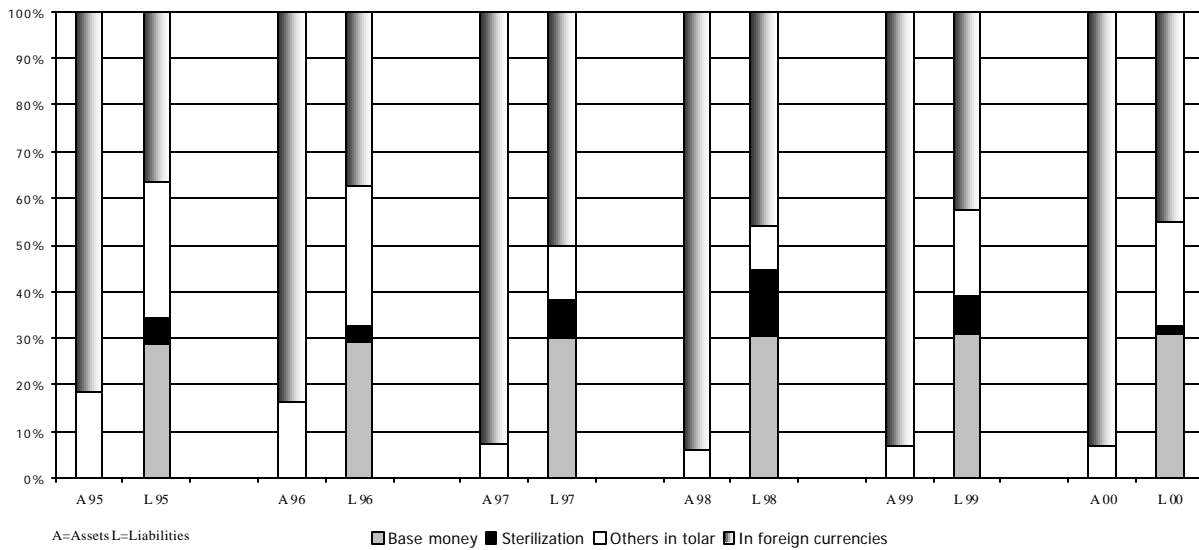
**Graph A3: National Bank of Hungary**



**Graph A4: National Bank of Poland**

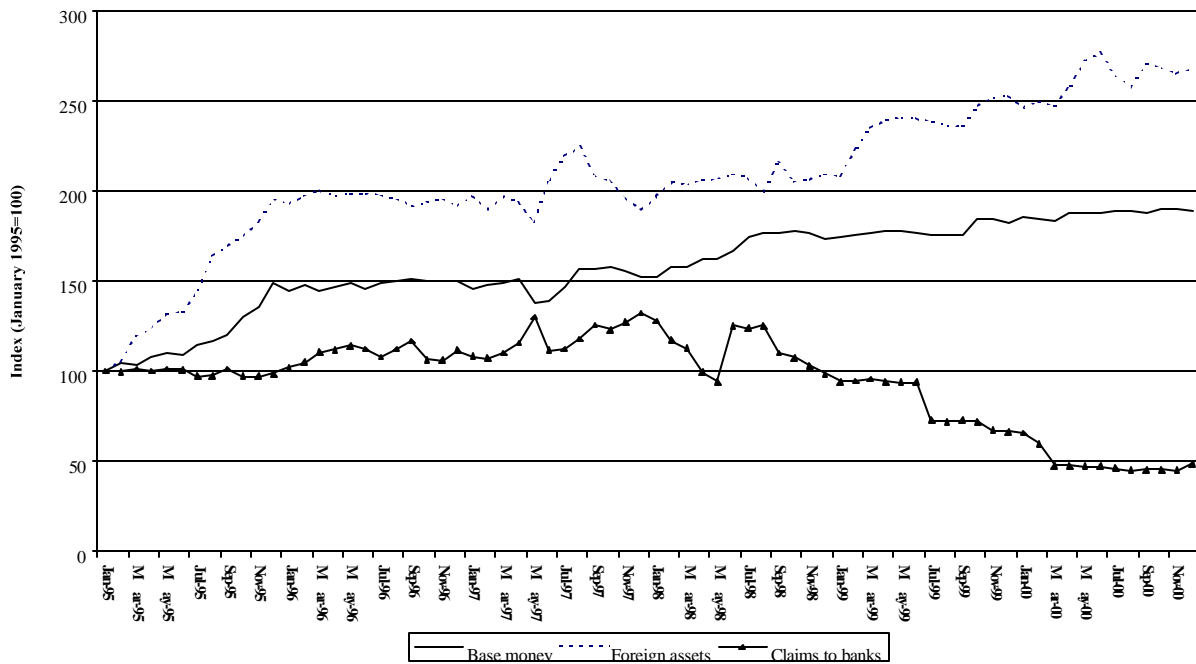


Graph A5: Bank of Slovenia

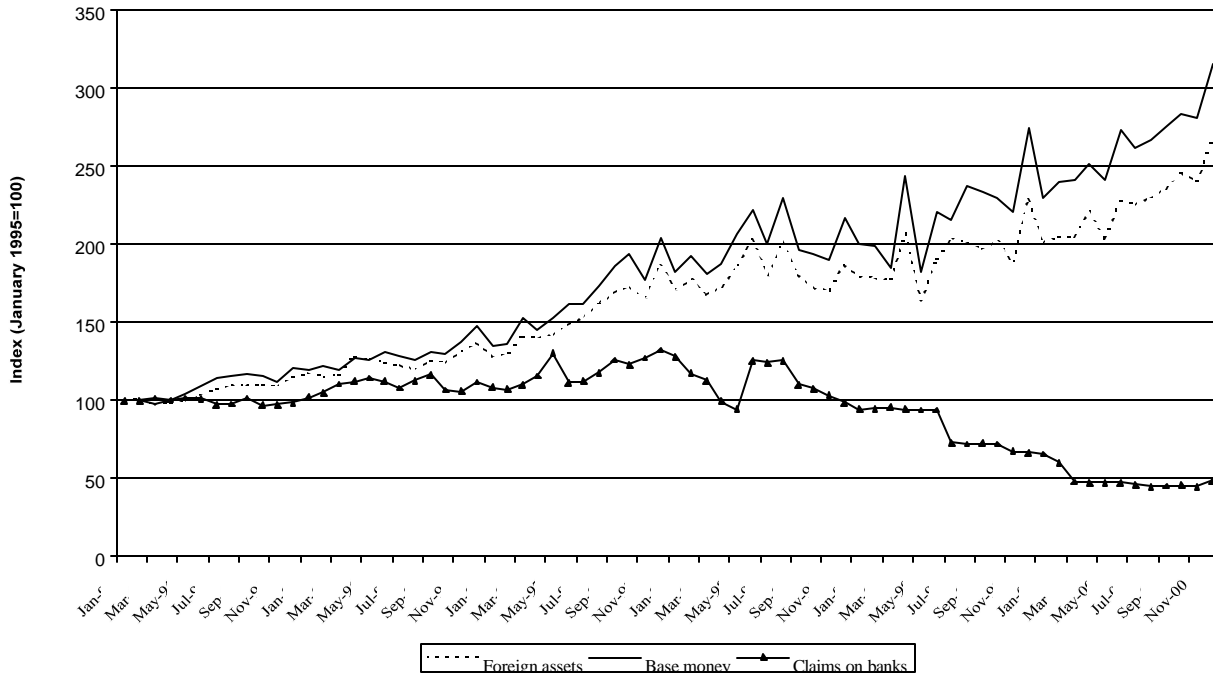


Evolution of base money, foreign assets and claims to banks:

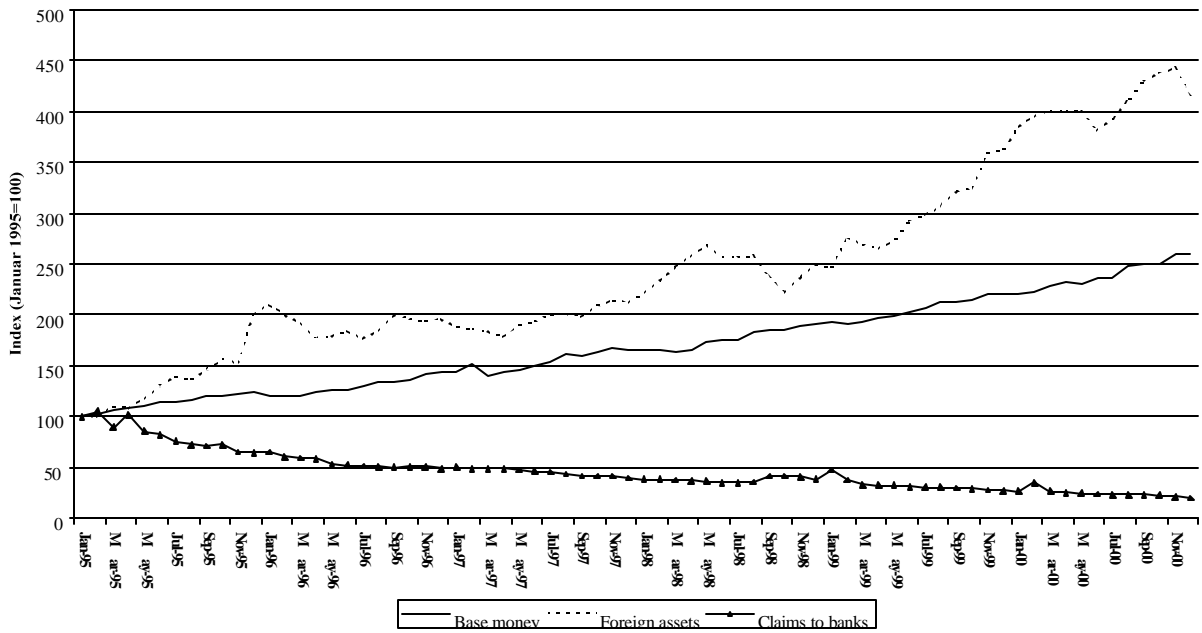
Graph A6: Czech National Bank



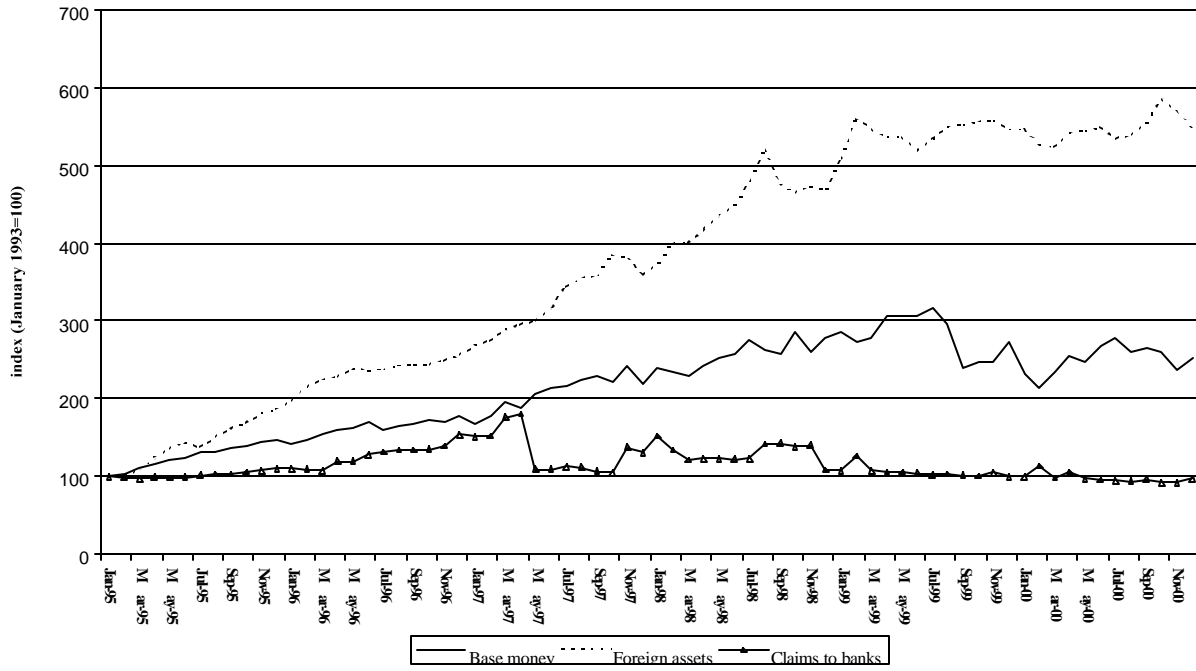
Graph 7: Bank of Estonia



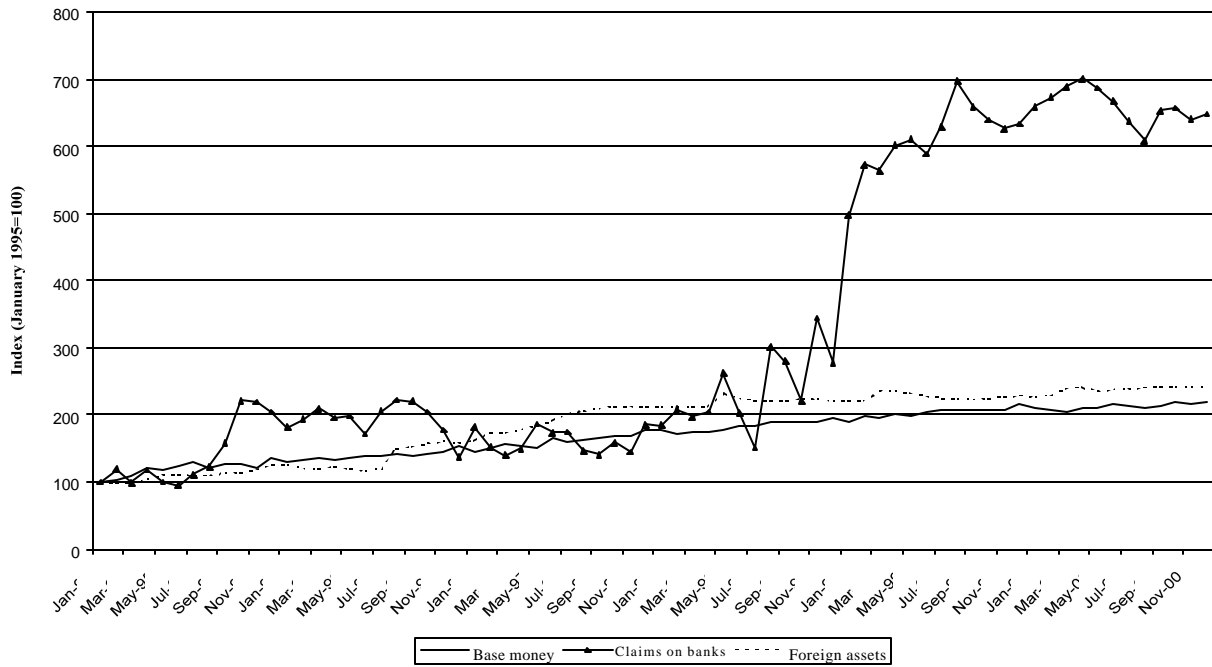
Graph A8: National Bank of Hungary



Graph A9: National Bank of Poland



Graph A10: Bank of Slovenia





## A.1 Budget accounting

### A.1.1 Inferring concepts of seigniorage

Concepts of seigniorage may be inferred from different presentations of the government's budget constraint.<sup>27</sup> In order to compare the concepts, it is assumed that no costs and valuation changes occur.

As has been described in part 1 the opportunity cost concept equals the fiscal concept, if base money is either created by purchasing outstanding government bonds or assets outside the government sector. In contrast, the monetary concept will arise as a special case of the fiscal concept, if base money is created with financing government expenditures in the same period. This is most obvious the case, if the central bank directly lends to the fiscal authorities, but it may also be the case, if the central bank purchases government bonds in the primary markets, i.e. it monetises newly issued government debt in the same period.

First, assume that the central bank issues base money by purchasing outstanding government bonds. Thus the fiscal concept is given by  $S_t^f = i_{t-1}b_{t-1}^{cb}$  and equals the opportunity cost concept  $S_t^o = i_{t-1}h_{t-1}$ , because base money in this case is covered with government bonds.

The identity for the fiscal branch of a government is

$$A.1 \quad G_t + i_{t-1}B_{t-1} = T_t + B_t - B_{t-1} + S_t^F$$

where upper case letters are nominal variables. Government expenditures,  $G_t$ , and interest expenditures on total outstanding bonds,  $i_{t-1} \cdot B_{t-1}$ , are financed with tax revenues  $T_t$ , changes in bonds,  $B_t - B_{t-1}$ , and seigniorage received from the central bank,  $S_t^F$ .

Total bonds of the government,  $B_t$ , comprise bonds held by the public,  $B_t^P$  or at the central bank,  $B_t^{CB}$ .

The budget identity of the central bank is

$$A.3 \quad (B_t^{CB} - B_{t-1}^{CB}) + S_t^F = i_{t-1} \cdot B_{t-1}^{CB} + (H_t - H_{t-1})$$

where changes in government bonds held at the central bank  $(B_t^{CB} - B_{t-1}^{CB})$  and seigniorage distributed to the fiscal branch of the government equals interest revenues on these government

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<sup>27</sup> See Walsh (1998), pp. 132-147.

bonds and changes in the own liabilities of the central bank, i.e. changes in base money  $(H_t - H_{t-1})$ .

Combining the budget identities of the fiscal branch and the central bank produces the consolidated government-sector budget identity:

$$\text{A.4} \quad G_t + i_{t-1} B_{t-1}^P = T_t + (B_t^P - B_{t-1}^P) + (H_t - H_{t-1})$$

The funds available to the consolidated government sector originate from three sources: taxes, newly issued bonds held by the public and newly issued base money as noninterest-bearing debt. Accordingly, from the perspective of the consolidated government sector, the last two terms on the right hand side of the equation comprise total new debt issued by the government, but only debt held by the public and thus outside the government sector represents an interest-bearing liability.

Dividing A.4 by the price level,  $P_t$ , equation A.4 can be shown in real terms (indicated by lower case letters)<sup>28</sup>

$$\text{A.5} \quad g_t + r_{t-1}^\bullet \cdot b_{t-1}^p = \mathbf{t}_t + b_t^p - b_{t-1}^p + \frac{H_t - H_{t-1}}{P_t}$$

$$\text{where } r_{t-1}^\bullet = \frac{1 + i_{t-1}}{1 + \mathbf{p}_t} - 1$$

Adding and subtracting the term  $b_{t-1}^p \cdot \frac{(1 + r_{t-1}) \cdot (1 + \mathbf{p}_t)}{(1 + \mathbf{p}_t)}$  from the left hand side and rearranging gives:

$$\text{A.6} \quad g_t + r_{t-1} \cdot b_{t-1}^p = \mathbf{t}_t + b_t^p - b_{t-1}^p + \frac{(1 + r_{t-1}) \cdot (\mathbf{p}_t - \mathbf{p}_t^e)}{(1 + \mathbf{p}_t)} \cdot b_{t-1}^p + \frac{H_t - H_{t-1}}{P_t}$$

$$\text{where } r_{t-1} = \frac{1 + i_{t-1}}{1 + \mathbf{p}_t^e} - 1$$

The third term on the right hand side,  $(1 + r_{t-1}) \cdot (\mathbf{p}_t - \mathbf{p}_t^e) / (1 + \mathbf{p}_t) \cdot b_{t-1}^p$ , represents reductions of the real value of the government's outstanding interest-bearing nominal debt when inflation is unanticipated and thus has not been correctly priced into nominal interest rates.

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<sup>28</sup> Bonds of the previous period are presented as  $B_{t-1} / P_t = B_{t-1} / P_{t-1} \cdot P_{t-1} / P_t = b_{t-1} \cdot 1 / 1 + \mathbf{p}_t$  and then rearranged.

Reductions of debt denominated in domestic currency due to unanticipated inflation<sup>29</sup> should not be confused with the inflation tax, which arises as part of seigniorage as shown in A7. Here changes in base money are rearranged into:

$$A.7 \quad \frac{H_t - H_{t-1}}{P_t} = \mathbf{q}_t \cdot h_{t-1} = h_t - h_{t-1} + \frac{\mathbf{p}_t}{1 + \mathbf{p}_t} \cdot h_{t-1}$$

The first term on the right hand side of A.7 gives the change in real base money holdings leaving velocity constant. The second term is normally regarded as the inflation tax. Assuming, that the growth of base money is either driven by real growth (population and economic growth) or by inflation, these revenues will arise, even if the economy is stationary. However, the interpretation appears to imply that the government then receives no revenue if additionally inflation is zero. The inference neglects the real interest savings to the government of issuing base money as opposed to bonds. For a given level of total liabilities of the government, interest costs will decrease, if base money takes up an increasing share of total liabilities. A shift from interest-bearing debt (bonds held by the public, i.e. outside the central bank) to noninterest-bearing debt (base money) would allow the government to reduce total tax revenues or increase government expenditures or both. Using equation A.6 and A.7 and assuming that inflation is fully anticipated, gives

$$A.9 \quad g_t + r_{t-1} \cdot b_{t-1}^p = \mathbf{t}_t + b_t^p - b_{t-1}^p + h_t - h_{t-1} + \frac{\mathbf{p}_t}{1 + \mathbf{p}_t} \cdot h_{t-1}$$

Adding  $r_{t-1} \cdot h_{t-1}$  to both sides of the equation gives the government's budget constraint expressed in terms of total liabilities of the government.

$$A.10 \quad g_t + r_{t-1} \cdot d_{t-1} = \mathbf{t}_t + d_t - d_{t-1} + \frac{i_{t-1}}{1 + \mathbf{p}_t} \cdot h_{t-1}$$

where  $d$  resembles total liabilities of the government, i.e. bonds held outside the government sector and base money. In this case  $d$  actually equals total outstanding bonds,  $b$ , because base money is backed with government bonds held at the central bank. The opportunity cost on base money depends directly on the nominal rate of interest. It includes the rate on the inflation tax  $\frac{\mathbf{p}_t}{1 + \mathbf{p}_t}$  and the rate of return, the government would have to offer as an opportunity cost if it were

not able to issue base money  $r_{t-1}$ .

Thus, seigniorage measured by the monetary concept ignores any interest savings due to the privilege of the government to issue base money as noninterest-bearing debt. If the government has no alternative of financing deficits than to print money, i.e. it has no access to bond financing at capital markets, these opportunity costs do not apply to this situation (but other opportunity costs may apply as discussed in part 3). The monetary concept will reflect the choice of the government,

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<sup>29</sup> Or equivalently, unanticipated depreciation when measuring variables in a foreign currency.

namely financing government deficits by directly lending at the central bank. The fiscal concept measures seigniorage by the lending activity to the government in each period  $S_t^f = C_t$ , which directly translates into changes in base money and thus into the monetary concept.

The budget identity of the central bank, A.3, reduces to

$$\text{A.3.a} \quad G_t = T_t + S_t^F$$

and the governments budget constraint expressed in terms of total liabilities of the government becomes

$$\text{A.10a} \quad g_t = t_t + q_t \cdot h_{t-1}$$

If the central bank issues base money exclusively by purchasing assets outside the government sector, the result of the analysis will not change to the first case, where the central bank purchases outstanding government bonds, but the reasoning is different. The fiscal concept is given by  $S_t^f = i_{t-1}a_{t-1}$  and equals the opportunity cost concept  $S_t^o = i_{t-1}h_{t-1}$ , because base money now is covered with assets.

The budget identity of the central bank, A.3, becomes

$$\text{A.3b} \quad (A_t - A_{t-1}) + S_t^F = i_{t-1} \cdot A_{t-1} + (H_t - H_{t-1})$$

And the consolidated government-sector budget identity, A.4, is now

$$\text{A.4b} \quad G_t + i_{t-1}B_{t-1} = T_t + (B_t - B_{t-1}) + (H_t - H_{t-1})$$

because total bonds are held outside the government sector. Expressed in real variables, assuming again fully anticipated inflation and adding  $r_{t-1} \cdot h_{t-1}$  yields A.10.

The opportunity costs arise more indirectly, because the central bank now receives assets and thereby the government accumulates wealth. In contrast, issuing base money by purchasing government bonds has just shifted already existing interest-bearing debt to noninterest-bearing debt. Arguing with the opportunity cost is easier in case of purchasing outstanding government bonds, which have financed budget deficits. In case net assets are purchased the opportunity cost argument will hold, if the purchase of assets is compulsory for the government. For example the government must build up foreign exchange reserves, which it otherwise had financed with interest-bearing debt.

### **A.1.2 Linking seigniorage and government wealth**

So far the analysis showed, that concepts of seigniorage can be derived from different processes of base money creation and that they can be inferred from budget identities of the government. The following analysis shows that base money can either be backed by marketable assets or by government indebtedness. The distinction may be important for a government, which considers the

unilateral adoption of a foreign currency. Therefore, the effect of seigniorage on government wealth is shown. The analysis is extended for infinite periods over which an intertemporal balanced budget is required. The government's wealth constraint is then given by

$$A.11 \quad h + b^p = w + \Omega$$

which defines that total assets of the government,  $w$ , will be either financed with base money,  $h$ , or with bonds held outside the government sector,  $b^p$ . Assuming, that assets and outstanding bonds bear the same rate of return, A.11 can be written as

$$A.12 \quad h = a + \Omega$$

where  $a = w - b^p$ . Net assets arise by virtue of the monopoly in base money. For example, a central bank purchases foreign assets in exchange of base money by its privilege to issue noninterest-bearing paper money. In contrast, if a government finances budget deficits by directly borrowing from the central bank, it will increase its indebtedness.

But issuing base money by purchasing government bonds can either result in net assets or in net government indebtedness backing base money.

To underline the argument, assume two extreme cases. In the first case the central bank purchases government bonds, but a balanced budget is always required. Bonds can only be issued to finance new assets, thus any retirement of outstanding bonds increases net assets. And as the issuance of base money induces an equivalent retirement of interest bearing debt, base money is always backed by net assets and grows each period by  $q_t \cdot a_{t-1}$ . The wealth constraint reduces to  $h + b^p = w$  or  $h = a$ .

If only an intertemporal budget balance is required, the issuance of new bonds can also finance budget deficits over some periods and than be retired over other periods. In this case a retirement of bonds does not necessarily increase net assets backing base money.

To stress the other extreme assume the second case, in which the issuance of bonds only finance budget deficits by base money and not the purchase of assets. A central bank which purchases bonds when issuing base money then shifts a financing of budget deficits by bonds to a financing by base money. Whereas the financing of deficits by bonds is only possible temporarily, because an intertemporal balanced budget is required, the financing of deficits by base money is permanent, because base money is considered as a nonrepayable liability. The government wealth constraint becomes  $h = \Omega$ . Base money is now backed by net government indebtedness, which resembles the sum of all budget deficits financed by base money.

Does it matter whether base money is backed by net assets or by net government indebtedness? It matters for a country, which considers dollarization or euroisation. The financial implication will be shown in appendix A2.

### *A1.3 Base money creation by purchasing government bonds*

So far the analysis has shown that issuing base money by purchasing government bonds may either increase net assets or net government indebtedness. Only the latter case represents a financing of budget deficits and therefore may cause the exploitation of the inflation tax. However, issuing bonds to finance budget deficits is generally assumed to be the more relevant case in practice. So the analysis will concentrate on it. It is shown, that purchases of these bonds may only lead to inflationary financing as one of several choices. Additionally, it is shown, that purchases of outstanding government bonds generally finance past budget deficits and that in this case the fiscal concept equals the opportunity cost concept. However, in the special situation, in which the central bank purchases bonds, which are issued to finance current budget deficits, the fiscal concept may equal the monetary concept.

The budget equation of the consolidated government sector for each period is given by

$$A14 \quad g_t + r_{t-1} \cdot b_{t-1}^p = t_t + b_t^p - b_{t-1}^p + q_t \cdot h_{t-1}$$

Assuming a constant real interest rate, the equation can be solved forward to obtain:

$$A15 \quad b_{t-1}^p + \sum_{i=0}^{\infty} \frac{g_{t+i}}{(1+r)^i} = \sum_{i=0}^{\infty} \frac{t_{t+i}}{(1+r)^i} + \sum_{i=0}^{\infty} \frac{q_{t+i} \cdot h_{t-1+i}}{(1+r)^i} + \lim_{i \rightarrow \infty} \frac{b_{t+i}^p}{(1+r)^i}$$

where  $\sum_{i=0}^{\infty} \frac{1}{(1+r)^i} \cdot \frac{r \cdot b_{t-1}^p}{(1+r)} = b_{t-1}^p$ . The government's expenditure and tax plans are said to

satisfy the requirement of intertemporal budget balance (the "no Ponzi condition") if the last term equals zero.<sup>30</sup>

$$\lim_{i \rightarrow \infty} \frac{b_{t+i}^p}{(1+r)^i} = 0.$$

Accordingly, equation A.15 can be written as

$$A16 \quad b_{t-1}^p = \sum_{i=0}^{\infty} \frac{t_{t+i}}{(1+r)^i} - \sum_{i=0}^{\infty} \frac{g_{t+i}}{(1+r)^i} + \sum_{i=0}^{\infty} \frac{q_{t+i} \cdot h_{t-1+i}}{(1+r)^i}$$

The right side of A16 becomes the present discounted value of all current and future government expenditures and tax and seigniorage revenues. It equals current outstanding debt,  $b_{t-1}^p$ , which has financed past deficits. The government must plan to raise sufficient revenues or reduce its expenditures, in present-value terms, to repay its existing debt, if the intertemporal budget balance holds over infinite periods.

Base money creation by purchases of outstanding bonds retires debt, which has financed past deficits. Seigniorage therefore finances past budget deficits and not current government expenditures, which are instead financed by new bonds. The intertemporal budget balance will hold

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<sup>30</sup> See e.g. Walsh (1998), p. 138.

if the government revises its future plans and it has basically two choices. Either it reduces government expenditures and/ or it increases taxes. Or it finances the deficit with future seigniorage. It will lead to higher inflation in this framework, if the growth in base money is not sustained by real growth and if the velocity of base money either stays constant or even increases.

If the central bank purchases bonds, which are issued to finance expenditures during the same period, the choice of the government will be the same, though the reasoning will be modified. The central bank will not retire outstanding bonds, but it will only purchase newly issued bonds and thus directly finance current primary deficits. The government now still has an unchanged stock of outstanding debt  $b_{t-1}$ , which is not consistent with the required intertemporal budget balance. The present value of future primary deficits must be revised, i.e. the government must reduce its planned future government expenditures and/or increase future taxes. Or seigniorage is increased to generate the surpluses and may then lead to inflationary financing.

The only difference, which occurs between the purchasing government bonds, which have financed past deficits or current deficits, is the fiscal income during the same period. If already outstanding bonds are purchased, which have financed past deficits, the fiscal income will equal seigniorage measured by the opportunity cost concept. But if the central bank purchases bonds, which the government issued to finance current expenditures, the central bank actually finances current expenditures. The monetary concept will be more applicable in this case, if the government is either not able or not willing to sell the bonds on the capital market. The case of the National Bank of Ukraine described in part 3.1 gives an example of avoiding market determined prices for financing deficits.

In practice it is hard to foresee the implications of purchasing government bonds at the central bank. It may just reflect central banking operations, which are conducted to implement monetary policies without any fiscal intentions. But if an intertemporal budget balance is required, an exploitation of the inflation tax remains eventually one of several choices. Central bank laws, which strictly prohibit purchases of government bonds as well as direct lending to the government, support this view. Some central bank laws are less strict and only prohibit purchases of government bonds at the primary market whereas they will allow purchases of bonds at the secondary market, if the transaction is used to achieve the objectives of the central bank and to carry out its tasks (see for example the article 18 of the statute of the European System of Central Banks). Prohibiting purchases at the primary market therefore can be seen as an attempt to limit fiscal financing.

## **A.2 Measuring losses on seigniorage after euroisation**

In the following example losses on seigniorage are analysed for an economy in which base money is generated either by creating net assets (case I) or by lending to the government (case II). Case I may be an example of a central bank, which is financially independent, because it only acquires assets outside the government sector when issuing base money. In contrast case II gives an example of a central bank, which may serve the fiscal needs of the government by issuing base money and receiving claims to the government. The most important difference for the following analysis arises in case of euroisation. If the economy in case I euroises it will have a sufficient backing of base

money by marketable assets, whereas the economy in case II would need to take up a loan to acquire cash in euro which substitutes for cash in domestic currency.

Let  $\mathbf{p}_t$ ,  $r_t$  and  $n_t$  denote the inflation rate, the real interest rate and the domestic real growth rate in period  $t$ . For simplicity, they are assumed to be constant over time and equal, respectively, to  $r$ ,  $\mathbf{p}$  and  $n$ . And assume that the income elasticity of the demand for real balances and the elasticity of nominal balances with regards to the price level are unity and other velocity changes do not exist. Real balances accordingly grow at the rate  $n$  and nominal balances at the rate  $n + \mathbf{p}$ . For analytical purposes base money and cash in circulation are identical.

*Case I: Base money is fully backed by net assets*

Assume, the central bank issues base money by receiving assets in exchange, for example it creates base money by interventions in the foreign exchange market. Assume again, that costs and valuation changes do not occur, i.e. the evolution of base money equals the evolution of net assets at the central bank and the flow of seigniorage in each period consists of the interest revenues on the net assets held as counterparts of base money.

Defining  $1 + \mathbf{m} = (1 + \mathbf{p}) \cdot (1 + n)$ , the nominal value of net assets in period  $t$  is equal to  $A_t^n = (1 + \mathbf{m})^t \cdot A_0^n$  and the present discounted value of seigniorage,  $PDVS^I$ , is given by: <sup>31</sup>

$$PDVS^I = \sum_{t=0}^T \left( \frac{1}{1+i} \right)^t (1 + \mathbf{m})^t \cdot \frac{i \cdot A_0}{(1+i)}$$

or for a sufficiently long period:

$$PDVS^I = \frac{i \cdot A_0}{i - \mathbf{m}}$$

In order to arrive at a steady state value,  $r > n$  is postulated as a standard condition in dynamic optimisation, so  $i > \mu$ .

*Case II: The counterpart of base money is net government indebtedness*

Now the central bank issues base money to cover budget deficits and the government has no access to financial markets. Seigniorage is measured by the monetary concept,  $\mathbf{q} \cdot h_{t-1}$ , where  $\mathbf{q}$  equals  $n + \mathbf{p}$ , because velocity changes of base money are assumed to be zero. The growth rate of base money includes the inflation rate in order to offset changes in real base money due to a rising price level. The present discounted value of seigniorage (PDVS) gives

$$PDVS^{II} = \sum_{t=0}^T \left( \frac{1}{1+i} \right)^t (1 + \mathbf{m})^t \cdot \frac{\mathbf{m} \cdot H_0}{(1+i)}$$

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<sup>31</sup> For similar results see Schmidt-Grohe and Uribe (1999).



or over a sufficiently long period:

$$PDVS^{II} = \frac{\mathbf{m} \cdot H_0}{i - \mathbf{m}}.$$

If the country unilaterally euroises the loss on foregone seigniorage is measured by  $PDVS^I$  in case I and by  $PDVS^{II}$  in case II. But the economy in case II additionally needs to take up a loan to acquire foreign cash substituting domestic cash.

Let  $\mathbf{r} \equiv \frac{PDVS^I}{PDVS^{II}}$  be the ratio of the loss of seigniorage in case I and in case II,  $\rho$  is given for a sufficiently long period by

$$\mathbf{r} = \frac{i}{\mathbf{m}}$$

Because  $i > \mathbf{m}$  according to the standard condition the country in case I will always suffer a higher loss of seigniorage. Because  $H_0 = A_0$ , the difference between  $PDVS_b^I - PDVS_b^{II}$  gives

$$\frac{(i - \mathbf{m}) \cdot H_0}{i - \mathbf{m}} = H_0$$

The difference between losses in case I and in case II equals the nominal value of base money at the time the economy became euroised. It is the value of the loan, which the economy in case II needs to take up in case of euroisation. The loan actually finances past deficits, which have been financed with base money so far. So in contrast to corporate finance the loan finances past debt and no new investment. Accordingly, the government services past budget deficits, which it would otherwise not redeem, if it held on to its monopoly in base money.

Imagine for example a non-repayable loan of the value  $L = H_0$  with infinite constant interest payments. The present discounted value of borrowing (PDVB) is given by

$$PDVB = \frac{i_L}{i} \cdot H_0$$

where  $i_L$  is the interest rate paid on the loan and  $i$  is the discount rate.<sup>32</sup> Assuming that the interest rate on the loan and the discount rate are equal, the present value of borrowing is equal to the initial value of base money,  $H_0$ . The economy in case I and in case II face the same costs when they euroise.

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<sup>32</sup> The relevant discount rate is the rate at which seigniorage is earned each period. It presents the opportunity cost on the loan, because seigniorage would be earned if no loan is taken up to substitute cash in domestic currency for cash in foreign currency.

However, before drawing conclusions on the theoretical analysis several caveats have to be kept in mind:

The analysis is based on the steady state assumption, in which interest rates are equal and like growth rates and inflation are constant over time and in which the steady state condition  $r > n$  always holds. Especially for shorter time horizons economic developments might significantly deviate from steady state conditions. Time horizons of just a couple of years are relevant for many EU-accession countries and maybe even for non EU-accession countries, which attempt to join the group of accession countries. For them, any measurement of seigniorage based on infinite horizons and on steady state assumptions may be misleading, as velocity changes to base money may lead to very different results than those derived from steady state conditions. And the interest rate on net assets backing base money depends on the portfolio structure which in turn depends on the process of base money creation. In particular when comparing *foreign* nominal interest rates with *domestic* growth rates of base money the standard condition  $r > n$  does not seem to be plausible any more.<sup>33</sup>

Additionally, EU-accession countries only temporarily face losses on seigniorage as discussed in part 2. Central banks, which have backed base money by assets only lose interest income on assets held against base money over a couple of years. This foregone income may then be far less than lost seigniorage due to monetary financing *plus* the costs of a loan, which has been taken up to substitute base money in domestic currency.

However, an economy without marketable assets backing base money may not need to take up a loan to substitute total domestic cash by foreign cash. Depending on the degree of currency substitution the government may only supply part of the cash in foreign currency because the other part is already used in the economy for transaction purposes. Technically the government would not substitute total cash financed by the loan, but it could attract a share of cash in foreign currency by legalising unofficial currency substitution. In an economy which runs a large share of its payments in foreign currency the crucial amount of cash for a successful changeover to another currency is then not the amount which totally substitutes domestic cash, but the amount which enables the government to fulfil its payment obligations in cash. Both currencies could circulate officially and by introducing a flexible exchange rate between the old domestic currency and the official foreign currency the government would simply wait until cash in domestic currency has depreciated and has been driven out of circulation. Though technically feasible, a government conducting sound and prudent policies would have to consider a retirement of base money as part of its total outstanding debt.

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<sup>33</sup> Even without this precondition the condition may not hold practically and theoretically. Bohn (1995) has shown that for dynamically efficient economies the safe interest can be below the average growth rate in a stochastic environment and has stressed the empirical relevance for the United States for most of the twentieth century.

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Centre for European Policy Studies  
1 Place du Congrès  
1000 Brussels, Belgium  
Tel: 32(0)2.229.39.11 Fax: 32(0)2.219.41.51  
E-mail: [info@ceps.be](mailto:info@ceps.be) Website: <http://www.ceps.be>