

Seigniorage, Electronic Money and Financial Independence of Central Banks *

JOHANNES M. GROENEVELD and AD VISSER

1. Introduction

In recent years, the subject of seigniorage, the revenues deriving from the monetary monopoly, has attracted renewed attention of academics as well as policy-makers. There are several reasons for this increasing interest. First, the move to European Monetary Union (EMU), foreseen to happen in 1999, will entail the replacement of several national currencies by a single currency: the euro. The introduction of the euro implies that the revenues stemming from the monopoly of the creation of base money will, in the first instance, no longer flow to the national central banks but to the European Central Bank (ECB). In the second instance, seigniorage revenues will be redistributed among participating national central banks. Recently, the transition to EMU has inspired several economists to study seigniorage and its consequences for fiscal policy.¹

Second, in recent years, several new payment instruments have been developed and introduced which may bear significantly upon the amount of banknotes and coin in circulation. Particularly interesting in this respect are so-called electronic money products. We use the term electronic money for products with an information carrier,

□ De Nederlandsche Bank, Monetary and Economic Policy Department, Amsterdam (The Netherlands).

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¹ See, for example, Daniels and van Hoose (1996) and Gros (1993).

e.g. a microchip or a computer hard disk, containing prepaid value to be used as a multipurpose means of payment. This definition covers prepaid cards (electronic purses) as well as software products that use computer networks such as Internet (digital cash). Since electronic money is an attractive and efficient payment instrument for the issuer as well as for consumers and retailers, it will presumably at least partly replace notes and coin used for transaction purposes. A decrease in the amount of notes in circulation would result in an accompanying decrease in seigniorage revenues.

This article focuses on the implications of a large scale introduction of electronic money products on the seigniorage revenues and financial independence of central banks in the group of G10 countries.² In this respect, our research is one of the first studies dealing with the issues of electronic money, seigniorage and central bank financial independence simultaneously. On the basis of central bank balance sheet figures, we explore past developments in seigniorage revenues and estimate the revenue losses that may occur if the amounts of banknotes in circulation drop substantially. By confronting these calculations with the operating expenses of central banks, we obtain some insights in the potential financial "threat" that may occur from a widespread use of electronic money. In an extreme scenario, it is conceivable that the central banks' revenues no longer suffice to cover its operational expenses. A central bank not capable of supporting itself becomes financially dependent on its only or major owner: the government. It may be argued that, at least in principle, a loss of financial independence makes central banks more vulnerable to political pressures to run a monetary policy that jeopardizes the achievement of price stability. Such a development could also ultimately lead to the reversal of the process of greater operational and political central bank independence, which has been apparent in most of the G10 countries and has attracted much attention in the literature in the past few years.³

Drazen (1985) notes that if one studies the subject of seigniorage it is important to distinguish the government's role as a taxing authority from its role as a monopolistic producer of base money.

² As a matter of fact, the group of G10 countries consists of 11 members: Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the UK and the US.

³ Cukierman (1992) and Eijffinger and de Haan (1996) provide an excellent overview of the literature on central bank independence.

Implicitly, this view considers the government and the central bank on a consolidated basis. We feel, however, that this view does not correspond with the current institutional, operational and legal situation in the G10 countries. In this connection, we agree with Klein and Neumann (1990), who assert that the latter aspects should largely determine which approach for studying the amount of seigniorage revenues and its distribution is appropriate. In case of Western countries, one should therefore treat the government and the central bank as separate bodies. Nowadays, most governments have granted the exploitation of the monopoly of base money creation (except coins) to the central bank. Moreover, in an increasing number of countries, including several G10 countries, the central bank has become quite independent from the government. In several countries, this independence is reflected in a legal prohibition for the central bank to extend credit to the public authorities or to purchase debt instruments directly from them. In this respect, Article 104 of the Maastricht Treaty is particularly important for the EU member states.

Against these backgrounds, it is not realistic to assume that G10 countries' governments make a trade off between financing via taxes or debt issuance on the one hand and via base money creation on the other. On the contrary, their attitude is more passive in this respect. Initially, seigniorage revenues accrue to the central bank. Subsequently, these revenues are transferred to the national Treasuries in the form of dividend payments to the government, its only or major shareholder. Moreover, because of legal or other regulations and traditions, the central bank's dividend payments often differ from its seigniorage revenues. For example, in several countries, mechanisms are in operation to smooth the stream of dividend payments over the years, in order to decrease government's budgetary uncertainties. In the choice of our empirical concept of seigniorage, all these considerations will be taken into account.

The remainder of this article is organised as follows. In Section 2, we briefly discuss two concepts of seigniorage, that are proposed in the literature. In subsequent Sections, we present the results of our empirical research. To put the analysis in a medium term perspective, we first pay attention to the evolution of seigniorage in the G10 countries in the past fifteen years (Subsection 3.1). This investigation may give indications for the potential consequences of electronic money on central banks' revenues. This approach is also helpful in determining the impact of a large reduction in cash in circulation in

each country. Indeed, there are no *a priori* reasons to expect that each central bank will suffer an equal loss of seigniorage as a result of the issuance of electronic money. In Subsection 3.2, we look at the operating expenses of central banks since 1980. Thereafter, we relate the revenues from seigniorage to the operational costs. This exercise enables us to identify the thresholds below which seigniorage does not fully compensate for these expenditures (Section 4). Section 5 presents some options to neutralize the potential losses of seigniorage in order to keep central banks financially independent from the government. The final Section contains a brief summary.

2. Different concepts of seigniorage

In the literature, several concepts are used to measure the size of seigniorage (S). In this Section, we briefly discuss two different measures. The first, and most commonly used concept is simply the change in the amount of base money (M):

$$S1 = \Delta M \quad (1)$$

This concept measures the amount of goods and services the government obtains in exchange for the issuance of new base money. Here, it is assumed that the costs of base money creation are nil. Since, by definition, goods and services bought by the central bank are paid for by the issuance of base money, they can, in effect, be considered "for free". It could be argued that concept (1) is not a real measure of seigniorage because the goods and services are obtained in exchange for a claim on the central bank. However, as this claim is the only legal tender in most countries, i.e. the ultimate non-redeemable means to settle debts, the central bank's earnings from (1) can indeed be considered as seigniorage.⁴ Nonetheless, in our empiri-

⁴ This reasoning is based on the assumption that monetary financing by the central bank and/or government does not happen at so large a scale that it leads to hyperinflation. Under such circumstances, it is likely that the public will no longer accept (base) money as a means of payment and that it, for instance, will switch to another currency. Then, of course, the position of the government and the central bank and their ability to raise seigniorage revenues would be severely damaged.

cal research in the next Sections, we have chosen not to use this concept. This decision is based on the fact that, as van Ewijk and Scholtens (1992) note, concept (1) mirrors the situation in which government expenditures are financed by the issuance of base money. This strand of literature concentrates on the trade off between financing via taxes or debt issuance on the one hand and money creation on the other.⁵ As explained in the introduction, this notion is fairly unrealistic under present institutional circumstances in the G10 countries. In these countries, the government is not able to influence the amount of base money to be issued (except coins). This is not to deny, of course, that the issuance of base money entails seigniorage revenues as measured by (1). However, those revenues accrue directly to the central bank rather than to the government. Concept (1) thus seems more useful in research devoted to countries where the central bank is less independent from the government, so that it is appropriate to view the two entities on a consolidated basis.⁶

The second concept focuses on the revenues ensuing from the amount of outstanding base money:

$$S2 = rM \quad (2)$$

In this setup, r is a measure of the (foregone) return on base money. It is assumed that the central bank pays no interest on base money. Actually, concept (2) can be viewed from three different angles: the private sector's, the central bank's and the government's. In the eyes of the private sector, concept (2) measures its foregone interest earnings from holding base money instead of interest-bearing financial assets. In this view, the appropriate interest rate would be the average return on the private sector's alternative financial assets. From the central bank's perspective, concept (2) represents its revenues deriving from interest-bearing assets that are financed by the issuance of non-interest-bearing base money. In this approach, the average return on these assets would be the appropriate interest rate. For the government, concept (2) represents its savings from financing its expenses by issuing base money instead of interest-bearing debt. Here, the amount of outstanding base money is seen as a zero interest

⁵ See, for example, Gros (1989) for empirical research using this concept. In order to study seigniorage in real terms, (1) is often deflated by the general price level.

⁶ See, for example, de Haan, Zelhorst and Roukens (1993).

loan to the government, so that the interest rate on government bonds would be the appropriate interest rate. It may be noted that the latter approach, in effect, implicitly considers the government and the central bank as one entity.

Our empirical research in the next Sections concurs with concept (2). More specifically, the framework of our research and the current institutional circumstances in G10 countries make the second interpretation of concept (2) – in theory – the most valid one. Ideally, r should thus reflect the central bank's average return on the interest-bearing assets that are financed by the issuance of non-interest-bearing base money. This interpretation is preferred because it approximates the actual revenues for the central bank best. In order to assess the potential influence of electronic money on central bank financial independence, we are mainly interested in the central bank revenues, not in the private sector's foregone interest earnings (first view), nor in the government's interest savings (third view). In practice, it is, however, extremely difficult to determine which central bank assets are financed by base money and generate seigniorage. Indeed, a substantial part of central bank assets is financed by non-base-money liabilities, e.g. liquidity paper or share capital and (different types of) reserves. Since the precise appropriation of base money is not reported by most central banks, the seigniorage revenues based on the theoretically preferred second interpretation of concept (2) are simply unknown.⁷ Because of this, a proxy for the average return on central bank assets financed by base money has to be selected. In our empirical work, the interest rate on government bonds is used as proxy.⁸ This means that, despite our preference for the second interpretation, we actually use the third.

In our calculations, we use a modified version of concept (2). The commercial banks' reserves with the central bank are excluded from our computations of seigniorage. We measure seigniorage by multiplying the amount of banknotes and coin in circulation by r . The reason for ignoring the former component of base money has to do

⁷ The Bank of England is an exception in this respect. Its overall balance sheet is divided in two different balance sheets: that of the Issue Department and that of the Banking Department. On its liabilities side, the former only contains banknotes in circulation. The proceeds of the corresponding assets are considered the bank's seigniorage and are completely transferred to the Treasury.

⁸ It should be noted that this rate will probably overestimate the yield on the central bank financial assets to some extent. For instance, central banks are confronted with limitations regarding the liquidity of their assets.

with the fact that the reaction of central banks on the increase of bank reserves caused by a decline in the amount of banknotes in circulation, possible due to an increased use of electronic money, is uncertain. Initially, a reduction in the amount of currency outstanding leads to a similar increase in the amount of bank reserves, leaving the total value of base money unchanged. In other words, a shift from notes and coin to electronic money is reflected in a shift from banknotes to banks' reserves on the central bank balance sheet and does not affect seigniorage according to both concepts (1) and (2). It is expected, however, that the central bank will take action if the amount of commercial bank reserves rises substantially. If no interest is paid on banks' reserves, they entail a significant tax for the banking system.⁹ Therefore, the central bank would probably react in some manner, e.g. by paying interest on reserves or by issuing interest-bearing liquidity paper. These "second order effects" of a drop in notes and coin in circulation would lead to a decrease in seigniorage revenues. If one takes account of the possibility of interest payments on bank reserves, concept (2) can be reformulated as follows:

$$(2') \quad S2' = rBN + (r - r_{br}) BR$$

In (2'), BN denotes banknotes and coin in circulation and BR stands for bank reserves. BN and BR add up to M . The rate of interest paid on bank reserves is represented by r_{br} . As argued, a replacement of banknotes and coin will lead to a decline in rBN and an equal increase in $(r - r_{br})BR$. By focusing on the former term, our calculations provide an insight in the central bank revenues deriving from its monopoly of banknote issuance. These are the revenues that central banks stand to lose if banknotes and coin disappear. The latter part of the equation represents the revenues stemming from the central bank's monopoly of bank reserve creation. In order to compensate for seigniorage losses, central banks could make some adjustments in this area. This topic is discussed further in Section 5.

⁹ Provided that electronic money is issued by commercial banks only and that no interest is paid on electronic balances, the banking system as a whole is fully compensated for this tax by the revenues it earns on its 'electronic money in circulation'.

3. Seigniorage and the operating expenses of central banks in a historical perspective

It is often argued that the increased sophistication of the payments system technology in the past decades has already led to a considerable decline in the volume of notes and coin in circulation in relative terms. Hence, this process is generally considered to be a prominent factor influencing the demand for liquid monetary claims. Electronic money can be considered a new factor in this ongoing process. In Subsection 3.1, we verify whether this impression is true. We present some comparative and tentative estimates of the evolution of currency and seigniorage since 1980 for the G10 countries. This analysis could provide useful insights for assessing the potential effects of the issuance of electronic money on seigniorage.

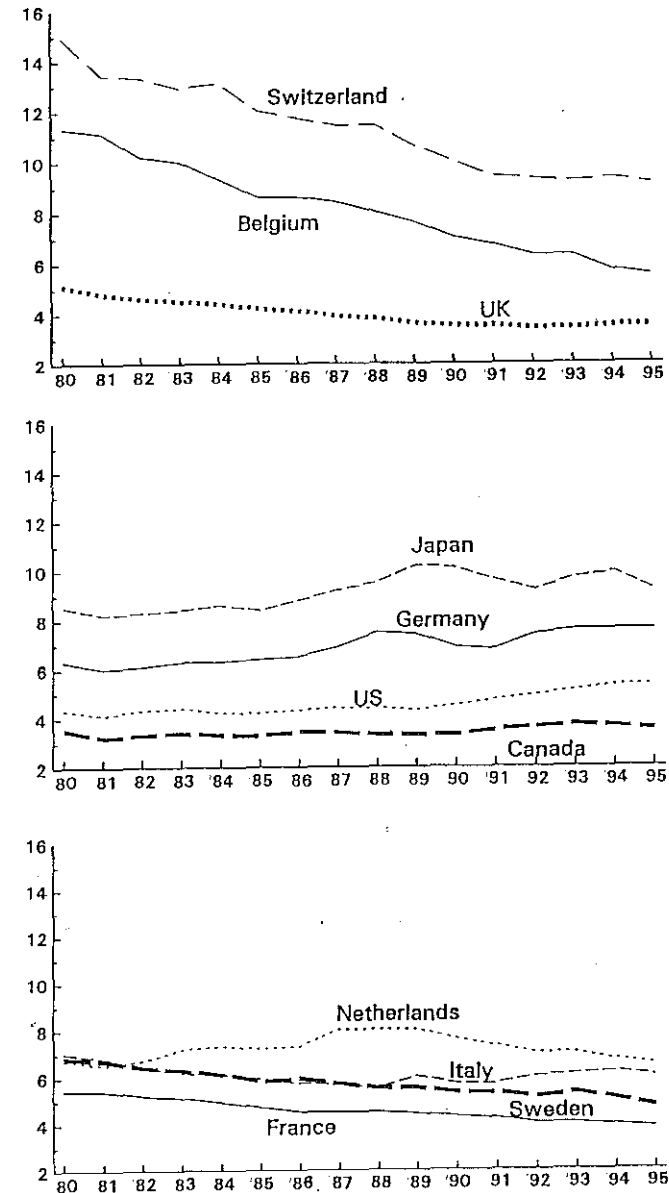
Before turning to the empirics, it should be stressed that the estimates for central bank revenues as well as expenditures are traditionally surrounded by some uncertainty. This holds in particular for the operational expenditures of central banks due to difficulties in collecting uniformly defined figures (see Subsection 3.2). Like most previous studies, the computations are thus based on a number of simplifying assumptions. We shall also confine ourselves to extracting general trends, since differences between individual countries are often attributable to many country-specific factors.

3.1. Seigniorage

As regards currency, we have used end of year data included in the BIS-databank or published in the annual reports of central banks. For the sake of comparability, we have added the amounts of notes and coin outstanding, although we are aware of the fact that coin and some small-denomination banknotes may be issued directly by the Treasury in some countries. Chart 1 displays the development of currency relative to nominal GDP since 1980.

CHART 1

CURRENCY AS A PERCENTAGE OF GDP



Some interesting things emerge from this picture. First, the ratios do not move in the same direction. Since the early 1980s, six countries experienced a gradual decline in notes and coin in circulation relative to GDP (Belgium, France, Italy, Sweden, Switzerland, and the UK). In this respect, it is interesting to note that, since 1980, the amount of currency in circulation in absolute terms has not dropped in any of the G10 countries. Canada and, to a lesser extent, the Netherlands are the only countries where currency as a percentage of nominal GDP has – on balance – remained virtually constant. Three countries are faced with a modest rise in the currency to GDP ratio. It is worth noting that the latter category only comprises relatively large countries like the United States, Germany and Japan. For the United States, Porter and Judson (1996) fully attribute this phenomenon to the growth in foreign demand for US currency. On average over the 1990s, the overseas stock has been expanding by about three times the growth rate of the domestic stock. As usual, episodes of economic and political turmoil also appear to have been the catalyst for the recent surge of dollars circulating abroad. Especially, Latin America and the former Soviet Union have received large inflows of dollars in the 1990s.¹⁰ Nowadays, between 55 and 70% of the US currency stock is estimated to be located outside the United States. In the case of Germany, research at the Bundesbank indicates that the German mark is increasingly used as a unit of account, a medium of exchange, and a store of value in countries where the purchasing power of the domestic currency is uncertain (Seitz 1995). The volume of German currency outside Germany is estimated to amount to about 30 and 40% of the total value of German banknotes and coin in circulation.

A second observation from this Chart is that the levels of the ratios vary considerably across countries. These differences can be partly explained by divergencies in the principal determinants of currency holdings, i.e. interest rates, inflation and spending (Porter and Judson 1996). Other important factors underlying these cross-country differences include discrepancies in the relative size of large-denomination banknotes in the total value of banknotes and coin outstanding, the availability of automatic teller machines as well as

¹⁰ The use of foreign currencies in these parts of the world is encouraged by chronic high domestic inflation, confiscatory currency reforms and the underdevelopment of the banking sector. These forces are treated in detail in Heymann and Leijonhufvud (1995) and Végh (1992).

differences in payment systems and practices. In 1995, the dispersion between the highest and lowest ratio amounted to approximately 5.5 percentage points. The ratios are highest for notes and coin denominated in Japanese yen, Swiss francs, German marks and Dutch guilders, respectively. This can probably be ascribed to the relatively high purchasing power associated with the largest denominations in these countries (with the exception of Japan), all of which are worth more than 500 US dollars. Indeed, this category of banknotes is mostly used for hoarding currency. Moreover, the countries involved have a tradition of moderate inflation and interest rates, which keeps the opportunity costs of holding cash money relatively low. On the other hand, the currency-to-GDP ratios for Canada and the United States were already quite low in 1980. This can be ascribed to the presence of numerous alternative, and widely accepted, means of payments which minimize the need for currency, that does not pay interest.

In determining the effects of changes in currency in circulation on central banks' seigniorage revenues, we have made some simplifying assumptions. As argued in the previous Section, we have chosen to measure the central banks' seigniorage by multiplying the total stock of banknotes and coin by the average long-term interest rate on 10-year government bonds. This interest rate is used as a proxy for the average return on central bank assets financed by base money. Moreover, we have not taken account of the costs of producing, distributing and withdrawing banknotes and coin due to lack of data. Hence, the computations presented below give an indication of gross seigniorage.

Table 1 records our tentative estimations of the nominal amounts of seigniorage expressed in percentages of nominal GDP for four years. Several noteworthy observations can be inferred from this Table. Over the full sample, one can conclude that the revenues from seigniorage exhibit a clear downward trend in most instances. However, the overall drop in seigniorage revenues differs widely across the G10 countries. The reduction varies from zero to sixty percentage points since 1980. Classifying the countries by the size of the decrease, we have Belgium, Italy, France and the United Kingdom.

SEIGNIORAGE AS A PERCENTAGE OF NOMINAL GDP

TABLE 1

	1980	1985	1990	1994
Belgium	1.35	0.92	0.70	0.44
Canada	0.44	0.37	0.35	0.31
France	0.71	0.52	0.43	0.28
Germany ^a	0.53	0.44	0.60	0.52
Italy	1.06	0.81	0.68	0.65
Japan	0.75	0.55	0.75	0.42
Netherlands	0.68	0.53	0.68	0.46
Sweden	0.80	0.76	0.70	0.48
Switzerland	0.90	0.71	0.63	0.45
United Kingdom	0.70	0.44	0.41	0.28
United States	0.50	0.45	0.38	0.38
Weighted average ratio ^b	0.64	0.50	0.53	0.41

^a The German data are adjusted for breaks in the time series caused by German unification. To this end, we have multiplied the stock of cash denominated in West-German marks before unification by the ratio of the total amount of German marks to the volume of banknotes and coin in circulation denominated in West-German marks in 1991

^b The weights are the shares of nominal GDP in individual countries in the aggregated GDP computed with average actual exchange rates against the dollar.

When looking more closely at the time path of seigniorage, it is apparent that seigniorage reached its highest value in the early 1980s, partly because of relatively high interest rates. Since then, seigniorage steadily dropped due to both the decline in long-term interest rates and the decrease in the currency-to-GDP-ratio. Around 1990, revenues from seigniorage have temporarily reverted to the levels reached in the beginning of the sample in case of the Netherlands, Germany and Japan in particular. The rise in interest rates is largely responsible for this. Not surprisingly, the decrease in seigniorage observations can be inferred from this Table. Over the full sample, one can conclude that the revenues from seigniorage exhibit a clear downward trend in most instances. However, the overall drop in seigniorage revenues differs widely across the G10 countries. The reduction varies from zero to sixty percentage points since 1980. Classifying the countries by the size of the decrease, we have Belgium, Italy, France and the United Kingdom.

3.2. Operating expenses

In this Subsection, we report estimates of the operational expenses of central banks. The relevant data are collected from income statements published by the respective central banks in their annual reports.¹¹ Generally speaking, the expenses comprise costs associated with salaries, pensions, premises, printing, publications, banknote circulation, information, communication, depreciation of buildings, and "other materials". Table 2 documents the results of our computational exercise.

OPERATING EXPENSES^a AS A PERCENTAGE OF NOMINAL GDP

TABLE 2

	1980	1985	1990	1994
Belgium	0.26	0.23	0.18	0.17
Canada	0.03	0.03	0.03	0.03
France	0.14	0.14	0.12	0.13
Germany ^b	0.09	0.07	0.09	0.07
Italy	0.06	0.08	0.06	0.06
Japan	0.08	0.11	0.12	0.06
Netherlands	0.06	0.06	0.06	0.06
Sweden	0.04	0.04	0.05	0.04
Switzerland	0.05	0.04	0.05	0.05
United Kingdom	0.04	0.03	0.03	0.03
United States	0.03	0.03	0.02	0.03
Weighted average ratio ^c	0.06	0.06	0.06	0.05

^a Excluding interest costs and revaluations of currency reserves and investments.

^b The German data are adjusted for breaks in the time series caused by German unification.

^c The weights are the shares of nominal GDP in individual countries in the aggregate GDP computed with average actual exchange rates against the dollar.

The results justify the conclusion that large variations across central banks in the cost ratios exist. This is due to differences in the organisation, operational structures and tasks of central banks. Regarding the first factor, the degree of centralisation of central banks' activities seems to play an important role. For instance, some central banks have many branches throughout the country that take care of collecting, sorting and distributing banknotes, whereas these actions

¹¹ The comparability of the figures may be hampered somewhat by the fact that the valuation and reporting techniques differ across countries. The effects of revaluations of currency reserves and investments have been ignored if possible.

are more centralized in other central banks. Variations in the ratios also ensue from the fact that some central banks are charged with banking supervision, whereas this job is delegated to a public institution (e.g. the Ministry for finance) in other countries. Furthermore, some central banks also compile a wide range of national statistics as opposed to countries where this task is predominantly carried out by national statistical offices.

In 1994, the ratios vary between 0.03 (the US, the UK and Canada) and 0.17 (Belgium). For most other countries, the value of the ratio is located in the lower part of this range. The weighted average ratio amounts to 0.05. Compared to the seigniorage ratios, the cost ratios have not been subject to substantial changes. Remarkable exceptions in this respect are Belgium and Japan. The Belgian central bank has cut its expenditures by about 10 percentage points since 1980. On the other hand, the costs of the Bank of Japan fluctuate fiercely. Large swings in the donations to its pension fund appear to be one of the main reasons for the erratic pattern of expenditures.

4. Substitution of currency by electronic money and financial independence

After having briefly sketched the evolution of seigniorage and operating expenses of central banks in the past fifteen years, we now turn to the implications of a further reduction in seigniorage due to increased use of electronic money (henceforth e-money) on the financial status of central banks. However, before these interrelated issues can be tackled, assumptions have to be made regarding the extent to which e-money is likely to spread. Above all, this seems to depend on the willingness of the public to use e-money. Key factors in this respect are the fees charged by the suppliers, its perceived security – including arrangements for dealing with loss, robbery, fraud and counterfeiting – and the general acceptability of e-money as a medium of payment, among other things. Boeschoten and Hebbink (1996) also point to the distinction between the part of cash balances used for transaction purposes and the part used for currency hoardings. They assert that in the foreseeable future it is more likely that

e-money will mainly replace cash as a medium of exchange. In the longer run, its use could be boosted if new technologies offer a safe and anonymous electronic store of value, possibly bearing interest. By that time, it would be more efficient to switch the currency hoardings to electronic balances. Apart from the behaviour of the final users, the willingness of merchants to participate in these e-money schemes also plays an important role. Here, the size and nature of charges imposed on them by the providers are important determinants. These costs have, however, to be weighted against the savings from having less cash in terms of lower costs imposed by financial institutions for handling cash and the reduced risk of theft. From the viewpoint of the issuers, important aspects affecting their efforts to develop or improve different forms of e-money concern the desired level of regulation by the authorities in this field¹² and the potential profits ensuing from the issuance of e-money. Actually, the potential revenue to issuers comes from fees on final users and merchants, savings from reduced currency handling, and the difference between the interest revenue from investing the outstanding float and the possible interest payments to holders of e-money.

The factors just mentioned imply that it is hard to predict the speed and magnitude of the spread of e-money. In this light, we shall consider two different scenarios. In the first variant, we simply combine the results obtained from the previous Sections to quantify the thresholds below which seigniorage does not make up for all operating expenses anymore. In the second scenario, we repeat this exercise using the nominal interest rates prevailing in November 1996 and the balance sheet figures of 1994. This way, we obtain some insight in the sensitivity of the results to changes in interest rates. Indeed, long-term interest rates have declined to a considerable extent in the past two years in the G10 countries. For the EU countries, these rates have also converged towards the German level in the run-up to EMU.

Merging the evidence from Tables 1 and 2, it is obvious that total expenses are just a small fraction of seigniorage. This means that the amounts of currency outstanding will have to fall dramatically before the “break-even point” is reached. The aforementioned thre-

¹² In 1994, the central banks of the EU countries concluded that only credit institutions should be allowed to issue electronic purses (see EMI 1994).

holds are identified in column E of Table 3, where 1994 has been chosen as the benchmark year. The estimates demonstrate that some countries are much further away from the break-even point than others. The countries thus do not start from the same initial position. France and Belgium are most closely to their thresholds. In these countries, the operating expenses will be matched by seigniorage if the amount of cash in circulation as a percentage of GDP drops by about 55%. The largest gap between seigniorage and expenses exists in the United States. It should be noted, however, that a significant drop in cash in circulation will probably lead to a fall in operating expenses related to the printing and distribution of banknotes as well. The precise size of this potential windfall cannot be calculated.

TABLE 3

EFFECTS OF A REDUCTION IN CURRENCY CIRCULATION ON SEIGNIORAGE: TWO SCENARIOS^a

	Long-term interest rate		Currency 1994 C	Costs 1994 D	Cash ^b	
	1994	1996			1994	1996
	A	B			E	F
Belgium	7.8	6.0	5.7	0.17	2.1 (-62%)	2.8 (-50%)
Canada	8.6	6.1	3.6	0.03	0.3 (-91%)	0.5 (-86%)
France	7.2	5.8	3.9	0.13	1.8 (-54%)	2.2 (-43%)
Germany	6.8	5.9	7.6	0.07	1.1 (-86%)	1.2 (-84%)
Italy	10.5	7.7	6.2	0.06	0.6 (-91%)	0.8 (-87%)
Japan	4.2	2.6	9.9	0.06	1.5 (-85%)	2.4 (-77%)
Netherlands	6.9	5.8	6.7	0.06	0.8 (-87%)	1.0 (-85%)
Sweden	9.6	7.2	5.0	0.04	0.4 (-92%)	0.6 (-89%)
Switzerland	5.0	3.9	9.0	0.05	1.1 (-88%)	1.4 (-86%)
United Kingdom	8.0	7.6	3.5	0.03	0.4 (-89%)	0.4 (-89%)
United States	7.1	6.2	5.3	0.03	0.4 (-93%)	0.4 (-91%)

^a The figures in columns C to F are expressed in percentage of nominal GDP.

^b The figures in columns E and F represent the level of currency in circulation which generates just enough seigniorage to cover all expenses. Column E reports the calculations based on interest rates presented in column A, whereas the estimations in column F are based on the average long-term interest rates in November 1996 (column B). The figures in parentheses denote the implied decline of currency outstanding in terms of percentages compared to 1994.

The results with the average long-term interest rates in November 1996 are recorded in column F. Although interest rates in countries belonging to the European Union have converged towards substantially lower levels in the past two years, the calculations do not differ significantly from those reported in column E. Hence, the

financial independence of EU central banks does not seem to be threatened seriously by lower interest rates caused by the necessary nominal convergence process preceding the formation of EMU. One can only observe clearly higher thresholds in the case of Belgium and France. Outside the European Union, Japan is faced with the largest rise in its break-even point.

In the scenarios considered, no problems arise concerning the financing of the expenses in the near future. All central banks remain able to maintain their independent financial position and do not have to tap new sources of revenues. In the more distant future, it is conceivable that the amounts of banknotes and coin in circulation decline significantly, e.g. by 30-40%, due to the spread of e-money. Under such circumstances, the French and Belgian central banks are the first to approach the 'danger zone' where expenses outstrip revenues. They will then have to find solutions for maintaining their budgetary independence. This can be achieved by trimming the expenses to the levels attained in the other G10 countries or by taking actions to obtain additional revenues.¹³ However, it is difficult to predict whether the introduction of the euro requires a reformulation of this conclusion, provided that Belgium and France participate in EMU from the outset. Eventually, the outcome depends on numerous factors, e.g. on how the monetary income of the ECB will be calculated and distributed among participating central banks.

5. Options to compensate for losses of seigniorage

In the previous Section, it was established that central banks' operating expenses would only surpass the revenues from seigniorage if currency in circulation is substantially squeezed as a result of a widespread use of e-money. In this situation, central banks have, however, various options to offset these potential losses at their disposal. At this point, it is important to note that the issuance of e-money is by no means the only threat to central bank revenues and financial independence. As discussed earlier, the introduction of cheques, debit and credit cards already reduced the currency to GDP ratio considerably in most countries in the past decade.

¹³ We shall return to this issue in more detail in Section 5.

A way of maintaining enough seigniorage to cover expenses could imply that central banks impose reserve requirements on e-money, provided that these requirements are not remunerated. Before issuers of electronic liabilities can be subjected to reserve requirements, proper operating procedures must be established. For instance, these institutions have to report the volume of e-money outstanding. This may be difficult in the case of the issuance of e-money by non-banks or by foreign institutions via computer networks like Internet. Actually, the imposition of reserve requirements comes down to transferring the seigniorage profits from the private sector back to central banks. This approach could reduce the incentive to develop e-money and could thus imply a setback in the overall efficiency of payments systems. Indeed, in this constellation the promotion of new payments technologies could lose some credibility.

The second option to neutralize these potential losses is to restrict the issuance of e-money to central banks or to make central banks a competing issuer. In this respect, the associated question arises whether the central bank would use its own network or a network developed and operated by private issuers. At first sight, one could say that the arguments for and against the central bank as (monopoly) issuer of e-money seem fairly similar to those put forward in the discussion related to the monopoly issuance of banknotes. These motives include the importance of certainty and legal tender as properties of currency, the costs to the public of assessing the quality of competing notes, and the economies of scale in issuance. In fact, these arguments are less relevant for e-money. Making the central bank the sole issuer of e-money is much less convincing in a world where a large fraction of wealth holding and a large proportion of assets held for transactions purposes are already in the form of claims on private banks. Furthermore, the economies of scale involved in issuing e-money seem to be much smaller, so that a natural monopoly would not emerge anyway. Moreover, if central banks have permitted other issuers to enter and develop the market for e-money and if the marketing efforts of commercial institutions have already led to a considerable elimination of cash balances by e-money, it is difficult to turn back the clock.

If currency in circulation largely disappears, central banks could also impose a fee on all banks for the explicit purpose of financing them. Another way of (partly) coping with the problem of declining revenues from seigniorage could be for the central bank to charge its clients for the services provided. Here, one can think of demanding

contributions for the costs associated with banking supervision, acting as an agent for the government, operating the payment system, etc. Finally, central banks could also start to pursue a more active asset management. By replacing relatively low-yielding assets, e.g. gold, by bonds or even equities, they could generate higher revenues.

6. Summary and conclusions

The improvements and efficiency gains realized in payment systems have clearly left their mark on central bank income since 1980, albeit to varying degrees. For the G10 countries, the drop in seigniorage revenues, as a percentage of GDP, ranges between zero and sixty percentage points. These reductions in seigniorage revenues in most countries are, of course, attributable to other factors than the introduction of e-money.

Since the acceptance, use and spread of e-money depend on numerous factors, it is difficult to predict its potential impact on seigniorage in the medium and long run. In order to get some idea of the possible threat it poses to the budgetary independence of central banks, we have presented two scenarios. Under the specified assumptions, we find that if e-money ultimately substituted for 40% or more of all currency outstanding, only the French and Belgian central banks have to start looking for alternative ways of raising revenues to preserve their financial independent position from the government. Otherwise, they have to rely on subsidies or other financial donations to cover their operating expenses. For the other countries, the estimates point to a significantly greater positive gap between seigniorage and operational expenses.

To remain financially independent in the distant future, central banks may choose from a range of other sources to be able to cover their expenses. In this respect, it should also be noted that a sharp decrease in the demand for cash will probably lead to a reduction in the costs related to the distribution, printing and development of banknotes and coin as well. Due to a lack of data, these 'savings' could not be taken into account in our computations. Finally, it must be stressed that the calculations presented in this article are of an indicative nature, because some simplifying assumptions, e.g. regarding interest rates (see Section 2), had to be made.

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