

SEIGNIORAGE

AN ARGUMENT FOR A NATIONAL CURRENCY?

FRANZISKA SCHOBERT

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Franziska Schobert is formerly Assistant at the Goethe University in Frankfurt.

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Centre for European Policy Studies
Place du Congrès 1, B-1000 Brussels
Tel: 32(0)2 229.39.11 Fax: 32(0)2 219.41.51
E-mail: info@ceps.be
Website: <http://www.ceps.be>

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Abstract

Seigniorage has often been cited 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 in this paper 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 the 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 that are willing to stabilise prices but that lack the credibility to do so, may be increasingly interested in euroisation. The more advanced EU accession countries have received low revenues from having a national currency in recent years. Seigniorage has arisen as a by-product of other central bank objectives, such as price and exchange rate stability. This caused high sterilisation costs, and valuation gains of a central bank's asset portfolio have often been the main reason for positive results of seigniorage. In their search for a viable monetary regime and in the face of further liberalisation of capital markets, these countries might be advised to look at euroisation as a choice to achieve price stability without exchange rate volatility.

CHAPTER 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 dollarisation 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 dollarisation 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 dollarisation 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.

Chapter 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 Chapter 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 East 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 in the first instance and now the euro 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.

Chapter 4 offers conclusions.

CHAPTER 2 CONCEPTS

There is no single measure of seigniorage that is generally applicable; its measurement eventually depends on the model and on the policy experiment being considered (Drazen, 1985, p. 327).

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 current 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 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:

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

where H is nominal base money (including currency in circulation and deposits of banks at the central bank), P is the price level, Δ are absolute changes and θ is the growth rate of nominal balances. The concept has been widely used in the theoretical and empirical literature, for example by Cagan (1956, pp. 77-86), Marty (1967, p. 72), Friedman (1971, pp. 848-850) and Fischer (1982, pp. 300-305) and as will be argued later, it is 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 :

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

This measure takes into account the opportunity costs borne by the government and has also been extensively analysed in the literature; see for example Marty (1978, pp. 437-452) and Phelps (1971, pp. 174-178).

The opportunity 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.¹

Most estimates of seigniorage for developed economies use an opportunity cost concept with a short-term interest rate, e.g. a money market rate.² 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 the fact that the central bank receives returns from a stock of assets accumulated by the outstanding quantity of base money.

And another caveat may be kept in mind when relying on the original idea of the opportunity cost concept. Issuing bonds is not the only way of eventually balancing the budget, when seigniorage is not available. 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.³

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 and which are distributed to the fiscal authorities. Klein and Neumann (1990) or Lange (1995, pp. 26-29) have called it fiscal seigniorage; it has also been occasionally called “total seigniorage”.

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

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} .⁴

¹ The opportunity cost concept then precisely gives $i/(1+p) \cdot h$.

² See for example Hochreiter, et al. (1996) and Bini-Smaghi and Gros (2000).

³ However, a reduction in government expenditures, which may have been more harmful than beneficial to the economy, such as subsidising unproductive state companies or a temporary increase in revenues received from foreign aid and 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.

⁴ In order to simplify the analysis, the interest rate does not differ between assets.

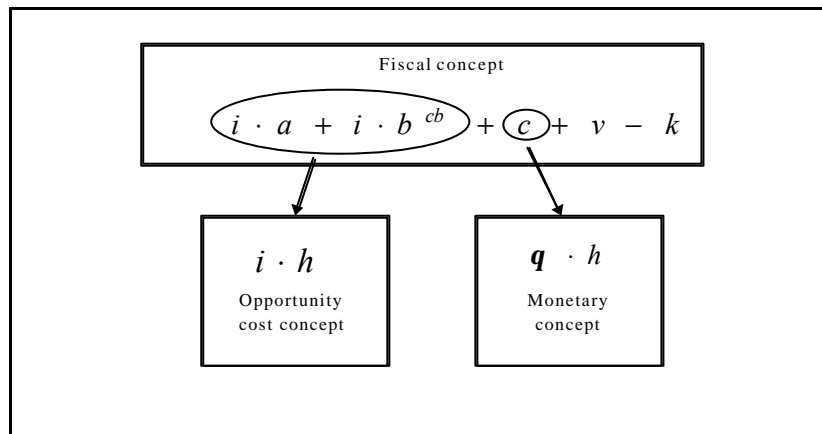
The issuance of base money in order to finance current expenditures – “money printing” - is shown by C . It reflects a claim to the government, which is held against base money issued for the fiscal purpose of financing government consumption.

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.

The measurement can also include interest revenues on retained earnings, which have been neglected here for simplicity, although this case can be relevant in practice.⁵ 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.

Assuming that no valuation changes and costs arise and that interest rates are equal 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 Annex II, the link between the concepts is shown in detail by deriving them from budget identities.

Figure 1. Concepts of seigniorage



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.

⁵ 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 inclusion of the costs on the one hand is important, because 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 hold foreign exchange reserves in euro and 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.

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 Annex II, 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, because 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 dollarisation, this issue becomes technically relevant, because the government will need to convert its stock of cash in domestic currency into cash in foreign currency. 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 non-interest-bearing liabilities (its outstanding cash in domestic currency) into an interest-bearing loan. In Annex II, it is shown, that under given assumptions a government bears the same costs in both cases.

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 that 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,

pp. 20-21), 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 euro. 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 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 only loses 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 although it will not be able to contribute any monetary income of its own 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 that have acquired their assets in exchange for euro 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. They do not lose the stock of assets backing base money, because they joined the monetary union without base money and therefore will not contribute to the common pool of seigniorage, but nevertheless participate in the sharing of seigniorage. The saved contribution equals the interest income on the assets, which have been used to purchase cash in foreign currency, and over a sufficiently long period of time, the net present value of the stream of interest income will equal the stock of assets. Central banks, which have no marketable assets, have to carry the debt-service cost of the loan in addition to losses on seigniorage. But assuming that the cost of servicing the loan equals the income, which they do not contribute to the common pool of seigniorage, the costs of foregone seigniorage and debt-service costs are limited for the period prior to their joining the monetary union. Thus, in both cases losses are only borne temporarily until the country joins the monetary union. This result, is derived in more detail in Annex II.

CHAPTER 3

THE MEASUREMENT OF SEIGNIORAGE

Seigniorage is now measured by different concepts over the most recent years in order to assess whether temporary losses of seigniorage would have been fiscally significant. First, the monetary concept is used to calculate seigniorage in Central and East European countries. Then a fiscal concept is applied to a group of more advanced EU accession countries and compared to the results received by using an opportunity cost concept.

3.1 Applying the monetary concept to Central and Eastern Europe

Measuring seigniorage by the monetary concept is the most common method and it will be applied for a sample of countries, which consists of all EU accession countries in Central and Eastern Europe⁶ and Albania, Belarus, Croatia, Macedonia, Montenegro, Russia and Ukraine (thereby covering most countries in the region) from 1995-99.⁷

To treat the results as *fiscal* revenues, which have been received on average from seigniorage, would be misleading. As argued above this will only be the case under certain conditions of base money creation, which may only have existed in some less advanced economies with central banks lacking any financial independence. As shown in table A2 in Annex I, the statutes of all central banks formally either limit or prohibit fiscal financing. However, many of these statutes have been heavily amended in the second half of the 1990s, and even despite being stipulated by law, the fiscal financing restrictions were not always binding or were disguised in other transactions with the central bank.

Take for example Montenegro, the smaller of the two remaining republics of Yugoslavia, which used the D-mark and then the euro as the only official currency since November 2000, and thereby can be considered a “euroised” economy. In order to assess the loss of seigniorage as a consequence of the Montenegrin decision, the Montenegrin share of seigniorage of the Federal Republic of Yugoslavia is measured by assuming a 5% share of total monetary seigniorage in Yugoslavia (which roughly represents the Montenegrin share of output and population in the Federal Republic of Yugoslavia).⁸ Formally, the Federal Law on the National Bank of Yugoslavia only allows 10% of the budget to be financed by the central bank. But during the 1990s, when war and sanctions contributed to serious fiscal distress, base money had neither been created by receiving marketable, interest-bearing assets at the central bank nor had there existed any access to capital markets to finance budget deficits alternatively with interest-bearing bonds. The creation of base money can be regarded as directly financing fiscal or quasi-fiscal deficits or as an accommodation of the extra demand for reserves from state banks, which lent to the public sector.

⁶ Including Turkey, which is regarded as European according to international economic standards.

⁷ The time period until 1999 allows a comparison with Montenegro, which used the new Yugoslav dinar from 1994 to 1999, then switched to a parallel system with the D-mark and officially introduced the D-mark/euro as the only currency in 2000.

⁸ Seigniorage was not officially shared with the Republic of Montenegro, although some unofficial agreements on its sharing may have existed between the two republics.

Ukraine represents another example in support of using the monetary concept as an approximation for fiscal revenues. The government's current financing needs were sometimes not served by its ability to borrow, because domestic and foreign investors' interest in government bills or bonds remained weak, partly because of the uncertain economic environment, but also because of 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.⁹

Box 1. Limiting the effects of public sector deficits on base money – The case of Turkey

Monetising the deficit by borrowing directly at the central bank increases base money, whereas borrowing from the rest of the banking system does not automatically have this effect. It will only do so, if the central bank accommodates extra demand for credit from banks by supplying them with additional reserves (See Barth and Hemphill, 2000, pp. 72-73). Otherwise, crowding out of credit to the private sector usually takes place through higher interest rates and will affect the profitability of banks, which can cause problems in the banking systems. Most obviously the effects of public sector deficits on base money will stop, if the government gives up its own currency and unilaterally introduces a foreign currency. But even less strict institutional changes can have similar effects.

The case of Turkey may give an example along these lines. In the Turkish banking system, state banks have provided subsidised credits to certain borrowers, belonging to preferential groups of the government. As the operations of the central bank became more transparent (the structure of base money creation was limited by a ceiling on domestic assets and had to fulfil a floor on foreign assets), the state banks needed to acquire additional funds from the bank deposit and repo market. Up until around 1994-95, the cost of these quasi-fiscal activities could be borne by these banks and covered by their own profits. Their large market share both for deposits and commercial lending helped to limit the spread between their cost of borrowing and the subsidised rate of their lending. But under the impetus of financial liberalisation since about 1995, the banking system became more competitive and the spread started to rise eroding their profitability and causing large deficits. The state banks did not need to react to losses of their profitability, however, because deficits were filled by an accumulation of claims on the government (the so-called unpaid duty losses), the yield of which was *de facto* set so as to cover any loss accumulated during each year. Attracting new funds at higher interest rates further increased their losses as their lending policy remained unchanged. Nevertheless, any shortfall of revenues over expenses was covered by the treasury and the banks did not need to face a clear budget constraint.¹⁰ At the end of 2000, duty losses amounted to about 12% of output and yearly increases in duty losses averaged at 3.5% of output during 1995-99, thereby exceeding any revenues collected from seigniorage. According to the Central Bank of the Republic of Turkey, these sums were calculated as net claims on special duty accounts of deposit money banks.

Institutional changes, like more transparent central bank operations combined with a more competitive banking system, made the situation unsustainable and contributed to the Turkish banking and currency crises in 2001. Now these costs are eventually borne by the government and public debt has been increased substantially. If Turkey had been euroised, it would have avoided a currency crisis, but not necessarily a banking crisis. Giving up the monopoly in base money stops the effects of financing public sector deficits on base money, but without additional reforms, public sector deficits will cause problems elsewhere.

⁹ IMF Ukraine Country Report (1999, p. 57). In the Annex this process is formally described in detail.

¹⁰ IMF country report (2000, pp. 12-14).

Refinancing the credit expansion of the domestic banking system can also imply a fiscal exploitation of the monopoly in base money under certain conditions and therefore contribute to monetary seigniorage. It will stop if either the refinancing operations of the central bank become more market-oriented, as shown in the example of Turkey as described in Box 1, or if the government eventually decides to give up its own currency. When the banking system then continues to finance fiscal and quasi-fiscal deficits, however, the government is likely to ultimately bear the costs. Therefore, a government considering unilateral euroisation as a rapid approach to break the fiscal link between the central bank and the banking system should consider the same rapid approach to banking and fiscal reform as well. These reforms are needed in any event and postponing them should not be a reason to hold on to a national currency.

In Table 1, the results of measuring seigniorage by the monetary concept are presented as averages of yearly data. Annual data are given in Table A1 in Annex I. For each country, the ratio of the change in base money to nominal GDP is calculated in the first column. In the second column, seigniorage is calculated as a share of total fiscal revenues.

For countries with relatively low inflation rates, seigniorage is generally not an important source of revenues, but it is even relatively unimportant in high inflationary economies, in contrast to Fischer's results, in which seigniorage accounted for well above 2% of output and 10% of total fiscal revenues.¹¹ In this sample, 7 out of 12 economies, which on average suffered from double-digit inflation during the period, have had seigniorage above 2% of GDP and only 3 of them above 10% of total fiscal revenues.

The figures in parenthesis show the results for monetary seigniorage calculated by changes in currency in circulation, one component of base money. The difference between the two results are mainly due to changes in deposits that banks hold at the central bank.¹² When measuring seigniorage, it is usually assumed that deposits of banks at the central bank consist of non-interest bearing reserves and thereby are similar to currency in circulation. However, when considering the unilateral adoption of a foreign currency, losses from revenues on currency in circulation are the most relevant figure to look at, whereas losses on the other components of base money mainly depend on financial regulations. For example, a government does not necessarily lose revenues from non-interest bearing deposits held by banks at a monetary authority, as long as it enforces reserve requirements on banks and as long as it does not remunerate these deposits. In contrast, as countries move closer to the accession of the monetary union, in which reserves are remunerated, they may decide to pay interest on reserves and thereby lose this part of seigniorage even without unilaterally introducing the euro.

According to this measurement of seigniorage, only 4 out of 12 high inflationary economies receive seigniorage above 2% of output and only Albania receives seigniorage above 10% of fiscal revenues. Most striking are the results for Turkey, which earns almost three times as much seigniorage, when calculated with base money

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

¹² Precisely, the difference in base money (reserve money in the definition of the IMF) and currency in circulation are deposits of banks at the central bank and other deposits excluding deposits of the central government. However, the size of other deposits is generally not significant.

as when calculated with currency in circulation. The difference is mainly due to the financial repression by the government on banks, which are asked to hold deposits at the central bank. In contrast, the low figure for seigniorage, measured with currency in circulation, better reflects the flight from the domestic currency, which has considerably reduced this source of revenue.

Table 1. Seigniorage of selected countries in Central and Eastern Europe (1995-99)

	Seigniorage in % of output		Seigniorage in % of total fiscal revenues		Inflation rate in % p.a.	Change in real GDP in % p.a.
Albania	3.6	(3.5)	17.0	(16.6)	14.8	2.1
Belarus	4.2	(2.2)	9.8	(5.3)	155.8	3.1
Bulgaria	5.1	(3.1)	12.7	(8.4)	180.1	-1.6
Croatia	1.0	(0.6)	2.3	(1.3)	4.5	3.9
Czech Rep.	3.4	(1.2)	6.3	(2.5)	7.1	1.6
Estonia	2.4	(1.2)	5.6	(2.9)	12.8	4.5
Hungary	1.5	(1.2)	3.3	(2.8)	17.6	3.3
Latvia	1.6	(1.2)	5.0	(3.8)	9.9	3.2
Lithuania	0.9	(1.0)	2.7	(2.9)	12.0	3.5
Macedonia	0.8	(0.4)	2.5	(1.3)	2.2	1.4
Montenegro	1.4	(1.1)	2.3	(1.8)	72.0	6.6
Poland	1.6	(1.3)	3.7	(3.0)	14.4	5.8
Romania	2.3	(1.5)	7.3	(4.9)	66.3	-0.7
Russia	2.0	(1.9)	9.4	(9.8)	57.0	-1.7
Slovak Rep.	1.9	(1.1)	4.1	(2.5)	7.8	5.0
Slovenia	0.9	(0.5)	2.0	(1.0)	8.6	4.0
Turkey	3.3	(1.2)	14.1	(5.7)	78.0	4.0
Ukraine	2.4	(2.1)	6.3	(5.6)	54.1	-5.6

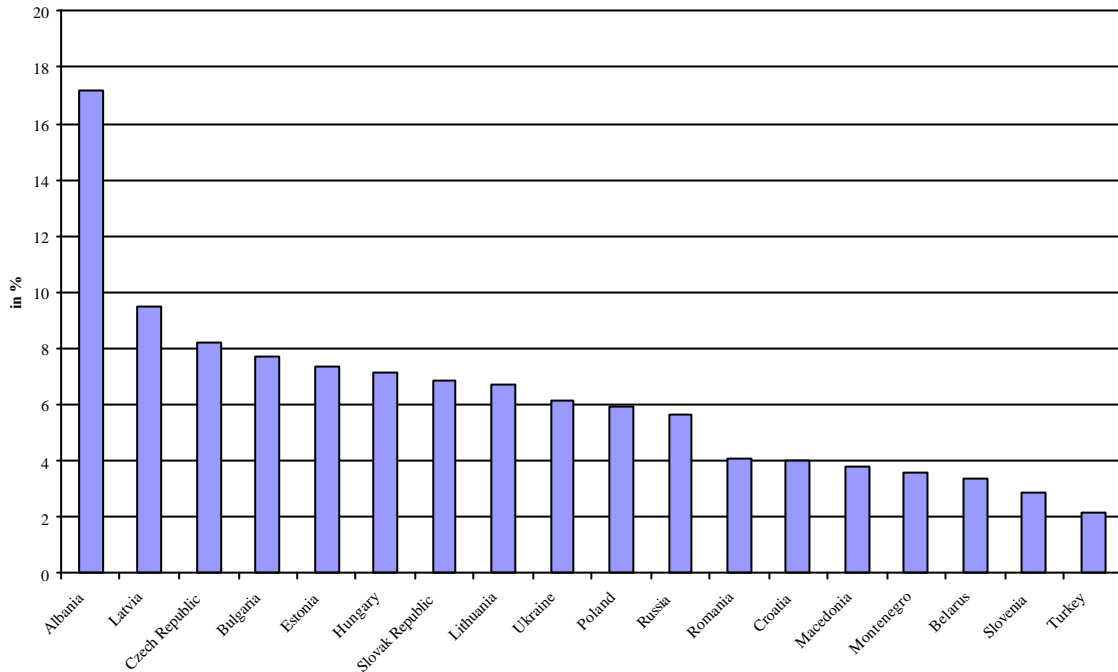
Inflation: December to December change of CPI index (RPI for Albania and Croatia). Total fiscal revenues: Revenues of the consolidated budget and monetary seigniorage (for Montenegro: revenues of the central government and social funds). Reserve money: Currency in circulation, deposits of banks, and deposits of other residents apart from the central government, with the monetary authorities.

Sources: MONET, International Monetary Fund (IMF) country reports, International Financial Statistics (IFS) and central banks.

High inflation rates have usually an ambiguous effect on seigniorage. On the one hand, they increase seigniorage because of the higher nominal value of transactions conducted with domestic currency, but on the other hand higher inflation also shifts the economy into economising cash holdings or into other means of payments and thereby decreases the demand for domestic currency. Montenegrin seigniorage gives an example of this

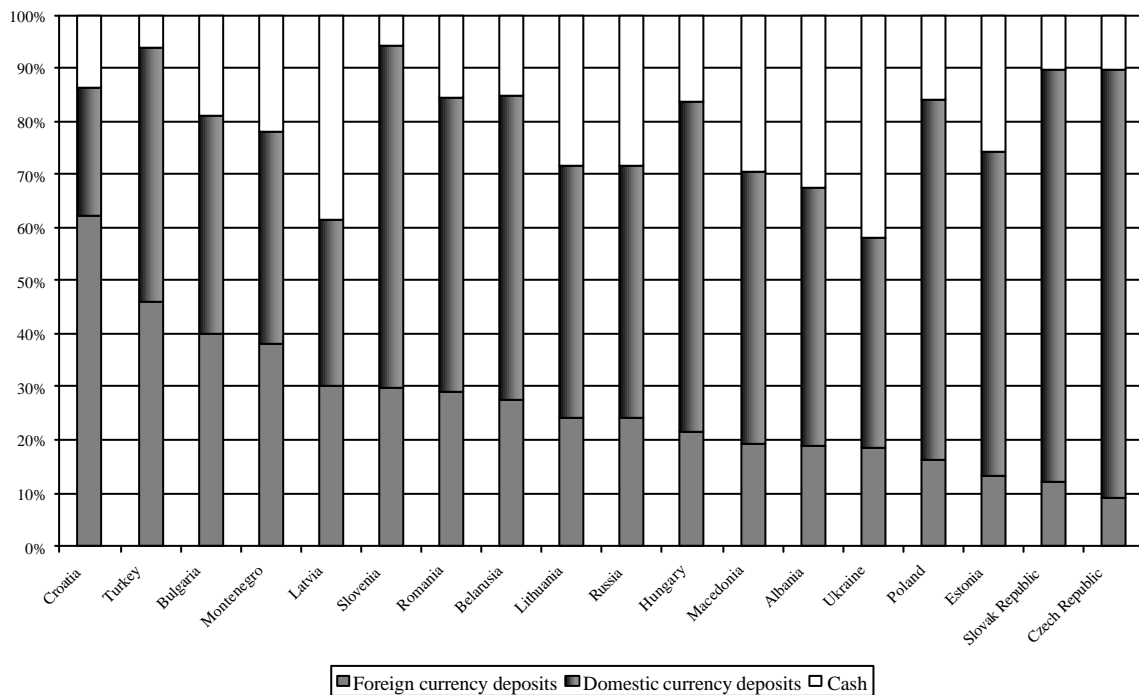
case. With 1.4% of GDP and about 2.3% of total fiscal revenues, it strikes out as being extremely low compared to inflation. In Figures 2 and 3, some further evidence on this is presented by cash-to-GDP ratios and by the structure of broad money.

Figure 2. Cash-to-GDP ratio (average for 1995-1999)



Sources: IMF country reports, central banks and own calculations.

Figure 3. Structure of broad money (average for 1995-99)



Sources: IMF Country Reports, central banks and own calculations.

A high ratio of cash to GDP supports revenues collected from seigniorage. In developed economies, the ratio ranges between 5 and 10%. Therefore, less advanced economies with less developed financial systems should tend to have higher ratios when assuming no flight out of their own currency. But in Figure 2, only Albania strikes out with a cash ratio of about 17%. Economies with rather low ratios with regard to their level of financial development are Romania, Belarus, Turkey, Montenegro and the former republics of Yugoslavia (Croatia, Macedonia and Slovenia). Especially Montenegro and the former republics of Yugoslavia share the same unstable monetary past until the early 1990s, in which high inflation and a loss of confidence in the banking system were key features of the financial system. Though this monetary environment persisted in Montenegro, but changed in the former republics of Yugoslavia, it may have not changed the habits of economising on cash in domestic currency and using foreign currency instead. In Turkey an extremely high inflationary environment for decades has probably contributed to a serious erosion of using the domestic currency.

In Figure 3 the structure of broad money is used to show which other means of payments than domestic currency may have been used in these countries. The ratio of foreign currency deposits to broad money (including cash and deposits in domestic currency and deposits in foreign currency) usually serves as an indicator of currency substitution. Although cash in foreign currency is probably the most important substitute for domestic currency, data on it are missing because they are extremely hard to detect.¹³ By using this indicator in order to assess the extent to which international currencies have substituted cash in domestic currency, it is thereby implied that deposits and cash in foreign currency are held for similar reasons. This is not necessarily the case, but the interpretation seem to fit well for some countries, for example Croatia and Turkey, and to a lesser extent to Montenegro, because here deposits in foreign currency are mainly held by legal entities, whereas private households practically hold foreign currency only as cash.

The evidence does not give a clear picture on which factors have driven the different results on seigniorage in these economies. Overall, seigniorage measured by the monetary concept seems to be only important in some high-inflationary economies in Central and Eastern Europe.

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

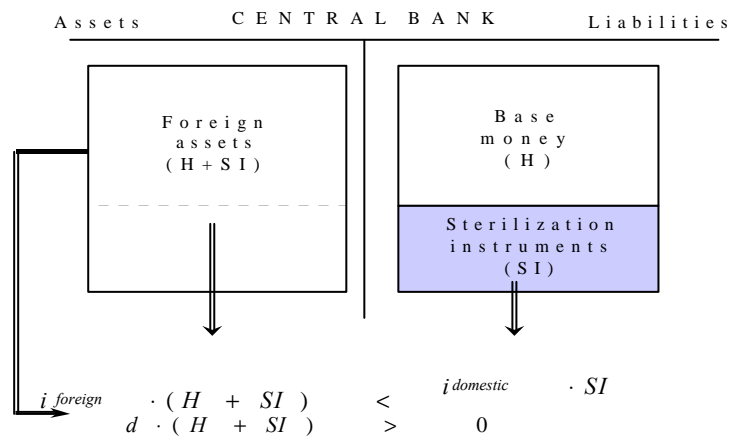
¹³ The most recent studies for Croatia are found in Feige et al. (2000). The significance of the national currency as a means of payment would be lowered additionally if cash in foreign currency were included.

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 need 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, in order 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 caught 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.¹⁴ 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.¹⁵ The central bank's policy dilemma can be similarly described for the Czech Republic and Hungary. Aiming at price *and* exchange rate targets is the crucial ingredient of the dilemma, but just pursuing one of the two objectives did not seem to be a viable option for these countries. Interestingly, even in Slovenia, which officially 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 sheets and eventually in their profit and loss account.

Figure 4. Stylised balance sheet



¹⁴ See Nuti (2000, p. 57).

In Figure 4 on the previous page, 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 causes 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.¹⁶

A closer look at the balance sheets of the five central banks in Graphs A1 to A5 in the Annex I 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 carrying out 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

¹⁵ See IMF Country Report (2000, p. 39).

¹⁶ 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).

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 of a significant share of base money created by fiscally related transactions. In line with the central bank laws (see Table A1 in Annex I), 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 in 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 Graphs A1-A5 in Annex I.

In Graphs A6 to A10, 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.¹⁷ However, at the Bank of Slovenia the picture is less clear-cut. Though foreign assets dominate 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 bank's 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 back to the central bank through repos. In fact, foreign exchange bills had reached about 13% of total assets in commercial banks' balance sheets in 1997-98, which highlights the importance of these instruments for exchange rate interventions, but also for some monetary policy-related transactions at the Bank of Slovenia.¹⁸

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.¹⁹ The proposed measure of fiscal seigniorage is:

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

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 therefore it is assumed that it is equal to the structure of the currency basket of the exchange rate peg for Poland, Hungary and the Czech Republic, to the euro for Estonia and to the structure of currencies, as stated by

¹⁷ 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).

¹⁸ IMF country report (2000).

¹⁹ Many thanks to Daniel Gros for pointing out this issue.

the Bank of Slovenia in its comments to its balance sheet at each end of the year, for Slovenia. The investment of foreign assets is supposed to be mainly short term, so interest rates i_x 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_x 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_{si} 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.²⁰ So different accounting policies of the central banks are ignored in order to make the results comparable, as already discussed in Chapter 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.

More details to the data and methods used for the measurement of seigniorage are given in Table A8 in Annex I.

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

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

²⁰ At the National Bank of Poland and at the Bank of Slovenia, revaluation gains that are not yet realised are held as reserves. The National Bank of Hungary changed accounting practices in 1999 and only distributes realised revaluation gains as well, whereas the Czech National Bank distributed all revaluation gains, which adds a volatile feature to their stated profits.

The proposed fiscal concept is compared with the opportunity cost concept used in other studies of seigniorage,²¹ 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 Fibor/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.²²

In Table 2, the results are presented as an average for the period 1995-2000. Annual results are given in Tables A3-A7 in Annex I.

Table 2. Seigniorage by concepts (average 1995-2000)

As % of GDP	Czech Republic	Estonia	Hungary	Poland	Slovenia
Opportunity cost concept	1.49	0.69	1.99	1.86	0.62
Implied EMU	0.38	0.30	0.24	0.21	0.10
Fiscal concept	0.19	0.38	0.89	0.02	0.47
of which:					
+ Net interest revenues	0.43	0.38	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.

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. This result can be attributed to lower returns earned on foreign assets compared to the returns implied by the opportunity cost concept. Due to high inflation gaps with respect 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 to the fiscal concept but only to the opportunity cost concept.

²¹ Most recently in Hochreiter and Rovelli (1999).

²² Only averages of yearly data on minimum reserves and on sterilization instruments have been available from the Czech National Bank.

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 resulting from 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,²³ 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 membership.

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.²⁴ The Czech National Bank has actually increased reserve requirements over some periods, though its true motivation for it remains unclear.²⁵ 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.²⁶ So, even if central banks have postponed more progressive reductions of reserve requirements in 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 the case of Hungary, but at all central banks apart from the Bank of Estonia they have heavily influenced the overall positive results.

²³ 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 in Annex I only include tolar bills.

²⁴ 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 sterilisation costs if the decrease of domestic interest rates due to lower inflation had not decreased capital inflows and therefore the need for sterilisation instruments.

²⁵ 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.

²⁶ Reserve requirements in the Eurosystem are 2% on all deposits and are remunerated at market interest rates.

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 on 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”.

CHAPTER 4 CONCLUSIONS

The loss of seigniorage is often argued to be a major disadvantage of official dollarisation 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 concepts arise as special cases.

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 or purchasing government bonds that could not be sold on the capital markets. The central bank serves the fiscal needs of the government, because the government is eventually not able or willing to finance deficits with marketable bonds as an alternative. In this monetary environment the fiscal impact of the monopoly in base money can be measured by the monetary concept.

The monetary concept is applicable for Yugoslavia in the 1990s or to some other less advanced economies in Central and Eastern Europe, but for comparison it has been measured for a large group of countries in the region. If at all, monetary seigniorage has only been important in high inflationary countries. Permanent shifts to other means of payments, i.e. currency substitution or economising of cash holdings, have influenced the relatively low success in collecting seigniorage.

For more advanced Central and Eastern European countries, which aim at an early EU accession and therefore try to achieve a high degree of central bank independence and stable prices, seigniorage is not an actively exploited source of fiscal revenue. It has rather arisen as a by-product of the operations, which are used to achieve other central bank objectives, namely price and exchange rate targets. For these countries a fiscal concept for measuring seigniorage has been developed, which takes into account the specific monetary environment in which base money is created and costly managed. Seigniorage has been relatively low and its overall positive result has often depended on valuation gains. Central banks of these countries have actually struggled to manage their national currencies in an environment of high and volatile capital flows unless they explicitly targeted only one objective, for example only exchange rate stability as in case of Estonia. The monopoly in base money has eventually not only been 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.

Overall, the fiscal argument against euroisation in more advanced EU accession countries is quite weak, because these countries have not earned much from their monopoly in base money. On the contrary, 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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ANNEX I. STATISTICAL TABLES AND GRAPHS

Table A.1 Seigniorage of selected countries in Central and Eastern Europe

	Seigniorage in % of output	Seigniorage in % (of total fiscal revenues)	Inflation rate	Change in (real GDP in %)
Albania				
1995	5.1	22.9	6	8.9
1996	2.7	14.9	17.4	9.1
1997	8.6	38.9	42.1	-7
1998	-0.2	-1.4	8.7	-8
1999	1.7	9.5	0	7.3
Av 95-99	3.6	17.0	14.8	2.1
Belarus				
1995	4.2	12.0	244	-10.4
1996	2.9	7.2	39	2.8
1997	3.7	8.0	63	11.4
1998	6.1	12.8	182	8.4
1999	4.1	8.8	251	3.4
Av 95-99	4.2	9.8	155.8	3.1
Bulgaria				
1994				
1995	5.2	12.8	32.7	2.9
1996	6.7	18.0	311.3	-10.1
1997	11.3	26.6	547.8	-6.9
1998	1.0	2.6	1.6	3.5
1999	1.5	3.6	7.0	2.4
Av 95-99	5.1	12.7	180.1	-1.6
Croatia				
1995	2.1	4.4	4.6	6.8
1996	1.9	4.1	3.7	6.0
1997	1.3	2.9	5.0	6.5
1998	-0.3	-0.6	5.3	2.5
1999	0.2	0.5	3.8	-2.1
Av 95-99	1.0	2.3	4.5	3.9

Czech Republic				
1995	10.1	16.1	7.8	6.4
1996	0.1	0.3	8.6	4.8
1997	0.0	0.0	9.9	-1.03
1998	4.6	10.0	6.9	-2.20
1999	2.0	4.9	2.5	-0.20
Av 95-99	3.4	6.3	7.1	1.6
Estonia				
1994				
1995	2.1	4.9	28.9	4.28
1996	2.1	5.2	14.8	3.90
1997	3.6	8.4	12.5	10.59
1998	0.7	1.8	4.2	4.09
1999	3.2	7.7	3.8	-0.50
Av 95-99	2.4	5.6	12.8	4.5
Hungary				
1995	1.9	4.4	28.3	1.5
1996	-0.9	-2.2	19.8	1.3
1997	2.3	5.2	18.4	4.6
1998	1.7	4.0	10.3	4.9
1999	2.3	5.3	11.0	4.2
Av 95-99	1.5	3.3	17.6	3.3
Latvia				
1994				
1995	0.2	0.6	23.2	-0.8
1996	2.2	7.4	13.2	3.3
1997	3.2	9.8	7.0	8.6
1998	0.8	2.6	2.8	3.9
1999	1.4	4.8	3.2	1.1
Av 95-99	1.6	5.0	9.9	3.2
Lithuania				
1994				
1995	0.2	0.7	35.8	4.8
1996	2.6	8.0	13.0	4.7
1997	2.5	7.1	8.4	7.3
1998	-0.4	-1.2	2.4	5.2

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1999	-0.3	-1.0	0.3	-4.2
Av 95-99	0.9	2.7	12.0	3.5
Macedonia				
1995	1.1	4.7	9.0	-1.1
1996	-0.1	-0.4	-0.6	1.2
1997	1.0	3.0	2.6	1.4
1998	0.3	0.9	-2.4	2.9
1999	1.6	4.5	2.4	2.7
Av 95-99	0.8	2.5	2.2	1.4
Montenegro				
1995	1.5	2.7	104.1	14.1
1996	2.1	3.5	47.2	27.7
1997	2.1	2.9	18.1	6.6
1998	0.6	1.0	44.8	-1.5
1999	0.8	1.4	146.0	-13.8
Av 95-99	1.4	2.3	72.0	6.6
Poland				
1995	2.9	6.4	22.0	7.1
1996	1.5	3.4	18.7	6.0
1997	2.5	5.6	13.2	6.9
1998	1.4	3.3	8.5	4.9
1999	-0.1	-0.3	9.8	4.0
Av 95-99	1.6	3.7	14.4	5.8
Romania				
1995	2.0	6.5	27.8	7.1
1996	2.9	9.8	56.9	3.9
1997	1.1	3.9	151.4	-6.1
1998	2.4	7.8	40.6	-5.4
1999	2.9	8.6	54.8	-3.2
Av 95-99	2.3	7.3	66.3	-0.7
Russia				
1995	2.3	9.9	131.3	-4.1
1996	2.1	9.8	21.8	-3.4
1997	2.1	9.8	11.0	0.9
1998	0.1	7.6	84.4	-4.9
1999	3.4	9.9	36.5	3.2

Av 95-99	2.0	9.4	57.0	-1.7
Slovak Republic				
1994				
1995	2.7	5.6	7.2	6.7
1996	3.0	6.2	5.4	6.2
1997	2.2	4.8	6.5	6.2
1998	-0.7	-1.8	5.6	4.1
1999	2.2	5.5	14.2	2.0
Av 95-99	1.9	4.1	7.8	5.0
Slovenia				
1995	1.3	2.7	8.7	4.1
1996	0.7	1.4	8.8	3.5
1997	0.9	2.0	9.4	4.6
1998	0.8	1.9	7.5	3.9
1999	1.0	2.2	8.8	3.8
Av 95-99	0.9	2.0	8.6	4.0
Turkey				
1995	2.9	13.8	78.9	6.7
1996	3.1	14.6	76.5	7.0
1997	3.4	14.3	99.2	7.9
1998	2.9	11.9	68.4	3.2
1999	4.1	15.8	67.0	-5.0
Av 95-99	3.3	14.1	78.0	4.0
Ukraine				
1995	3.7	9.6	181.7	-12.2
1996	1.6	4.2	39.7	-10
1997	2.3	6.1	10.1	-3
1998	1.5	4.2	20	-1.7
1999	2.7	7.5	19.2	-1.2
Av 95-99	2.4	6.3	54.1	-5.6

Notes: Inflation: December to December change of CPI index (RPI for Albania and Croatia). Fiscal revenues: taxes, social contributions, customs duties (excluded in Montenegro).

Table A2. Lending to the government dealt with in statutes of central banks in 2001 (unless otherwise stated)

Country	Limit	Maturity	Legal Act
Albania	5% of the annual average of the Government of the Republic of Albania's 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	Arts. 30, 31, 32 of the Law on the of Albania
Belarus	N/A		
Bulgaria	No credit to the state or to state institutions		Art. 45 of the Law on the Bulgarian National Bank
Croatia	5% of the budget for the current year (to be banned in the new law)	Not beyond the end of the fiscal year	Arts. 57 & 58 of the 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).		Arts. 30 (2) & 32 of the Act on the Czech National Bank
Estonia	No direct or indirect granting of credits to the government, no purchases 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)
Latvia	No credits to the state or to state institutions and no purchases of government bonds on the primary market.		Art. 36 of the Law on the Bank of Latvia

Lithuania	No credits to the state or to state institutions and no purchases of government bonds on the primary market.		Art. 37 of the Law on the Bank of Lithuania
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
Russia	No credits to the state or to state institutions and no purchases of government bonds on the primary market unless foreseen by the federal law for the federal budget.		Art. 22 of the Federal Law of the Bank of Russia
Slovak Republic	Only payments from credit balances of the accounts of state entities, but credits to the Deposit Protection Fund are possible.		Arts. 25 and 24 (3) of the National Bank of Slovakia Act
Slovenia	5% of the budget of the Republic of the current year and 1/5 of the total anticipated budget deficit.	Not beyond the end of the fiscal year	Law of the Bank of Slovenia, Art. 61
Turkey	No credits to the state or to state institutions and no purchases of government bonds on the primary market.		Art. 56 of the Law on the Central Bank of the Republic of Turkey (amended 25.4.01)
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 (Version: 1999)

Source: Based on central bank laws and on Hochreiter and Kowalski (2000).

Table A3. Seigniorage by concepts in the Czech Republic (in million € or as stated otherwise)

	1995	1996	1997	1998	1999	2000
Opportunity cost (as a % of GDP)	740 1.95	793 1.73	942 2.13	893 1.73	401 0.79	309 0.58
Implied EMU (as a % of GDP)	314 0.83	122 0.27	109 0.25	136 0.26	131 0.26	226 0.43
Fiscal concept (as a % of GDP)	91 0.24	-557 -1.22	975 2.21	-1.132 -2.20	956 1.88	120 0.23
Of which:						
Net interest revenues (as a % of GDP)	135 0.36	258 0.56	226 0.51	254 0.49	213 0.42	120 0.23
Sterilisation costs (as a % of GDP)	285 0.75	493 1.08	216 0.49	437 0.85	195 0.38	27 0.05
Valuation gains (as a % of GDP)	241 0.63	-322 -0.70	965 2.19	-949 -1.84	938 1.84	27 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 as stated otherwise)

	1995	1996	1997	1998	1999	2000
Opportunity cost (in % of GDP)	15.17 0.58	12.12 0.36	30.55 0.74	61.49 1.31	26.38 0.55	30.82 0.57
Implied EMU (in % of GDP)	10.9 0.42	9.66 0.29	11.03 0.27	12.13 0.26	10.83 0.23	18.91 0.35
Fiscal concept (in % of GDP)	13.09 0.50	11.39 0.34	14.68 0.36	18.82 0.40	14.29 0.30	20.07 0.37
Of which:						
Net interest revenues (in % of GDP)	13.11 0.50	11.4 0.34	14.68 0.36	18.83 0.40	14.29 0.30	20.07 0.37
Sterilisation costs (in % of GDP)	0.02 0.00	0.01 0.00	0.00 0.00	0.01 0.00	0.01 0.00	0.00 0.00
Base money to GDP in %	9.32	10.27	10.79	11.41	12.24	12.97
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 as stated otherwise)

	1995	1996	1997	1998	1999	2000
Opportunity cost (in % of GDP)	829 2.16	920 2.77	855 2.22	760 1.93	737 1.65	572 1.25
Implied EMU (in % of GDP)	91 0.24	79 0.24	86 0.22	91 0.23	131 0.21	138 0.30
Fiscal concept (in % of GDP)	882 2.29	288 0.87	82 0.21	465 1.18	88 0.20	262 0.57
Of which:						
Net interest revenues (in % of GDP)	1 0.00	-40 -0.12	-39 -0.10	-0 0.00	23 0.05	76 0.17
Sterilisation costs (in % of GDP)	15 0.04	225 0.68	345 0.90	369 0.94	221 0.49	97 0.21
Valuation gains (in % of GDP)	896 2.33	553 1.67	466 1.21	834 2.12	286 0.64	283 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 as stated otherwise)

	1995	1996	1997	1998	1999	2000
Opportunity cost (in % of GDP)	2.252 2.48	2.215 2.08	2.824 2.31	2.433 1.81	1.667 1.22	2266 1.27
Implied EMU (in % of GDP)	252 0.28	227 0.21	228 0.19	277 0.21	264 0.15	401 0.23
Fiscal concept (in % of GDP)	123 0.14	270 0.25	-765 -0.63	-22 -0.02	1.667 1.13	-1.291 -0.73
Of which:						
Net interest revenues (in % of GDP)	375 0.41	376 0.35	430 0.35	525 0.39	485 0.33	635.5 0.35
Sterilisation costs (in % of GDP)	260 0.29	205 0.19	1.359 1.11	1.231 0.92	614 0.42	1089.3 0.61
Valuation gains (in % of GDP)	9 0.01	98 0.09	163 0.13	684 0.51	1.795 1.22	-836.7 -0.47
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 as stated otherwise)

	1995	1996	1997	1998	1999	2000
Opportunity cost (in % of GDP)	62 0.45	65 0.47	79 0.57	98 0.71	95 0.69	112 0.81
Implied EMU (in % of GDP)	15 0.11	12 0.08	12 0.08	17 0.10	17 0.09	26 0.14
Fiscal concept (in % of GDP)	31 0.22	79 0.55	77 0.50	2 0.01	144 0.78	149 0.78
Of which:						
Net interest revenues (in % of GDP)	25 0.18	22 0.15	23 0.14	31 0.18	32 0.17	44 0.23
Sterilisation costs (in % of GDP)	4 0.03	6 0.04	34 0.22	16 0.09	13 0.07	7 0.04
Valuation gains (in % of GDP)	10 0.07	63 0.44	88 0.57	-13 -0.07	125 0.68	113 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.

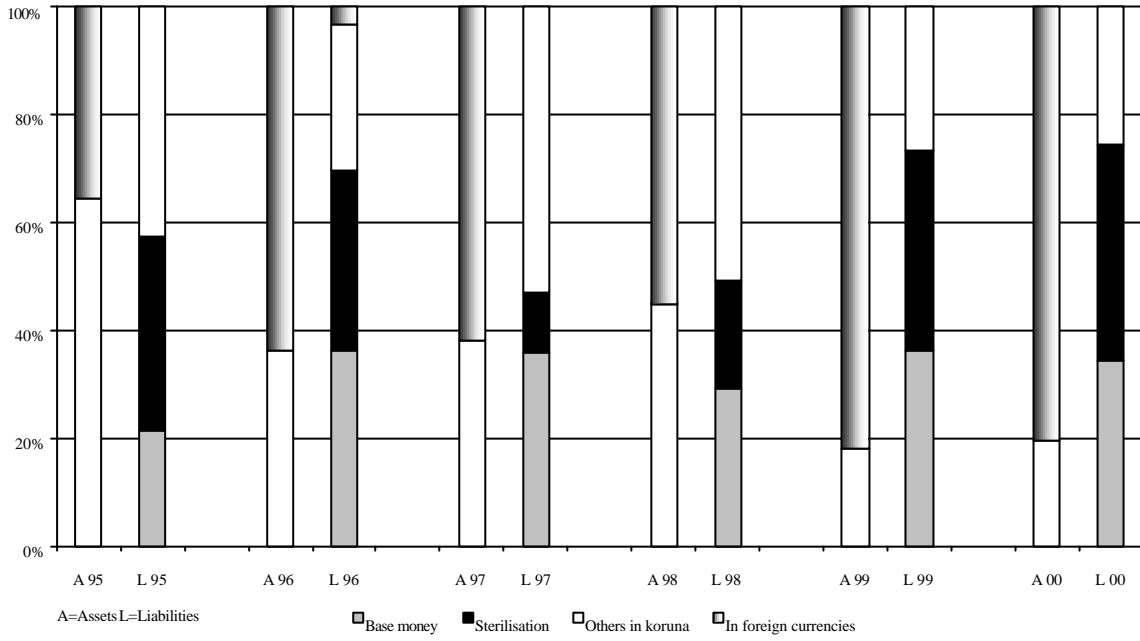
Table A8. Chosen variables and assumptions for the calculation of seigniorage

	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 26 May 1998: basket peg 35% USD, 65% DEM Since 27 May 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 11 April 2000: 45% USD, 55% EUR Since 12 April 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 Bank	Securities (CDs)	Overnight lending rate	100% DEM/EUR	Currency board to DEM/EUR

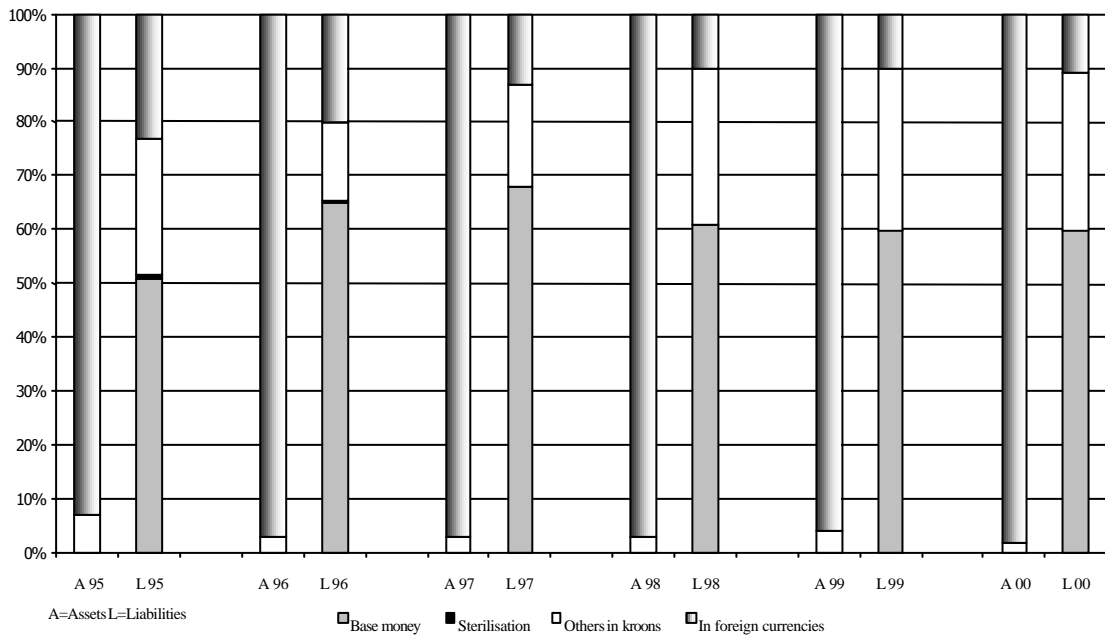
* (Discount + lombard rate)/2 in 1995 (Jan-Nov), Pribor 2 weeks in 2000.

Balance sheets of central banks (calculated from monthly averages)

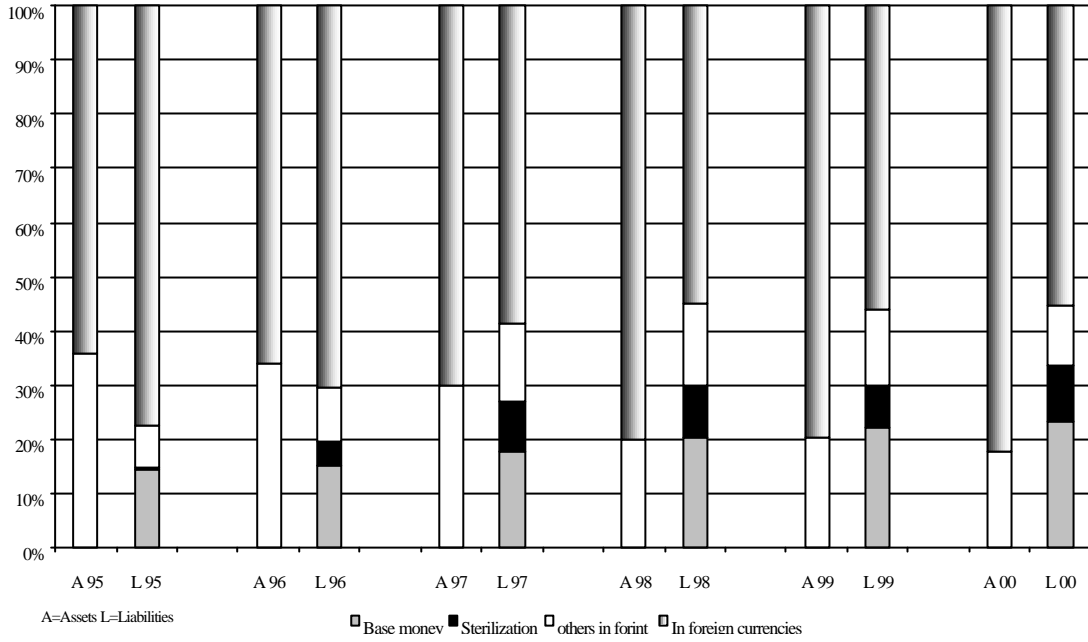
Graph A1. Czech National Bank



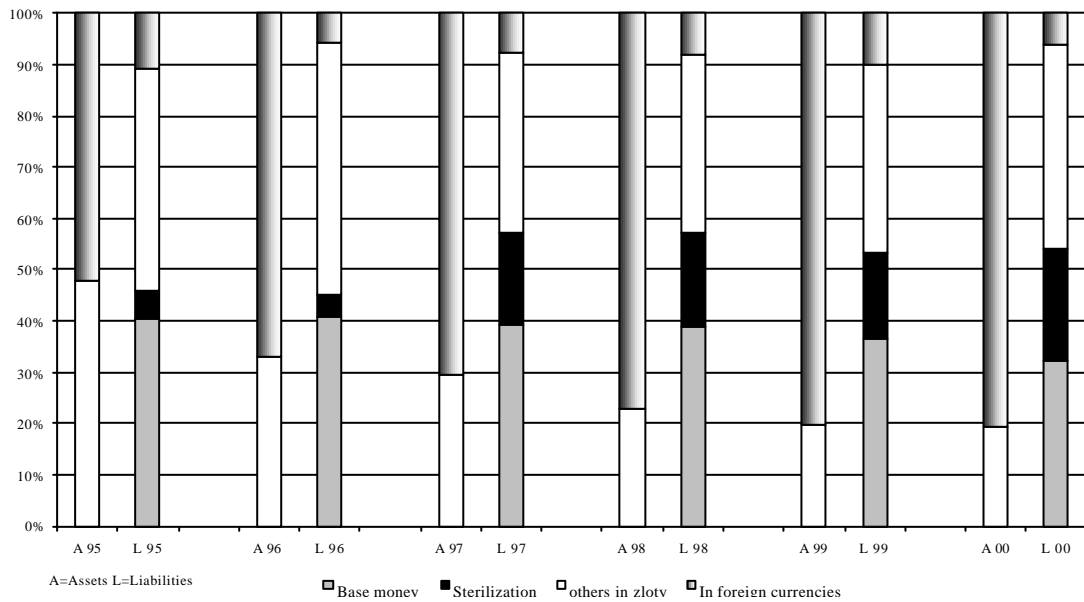
Graph A2. Bank of Estonia



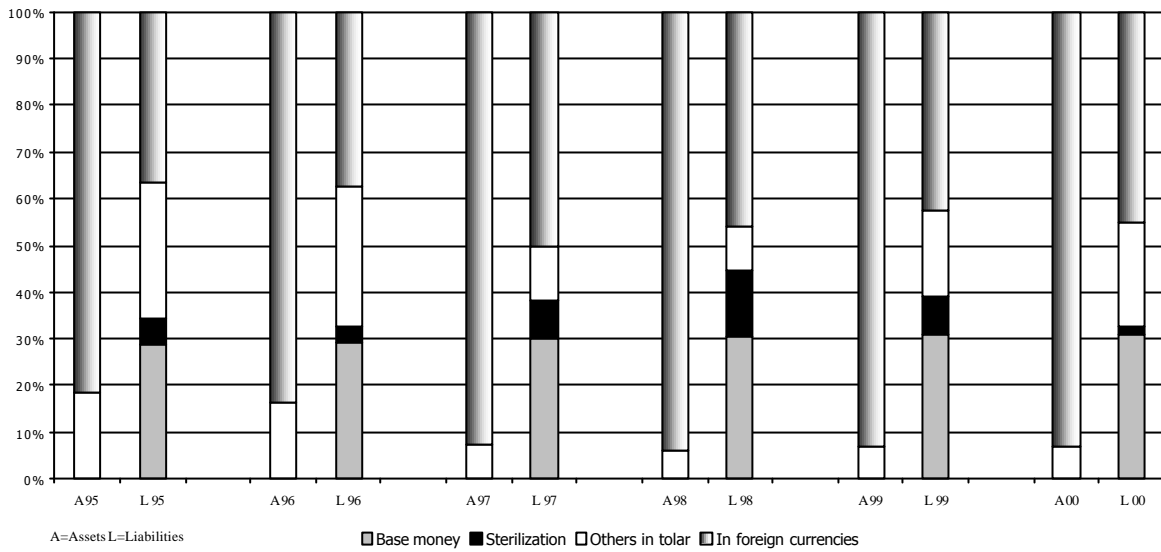
Graph A3: National Bank of Hungary



Graph A4: National Bank of Poland

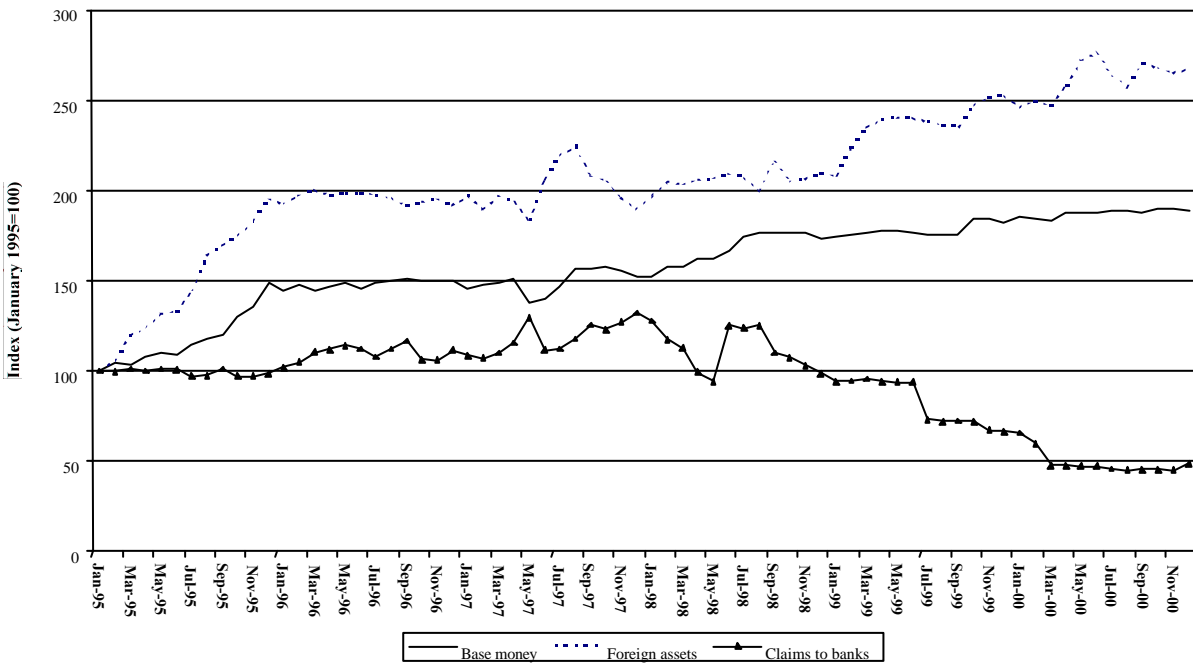


Graph A5: Bank of Slovenia

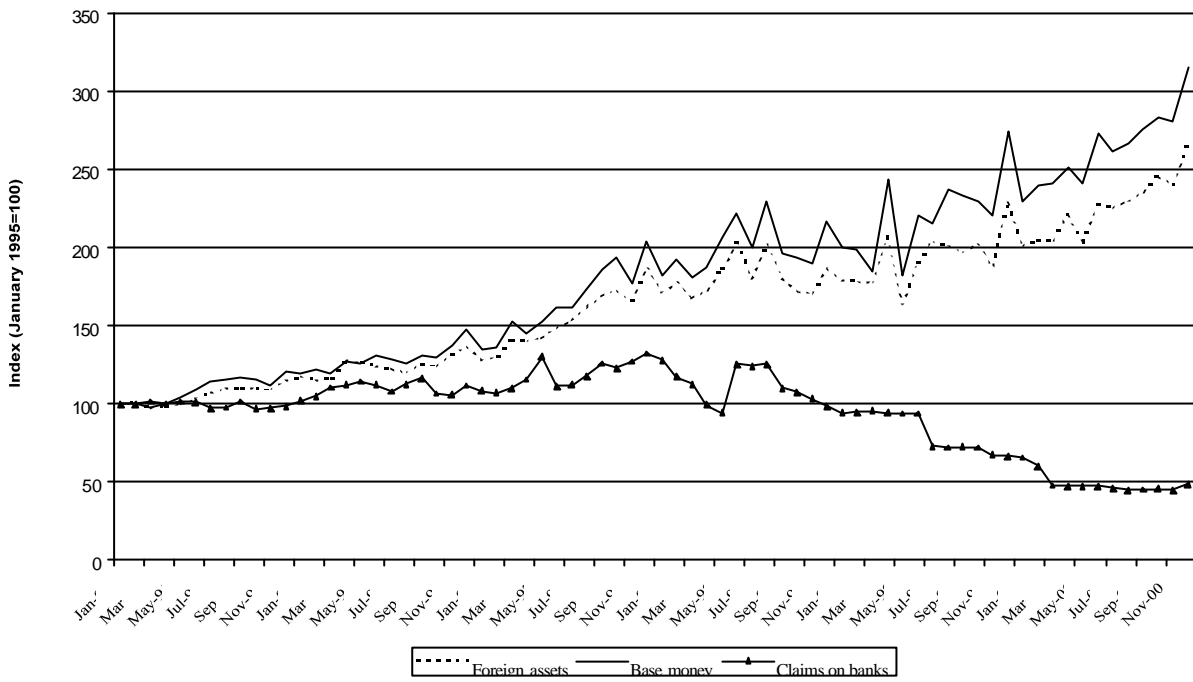


Evolution of base money, foreign assets and claims to banks

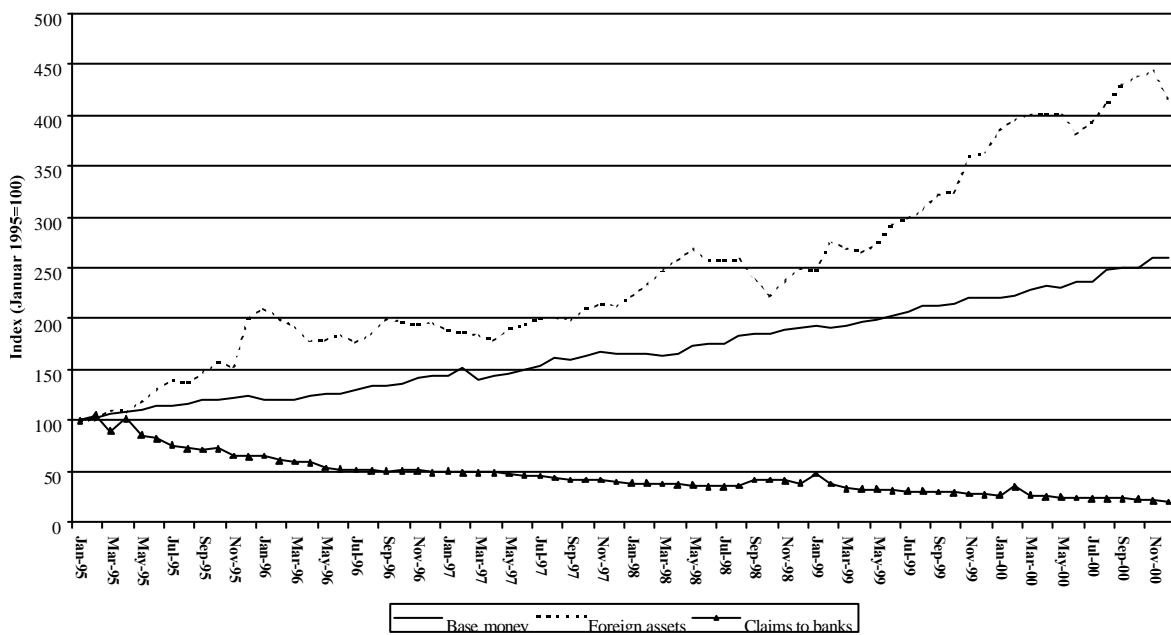
Graph A6 Czech National Bank



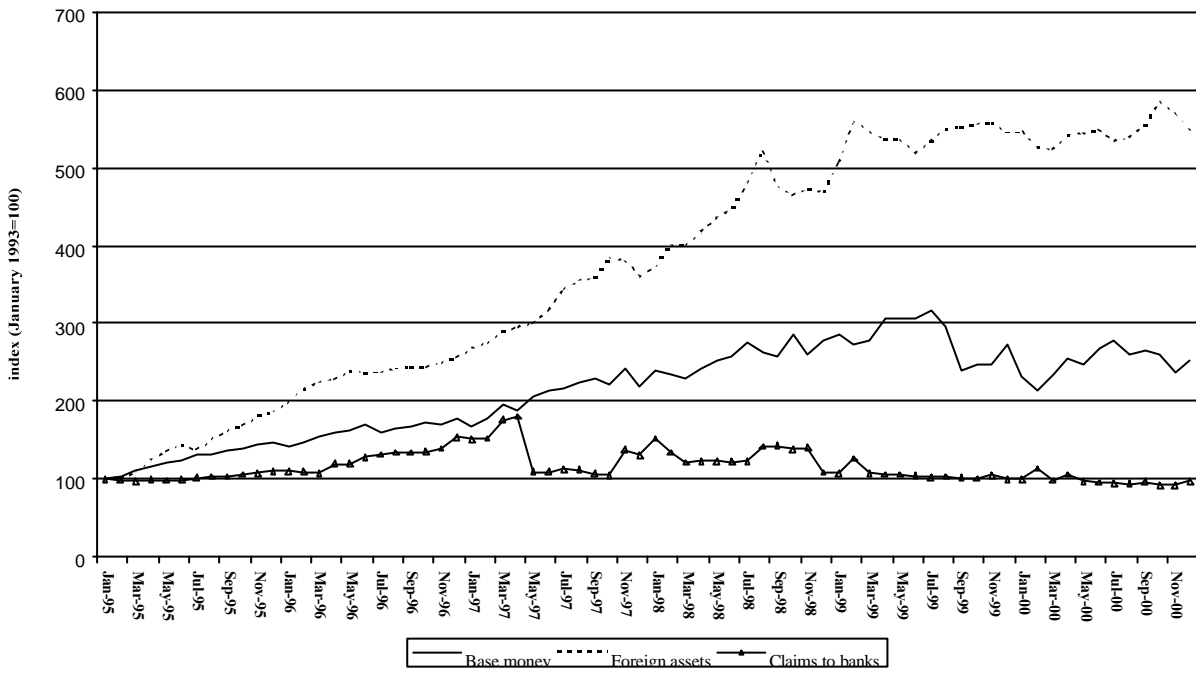
Graph 7: Bank of Estonia



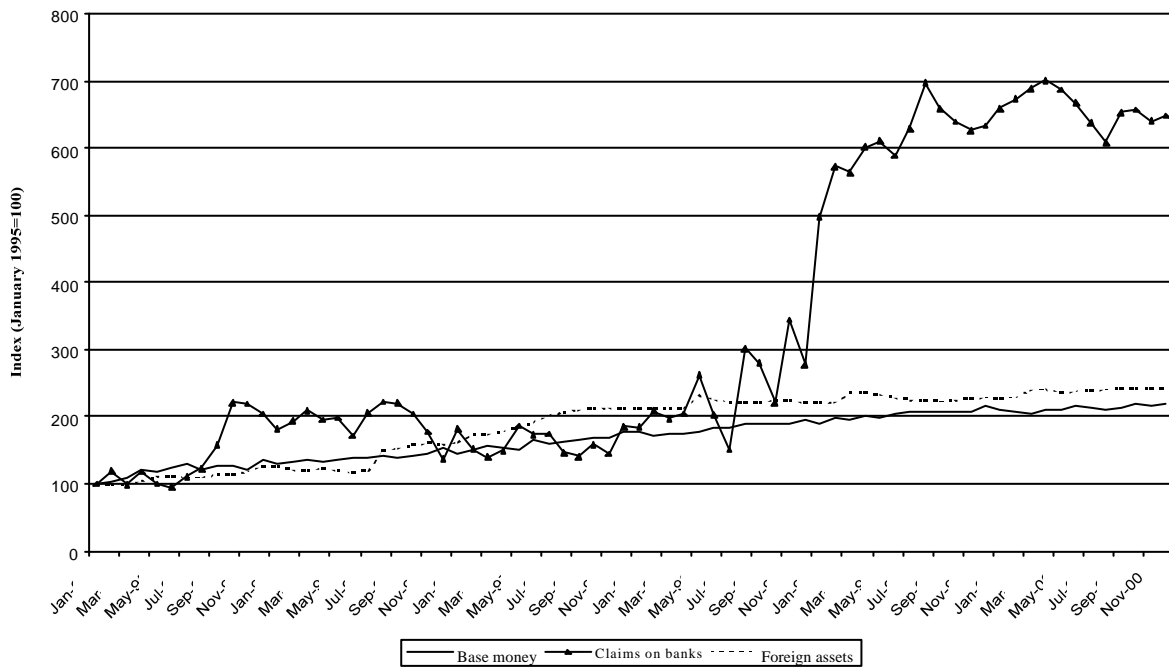
Graph A8: National Bank of Hungary



Graph A9: National Bank of Poland



Graph A10: Bank of Slovenia



ANNEX II. INFERRED CONCEPTS OF SEIGNIORAGE FROM BUDGET IDENTITIES

In the following analysis it will be shown that concepts of seigniorage can be inferred from different presentations of the government's budget constraint.²⁷ The theoretical concepts, the monetary and the opportunity cost concept, thereby will match a fiscal concept, if special processes for the creation of base money are considered. For this purpose, it is assumed that no costs and valuation changes occur and that the central bank distributes total net revenues from the monopoly in base money to the fiscal authorities.

Creation of base money by purchases of government bonds

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

$$A.2 \quad (B_t^{CB} - B_{t-1}^{CB}) + S_t^F = i_{t-1} \cdot B_{t-1}^{CB} + (H_t - H_{t-1})$$

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 equal interest revenues on these government 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 budget identity of the consolidated public sector:

$$A.3 \quad G_t + i_{t-1}B_{t-1}^P = T_t + (B_t^P - B_{t-1}^P) + (H_t - H_{t-1})$$

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

²⁷ See Walsh (1998; pp. 132-147).

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.3 by the price level, P_t , it can be represented in real terms (indicated by lower case letters)²⁸ as shown in A. 4

$$A.4 \quad g_t + r_{t-1}^\bullet \cdot b_{t-1}^p = t_t + b_t^p - b_{t-1}^p + \frac{H_t - H_{t-1}}{P_t}$$

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

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

rearranging gives:

$$A.5 \quad g_t + r_{t-1} \cdot b_{t-1}^p = t_t + b_t^p - b_{t-1}^p + \frac{(1 + r_{t-1}) \cdot (p_t - p_t^e)}{(1 + p_t)} \cdot b_{t-1}^p + \frac{H_t - H_{t-1}}{P_t}$$

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

The third term on the right hand side, $(1 + r_{t-1}) \cdot (p_t - p_t^e) / (1 + p_t) \cdot b_{t-1}^p$, 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. Reductions of debt denominated in domestic currency due to unanticipated inflation²⁹ should not be confused with the inflation tax, which arises as part of seigniorage as shown in A6. Here changes in base money are rearranged into:

$$A.6 \quad \frac{H_t - H_{t-1}}{P_t} = q_t \cdot h_{t-1} = h_t - h_{t-1} + \frac{p_t}{1 + p_t} \cdot h_{t-1}$$

The first term on the right hand side of A.6 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 seems to imply that the government then receives no revenue if 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

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

²⁹ Or equivalently, unanticipated depreciation when measuring variables in a foreign currency.

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.5 and A.6 and assuming that inflation is fully anticipated, gives

$$\text{A.7} \quad g_t + r_{t-1} \cdot b_{t-1}^p = t_t + b_t^p - b_{t-1}^p + h_t - h_{t-1} + \frac{p_t}{1+p_t} \cdot h_{t-1}$$

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.

$$\text{A.8} \quad g_t + r_{t-1} \cdot d_{t-1} = t_t + d_t - d_{t-1} + \frac{i_{t-1}}{1+p_t} \cdot h_{t-1}$$

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 $\left(\frac{p_t}{1+p_t}\right)$ 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}).

Creation of base money by purchases of assets outside the government sector

If the central bank issues base money exclusively by purchasing assets outside the government sector (A), 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.2, becomes

$$\text{A.9} \quad (A_t - A_{t-1}) + S_t^F = i_{t-1} \cdot A_{t-1} + (H_t - H_{t-1})$$

And the consolidated government-sector budget identity, A.3, is now

$$\text{A.10} \quad G_t + i_{t-1} B_{t-1} = T_t + (B_t - B_{t-1}) + (H_t - H_{t-1})$$

because total bonds are held outside the government sector. Expressed in real variables, assuming again fully anticipated inflation and adding $r_{t-1} \cdot h_{t-1}$ to both sides yields A.8.

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.

Creation of base money by direct lending to the government

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 it matches the fiscal concept, it reflects the financing of current government deficits by receiving non-interest bearing advances from the central bank. Advances to the fiscal authorities for current expenditures are measured in each period by $s_t^f = c_t$, which directly translates into changes in base money and thus into the monetary concept.

The budget identity of the fiscal branch of the government, A.1, reduces to

$$\text{A.11} \quad G_t = T_t + S_t^F$$

and the government's budget constraint expressed in terms of total liabilities of the government, A.8, becomes

$$\text{A.12} \quad g_t = t_t + q_t \cdot h_{t-1}$$

However, fiscally exploiting the monopoly in base money is usually more complicated in practice. For example, if the government finances its deficits by newly issued bonds and if the central bank purchases these government bonds during the same period, in which the deficit occurred, interest revenues and expenditures are netted out in the budget identity of the consolidated government and the real value of changes in base money reflect the additional revenues, the government receives from its monopoly in base money. A precondition is, that the issuance of government bonds solely finances government deficits. This will become clear in the next section.

Wealth or net indebtedness of the public sector?

The creation of base money at the central bank either leads to the accumulation of claims to the government or to other sectors. On a consolidated basis claims to the government held against base money are part of the indebtedness of the public sector. The following analysis elaborates this difference more explicitly because the distinction can become important for a government, which considers the unilateral adoption of a foreign currency.³⁰

Assuming infinite periods over which an intertemporal balanced budget is required, the government's wealth constraint is given by

$$\text{A.13} \quad h + b^P = w + \Omega$$

Total assets of the government are given by w , whereas Ω comprises net government indebtedness arising by virtue of the monopoly in base money. Both will be either financed with base money, h , or with bonds held outside the government sector.

³⁰ For a similar analysis on the effects of seigniorage on government's wealth, see Drazen (1984).

Assuming, that assets and outstanding bonds bear the same rate of return, A.13 can be written as

$$\text{A.14} \quad h = a + \Omega$$

where $a = w - b^p$. These net assets also 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 Ω .

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 then 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. In principle, the two cases can be sharply divided, but in practice it will be hard to assess whether the purchase of a particular bond increases net assets or net government indebtedness.

The creation of base money, which is backed by net government indebtedness, facilitates the analysis, whether purchases of government bonds by the central bank have inflationary consequences.

Inflationary consequences from the creation of base money

Direct borrowing from the central bank in order to finance current deficits enables extra demand from the government. It will cause inflation if extra demand followed by a subsequent creation of money takes place at a rate that exceeds demand at the current price level. This mechanism is straightforward, however, deriving at inflationary consequences from the creation of base money by purchasing government bonds is less simple.

In order to show under which conditions purchases of government bonds at the central bank bear inflationary consequences, it is assumed that issuing base money by purchasing government bonds increases net indebtedness rather than net assets. Even

under this precondition purchases of bonds may only lead to inflationary financing as one of several choices. Assume the budget equation of the consolidated government sector for each period is given by

$$A.15 \quad g_t + r_{t-1} \cdot b_{t-1}^p = t_t + b_t^p - b_{t-1}^p + q_t \cdot h_{t-1}$$

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

$$A.16 \quad b_{t-1}^p + \sum_{i=0}^{\infty} \frac{g_{t+i}}{(1+r)^i} = \sum_{i=0}^{\infty} \frac{t_{t+i}}{(1+r)^i} + \sum_{i=0}^{\infty} \frac{q_{t+i} \cdot h_{t-1+i}}{(1+r)^i} + \lim_{i \rightarrow \infty} \frac{b_{t+i}^p}{(1+r)^i}$$

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.³¹

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

Accordingly, equation A.16 can be rewritten as

$$A.17 \quad b_{t-1}^p = \sum_{i=0}^{\infty} \frac{t_{t+i}}{(1+r)^i} - \sum_{i=0}^{\infty} \frac{g_{t+i}}{(1+r)^i} + \sum_{i=0}^{\infty} \frac{q_{t+i} \cdot h_{t-1+i}}{(1+r)^i}$$

The right side of A.17 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.

In this analytical framework purchasing government bonds, which have financed past budget deficits or which finance current deficits, bear the same inflationary consequences. In the first case the stock of outstanding government bonds of the previous period has been reduced and seigniorage has financed past budget deficits and not current government expenditures, which are instead financed by newly issued bonds of the current period. In the second case outstanding government bonds of the previous period remain unchanged and seigniorage finances current expenditures. So in both cases, the stock of outstanding bonds in the current period remains constant and the current deficit has been financed by newly issued bonds, which have been either bought by the central bank or by the private sector. The intertemporal budget balance will hold if the government revises its plans and it has basically three choices. Either it reduces government expenditures or it increases taxes or it finances the deficit with seigniorage. The last alternative 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. Eventually it is hard to foresee inflationary consequences of

³¹ See e.g. Walsh (1998, p. 138).

purchasing government bonds at the central bank, because an exploitation of the inflation tax just remains one of several choices.

In practice, some statutes of central banks prohibit purchases of government bonds as well as direct lending to the government. Other central bank laws are less strict and only prohibit purchases of government bonds at the primary market whereas they 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.³² Purchases of government bonds at the primary market can have an additional effect on the cost of credit of the government, if the extra demand of the central bank reduces the yield on the bond. If the reduced cost of credit then leads to a higher demand for borrowing of the government, it can add to inflationary impulses.

Financing the unilateral adoption of a foreign currency

Now the analysis turns to the question how the official substitution of base money by a foreign currency is financed. As will be shown it will be principally irrelevant whether the country needs to take up a loan to finance the purchase of cash in foreign currency or whether it can use marketable assets which have backed base money.

In order to show this result 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 and 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 an unilateral adoption of a foreign currency. If the economy in case I euroises or dollarises 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 foreign currency, which substitutes for cash in domestic currency.

Let 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 , 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 velocity changes do not exist. Real balances accordingly grow at the rate n and nominal balances at the rate $n + p + np$, which equals θ under these assumptions. For analytical purposes base money and cash in circulation are identical and costs and valuation changes do not occur with the creation of base money.

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. Seigniorage in each period consists of the interest revenues on the net assets held as counterparts of base money.

³² See for example Article 18 of the statute of the European System of Central Banks or selected central bank laws of Central and Eastern European countries given in the Annex.

Defining $1+\mathbf{q}=(1+\mathbf{p})\cdot(1+n)$, the nominal value of net assets in period t is equal to $A_t^n=(1+\mathbf{q})^t\cdot A_0^n$ and the present discounted value of seigniorage, $PDVS^I$, is given by: ³³

$$A.18 \quad PDVS^I = \sum_{t=0}^T \left(\frac{1}{1+i} \right)^t (1+\mathbf{q})^t \cdot \frac{i \cdot A_0}{(1+i)}$$

or for a sufficiently long period:

$$A.19 \quad PDVS^I = \frac{i \cdot A_0}{i-\mathbf{q}}$$

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

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

Now the central bank issues base money to cover budget deficits. Seigniorage is measured by the monetary concept, $\mathbf{q} \cdot h_{t-1}$. The present discounted value of seigniorage (PDVS) gives

$$A.20 \quad PDVS^{II} = \sum_{t=0}^T \left(\frac{1}{1+i} \right)^t (1+\mathbf{q})^t \cdot \frac{\mathbf{q} \cdot H_0}{(1+i)}$$

or over a sufficiently long period:

$$A.21 \quad PDVS^{II} = \frac{\mathbf{q} \cdot H_0}{i-\mathbf{q}}.$$

If the country unilaterally euroises the loss of 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, ρ is

given for a sufficiently long period by $\mathbf{r} = \frac{i}{\mathbf{q}}$

Because $i>\mathbf{q}$ 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

$$A.22 \quad \frac{(i-\mathbf{q}) \cdot H_0}{i-\mathbf{q}} = H_0$$

The difference between losses in case I and in case II equals the nominal value of base money at the time, at which the economy introduced a foreign currency. It is the value of the loan, which the economy in case II needs to take up to finance cash in foreign currency. 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

³³ For similar results, see Schmidt-Grohe and Uribe (1999).

investment. Accordingly, the government services past budget deficits, which it would otherwise not redeem, if it held on to its monopoly in base money.

The present value of the loan can be simply derived by assuming non-repayable debt of the value $L=H_0$ with infinite constant interest payments. The present discounted value of borrowing (PDVB) is given by

$$A.23 \quad PDVB = \frac{i_L}{i} \cdot H_0$$

where i_L is the interest rate paid on the loan and i is the discount rate.³⁴ 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 . Under these assumption the governments in case I and II bear the same costs when they adopt a foreign currency.

The result holds for infinite periods and neglects any cash constraints, governments may face during some periods. Especially EU-accession countries³⁵ only temporarily face losses of seigniorage until they join the monetary union and so it will be analysed whether this fact will change the result.

Central banks of case I, which have backed base money by marketable assets, can readily convert cash in domestic currency to cash in foreign currency. They will lose seigniorage arising from the interest income on these assets until they join the monetary union and participate on the sharing of seigniorage without contributing to the common pool of seigniorage, because they do not hold the assets backing base money any more. The saved contribution to the common pool per period will be $i \cdot A_0$ and its net present value over sufficiently long periods³⁶ will be the value of the assets, which have been used to purchase cash in foreign currency. So eventually, the government will only use the foregone interest income on these assets until it joins the monetary union.

A government as in case II, which has no marketable assets to back base money, bears losses on foregone monetary seigniorage *plus* the debt-service of the loan until it joins the monetary union. Then it will participate on the sharing of seigniorage without contributing to the common pool. Its saved contribution will be equal to $i \cdot H_0$, its stock of base money at the time it introduced a foreign currency times a reference rate. This is the so called indirect method to calculate the contribution of seigniorage. According to the statute of the ESCB, seigniorage should be calculated by applying the direct method, which is based on the return of assets backing base money. But a central bank as described by case II would not have any interest-bearing assets and therefore it is assumed, that it would have to apply the indirect method to assess its contribution of seigniorage to the common pool. If the reference rate equals the interest rate paid on the loan, the government would not bear any debt-service costs any more after it joins the

³⁴ 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.

³⁵ Or even non EU-accession countries, which will join the accession process later.

³⁶ Again assuming equal interest and discount rates.

monetary union and therefore it will only lose seigniorage and pay the debt-service on the loan until it joins the monetary union.

Finally, more general qualifications to the theoretical analysis have to be kept in mind. The analysis is based on the steady state assumption, in which interest rates are equal and 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 a country may not need to take up a loan, which covers total domestic cash by foreign cash at the exchange rate chosen for conversion. Rather than unilaterally introducing a foreign currency the government can legalise the foreign currency and thereby introduce a parallel currency system with a flexible exchange rate. The government can drive out the domestic currency gradually by making its payments to the private sector in foreign currency. The initial amount of cash in foreign 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. The government would reduce its costs, if the value of domestic cash measured in foreign currency reduces during this process. However, this crucially depends on a depreciation of the domestic currency, which will not necessarily be the case.