The generation and distribution of central bank seigniorage in the Czech Republic, Hungary and Poland [*]

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1. Introduction

Two main macro policy challenges facing the economies in transition (EITs) of Central and Eastern Europe, over the last decade, have been to finance public expenditure and sustain disinflation. Securing funds to finance public expenditure has proved particularly difficult for the less advanced EITs, where tax collection was weak and the tax base had been diluted. In addition, many countries also suffered from a weak financial sector, as a number of intermediaries were burdened by bad loans and desperately needed to clean their portfolios and recapitalize, often through recourse to public funds. In a number of cases, given the inefficiency of the tax system,[1] recourse to the inflation tax seemed to be an obvious solution, as it can be instituted quickly and

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[1] See Cukierman (1992, ch. 4).

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does not need parliamentary approval. All it needs is a subservient central bank.

Yet, inflationary finance through seigniorage or the inflation tax[2] runs counter to the need for macroeconomic stability, and in particular works against a central bank's commitment to price stability. Moreover, for those countries, which aspire to join the EU and ultimately to adopt the euro, control of the fiscal deficit and the achievement of price stability form part of the Maastricht convergence criteria, which they must meet before adopting the euro.

In this paper we study the evolution of seigniorage in the Czech Republic, Hungary and Poland in the 1990s. To a large extent, these countries represent the bright side of transition, especially with respect to their macroeconomic achievements. They are expected to accede to the EU in 2004, and subsequently to adopt the euro. With the adoption of the euro they will be no longer able to control the flow of seigniorage. Seigniorage will then accrue to each of them in proportion to their capital key, computed according to article 32 of the Protocol on the Statute of the ESCB. We investigate to what extent, if at all, the need to support the government budget has conditioned the choices regarding the inflation rate (or the path towards disinflation) made by the monetary authorities up to now.

In Section 2 we examine issues related to the definition and measurement of seigniorage. Section 3 evaluates the amount of total (central bank) seigniorage generated in the 1990s. In Section 4 we study to what extent this has resulted in subsidies to the government, while Section 5 provides specific comments on the interpretation and policy implications of our findings and Section 6 draws some conclusions. The institutional aspects and data sources for individual countries are discussed in the Appendix.

[2] Inflation tax is the loss of purchasing power which affects the monetary base and, more generally, any nominal (non-indexed) financial asset. Seigniorage is defined in Section 2.1 below.

2. Definition and measurement of seigniorage

2.1. *Definitions of seigniorage*

The concept of seigniorage is not unambiguously defined.[3] We may characterize the concept starting from a general, encompassing definition of seigniorage, such as the one suggested by Drazen (1985) and later also by Klein and Neumann (1990). Drazen (1985, p. 328) defines "total revenues associated with money creation" as the algebraic sum of:

a) "revenue from assets purchased due to money issue" [i A/Y],

b) "netting out that part of revenue used to keep [assets] constant" [(π + g)/Y],

c) "current flow revenue, i.e., revenue from current expansion of the money supply in real, per capita terms" [ΔH/Y],

where *i* is the nominal interest rate, *A* central bank assets, *Y* nominal GDP, ***p*** the inflation rate, *g* the growth rate of real GDP, and *H* the monetary base. Formally, this adds up to the following definition, which can be simplified (as is done on the left-hand side) by using r = i – π for the real rate of interest:

$$\mathbf{S^D\ o}\ \ i\frac{A}{Y}-[\pi+g]\frac{A}{Y}+\frac{\Delta H}{Y}=(r-g)\frac{A}{Y}+\frac{\Delta H}{H}\frac{H}{Y} \qquad (1)$$

If we also assume that the monetary base is invested in interest yielding assets, so that A = H, and also noting that ΔH/H = π + g–ν, where ***n*** is the growth rate of the velocity of base money, we may rewrite and again simplify the above equation as:

$$\mathbf{S^D} = (r-g)\frac{H}{Y}+(\pi+g-\nu)\frac{H}{Y} = i\frac{H}{Y}-\nu\frac{H}{Y} \qquad (2)$$

Thus Drazen's "total revenues associated with money creation" coincide with the (net) interest earned on central banks' reserves, minus losses (gains) due to an increase (decrease) in the GDP velocity of the monetary base.

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[3] For a useful discussion of various concepts see Schobert (2001).

In practice, three concepts of seigniorage have been used in the literature:

i) the opportunity cost concept, $S^{opp} = i \frac{H}{Y}$, that is the (net) interest earned on a central bank's reserves;

ii) monetary seigniorage, $S^{mon} = \frac{\Delta H}{H} \frac{H}{Y} = \frac{\Delta H}{H}$, i.e. change in the monetary base;

iii) the inflation tax concept,[4] $S^{\Pi} = \pi \frac{H}{Y}$.

All three definitions may easily be derived from different ways of rearranging and simplifying the framework suggested by equations 1 and 2. In particular, it is clear that in all three definitions, the "tax base" for seigniorage is given by the stock of the monetary base, and they only differ in terms of the assumed "tax rate". Moreover, it is also clear that, with reference to equations 1 and 2:

– the *opportunity cost* approach neglects the effects due to changes in base velocity (and thus coincides with Drazen's approach when $\nu = 0$);

– the *monetary approach* neglects the effects due to the fact that real rate of interest and rate of GDP growth may well differ from each other (and thus coincides with Drazen when $r = g$);

– the *inflation tax approach* neglects both the value of the real rate of interest and the effects due to changes in base velocity (and thus coincides with Drazen when $\nu = r = 0$).

Thus, in practice, the three definitions will yield different results, except possibly for the long run, when it might become true that velocity is constant and capital accumulation proceeds along the path of dynamic efficiency, thus implying $r = g$, and the first two approaches will then coincide. Choosing any one definition for practical purposes thus becomes a matter of weighting pros against cons. The inflation tax is a natural concept to employ for economies where the

[4] The notion of an inflation tax is potentially wider than seigniorage, as also all nominal liabilities of the government (thus including all non-indexed bonds) are subject to it. However, this latter component of the inflation tax does not qualify as 'seigniorage', so we do not discuss it here.

real rates of interest and growth are overwhelmingly dominated by inflation, but this is certainly not the case for the countries in our study. Both the inflation tax and the monetary approach neglect the role of real interest rates in generating seigniorage, while we feel that setting nominal interest rates over and above expected inflation has been a central component of the disinflation policy of the central banks in each of these countries. The only definition that allows us to take this into account is the opportunity cost version. In addition, there are two, more specific reasons to choose the opportunity cost concept as a basis for our study:

– The countries under study have by now developed financial markets according to market principles. Thus market interest rates in these countries may now effectively reflect the opportunity cost of the monetary base (although with varying degrees of market efficiency).

– The opportunity cost concept is quite similar to the accounting definition of seigniorage ("net interest accrued to reserves"). Hence, it is compatible with measuring seigniorage flows from the central bank to the government (and possibly to other economic entities) as balance sheet transfers. This is particularly important in the new framework of independent central banks, where the accounts of the central bank and of the finance ministry are *not* consolidated, and direct financing of the government deficit through the central bank is prohibited (with minor exceptions).[5]

Finally, we must be aware that in practice the institutional and market environment in the countries under study underwent rapid change during the observation period. In such circumstances any choice of measurement must, even at the conceptual level, be considered an approximation of the true seigniorage measure.

[5] Note that for a correct computation of the opportunity cost measure, it is not so critical to have a precise definition of what constitutes the monetary base, which, for some countries, is hard to identify without ambiguity. It is, however, important to measure the remuneration of all central banks assets and liabilities correctly. For instance, if we wrongly include a liability as a component of the monetary base, but we correctly measure it to be remunerated at market rates, then it would still end up having zero weight in the opportunity cost measure of seigniorage.

2.2. *Analysis of central banks' balance sheet*

The seigniorage-generating liabilities of the monetary authority are defined as:

$$H + EK \tag{3}$$

where H is the monetary base, a liability of the central bank, and EK is "excess capital".[6] The monetary base H may be held as currency (Cu), or as deposits of domestic residents with the central bank (R); these deposits include free and required reserves of the banking sector (RB), and possibly also deposits of the government sector (RG), and deposits of other agents (RO). With the term EK, we attempt to distinguish between reserve accumulation as a tool of risk management and reserve accumulation aimed at increasing future seigniorage. This requires definition of a conventional benchmark: the accumulation of reserves (out of current profits) beyond such a benchmark is assumed to be aimed at increasing the future seigniorage-earning ability. Thus, in any future period, accrued seigniorage will depend on both the stock of monetary base and on excess reserves accumulated from previous periods (see Section 2.3).

Other liabilities in the balance sheet of the monetary authority are: capital and reserves (K), non-monetary base domestic liabilities (such as bills or bonds directly issued by the central bank, ODL) and loans from the International Monetary Fund and other foreign liabilities ($IMF+FL$). On the asset side, we find gold (plus other zero-yield assets,[7] G), convertible foreign assets denominated in domestic currency (FA), claims on government (BC), claims on banks (LC), claims on other agencies (AC), and other net assets (OA).Thus, the following identities hold:

$$\begin{aligned} H + EK + K + ODL + IMF + FL = G + FA + BC + \\ + LC + AC + OA \end{aligned} \tag{4a}$$

and:

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[6] The role of excess capital, or excess reserve accumulation, in the generation of seigniorage has been considered by Hochreiter, Rovelli and Winckler (1996). This notion raises the issue of how to define the benchmark for excessive reserve accumulation. We discuss this point below, Section 2.3.

[7] For the sake of simplicity we disregard capital gains or losses on gold reserves.

$$H = Cu + R = Cu + RB + RG + RO \tag{4b}$$

Using the opportunity cost definition, the amount of seigniorage imputed to the central bank is:

$$S = i_M (H + EK) - i_R R \tag{5}$$

where i_M is the opportunity cost measure, a money market rate, and i_R represents the rate of interest on deposits with the central bank; $i_R R$ includes remuneration on the required and free reserves of the banking sector, and on deposits from other sectors with the central bank.

The amount of seigniorage accruing or transferred to each sector is measured by the difference between the opportunity cost of seigniorage and the rate charged on the liabilities of that sector to the central bank, plus the difference between the rate of interest received by that sector on its claims towards the central bank, less the opportunity cost.

In particular, seigniorage transferred to (or appropriated from) the banking sector is defined by:

$$S^B = (i_M - i_{LC})\, LC + (i_{RB} - i_M)\, RB \tag{6}$$

where i_{LC} and i_{RB} are, respectively, the rate which the banking sector pays on its liabilities (loans from the central bank, *LC*) and receives on its deposits with the central bank (*RB*).

Seigniorage accrued to the government is defined by:

$$S^G = (i_M - i_{BC})\, BC + (i_G - i_M)\, RG + TRANSF \tag{7}$$

where i_{BC} and i_G are, respectively, the rate which the government pays on its liabilities (*BC*) and receives on its deposits with the central bank (*RG*), and *TRANSF* includes non-interest payments to the government originating from the central bank, such as taxes, dividends, and transfers of central bank profits.

Seigniorage transferred to/from the foreign sector is defined by:

$$S^F = (i_M - i_{FA})\, FA + (i_{FL} - i_M)\, (FL + IMF) \tag{8}$$

where i_{FA} and i_{FL} are, respectively, the rate which the central bank receives on its foreign assets and pays on its foreign liabilities.

In addition, we have to consider foregone seigniorage, or, in other words, the amount of seigniorage 'wasted' by the central bank by holding gold or other zero-yield assets; it is defined by: $i_M G$.[8]

It may be useful to make explicit the relation between central bank profits and seigniorage. Using the balance sheet in equation 4a, profits (disregarding for the sake of simplicity all non-interest revenues and costs) are given by:

$$\Pi = i_{FA}\,FA + i_{BC}\,BC + i_{LC}\,LC + i_{AC}\,AC + i_{OA}\,OA + \\ - i_R\,R - i_{ODL}\,ODL - i_{FL}\,(FL + IMF) \qquad (9)$$

and substituting definitions 4b to 8 we may write:

$$\Pi = [S - S^G - S^B - S^F] + [\,(i_{OA} - i_M)\,OA + (i_{AC} - i_M)\,AC + \\ - i_M\,G - i_{ODL}\,ODL\,] \qquad (10)$$

$$= \text{Retained seigniorage} + \text{Profits from non-monetary base intermediation}$$

where the definition of all interest rates is obvious. Equation 10 states that a central bank's profits are equal to retained seigniorage, i.e. central bank seigniorage less any amount transferred to the government, foreign or banking sector, plus non-seigniorage profits. The latter may be seen as profits resulting from the 'banking' as opposed to the 'issuing' department of the central bank; they include excess returns (over the opportunity cost) earned on claims on other agents or by holding other assets, minus the opportunity cost of holding gold and the cost of other domestic (non-monetary base) liabilities.[9] This distinction between the banking and issuing departments of a central bank, which goes back to the early years of the Bank of England,[10] may be particularly useful when dealing with central banks in some EITs. As these banks had previously operated as 'monobanks' in the socialist regime,

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[8] Note, however, that central banks can obtain a positive return on their gold holdings if they engage in gold/forex swaps. However, we are unable to measure empirically such returns.

[9] In writing equation 12, we have assumed implicitly that:

$$FA - (FL + IMF) + BC + LC \leq H + EK$$

otherwise we could not impute the entire yield on the assets on the left side as 'seigniorage'. In practice this condition is always met. However, as we remark below, in the case of Hungary it is met only in the specific sense that a fairly large amount of claims on the government (*BC*) is financed by an equally large amount of foreign liabilities of the central bank (*FL*).

[10] See, for instance, the balance sheet discussed in Bagehot (1873, ch. 2).

they have often inherited an inflated balance sheet structure – in comparison to their counterparts in other European and American countries – with a large proportion of non-monetary base liabilities. We shall comment on this feature in the next section.

2.3. *The data*

The analysis is based on the balance sheets and profit and loss accounts of the central banks. For each country covered in our paper, the data are in domestic currency, with foreign currency assets and liabilities converted at average exchange rates. The basic reclassified balance sheet data are given in Table 1.[11] A more detailed description of the data is contained in the Appendix.

Two facts stand out from the comparative examination of Table 1. First, in the Czech Republic the intermediation of the central bank with respect to the banking sector is considerable: between 1994 and 1996 (but not in 1993) central bank deposits from and loans to the banking sector were both in the order of 20% of GDP. Second, the size of the portfolio of the National Bank of Hungary (NBH) is unusual in the panorama of other central banks, as it oscillates between 75 and 100% of GDP. This is essentially due to the large amount of claims on the government, backed by foreign liabilities. In terms of the discussion in the previous section, it may thus be remarked that a considerable part of the NBH balance sheet is taken up by its 'banking', as opposed to the 'issuing' department.[12]

In order to determine the total amount of central bank seigniorage, the opportunity cost of the monetary base is measured by yearly averages of a domestic money market rate (see Table 2, first row).

One question mentioned in the previous section refers to the appropriate benchmark to be used for the definition of EK. We ini-

[11] While the data in Table 1 are end of period stocks deflated by current year GDP, the data in the following Tables, used in the calculation of seigniorage, are average stocks held during the year.

[12] See for instance the Annual Report for 1994 of the NBH: "The forint borrowing of the National Bank [of Hungary] until 1990 can be interpreted as the debt of the state budget". More detailed references to this issue are in the Appendix.

Table 1 (orizzontale)

tially computed EK following what we call the 'German rule'.[13] For each of the three countries, at least in some years, this rule indicated that there had been some 'excessive' accumulation of reserves. However it was also clear that, for both the Czech and Hungarian central banks, this accumulation did not alter the basic fact that their total capital-asset ratio was still quite low (in the order of 1% for Hungary and 2% for the Czech Republic). Only for Poland did reserve accumulation allow the central bank to reach a high capital ratio. Thus we decided, for the purpose of calculating seigniorage, to set EK to zero for the first two countries, and, for Poland, to consider EK equal to the amount of reserves accumulated beyond 10% of total assets.

3. The generation of seigniorage

Table 2 summarizes the evolution of central bank seigniorage between 1993 and 1999. In the Czech Republic the amount of seigniorage increased from 1% of GDP in 1993 to 3% in 1997, but then became negligible by 1999. In Hungary seigniorage was generally higher, but decreasing after a peak of 7.4% in 1995, to 3.8% in 1996 and around 1% in 1997-99. In Poland it declined from 5.6% in 1993 to 2.4% in 1996 and 1997, but then increased in 1998 to almost 4%.

Changes of seigniorage over time and between countries may be explained with reference to both changes in the opportunity cost and in the seigniorage generating liquidity base. In particular, Hungary stands out with a sharp rise in the rate of interest in 1994-95, which raised seigniorage from 4.0% in 1993 to 7.4% of GDP in 1995.[14]

[13] According to this rule (prior to the establishment of the European Central Bank), the Bundesbank was authorized to accumulate reserves only up to 10% of currency in circulation.

[14] This measure differs sharply from the one suggested by Barabas, Hamecz and Neményi (1998). These authors adopt a monetary measure of seigniorage, with two specific adjustments: *i*) netting out the foreign credits taken out by the NBH on behalf of the Hungarian government from the monetary base; *ii*) measuring the contribution of seigniorage to the financing of the budget deficit *adjusted* for inflation. Hence, with this adjustment, they effectively *subtract* the inflation tax from their measure of seigniorage. As a result, their measure of seigniorage in 1995 is only 1.3% of GDP. However, to be comparable, the inflation tax component of seigniorage should be added on top of this measure. If this is done, then the difference becomes much smaller.

Table 2 (orizzontale)

Required minimum reserve deposits were sharply increased in 1995 in the Czech Republic (and to a smaller extent also in Hungary), thus inducing a jump in seigniorage, only partially compensated for by the increased remuneration of reserves. In contrast, in Poland bank deposits with the central bank are not only quite stable (between 2-3% of GDP) but also at a level comparable to that of many EU countries. Currency in circulation has been fairly stable almost everywhere, always within the range of 7 to 11% of GDP, with a slight increase in the Czech Republic, and some decline in Hungary.

4. The appropriation of seigniorage

In the context of the question raised at the outset we now consider how much of the seigniorage generated is appropriated to the government and how much to other sectors.[15] Specifically, and where possible, we investigate by which channels (in particular, whether interest rate subsidies or transfers; see Section 2.2, equation 7) the government benefits from the central bank's seigniorage.

There are in principle two methods for computing equations 6, 7 and 8. The first method entails attributing an interest rate to each type of liabilities of the central bank towards the government and financial or foreign institutions, and also to each type of claims of the central bank on the same macro sectors. By comparing these posted interest rates to the opportunity cost, the amount of seigniorage transfers between these sectors and the central bank can then be estimated. This method requires very detailed information about the composition of central bank assets and liabilities and about the relevant interest rates. While we have adopted this method in the past (see Hochreiter, Rovelli and Winckler 1996), for the three countries included in this study we were unable to find enough information (about both the composition of the central banks' balance sheets and the structure of their interest rates) to follow this method.

[15] Details of the institutional setup and policy choices for each country are given in the Appendix.

The alternative method uses more aggregate information, generally available from the profit and loss account, concerning total interest expenditure and revenue *vis-à-vis* each macro sector. Also in this case, however, data were available only for Hungary (for the whole period) and for Poland (1993 and 1994). We felt that the inability to provide data of seigniorage transfers for the Czech case was not altogether too important, as in any case the amount of total seigniorage in this country appears quite low throughout the period.[16]

Table 3 summarizes the results: Hungary stands out with the government appropriating more seigniorage than is generated. This is possible because, in addition to the imputed central bank seigniorage, the central bank benefits from negative seigniorage transfers from both domestic financial institutions and foreign institutions. As regards the latter, it must be pointed out that loans from foreign institutions to the NBH (at rates of interest below market rates) are in fact raised by the NBH on behalf of the government (see the Appendix). However, we note that the sum of the imputed central bank seigniorage plus the subsidy from foreign institutions is always higher than the seigniorage appropriated to the government, implying that the central bank also retains a considerable amount of seigniorage (except for 1997).

In Poland seigniorage appropriated to the government was around 1,5-2% of GDP in 1993-94. Although we lack data for the following years, it has certainly not increased since then.

As is well known, the financial sector in EITs is burdened with bad loans. It could therefore be argued that the authorities use part of the seigniorage in the form of interest rate subsidies or transfers to ease the burden of these institutions.[17] While we have no figures for the Czech Republic, this certainly has not been the case in Hungary

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[16] The results reported by Hochreiter, Rovelli and Winckler (1996), using a different method of analysis from the one adopted in this section, confirm that transfers of seigniorage to the government were not significant in the Czech Republic. In fact they found that in 1993 this transfer was actually negative, as a result of the transformation of a direct credit extended by the Czech National Bank to the Treasury into standard government bonds, on which the government paid an interest rate above the money market rate. Nevertheless, as elsewhere in the paper, we suggest that publishing detailed and reliable balance sheet data should be an integral part of the transparency and accountability of any central bank.

[17] With respect to another country in transition (Romania), Hochreiter, Rovelli and Winckler (1996) found that financial institutions benefited up to 10% of GDP in transfers of seigniorage during 1993, when inflation was as high as 255%.

Table 3 (orizzontale)

and Poland. In Hungary financial institutions contributed to the generation of seigniorage (through the remuneration of reserve requirements at below market rates), and did not directly appropriate any of it.[18] The Polish authorities seem to have had on average a neutral role in this process.

5. Interpreting and taking care of seigniorage

As the brief survey of the literature in Section 2 shows, quite different measures of seigniorage have been proposed and empirically examined. In the context of the EITs – with their rapidly changing institutional and market environment – it is not surprising that different measures are being used in different empirical studies. Yet we believe, for the reasons given in Section 2, that the opportunity cost measure is to be preferred to others.

Having employed such a measure, how are we to interpret it? How can we identify both the proximate and ultimate causes of, say, a high level of seigniorage?

To examine the issue, we rewrite the basic definition of central bank seigniorage, equation 5, in a more disaggregated fashion, as follows:

$$S = (r_M + \pi)[Cu + (RB + RG + RO) + EK] + \\ - (i_{RB} RB + i_{RG} RG + i_{RO} RO) \qquad (11)$$

This is obtained by substituting into 5 all relevant definitions. From equation 11, we observe that a 'high' level of seigniorage results from some combination of 'high' levels of :

a) real interest rates, r_M;

[18] This does not imply that financial institutions cannot benefit from *indirect* transfers of seigniorage. For instance, the 'cleaning up' of some Hungarian banks before privatization, and also that of Postabank, took place by swapping sub-standard assets of these banks for specially issued government bonds. Moreover, it is also possible that part of the seigniorage from low-remunerated commercial bank deposits with the central bank was ultimately transferred back to the banking sector during this process of consolidation: however we could not find supporting evidence, since seigniorage – like money – is perfectly fungible.

b) inflation, p ;

c) deposits held with the central bank and earning no interest or an interest rate below market rates. These can be commercial bank reserves (*RB*, with $i_{RB} < r_M + \pi$), or government deposits (*RG*, with $i_{RG} < r_M + \pi$), or deposits from other entities (*RO*, with $i_{RO} < r_M + \pi$);

d) currency in circulation, *Cu*;

e) excess reserves, *EK*.

In practice, we have found that *d*) was not used instrumentally for the purpose of generating seigniorage, and *e*) was not relevant, except, to some extent, for Poland.

Czech Republic: in this country, the modest increase in seigniorage after 1993 is related to the increase in the monetary base, mostly due to the increase of bank reserve requirements (only partly offset by their increased remuneration) and also by the continuing high level of nominal (and real) interest rates, which has characterized the process of disinflation. With the accomplishment of this process, seigniorage has almost disappeared.

Hungary: in contrast, inflation was quite high in Hungary, which explains why this country generated on average more seigniorage than the other two countries. The critical years for Hungary appear to have been 1994-95. Since then, both the inflation rate and the ratio of monetary base to GDP have decreased, and so has seigniorage, which reached around 1% of GDP in the last three years of our sample. Also, although Hungarian government deposits with the central bank are quite high,[19] they do not generate seigniorage to the extent that they were remunerated at market rates; in fact, as we noted earlier, the government is a net beneficiary of seigniorage transfers from the central bank.

Poland has the lowest ratio of monetary base to GDP among the three countries. However, the accumulation of excess reserves (*EK*) proved appreciable, reaching (even according to the most tolerant definition of "reserves accumulated beyond 10% of total assets", which we have adopted here) almost 4.0% of GDP in 1998. Nevertheless, despite the increase in 1998, on the whole seigniorage was de-

[19] This is due to the fiscal agent function of the NBH.

creasing throughout the period, although not in the same proportion as the decrease in inflation. In particular the increase of 1998 must be attributed to the high level of real interest rates, due to a renewed attempt at curbing inflation: hence, in this particular circumstance, the (temporary) increase in seigniorage is more an indicator of central bank discipline than of monetary accommodation.

To conclude, we must comment on one finding which is peculiar to Hungary: the high level of seigniorage transfers to the government. From Table 3, row 1, we see that these reached up to 11.4% of GDP in 1995, although they gradually declined to 1.65% in 1999. Throughout the period examined, appropriations of seigniorage to the government exceeded the overall creation of seigniorage. In principle there may be two alternative explanations for this occurrence:

i) according to the first, seigniorage is the by-product of high inflation. Inflation itself is high as a result of past decisions and the perceived high costs of bringing it down. Both the government and the central bank would currently rather have a much lower rate of seigniorage and of inflation, but not at the cost of pursuing drastic deflationary policies which would impose high costs on the real sector of the economy. In this view, the government is an almost unwilling beneficiary of seigniorage.[20]

ii) Alternatively, seigniorage appropriated to the government is high because *a*) the budget deficit is high, *b*) the government is unwilling to raise taxes or lower expenditures, and *c*) does not want or cannot borrow on the domestic or foreign markets but *d*) is able to persuade the central bank to finance the deficit.

Do our data help to discriminate between these two interpretations? First we notice that, as mentioned above, transfers to the government were drastically reduced (as ratios to GDP), from 11.5% in 1995 to 1.65% in 1999. That is, they declined more than the overall reduction in seigniorage during the same period (from 7.4 to 1.1% – Table 3, last row). Moreover, if we analyze the different components of equation 7 for Hungary for 1999, we find that, out of a total 1.65%

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[20] This interpretation seems to be the one taken up by the monetary authorities. Various analyses of a descriptive or econometric nature point to a high degree of inflation inertia in Hungary for the period 1990-95. See for instance Hamecz, Vincze and Zsoldos (1996), Krzak (1996), Neményi (1997), Golinelli and Rovelli (2002).

of seigniorage appropriated to the government, 1.47% comes from claims of the central bank on the government (*BC*) being charged below the opportunity cost, which we measure at 14.7%.[21] On the whole, then, we conclude that the amount of seigniorage still benefiting the government is more a *legacy* of history and the slow decline in the rate of inflation than a *cause* of the current inflation rate.

As a final point, we believe that we have shown how analysis of the sources and appropriation of seigniorage can prove a useful tool in assessment of macro-financial stabilization policies. This analysis requires the availability of reliable statistics on the central banks' balance sheets and on their costs and revenues.[22] The development and publication of such data, and improvement in their quality, is therefore an important step towards increased transparency of central bank policies, which in itself is a necessary prerequisite for both independence and proper accountability.

6. Conclusions

In this paper we have analyzed the sources and the appropriation of seigniorage in the Czech Republic, Hungary and Poland from 1992 to 1999. Despite some caveats, we argue that the opportunity cost concept is the most reliable tool for this analysis, especially for economies well advanced along the path of establishing central bank independence[23] and well functioning domestic money markets. We note four main points concerning our findings and their implications:

1. In all three countries, seigniorage substantially declined in the observation period. It is now negligible in the Czech Republic, around

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[21] As we discuss in the Appendix, before the conversion in January 1997, the NBH had a large amount of so called 'zero stock', which was a zero yield loan to the Hungarian government with an unspecified maturity. The loan originated from the fact that the NBH held foreign debts denominated in foreign exchange in its books and then on-lent it to the government (budget) denominated in HUF at fixed rates.

[22] As noted in the Appendix, the *Annual Report* of the NBH provides the most detailed balance sheet and income statements.

[23] According to the ranking provided by Cukierman, Miller and Neyapti (2001), the central banks of the three countries during the 1990s had levels of legal independence comparable to, or higher than, those of the Deutsche Bundesbank in the 1980s.

1% of GDP in Hungary. Although it has increased to almost 4% of GDP in Poland, this is a temporary effect due to the attempt to reduce inflation during 1998 by increasing the level of domestic *real* rates of interest. Thus, in general, all our data indicate that monetary discipline and independence were strengthened during the period under examination.

2. In all the three countries, the decline in inflation rates (with the induced reduction in nominal interest rates) proved a powerful factor in the reduction of seigniorage. In Hungary the decline in the ratio of monetary base to GDP and the increase in the remuneration on minimum reserves also contributed to the observed reduction in seigniorage. Both these data point to the fact that the monetary framework in Hungary has gradually become more similar to that of the EU countries, and thus reinforce our previous comments about the strengthening of monetary discipline.

3. Although in Hungary we still measure substantial transfers of seigniorage to the government sector at the end of the observation period, we interpret this fact more as the consequence of past policies of debt financing than as an obstacle to completing the process of disinflation.

4. As seigniorage is successfully reduced towards low levels, say to a range around some 0.5% of GDP,[24] an interesting tradeoff might arise for the EU candidate countries. Once they adopt the euro, it could be that they forego more seigniorage than they might be entitled to on the basis of their (ECB) capital key. However, they would also benefit from a rapidly vanishing risk premium on domestic currency government bonds (and possibly also on their euro-denominated government bonds). The net effect – on the government budget as well as the economy as a whole – could well be positive.

Overall, our reconstruction of the evolution of seigniorage through time has shown how this has been related both to institutional changes and to monetary policy decisions. While the monetary

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[24] With inflation at 5%, real short-term interest rates at 3%, a currency-to-GDP ratio of 6% and fully remunerated reserve requirements, seigniorage according to the opportunity cost concept would be 0.48% of GDP. Incidentally, this back-of-the-envelope calculation conforms quite well with the empirical results for the EU countries obtained by Hochreiter (1999).

policy strategies adopted during recent history in the three countries examined in our study have substantially differed,[25] analysis of seigniorage (our sole concern in this paper) reveals how successful they have all been in adopting an institutional framework of relations between the central bank and the government, which is both a necessary guarantee for enduring monetary discipline and a requirement for admission into the European monetary union.

APPENDIX

The data

A.1. Assets and liabilities

The analysis is based on data of the balance sheet and profit and loss account of the central banks of Poland, Hungary and the Czech Republic.

For each country the data are in domestic currency.

The average amount of stock within the year was proxied by taking geometric averages between beginning and end of period data.

Balance sheet data were processed according to the following criteria:

1) FA are total assets due from abroad. This generally includes foreign exchange (foreign currency, securities and placements at foreign banks) and also contributions to the IMF and the World Bank. These data are not available from the balance sheet of the Czech National Bank.

2) BC are claims on the general government. In the case of Hungary it includes state debt due to forint valuation changes.

3) LC includes all claims on the banking sector.

4) AC are claims on other agencies.

5) RB are the deposits of financial institutions with the central bank, including required reserves. For Poland, we included also NBP securities used for open market operations.

6) RG are the liabilities toward the general government, including central government deposits, local government deposits and deposits of special assistance funds (occasionally the latter may also be classified in some official publications as deposits from other sectors).

[25] See Golinelli and Rovelli (2001) for a comparative analysis of monetary policy strategies, transmission and outcomes in the three countries.

7) RO is the total amount of deposits of other institutions, short and long term. In the case of Poland, we have included all such deposits as government deposits.

8) EK (for Poland only) represents central bank reserves accumulated beyond 10% of total assets.

9) K indicates capital plus reserves. For Poland, we have indicated the amount of reserves separately from capital. We have defined as reserves of the NBP all the items listed under "Other liabilities and reserves" (Table 31 of the *Annual Report* for 1996).

10) FL + IMF are all liabilities due to foreign institutions. These data are not available from the balance sheet of the Czech National Bank.

11) ODL is a residual item including all other domestic liabilities.

A.2. Seigniorage earning liabilities

For the purpose of calculating seigniorage, we have defined the monetary base as the sum of currency and all short-term domestic liabilities of the central bank (inclusive, for Poland, money market bills issued by the NBP). Although this does not correspond to a textbook definition of the monetary base (as it is sometimes defined in relation to the calculation of the deposit multiplier for the banking system), it is nevertheless the appropriate definition in our context, as it includes all liabilities of the central bank which are potentially convertible, at short notice, into reserve assets for the banking system. Moreover, as the interest cost of such liabilities is deducted from the calculation of seigniorage, these liabilities increase the measured amount of seigniorage only to the extent that they are remunerated below the opportunity cost, which corresponds precisely to our definition of central bank seigniorage.

A.3. Opportunity cost

For Poland and the Czech Republic, the opportunity cost (i_M) is measured by the average annual rate on three month deposits in the interbank market; for Hungary we use the average annual rate on three month discounted Treasury Bills. It is possible that, at the beginning of the period, the concept of an opportunity cost might have had little operational significance, due to the imperfection of money markets; nevertheless, to the extent that our measure of an opportunity cost identifies the equilibrium level of a (possible virtual) money market rate, it is also the correct measure to be used in the context of seigniorage. In addition, we have also provided an alternative measure of seigniorage using the average rate of CPI inflation in place of an interest rate. The two measures obtained using respectively i_M and π are in general close to each other.

A.4. Other interest rates and transfers of seigniorage

(See first the discussion of the alternative methods of measuring seigniorage appropriations in Section 4). We have used the income statement (profit and loss account) of the central banks to obtain data on total interest paid to and received from the general government, financial institutions and non-residents.

In particular, for *Hungary* we have assumed that all interest revenues of the NBH in foreign currency from residents (*Annual Report*, Annex E/2, panel XII.A) could be attributed to the government. Note also that the explosion of interest paid to the government from 1995 to 1996 (from 17.6 to 85.9 billion HUF) is offset by an extraordinary budget allocation to the NBH of 58.1 billion HUF. In order to explain why transfer of seigniorage via interest payments to the general government are so important, it must be noted that on part of the state debt outstanding against the central bank the government does not pay any interest. This debt arose as a consequence of the devaluation of the forint.

> "In the 1970s and 1980s, the National Bank of Hungary took out foreign loans to finance the deficits of the general government. That is to say, the forint borrowing of the National Bank until 1990 can be interpreted as the debt of the state budget" (NBH, *Annual Report*, 1993, p. 65n).

The debt of the state towards the NBH was denominated in HUF and at fixed interest rates. Hence:

> "As the interest on the state debt generated before December 31, 1990 does not cover the losses arising from the devaluation of the national currency, the loss is accounted for in the balance sheet of the central bank as the increment of a special zero-interest state debt. Technically, this is executed so that the National Bank debits the budget with the amount, whereby the forint amount of its foreign debt increase owing to the official devaluations of the forint" (*ibid*.).

In other words, whenever the HUF was devaluated, the NBH created an additional stock of so-called 'zero stock' debt. This debt, amounting to 30.8% of GDP in 1992, 33.4% in 1993 and 26.4% in 1994, accounts for about one half of the entire state debt with the central bank.

> "The modification of the Central Bank Act regulated the transformation of the non-interest bearing and indefinite-term state debt into governments bonds from 1994 on. As a result, 5% of the budget debt due to the devaluations of the forint was transformed into government bonds with market interest rate, considering that the net foreign exchange debt did not decrease" (NBH, *Annual Report*, 1994, p. 144).

This implies that S^G should decrease after 1995, as it has been the case. Finally, in 1997, almost 2 billion HUF claims on central government have been transformed from forint assets of the central bank into foreign currency assets, basically matching the existing liabilities of the NBH in terms of both currency and maturity.

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