

# A Comparative Study of Seigniorage: Japan and Germany

MANFRED J.M. NEUMANN

*The paper presents a comparative study of the generation and distribution of seigniorage in Germany and Japan for the sample period 1961-91. Several measures of seigniorage are analysed and a comprehensive framework for measurement of the sources and uses of seigniorage is developed. Specifically, it is shown that the conventional concept of monetary seigniorage overstates government gains from money creation when the foreign and private sectors are the primary recipients of central bank credit. The study also reveals negative real returns on the portfolio of non-government debt for both countries. A major factor has been valuation losses on foreign assets, resulting from the appreciation of the yen and the deutsche mark. Those losses reduced real returns by more than two percentage points on average over the sample period in both countries.*

Key words: Seigniorage; Inflation tax; Bank of Japan; Bundesbank; Foreign exchange losses

## I. Introduction

Seigniorage is a classical source of government finance. Since antiquity, the profit gained from issuing money, face value minus production cost, has been the dominant motive of governments in defending their monopoly of money issuance against the demand for free banking and competing private monies. The alternative motive of providing economic agents with a stable medium of exchange, hence forgoing the inflation tax, has for most of the time been secondary in many countries. In fact, the conflict is not likely to be resolved if central banks remain government-dependent institutions.

This paper presents a comparative study of the generation and distribution of seigniorage in Germany and Japan. Focus is on the adequacy of different theoretical

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concepts of seigniorage for measuring the contribution of seigniorage to the financing of budget deficits. For example, a common measure of seigniorage is monetary seigniorage, which is defined as the change in a country's base money stock deflated by the general price level. Applying this concept, the German government should have received DM29.4 billion (in 1991 prices) in 1990, while in fact it only received DM0.4 billion if the correct definition of seigniorage (to be developed in the paper) is used. In the same year, while the Japanese government should have only received ¥1,348 billion (in 1991 prices), applying the correct definition it got much more, ¥3,546 billion. Similar differences can be found with respect to other definitions of seigniorage.

In order to clarify the properties of different concepts, we start from a definition of seigniorage that encompasses all definitions in theoretical literature and provide a framework of sources and uses of seigniorage that lends itself to empirical measurement. Applying the framework to Japan and Germany to the sample period 1961-91, we will show that for decades the governments of both countries have received from the monopoly of money production much less for budget finance than the conventional concept of monetary seigniorage suggests. It will be explained why monetary seigniorage misrepresents the gains for budget finance when the foreign and private sectors are the primary recipients of central bank credit. Studying Germany and Japan is of particular interest in this respect, because, in contrast to the United States, the monetary authorities of these countries hold larger stocks of foreign and domestic private debt. Moreover, they have suffered sizeable valuation losses on international reserves due to the strong appreciation of the deutsche mark and yen. These losses have been at the expense of the respective governments by reducing the flow of seigniorage available for budget finance.

The study proceeds as follows: Section II is devoted to analytical issues. It clarifies the content of alternative concepts of seigniorage and analyses how the distribution of seigniorage is affected by valuation losses on international reserves. Section III briefly describes the relevant institutional characteristics of the monetary authorities of both countries. Empirical work follows in Section IV based on a seigniorage framework in discrete time that takes specific institutional characteristics into account. Section V summarizes the results.

## II. Determinants of Seigniorage: Analytical Issues

Seigniorage can be defined in various ways. In theoretical literature the concepts of opportunity cost seigniorage and monetary seigniorage have been used. The first defines seigniorage as the private sector's loss of forgone interest revenue from holding non-interest bearing cash balances instead of earning assets. Given that the actual flow of revenue to government from base money creation generally differs from the private sector's opportunity cost, this concept is not well suited for the purpose of this study. The alternative concept of monetary seigniorage, in contrast, lends itself to easy measurement.

It is common to define monetary seigniorage as the change in base money stock  $M$  deflated by the general price level  $p$ :

$$s^M = \frac{\dot{M}}{p} = \frac{\dot{M}}{M} m, \quad (1)$$

where  $m$  denotes real balances. Since the pathbreaking study by Friedman (1953) this concept has been widely used in theoretical analysis and even in empirical application.<sup>1</sup> However, the conventional definition of seigniorage loses its relevance when there is little central bank financing of the domestic budget deficit. Monetary seigniorage neither measures the total flow of resources spent by the private sector on maintaining real cash balances at a desired level nor represents the profit the central government receives from its monopoly of issuing base money. Measurement of the total resource flow requires taking the private sector's debt service into account (Drazen, 1985), while measurement of the central government's profit requires taking into account the competing uses of seigniorage (Klein and Neumann, 1990).

The focus of this section is on analytical issues. We depart from the literature by adopting a gross concept of seigniorage that encompasses all other concepts of seigniorage. A general framework of the sources and the uses of total seigniorage will be developed for an open economy. The framework accounts explicitly for the existence of foreign assets in central banks' portfolios and permits tracing the implications of appreciation losses for seigniorage flows to government.

The exposition proceeds in two steps. First, we employ the simplifying

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<sup>1</sup> See, for example, Gros (1989), Grilli (1989), and De Haan, Zelhorst, and Roukens (1993).

assumption that the exchange rate is fixed. Thereafter, we drop this assumption and study what needs to be modified to account for valuation losses or gains from exchange rate changes. Finally, we will show how other definitions of seigniorage fit into our general framework.

## A. Sources and Uses of Total Seigniorage

### 1. Sources

We define total seigniorage as the real gross resource flow to the government sector associated with base money creation.<sup>2</sup> This flow results from two sources. The first is monetary seigniorage as defined by equation (1), which measures current resource flow from expanding the base money stock by buying interest-earning assets. These assets generate a flow of interest revenue, starting the following period. The second source of seigniorage in the current period is the flow of interest revenue on the stock of non-government debt that the central bank bought in the past in exchange for non-interest bearing base money.

Accordingly, total seigniorage,  $s$ , is defined as:

$$s = s^M + (i^P A^P + i^F A^F) / p . \quad (2)$$

There are two kinds of asset, private sector debt,  $A^P$ , and foreign debt,  $A^F$ . The latter is defined in terms of domestic currency. Respective nominal interest rates are denoted by  $i$  with superscript  $P$  or  $F$ . Note that the debt service on the central bank's stock of government debt is not included here because it is not a revenue flow to the government sector but just an inside transaction between the central government and the central bank.

### 2. Uses

Most of the theoretical literature equates the flow of seigniorage to the government sector with the monopoly profit used by the central government for budget finance. This is a simplification that abstracts from the cost of money production and from the existence of central banks in particular. In general, total seigniorage is used for covering the cost of money production and central bank operation,  $s^C$ , for net-investment in non-government debt by the central bank,  $s^{NI}$ ,

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<sup>2</sup> The definition was first used in Neumann (1992) under the heading "extended monetary seigniorage."

and for budget finance,  $s^G$ :

$$s = s^C + s^{NI} + s^G . \quad (3)$$

The portion of seigniorage used for covering the cost is given by

$$s^C = (C^{Coin} + C^{CB}) / p, \quad (4)$$

where  $C^{Coin}$  denotes the cost of coinage and  $C^{CB}$  the central bank's cost of printing notes and maintaining operations. A second use of seigniorage is net investment by the central bank in its portfolio of non-government debt:

$$s^{NI} = (\dot{A}^P + \dot{A}^F) / p. \quad (5)$$

The remaining use of total seigniorage is finance for the central government's budget,  $s^G$ . Following Klein and Neumann (1990), we call this use "fiscal seigniorage." The government receives fiscal seigniorage by means of three channels: net borrowing from the central bank, coinage, and appropriation of the central bank's profit, net of interest payment on the central bank's stock of government debt. Denoting government debt by  $A^G$ , the revenue from coinage by  $R^{Coin}$ , and appropriated profit by  $R^G$ , we have:

$$s^G = [\dot{A}^G + R^{Coin} + (R^G - i^G A^G)] / p. \quad (6)$$

The revenue from coinage equals the difference between the change in the circulation of coins, including holdings by the central bank and the cost of coinage.

The composition of appropriated profit  $R^G$  depends on the asset structure of the central bank. Consider a simplified flow balance sheet of the central bank after profit disbursement. Adding the change in coin circulation to both sides, it can be written as:

$$\dot{A}^G + \dot{A}^P + \dot{A}^F + \dot{Coin} = \dot{M} + \dot{K}, \quad (7)$$

with:  $\dot{K} = I - R^G$ ,

where  $K$  denotes total capital. The change in capital equals the difference between the central bank's net income  $I$  and distributed profit  $R^G$ . Net income  $I$  is total interest

revenue minus the central bank's cost:

$$I = i^G A^G + i^P A^P + i^F A^F - C^{CB}. \quad (8)$$

Deducting the change in capital gives the profit distributed to central government:

$$R^G = i^G A^G + i^P A^P + i^F A^F - C^{CB} - \dot{K}. \quad (9)$$

Note that the government gets back the interest paid on its debt so that this item nets out in the fiscal seigniorage measure defined by equation (6).<sup>3</sup>

### B. Book Losses or Gains on Foreign Assets

When exchange rates are not fixed but flexible, central banks mark foreign assets to market. This yields book losses or gains on the stock of foreign assets that can be substantial as we will see below in the empirical part of this study. A book loss reduces in terms of domestic currency a central bank's assets and net worth. To maintain growth of the asset portfolio in line with the growth of the economy requires, therefore, to make up for the loss by reducing the profit transfer to the government and investing the amount in asset formation. On the assumption that the central bank keeps the asset composition unchanged, the flow balance sheet after profit disbursement is again represented by equation (7).

Accounting for book losses or gains requires only to modify the equations describing the central bank's net income and the revenue transferred to the government, equations (8) and (9). If we define a book loss, denoted by  $L$ , as a positive number, it appears as a negative entry in both the central bank's net income

$$I = i^G A^G + i^P A^P + i^F A^F - L - C^{CB}, \quad (8^*)$$

where:  $L = -\dot{e}(A^F / e)$ ,

and distributed profit

$$R^G = i^G A^G + i^P A^P + i^F A^F - L - C^{CB} - \dot{K}. \quad (9^*)$$

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<sup>3</sup> In passing we note that Baltensperger and Jordan (1994) propose a definition of seigniorage that includes the opportunity cost revenue from interest-free central bank credit.

Note that foreign assets,  $A^F$ , are defined in terms of domestic currency. The exchange rate variable  $e$  denotes the domestic currency price of a unit of foreign exchange.

Substituting equation (9\*) into equation (6) yields:

$$s^G = [\dot{A}^G + R^{Coin} + i^P A^P + i^F A^F - L - C^{CB} - \dot{K}] / p. \quad (6^*)$$

Equation (6\*) makes the obvious point that distributing the book loss on foreign assets,  $L$ , to the government reduces the available amount of fiscal seigniorage. However, a book loss does not extinguish collected real seigniorage. Instead, this portion of seigniorage is used by the central bank for replacement investment to make up for the exchange rate induced loss of assets (in terms of domestic currency). Denoting the real value of this replacement investment by  $s^{RI}$ , we have

$$s^{RI} = L / p = -\dot{e}A^F / (ep). \quad (10)$$

Accordingly, equation (3) should now be written as

$$s = s^C + s^G + s^{NI} + s^{RI}. \quad (3^*)$$

This equation completes our framework for an open economy under a floating regime.

### C. Resource Flows: Goods and Services versus Debt

Given that the framework presented above is based on a gross definition of seigniorage, it encompasses all specific definitions used in theoretical literature. To prove this we will show how the seigniorage definition proposed by Drazen (1985) fits into our framework. As Drazen has demonstrated, his concept encompasses remaining concepts.

To develop the definition by Drazen, it is useful to consider that at the end of each period the gross flow of seigniorage has been used by the government sector either for receiving a flow of real resources, *i.e.* goods and services, or for stocking up the central bank's portfolio of non-government debt. Thus, we may split total seigniorage into a real resource component,  $s^R$ , and a debt component,  $s^D$ :

$$s = s^R + s^D. \quad (11)$$

An obvious part of the real resource component is the portion of seigniorage used for covering the operating cost,  $s^C$ , as defined by equation (4). A second part is fiscal seigniorage,  $s^G$ . Equation (6\*) above defines fiscal seigniorage as the sum of specific revenues. Now, we consider what the government gets in exchange. With primary deficit ( $G - T$ ), government debt outside the central bank ( $B$ ) and bond rate  $i^B$ , the budget constraint implies:

$$s^G = [(G - T) - (\dot{B} - Bi^B)] / p. \quad (12)$$

Thus, fiscal seigniorage measures the amount of goods and services acquired by money finance under the weak restriction that current borrowing in the bond market does not fall short of the interest service on outstanding bonds.

With the real resource component of total seigniorage given by

$$s^R = s^C + s^G, \quad (13)$$

and the debt component by

$$s^D = s^{NI} + s^{RI}, \quad (14)$$

we may write the real source component as the difference between total seigniorage and the debt component. Accordingly, using equations (5) and (10) in equation (14) and subtracting it from equation (2) yields the solution:

$$s^R = s^M + [(i^P - g^P)A^P + (i^F - g^F + g^e)A^F] / p, \quad (15)$$

where:  $g^P = \dot{A}^P / A^P$ ;  $g^F = \dot{A}^F / A^F$ ;  $g^e = \dot{e} / e$ ,

where  $g$  with superscript  $P$  or  $F$  denotes the nominal growth rate of stock of private sector debt or foreign debt held by the central bank, and  $g^e$  the percentage change in nominal exchange rate.

Solution (15) provides a general measure of the flow of real resources to the government sector. It can be transformed into the measure proposed by Drazen (1985) by assuming that the economy follows a steady state. In a steady state with the real income elasticity of money demand of unity, the central bank will keep the real value of its portfolio of non-government debt (in relation to output) by letting asset stocks



rise with the economy's nominal rate of growth:

$$\bar{g}^P = \bar{g}^F = \bar{g}^M = \bar{n} + \bar{\pi},$$

where  $n$  denotes the real rate of growth,  $\pi$  the rate of inflation, and  $g^M$  the money growth rate. Assuming further interest parity to hold

$$i^P = i^F + g^e$$

equation (15) reduces for a steady state to:

$$\begin{aligned} \bar{s}^R &= \bar{s}^M + (\bar{r} - \bar{n}) (a^P + a^F), \\ \text{where: } \bar{s}^M &= (\bar{n} + \bar{\pi}) m \\ a^P &= A^P / p \\ a^F &= A^F / p \end{aligned} \tag{16}$$

where  $r$  denotes the real rate of interest and  $m$  real balances. This is an open economy version of Drazen's measure. Note with Drazen that his concept encompasses other net concepts of seigniorage, from Friedman (1953) to Auernheimer (1974). As regards the traditional monetary seigniorage concept this is obvious from equation (16).

From a steady-state equilibrium point of view, Drazen's concept of seigniorage is the most appropriate one. When the economy follows a steady-state path, the actual seigniorage burden on the private sector equals the constant flow of real resources in terms of goods and services, while the flow of debt serves to cover the required debt service to the extent that it is not effected by delivering real resources.

However, equation (16) cannot be used for measurement, because actual economies do not follow steady-state paths so that the simplifying assumptions underlying equation (16) do not hold. Suppose, for example, that the elasticity of money demand with respect to real income differs from unity. Then this needs to be taken into account by the central bank in setting money growth. Preserving the real value of its portfolio of non-government assets in relation to output requires letting the stocks of assets grow by

$$g^P = g^F = g^M = \lambda n + \pi = n + \pi - g^V,$$

$$\text{with: } g^V = (1 - \lambda)n,$$

where  $\lambda$  denotes the real income elasticity of money demand and  $g^V$  the growth rate of the velocity of base money. Using the definitions of growth rates in equation (15) yields

$$s^R = s^M + (r - n + g^V) (a^P + a^F), \quad (17)$$

or, equivalently,

$$s^R = m(n + \pi) + (r - n)(a^P + a^F) - g^V(m - a^P - a^F). \quad (18)$$

This general version of the Drazen measure takes trend changes in the velocity of money into account and is consistent with the accounting equation (15). The last term of equation (18) indicates that a positive (negative) trend in the income velocity of the monetary base reduces (raises) the real resource flow (goods and services) provided the monetary base exceeds the central bank's portfolio of non-government debt, *i.e.* the bank holds government debt. Only in the special case where a central bank's asset portfolio does not contain any government debt, trends in velocity do not affect the seigniorage-induced real resource flow to the government. Therefore, the general version of Drazen's seigniorage measure, as provided by equations (15) or (18), is to be preferred to the steady-state measure (16) in terms of actual measurement.

Summing up, the analysis presented above has shown that there are three informative concepts of seigniorage: (i) total gross seigniorage,  $s$ , which measures the total resource flow to the government sector associated with base money production; (ii) the Drazen-measure of seigniorage,  $s^R$ , which defines that part of the total flow effected in terms of real resources; and (iii) fiscal seigniorage,  $s^G$ , which represents the flow of seigniorage that the government receives for budget finance. The information content of the conventional concept of monetary seigniorage,  $s^M$ , in contrast, is in doubt. Only in the very special case where central banks exclusively hold government debt is monetary seigniorage a meaningful measure. Then monetary seigniorage equals the total gross flow as well as Drazen's flow of real resources:

$$s = s^M = s^R > s^G.$$

There is no need to emphasize that the portfolios of actual central banks are diversified between government debt and non-government debt. Moreover, monetary seigniorage provides no information on the implications for the flow of seigniorage to government of changes in the central bank's asset composition or of changes in the exchange rate. The general framework of seigniorage measurement developed in this paper and the three preferred seigniorage measures, in contrast, provide such information.

### **III. Monetary Authorities in Germany and Japan**

Empirical measurement of the sources and uses of seigniorage requires combining data from central bank balance sheets with data from their statements of income and expenditure and profit distribution. This section briefly describes the institutions of both countries relevant for this purpose.

#### **A. Germany**

In Germany the Deutsche Bundesbank holds the authority over monetary policy. With the exception of one, all operations that affect the creation and distribution of seigniorage show up statistically in the balance sheet and in income and expenditure accounts. The exception is coinage. Since the Federal Government holds the monopoly of issuing coins, the profit stemming from coinage cannot be read from the accounts mentioned.

Table 1 is the balance sheet of the Bundesbank as of 1993. Since the Bundesbank supplies the anchor currency for the EMS (European Monetary System), it must be able to conduct large scale intervention in support of member currencies when there is a need. At the same time, the Bundesbank must have the capacity to neutralize the base money effect of such intervention by selling domestic assets. Though this consideration has become less important since July 1993 when the width of intra-EMS exchange rate bands was extended from 4.5 to 30 percent, it still shapes the techniques of policy implementation and the asset structure of the Bundesbank's portfolio. While the share of international reserves to total assets is 30 percent, the share of loans to commercial banks is twice as large, exceeding 60 percent. Note that the lending predominantly takes the form of repo transactions with maturities of one to two weeks. This permits the Bundesbank to terminate domestic lending if there is a sudden run on the deutsche mark. The EMS crisis of September 1992 has shown that the

Table 1  
Deutsche Bundesbank  
Balance sheet as of December 31, 1993 (DM billion)

Assets				Liabilities			
International reserves				Monetary base excl. coins			
Gold	13.7			Banknotes	224.3		
Deposits and loans	64.4			Deposits: banks	73.4		
European Fund	36.2			priv. non-banks	0.8	298.5	
IMF reserves	8.5	122.8		Foreign deposits		22.1	
Loans				Government deposits		13.5	
Bills	58.1			Liquidity paper		26.2	
Repos	184.5			Other liabilities		3.4	
Lombard	14.8	257.5		Allowances, accrued liabilities			
Loans to government				Allowance for pensions	2.7		
Advances	—			Other allowances	8.6		
From 1948	8.7			Accrued liabilities	0.5	11.8	
Bonds	4.7	13.4		Capital		11.2	
Other assets		11.9		Net income, 1993		18.8	
Total		405.6		Total		405.6	

implementation technique is a very flexible and efficient instrument for neutralizing large scale intervention within a few weeks.

In contrast, lending to government plays no role. Until the end of 1993 the Federal Government as well as state governments held the right to receive cash advances; however, because of tight legal limits on such borrowing, cash advances remained a negligible source of base money creation. Since the beginning of 1994, cash advances to public authorities have been made illegal with the amendment of the Bundesbank Law necessitated by the provisions of the Maastricht Treaty. As a result, the only major government asset on the Bundesbank's balance sheet is a debt entry of less than DM9 billion, the *Ausgleichsforderungeng*, which dates from the currency reform of 1948 that gave birth to the deutsche mark.<sup>4</sup>

The liabilities side of the Bundesbank's balance sheet is dominated by base money in circulation, in the form of banknotes and sight deposits, totalling 75 percent of total liabilities. Note that the deposits held by foreign monetary authorities are not

<sup>4</sup> The *Ausgleichsforderungen* was created to compensate commercial banks for losses stemming from currency reform. The Bundesbank had to buy this debt from the banks and redeem it gradually; see equation (22).

counted as part of the monetary base, because, as a rule, these deposits bear interest. This means they do not provide a seigniorage gain. Foreign institutions also hold the bulk of the interest-bearing liquidity paper issued by the Bundesbank. Finally note that the Bundesbank's capital is kept at a level that equals 5 percent of banknotes in circulation.

## **B. Japan**

Similar to the German case, the Japanese government retains the monopoly of coinage, while the Bank of Japan (BOJ), exerts authority over monetary policy. Major differences are that changes in minimum reserve ratios require approval of the Ministry of Finance and, more importantly, that the ministry maintains authority over foreign exchange market operations. While BOJ acts as an agent, the Ministry decides intervention and has a special account for this purpose, the Foreign Exchange Fund Special Account (FEFSA). About 75 percent of Japan's international reserves are controlled by the ministry through this special account rather than by BOJ. In order to develop a complete framework of the sources and uses of seigniorage, it is necessary to consolidate the balance sheets and the statements of income and expenditure of BOJ and of this special account. Here we will briefly discuss the balance sheets.

Table 2 shows the balance sheet of FEFSA. Consider first the liabilities side. The dominant source of finance is the issuance of foreign exchange fund bills which are offered in public auctions. However, far less than 10 percent are bought by the market, because the fixed offer rate is set below BOJ's official discount rate, rendering them unattractive to commercial banks. As a result, the BOJ underwrites close to 100 percent of new issues.

The largest entry on the assets side is international reserves, which are valued at market. However, a special feature of FEFSA is that book losses from marking foreign assets to market are not formally distributed to the government's central budget but are kept forever on the balance sheet. This accounting practice is unusual by international comparison, as it effectively amounts to counting the inherited stock of foreign assets at purchase value instead of market value.

At first sight, it may seem that the practice violates the principle of no-bankruptcy. Though FEFSA is not a public corporation but just a special government account, net worth should be kept at zero. This requires matching accumulated book losses by reserves. In fact, Table 2 shows that total reserves even exceeded accumulated losses at the end of fiscal 1991. On the other hand, it is to be noted that

Table 2  
Foreign Exchange Fund Special Account  
Balance sheet as of March 31, 1992 (¥ billion)

Assets				Liabilities			
International reserves				Foreign exchange fund bills			15,446.0
Gold	54.3			Liabilities to IMF			635.1
Deposits and securities	8,117.0			SDRs allocated			158.8
IMF reserves	1,073.6	9,244.9		Other liabilities			0.0
Book losses				Total reserves			
Accumulated	6,097.2			Funds		378.6	
Current	642.7	6,739.9		Reserves	7,041.3	7,419.9	
Yen assets				Net income, fiscal 1991			289.2
Deposit with BOJ*	179.6						
Trust Fund Bureau	7,239.4						
Loans to government	531.6						
Other	13.7	7,964.2					
<b>Total</b>		<b>23,949.0</b>		<b>Total</b>			<b>23,949.0</b>

\* Estimate by the author.

there have been periods during which FEFSAs reserves fell short of accumulated foreign exchange losses for several consecutive years. Examples are 1977-80 and 1986-89. Though we do not know why this happened, the practice can be interpreted as a device for smoothing annual revenue flow from this special account to the central budget.

While FEFSAs was founded for managing the government's foreign funds, it has also become a channel for the finance of public spending programmes. Table 2 indicates that about one-half of the funds acquired by selling foreign exchange fund bills to the Bank of Japan are deposited with the Trust Fund Bureau which finances public investments and public corporations.

BOJ's balance sheet is shown in Table 3. It need not be discussed in detail. A characteristic feature is that the asset portfolio is dominated by loans to the government and its agencies, while international reserves are negligible. The asset structure clearly is distorted by the existence of FEFSAs. In the absence of the latter, BOJ's international reserves would total more than ¥12,000 billion or 25 percent of joint total assets (adjusted for FEFSAs's accumulated book losses). Thus, the share of Japan's international reserves to total assets of the monetary authorities is similar to

Table 3  
Bank of Japan  
Balance sheet as of March 31, 1992 (¥ billion)

Assets		Liabilities	
International reserves		Monetary base excl. coins	
Gold	140.4	Banknotes	34,052.7
Foreign assets	2,986.2 3,126.6	Deposits: banks	3,634.6
Loans to banks		other	232.4 37,919.7
Bills	10,964.6	Government deposits	
Loans	5,227.1 16,191.7	FEFSA *	179.6
Loans to government		Treasury	1,167.2
Short-term bonds	14,283.1	Other	413.6 1,760.4
Long-term bonds	7,693.1	Allowances, accrued liab.	
Deposits with agencies	2,571.6 24,547.8	Allowance for losses	2,145.0
Other assets	1,010.9	Accrued taxes	491.1
		Other	22.3 2,658.4
		Other liabilities	56.6
		Capital	1,517.7
		Net income (Oct. 1991 – March 1992)	964.2
Total	44,877.0	Total	44,877.0

\* Estimate by the author.

the German case (30 percent).

The same does not hold with respect to the role of government debt. Netting out BOJ's holding of FEFSA bills, the joint stock of loans to government agencies amounted to about ¥18,000 billion or almost 40 percent of the joint total assets at the end of fiscal 1991, while the Bundesbank's lending to the German government has always been negligible.

As in the case of the Bundesbank, the liabilities side of BOJ's balance sheet is dominated by base money in circulation, excluding the coins that are liabilities of the government. Note that BOJ settles its accounts twice a fiscal year. The fiscal year is divided into two halves, called business terms. The first term runs from April 1 to September 30, the second from October 1 to March 31. Thus, the figure for net income just reflects the result of bank operations during the second business term. This will be taken into account below when the sources of the annual flow of seigniorage will be computed; for details see the Appendix.

#### IV. Empirical Analysis

In this section we draw on the analysis in Section II. First, we present a discrete-period model that accounts for the country-specific features discussed above (subsection IV.A). Next, we use it in subsections IV.B and IV.C to empirically investigate the differences and similarities in the generation and distribution of seigniorage between Germany and Japan. Finally, we compare the major alternative measures (subsection IV.D).

The sample period is 1961-91. The data are annual and will be denoted by subscript  $t$ . In the German case it is the calendar year, in the Japanese case it is the fiscal year, running from April 1 through March 31 of the following calendar year. The main data sources are: for Germany the *Annual Report* of the Deutsche Bundesbank; for Japan, the *Annual Review* of the Bank of Japan and the *Budget Plan* of the Japanese Government.<sup>5</sup>

##### A. A Framework for Measurement

The aim is to provide for Germany and Japan solutions for measurement in a comparable fashion. The Appendix explains in detail for both countries how specific entries to balance sheets and income statements are used to obtain seigniorage measures.

We begin with the sources of seigniorage. For both countries, total gross seigniorage is defined as the sum of the change in the monetary base and interest revenue from stock of foreign as well as domestic private assets, including realized gains from asset trading. This gives

$$\begin{aligned}
 s_t &= [\Delta M_t + i_t^P A_{t-1}^P + i_t^F e_t (A_{t-1}^F / e_{t-1}) + G_t^r] / p_t \\
 \text{with: } \Delta M_t &= C_t + D_t^P + D_t^B \\
 \text{Japan: } A_{t-1}^F &= A_{B,t-1}^F + A_{E,t-1}^F \\
 G_t^r &= G_{B,t}^r + G_{E,t}^r
 \end{aligned}
 \tag{19}$$

where  $M$  denotes the monetary base,  $A$  with superscripts  $F$  and  $P$  foreign and domestic private debt held by the monetary authorities,  $i^F$  and  $i^P$  the respective nominal

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<sup>5</sup> *Budget Plan*, available in Japanese only, gives the balance sheets of FEFSA as well as income and expenditure statements.



coupon rates,  $e$  the domestic currency price of a unit of foreign exchange,  $G^r$  the authorities realized gains from asset trading, and  $p$  the general price level. Monetary base  $M$  is the sum of currency in circulation,  $C$ , and deposits held with the central bank by domestic private non-banks,  $D^P$ , and by commercial banks,  $D^B$ . For Japan the foreign assets and the realized gains of FEFSAs, indicated by subscript  $E$ , are combined with those of BOJ.

Total seigniorage is allocated to the following uses:

$$s_t = s_t^C + s_t^G + s_t^O + s_t^{NI} + s_t^{RI}. \quad (20)$$

Some portion  $s^C$  of total current seigniorage is used to cover the cost of base money production and maintenance. Accounting rules determine what is distributed to the government,  $s^G$ , and to third parties,  $s^O$ . The rest is invested into extending the stock of non-government debt, where  $s^{NI}$  indicates net investment and  $s^{RI}$  replacement investment.

The different uses are measured as follows. A first use is cost seigniorage:

$$s_t^C = (C_t^{Coin} + C_t) / p_t, \quad (21)$$

Japan:  $C_t = C_{B,t} + C_{E,t}$ .

Total cost includes the cost of coinage,  $C^{Coin}$ , and the cost of printing banknotes and maintaining operations,  $C$ . A second use is fiscal seigniorage. The government receives it through four different channels.

$$s_t^G = [\Delta A_t^G + R_t^{Coin} + (R_t^G - i_t^G A_{t-1}^G) + T_{B,t}] / p_t,$$

where:  $R_t^{Coin} = \Delta Coin_t - C_t^{Coin}$ ,

Germany:  $T_{B,t} = 0$ ,

Japan:  $\Delta A_t^G = \Delta A_{B,t}^G + \Delta A_{e,t}^{TF}$  (22)

$$R_t^G = R_{B,t}^G + R_{E,t}^G$$

$$i_t^G A_{t-1}^G = i_{B,t}^G A_{B,t-1}^G + i_{E,t}^{TF} A_{E,t-1}^{TF}.$$

A first channel is borrowing from the central bank, and, in the case of Japan, additional borrowing through the Trust Fund Bureau from FEFSAs; the respective assets of FEFSAs are indicated by superscript  $TF$ . The second channel is revenue from

coinage and the third is the profits of the authorities, net of interest service for outstanding debt. A final channel in Japan is the taxes BOJ has to pay on property and income,  $T_B$ .

In both countries a small portion of the authorities' profit is distributed to third parties:

$$s_t^o = R_t^o / p_t. \quad (23)$$

In Germany, an amount of DM30 million is annually paid to the *Ausgleichsfonds*. The fund holds *Ausgleichsforderungen*, i.e. government debt that stems from currency reform in 1948.  $R^o$  serves to redeem that debt. In Japan, BOJ pays shareholders ¥5 million annually.

Finally, there is net investment in domestic private assets and foreign assets

$$s_t^{NI} = (\Delta A_t^P + \Delta A_t^F) / p_t \quad (24)$$

Japan:  $\Delta A_t^F = \Delta A_{B,t}^F + \Delta A_{E,t}^F$

and replacement investment

$$s_t^{RI} = L_t / p_t = -\Delta e_t (A_{t-1}^F / e_{t-1}) / p_t \quad (25)$$

Japan:  $A_{t-1}^F = A_{B,t-1}^F + A_{E,t-1}^F$ .

The latter serves to make up for the on-balance sheet loss of assets, in terms of domestic currency, that results from an appreciation of the domestic currency.

## B. Sources and Uses of Seigniorage in Germany and Japan

Tables 4 and 5 present annual averages of the sources and uses of seigniorage for the 1960s, 1970s and 1980s as well as for the overall sample period 1961-91. All flows are measured in real terms. For Germany they are expressed in 1991 GDP prices, for Japan in 1991 GNP prices.

As regards sources, we first note that monetary seigniorage is the dominant source, providing 57 percent in Germany and 67 percent in Japan of the total flow of seigniorage, on average, over the sample period. However, the interest revenue collected on the portfolio of domestic private assets and on foreign assets has become more important over time in both countries. In Germany its contribution to total

Table 4  
Sources and Uses of Seigniorage in Germany  
(Annual averages; 1991 GDP prices)

		1961-91	1961-70	1971-80	1981-91
		DM billion			
Total	$s$	21.0	11.0	22.2	28.9
Sources					
Monetary	$s^M$	11.9	8.8	13.6	13.0
Interest revenue		9.1	2.2	8.6	15.9
Uses					
Cost	$s^C$	1.3	0.8	1.4	1.8
Investment					
Net	$s^{NI}$	12.7	9.0	12.4	16.5
Replacement	$s^{RI}$	3.5	1.5	7.6	1.7
Fiscal	$s^G$	3.3	-0.4	0.9	8.9
		Percent of total			
Sources					
Monetary	$s^M$	56.6	80.2	61.5	45.0
Interest revenue		43.4	19.8	38.5	55.0
Uses					
Cost	$s^C$	6.4	7.6	6.1	6.2
Investment					
Net	$s^{NI}$	60.8	81.3	55.9	57.0
Replacement	$s^{RI}$	16.7	13.5	34.0	5.8
Fiscal	$s^G$	15.8	-3.6	3.9	30.0

Note: The small portion of Bundesbank profit used for the redemption of *Ausgleichsforderungen* is neglected.

Table 5  
Sources and Uses of Seigniorage in Japan  
(Annual averages; 1991 GNP prices)

		1961-91	1961-70	1971-80	1981-91
		¥100 billion			
Total	$s$	31.2	19.0	41.7	32.6
Sources					
Monetary	$s^M$	20.8	15.2	27.0	20.3
Interest revenue		10.3	3.8	14.7	12.3
Uses					
Cost	$s^C$	0.8	0.7	0.8	0.9
Investment					
Net	$s^{NI}$	13.1	11.1	13.7	14.2
Replacement	$s^{RI}$	4.0	-0.0	6.9	4.9
Fiscal	$s^G$	13.3	7.2	20.3	12.6
		Percent of total			
Sources					
Monetary	$s^M$	66.8	80.0	64.8	62.3
Interest revenue		33.1	20.0	35.2	37.7
Uses					
Cost	$s^C$	2.6	3.9	1.9	2.9
Investment					
Net	$s^{NI}$	41.9	58.3	32.9	43.7
Replacement	$s^{RI}$	12.7	-0	16.6	15.0
Fiscal	$s^G$	42.8	37.9	48.6	38.5

Note: The constant payment of dividends to shareholders of the Bank of Japan (¥5 million) is neglected.

seigniorage rose from 20 percent in the 1960s to 55 percent in the 1980s, thus surpassing monetary seigniorage. Similarly, in Japan the contribution of interest revenue increased from 20 percent in the 1960s to 38 percent in the 1980s.

Figures 1 and 2 show developments year by year. While the combined interest revenue of BOJ and FEFSa, measured in real terms, has remained at about ¥1,100 billion since the mid-1970s, the interest revenue of the Bundesbank shows a positive trend. This reflects a basic difference in the asset portfolios of the Bundesbank and of the Japanese authorities. The Bundesbank has never held much government debt and has recently run down this position to zero to comply with a corresponding amendment to the Bundesbank Act. In contrast, the FEFSa and BOJ regularly buy government debt on a larger scale, whose interest proceeds net out, and hence do not provide seigniorage. While BOJ's direct lending to the government is legally restricted, ruling out direct long-term lending as well as the acquisition of long-term bonds, the restriction does not apply to bills with maturities of less than one year. In fact, BOJ is the dominant underwriter for these bills. In addition, FEFSa channels funds to the

Figure 1  
Sources of Total Seigniorage in Germany  
(DM billion; 1991 prices)

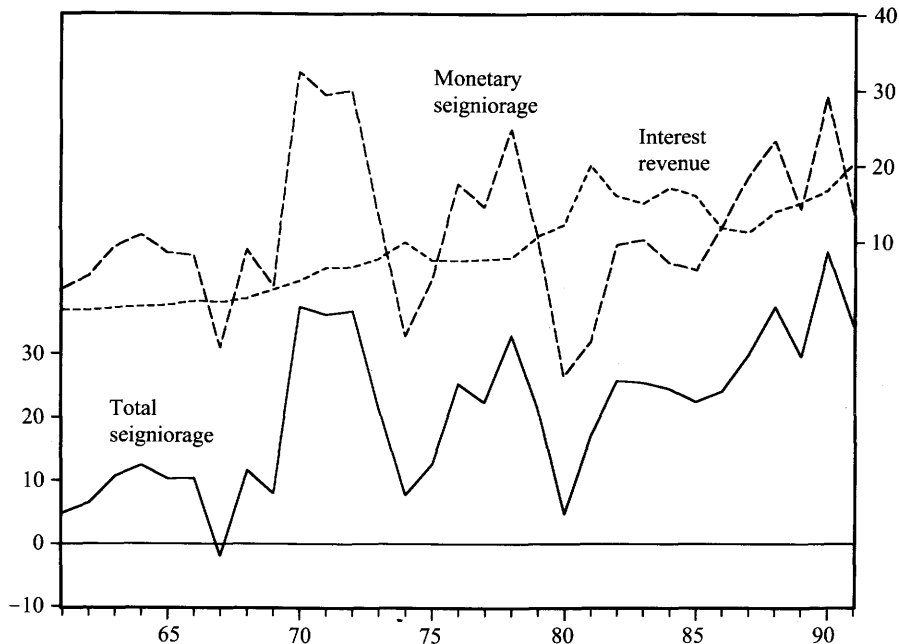
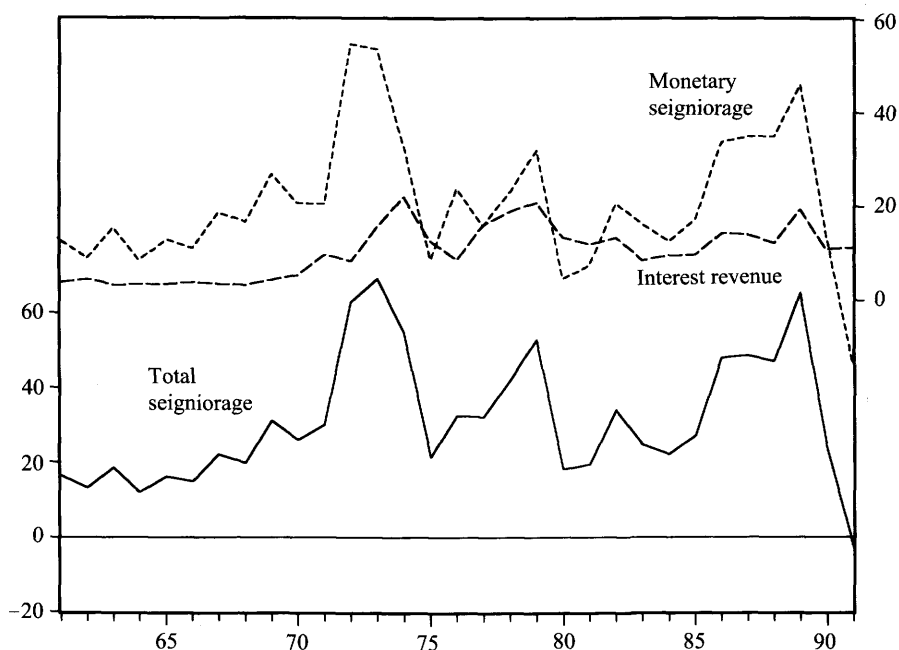


Figure 2  
Sources of Total Seigniorage in Japan  
(¥100 billion; 1991 prices)



government by lending to government agencies, notably the Trust Fund Bureau.<sup>6</sup> But note from Table 7 that total net lending was reduced during the 1980s, even falling short of the government's interest service on debt held by the monetary authorities.

As regards the uses of total seigniorage, Tables 4 and 5 indicate that in both countries the dominant use is investment in the acquisition of domestic private and foreign assets rather than fiscal seigniorage. The Bundesbank used 77 percent of total gross seigniorage for investment, on average over the sample period, leaving no more than 16 percent for the German government's budget finance. BOJ and FEFSa, in contrast, invested less heavily in domestic private and foreign assets, about 55 percent on average over the sample period. As a result, the Japanese government received 43 percent on average for budget finance.

Figure 3 shows that the German government did not receive any fiscal seigniorage worth mentioning until the mid-1970s. Only in the severe recession of

<sup>6</sup> Note that in the analysis of Section IV.A lending to the government by FEFSa was treated as lending by BOJ, because FEFSa finances the lending by selling foreign exchange fund bills to BOJ.

Figure 3  
Sources of Fiscal Seigniorage in Germany  
(DM billion; 1991 prices)

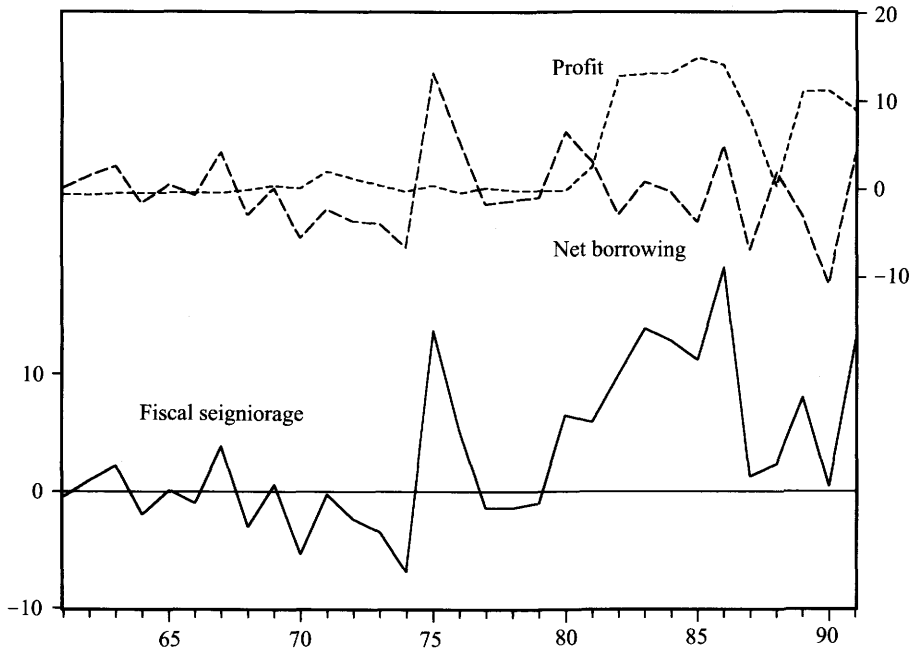


Table 6  
Sources of Fiscal Seigniorage in Germany  
(Annual averages; 1991 GDP prices)

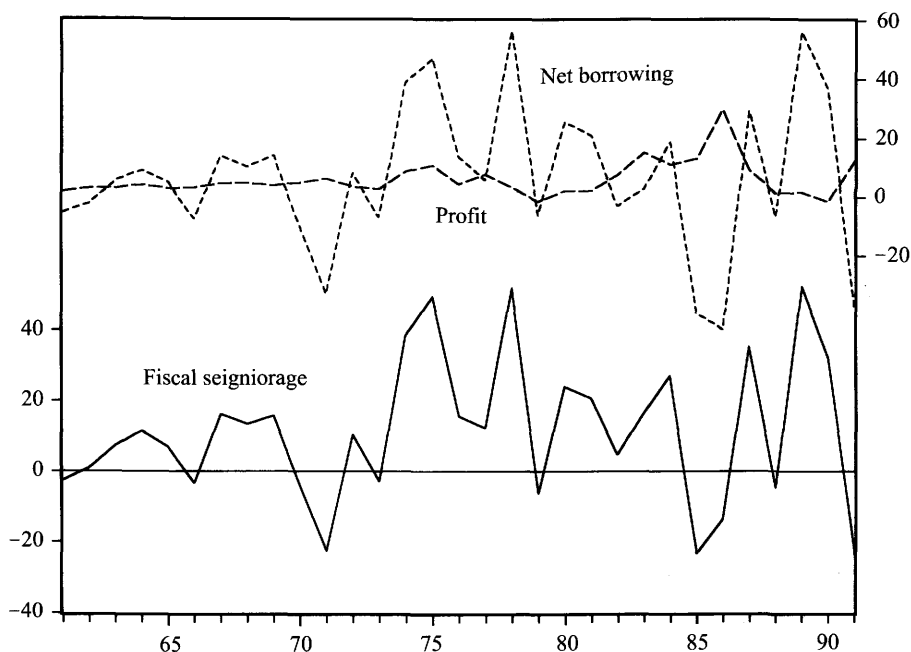
	1961-91	1961-70	1971-80	1981-91
	DM billion			
Net borrowing	-0.3	-0.1	0.5	-1.1
+				
Coinage	0.7	0.5	0.9	0.7
+				
Appropriated revenue	3.7	0.1	0.2	10.1
-				
Interest paid	0.8	0.9	0.7	0.7
=				
Fiscal seigniorage	3.3	-0.4	0.9	8.9
	Percent			
Fiscal seigniorage in percent of monetary seigniorage	27.9	-4.5	6.4	68.6

1975 did the net debt position vis-à-vis the Bundesbank accumulate, but it was run down again thereafter. In fact, fiscal seigniorage did not become sizeable in Germany before the 1980s when the profits of the Bundesbank jumped to an average level of DM10 billion (in 1991 prices); see Table 6.

There are two main reasons for the small scale of fiscal seigniorage flows during the 1960s and 1970s. The first and dominant one is the fact mentioned above that the Bundesbank's lending to government has always been restricted by a very tight legal ceiling. The second reason is that for most of the time the Bundesbank used the profits for raising reserves and, moreover, abstained from writing up its dollar assets when the dollar appreciated vis-à-vis the deutsche mark. It is only since the beginning of the 1980s, when the legal limits on revenue allocation to reserves were reached, that the Bundesbank has been forced to distribute profits to the Federal Government on a larger scale.

In Japan, fiscal seigniorage played a larger role during the 1970s and the late 1980s; see Figure 4. The figure also shows that net lending to the government, either

Figure 4  
Sources of Fiscal Seigniorage in Japan  
(¥100 billion; 1991 prices)





directly or through the Trust Fund Bureau, was the dominant source of fiscal seigniorage during the 1970s, while the profit flow from BOJ and FEFSA became more sizable during the early 1980s. As can be seen from Table 7, both sources of fiscal seigniorage were, on average, about at par over the sample period.

Table 7  
Sources of Fiscal Seigniorage in Japan  
(Annual averages; 1991 GNP prices)

	1961-91	1961-70	1971-80	1981-91
	¥100 billion			
Net borrowing	7.1	3.4	15.2	3.1
+				
Coinage	1.7	1.0	1.3	2.8
+				
Appropriated profit	6.7	2.0	6.0	11.6
+				
Taxes on BOJ	1.8	1.0	1.7	2.6
-				
Interest paid	4.0	0.3	3.9	7.5
=				
Fiscal seigniorage	13.3	7.2	20.3	12.6
	Percent			
Fiscal seigniorage in percent of monetary seigniorage	63.9	47.4	75.1	61.8

Although the simplifying steady-state assumptions of the early theoretical literature suggested that monetary seigniorage accounts for what the government receives for budget finance, we note that this is not supported by the data. Tables 6 and 7 show that, on average over the sample period, fiscal seigniorage amounted to 64 percent of monetary seigniorage in the case of Japan and to only 28 percent in the German case.

### C. Book Losses on Foreign Assets from Currency Appreciation

The Japanese yen and the deutsche mark have followed a strong upward trend against the U.S. dollar as well as against other currencies since the breakdown of the Bretton Woods fixed exchange rate regime in 1971. Between 1971 and 1991 the yen appreciated by 4.9 percent per year, the deutsche mark by 3.8 percent.

Figure 5  
Foreign Exchange Intervention by the Bundesbank

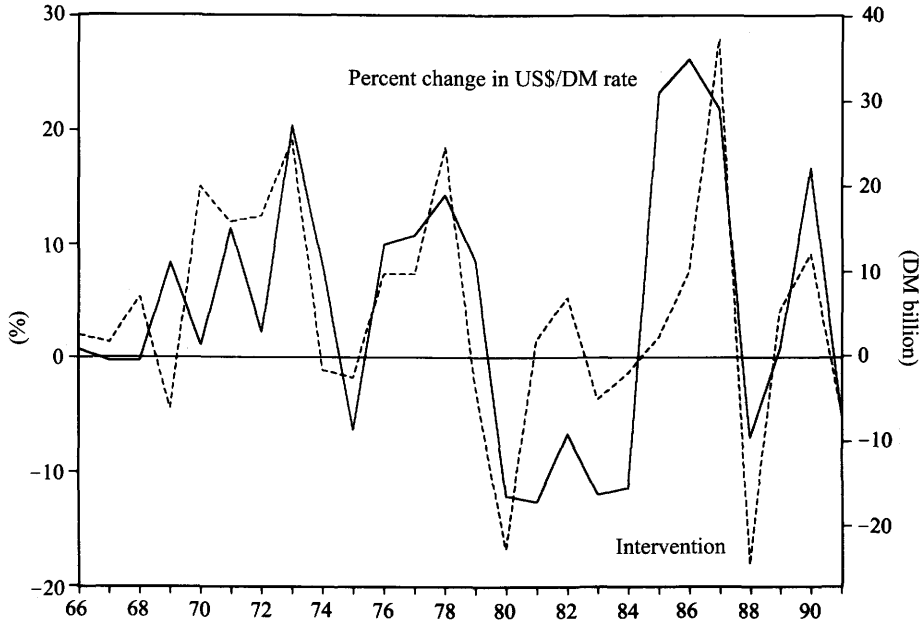
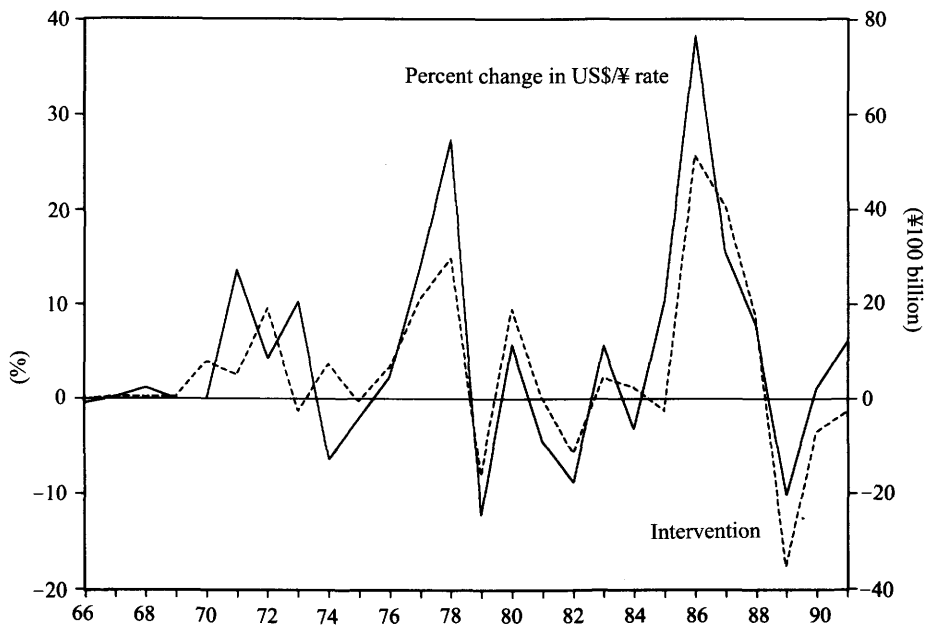


Figure 6  
US\$ Intervention by the FEFSA

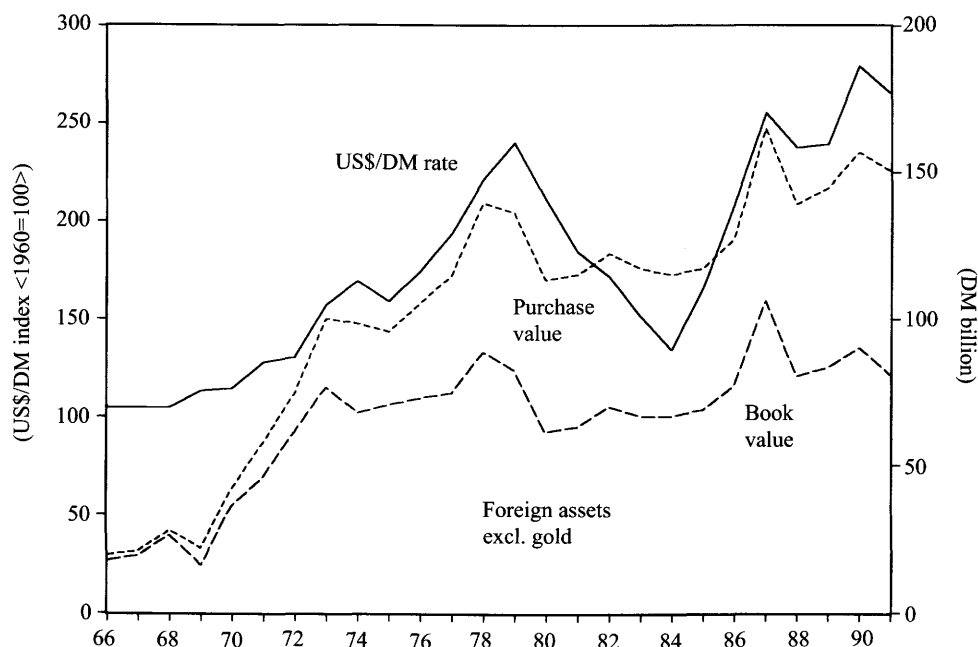


The authorities of both countries repeatedly tried to stem the trend and to smooth the fluctuations by means of intervention in the US dollar market as well as by accommodating money growth.<sup>7</sup> Figures 5 and 6 indicate the positive correlation between the rate of change in the exchange rates vis-à-vis the U.S. dollar and the scale of intervention. The Bundesbank and FEFSA, which is responsible for intervention in Japan, supported the dollar on a large scale throughout the 1970s and again in the mid-1980s.

The appreciation resulted in sizeable valuation losses on foreign assets in both countries. Figures 7 and 8 show how those losses accumulated from 1960 (equal to the difference between the curve showing purchase value and that showing book value of foreign asset stocks). By 1991, the Japanese authorities had lost 43 percent of the purchase value, the Bundesbank 46 percent.

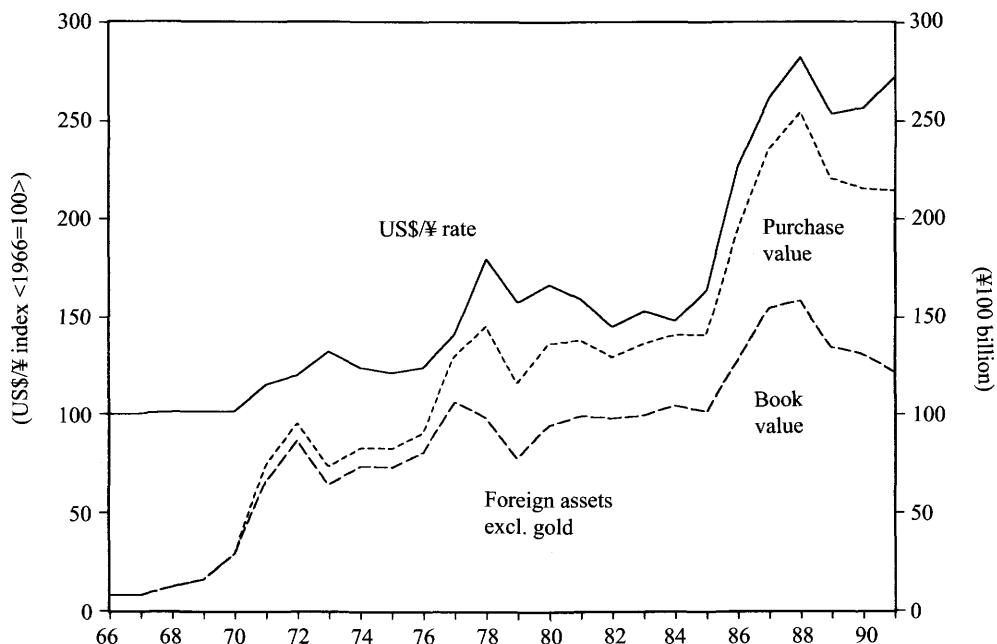
In the seigniorage framework discussed above, valuation losses are measured

Figure 7  
Foreign Assets of the Bundesbank



<sup>7</sup> See Neumann (1995) for an examination of the Bundesbank's policy of leaning against the wind of the deutsche mark's appreciation.

Figure 8  
Foreign Assets of Japan's Monetary Authorities



in real terms and show up as replacement investment,  $s^r$ . This use of seigniorage amounted to an average 13 percent in the case of Japan over the sample period, and to 17 percent in the German case; see Tables 4 and 5. Replacement investment is at the expense of fiscal seigniorage to the extent that interest rates on foreign assets do not properly account for the depreciation of the respective foreign currencies. Given that this appears to be the case for a number of foreign assets held by monetary authorities, the governments of both countries would have been better off if the external value of their currencies had not trended upwards.

#### D. A Comparison of the Major Measures of Seigniorage

In this last section we compare the empirical content of alternative measures of seigniorage. For each measure Table 8 presents annual averages over the overall sample period 1961-91.

The encompassing definition of seigniorage is total gross seigniorage, as defined by equation (19). It measures the total flow of resources spent by the private sector on maintaining real cash balances at the desired level. Part of this flow to the government sector is effected in terms of real resources (goods and services). It is represented by

Table 8  
Alternative Seigniorage Measures  
(Annual averages; 1961-91; 1991 GDP prices)

		Japan ¥100 bil.	Germany DM bil.	Japan Percent	Germany Percent
Total gross seigniorage	$s$	31.2	21.0	100	100
Real resource flow (Drazen)	$s^R$	14.1	4.7	45.3	22.4
Fiscal seigniorage	$s^G$	11.9	8.8	13.6	13.0
For comparison:					
Monetary seigniorage	$s^M$	20.8	11.9	66.7	56.7
Inflation tax	$s_{\pi}^M$	10.2	7.0	32.7	33.3
Percent p.a.					
Rates of return on non-government assets					
Nominal, adjusted for valuation losses					
		4.2	2.9		
Real	$r$	-1.1	-1.0		
Real growth	$n$	6.2	3.0		
Base velocity growth	$g^v$	-0.7	0		
Gap:	$r - n + g^v$	-8.0	-4.0		

the general Drazen measure.<sup>8</sup> Table 8 shows that the flow of real resources accounted for no more than 45 percent in the case of Japan and for less than 25 percent in the German case. This implies that the total flow of seigniorage was predominantly effected as a debt transfer in both countries. The flow of resources received by the government for budget finance, finally, is given by fiscal seigniorage. The Japanese government received on average 43 percent of total seigniorage, the German government no more than 16 percent.

Table 8 also provides data for the conventional measures of monetary seigniorage and the inflation tax.<sup>9</sup> The data impressively show that neither concept provides useful information on what the government of either country gained from the monopoly of base money production. The explanation for the large differences vis-à-vis the three preferred measures considered above is that the central banks of Japan and Germany

<sup>8</sup> See equations (15) and (17) of the text. The discrete-period version of equation (15) can be derived by subtracting equations (24) and (25) from equation (19).

<sup>9</sup> The latter has been computed as the product of the current rate of inflation,  $\pi_t$ , and lagged real balances,  $m_{t-1}$ .

$$s_{\pi,t}^M = \pi_t m_{t-1}.$$

do hold domestic private and foreign debt, instead of just government debt.<sup>10</sup>

Finally, we may ask why for both countries the real resource flow fell short of monetary seigniorage by an impressive margin of about one-third. To see what happened, we write the general version of the Drazen measure, as given by equation (17), in discrete form as

$$s_t^R = s_t^M + (r_t - n_t + g_t^V) (a_{t-1}^P + a_{t-1}^F), \quad (26)$$

where  $r$  denotes the monetary authorities' real rate of return on net non-government assets,  $n$  the real rate of growth, and  $g^V$  the growth rate of base money velocity.

The lower panel of Table 8 explains the large negative gap. The most important point to note is that the real rate of return on the monetary authorities' portfolio of net non-government assets was negative in both countries. This reflects the fact that central banks are accustomed to subsidizing lending to commercial banks as well as to international institutions like the IMF. The average nominal rate of return over the sample period was 6.4 percent per year for the Japanese authorities and 5.7 percent for the Bundesbank. The nominal rates of return were computed by dividing the current interest revenue on private plus foreign assets by the respective end-of-period stock of the previous year. Accounting for the book losses on foreign assets reduces the nominal rates to 4.2 and 2.9 percent, respectively. Using the GNP deflators for deflating the nominal rates yields negative real rates of return: for the portfolio of non-government assets of the Japanese authorities we computed an average real rate of return of -1.1 percent, for the Bundesbank's portfolio, -1.0 percent.

As a result, the relative gap, shown on the bottom line of Table 8, is negative and twice as large for Japan compared to Germany. It may seem, therefore, that the Drazen measure should have fallen short of monetary seigniorage more heavily for Japan. However, this was not the case because in Japan the ratio of the authorities' stock of non-government debt to monetary base was much lower than in Germany where the Bundesbank is legally hindered from buying much government debt.

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<sup>10</sup> For comparison it may be noted that in the case of the United States, the measured differences between total seigniorage and monetary seigniorage are negligible; see Neumann (1992). In fact, the asset portfolio of the Federal Reserve is dominated by government debt.

## V. Concluding Remarks

This study has presented a comparative framework of the generation and distribution of seigniorage in Japan and Germany. In contrast to other empirical studies we have not relied on the easy to apply concept of monetary seigniorage. In fact, we show that this conventional concept of seigniorage is misleading when the foreign and private sectors are the primary recipients of central bank credit. More appropriate measures of seigniorage that highlight different aspects of seigniorage are as follows: (i) a new measure is *total gross seigniorage* which encompasses all other measures; it measures the total flow to the government sector; (ii) the *Drazen measure* which accounts for part of the total flow effected by delivering real resources (goods and services); and (iii) *fiscal seigniorage* which measures the portion of seigniorage received for budget finance.

Empirical analysis for the period 1961-91 has revealed for both countries that the monetary authorities' interest earnings on non-government debt are an important and increasing source of seigniorage, contributing, on average, 33 percent in Japan and 43 percent in Germany. As a result, the conventional concept of monetary seigniorage understates the total flow of seigniorage. At the same time, there is ample evidence that monetary seigniorage overstates fiscal seigniorage by a wide margin for both countries. For Japan we find that fiscal seigniorage falls short of monetary seigniorage by about 35 percent, on average, over the total sample period, while for Germany the difference is as large as 75 percent.

The main reasons for these gaps are (i) a real rate of return on the monetary authorities' portfolio of non-government debt below the real growth rate of the economy in both countries, and (ii) a negative trend in the velocity of the monetary base in Japan. In fact, we find that the average real rate of return on the authorities' non-government assets has been negative over the last 30 years in Germany as well as in Japan. The study reveals the valuation losses on the monetary authorities' foreign assets from the appreciation of the yen and the deutsche mark as a major factor. The appreciation against the dollar reduced the authorities' real rate of return by more than two percentage points in the case of Japan and by almost three percentage points in the case of Germany.

## Appendix

This Appendix serves to show in detail for both countries how the discrete period framework is derived using the authorities' balance sheets and corresponding statements of income and expenditure, and profit distribution.

For both countries total gross seigniorage is defined as

$$s_t = [\Delta M_t + i_t^P A_{t-1}^P + i_t^F e_t (A_{t-1}^F / e_{t-1}) + G_t^r] / p_t \quad (\text{A.1})$$

where  $M$  denotes the monetary base,  $A$  with superscripts  $F$  and  $P$  foreign and domestic private debt, held by the monetary authorities,  $i^F$  and  $i^P$  the respective nominal coupon rates,  $G^r$  the authorities realized gains from asset trading, and  $p$  the general price level.

### 1. Germany

In the German case only one monetary authority needs to be considered, the Deutsche Bundesbank (BBK). Total foreign assets are managed at the exclusive discretion of the BBK. Net income from money creation is distributed at the end of the fiscal year which coincides with the calendar year.

The BBK's statement of income and expenditure reads as

$$I_t = i_t^F e_t (A_{t-1}^F / e_{t-1}) + i_t^P A_{t-1}^P + i_t^G A_{t-1}^G + G_t^r - C_t - L_t, \quad (\text{A.2})$$

where:  $L_t = -\Delta e_t (A_{t-1}^F / e_{t-1})$ .

The BBK collects interest on foreign assets, expressed in deutsche marks,  $A^F$ , on private debt,  $A^P$ , and on government debt,  $A^G$ .<sup>11</sup> Occasionally, the BBK may realize a gain from asset trading,  $G^r$ . Expenses include administration and printing banknotes,  $C$ . Finally, the BBK distributes losses from the appreciation of the deutsche mark,  $L$ .

Net income collected in period  $t-1$  is distributed in  $t$  as follows:

$$R_t = \Delta K_t^{LR} + R_t^O + R_t^G. \quad (\text{A.3})$$

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<sup>11</sup> But note again that an amendment of the Bundesbank Law prohibits lending to the government since the beginning of 1994.



Some portion is used for accumulating legal reserves,  $K^{LR}$ , such that they cover 5 percent of banknotes in circulation; another very small portion of seigniorage, denoted by  $s^O$ , is used to reduce a historic debt entry on the BBK's balance sheet, the *Ausgleichsforderungen* mentioned in Section III, and the rest is transferred to the Federal Government,  $R^G$ . We may write:

$$R_t^G = I_{t-1} - R_t^O - \Delta K_t^{LR}. \quad (\text{A.4})$$

Next, the BBK's flow balance sheet, extended by the net change in the circulation of coins, can be written as

$$\begin{aligned} \Delta A_t^G + \Delta A_t^P + \Delta A_t^F + \Delta \text{Coin}_t &= \Delta M_t + \Delta K_t, \\ \text{where: } \Delta K_t &= I_t - R_t^G - R_t^O, \end{aligned} \quad (\text{A.5})$$

The left-hand side sums the changes in net foreign assets, in loans to the private sector and loans to the government (net of government deposits). A final component is the change in coin circulation. The right-hand side sums changes in the monetary base and the BBK's total capital accounts. Note that the monetary base is defined as the sum of currency in circulation and the deposits of domestic private non-banks and commercial banks.

Fiscal seigniorage, finally, is given by the sum of the following revenues:

$$\begin{aligned} s_t^G &= (\Delta A_t^G + R_t^{\text{Coin}} + R_t^G - i_t^G A_{t-1}^G) / p_t, \\ \text{where: } R_t^{\text{Coin}} &= \Delta \text{Coin}_t - C_t^{\text{Coin}}. \end{aligned} \quad (\text{A.6})$$

Combining equations (A.2) through (A.6) with the definition of gross seigniorage, as given by equation (A.1), yields the uses side:

$$\begin{aligned} s_t &= s_t^C + s_t^G + s_t^O + s_t^{NI} + s_t^{RI}, \\ \text{where: } s_t^C &= (C_t^{\text{Coin}} + C_t) / p_t, \\ s_t^G &= [R_t^{\text{Coin}} + (R_t^G - i_t^G A_{t-1}^G) + \Delta A_t^G] / p_t, \\ s_t^O &= R_t^O / p_t, \\ s_t^{NI} &= (\Delta A_t^P + \Delta A_t^F) / p_t, \\ s_t^{RI} &= L_t / p_t = -\Delta e_t (A_{t-1}^F / e_{t-1}) / p_t. \end{aligned} \quad (\text{A.7})$$

## 2. Japan

The case of Japan requires consolidating the accounting frameworks of the Bank of Japan (BOJ) and the Foreign Exchange Fund Special Account (FEFSA).

Consider first the statement of income and expenditure of BOJ. BOJ settles accounts twice each fiscal year, at mid-term and at the end. Summing yields for the fiscal year:

$$\begin{aligned}
 I_{B,t} = & i_t^F e_t (A_{B,t-1}^F / e_{t-1}) + i_t^P A_{B,t-1}^P + i_t^G A_{B,t-1}^G + i_t^{FEF} FEF_{t-1}^B \\
 & + G_{B,t}^r - C_{B,t} - T_{B,t} - \Delta K_{B,t}^A - L_{B,t} \quad (A.8) \\
 \text{where: } & L_{B,t} = -\Delta e_t (A_{B,t-1}^F / e_{t-1}) .
 \end{aligned}$$

BOJ receives interest on foreign assets, expressed in yen,  $A^F$ , on private debt,  $A^P$ , on government debt,  $A^G$ , and on the stock of FEFSA bills,  $FEF^B$ ; like FEFSA, BOJ may realize a gain from asset trading,  $G^r$ . BOJ spends  $C_B$  on the printing of banknotes and administration and, in contrast to the Bundesbank, pays taxes on income and property,  $T_B$ . Net income is further reduced when BOJ's special reserves for covering accrued net liabilities,  $K^A$ , are accumulated. Finally, note that BOJ explicitly distributes book losses on foreign assets,  $L$ , by deducting them from gross income.

For FEFSA, indicated by subscript  $E$ , net income or profit in fiscal year  $t$  is:

$$I_{E,t} = i_t^F e_t (A_{E,t-1}^F / e_{t-1}) + i_t^{TF} A_{E,t-1}^{TF} + G_{E,t}^r - i_t^{FEF} FEF_{t-1}^T - C_{E,t} . \quad (A.9)$$

FEFSA receives interest on foreign assets,  $A^F$ , and on loans to government agencies,  $A^{TF}$ , mainly to the Trust Fund Bureau (TF); occasionally, there are also realized gains,  $G^r$ , from foreign asset trading. Expenses consist of servicing FEFSA bills outstanding,  $FEF^T$ , and administrative costs,  $C^E$ . Note that equation (A.9) does not show book gains or losses from marking foreign assets to market at the end of the year, because they are not formally distributed but kept on the balance sheet; see equation (A.18) below.

Summing equations (A.8) and (A.9) yields total net income collected by BOJ and FEFSA during the fiscal year  $t$ :

$$\begin{aligned}
 I_{B+E,t} = & i_t^F e_t (A_{t-1}^F / e_{t-1}) + i_t^P A_{t-1}^P + (i_t^G A_{B,t-1}^G + i_t^{TF} A_{E,t-1}^{TF}) \\
 & + G_t^r - C_{B+E,t} - T_t^B - \Delta K_{B,t}^A - L_{B,t} . \quad (A.10)
 \end{aligned}$$

Note that the superscripts denoting the different institutions are shown only when essential for the analysis below.

Next consider the distribution of net income. Two aspects need to be taken into account. First is the general rule that income collected in period  $t$  is not distributed during the same period but in the following period  $t+1$ . Second, in contrast to FEFSa, BOJ settles accounts twice a fiscal year. Consequently, the income collected during the first half is distributed in the second half while income collected during this period is distributed at the beginning of the following fiscal year.

Accordingly, revenue distributed by BOJ in fiscal year  $t$  is:

$$R_{B,t} = I_{B,t-1(2)} + I_{B,t(1)}. \quad (\text{A.11})$$

Note that the half years are indicated by numbers in brackets.

BOJ pays a fixed dividend of 5 percent on paid-in capital (which has remained constant) to shareholders,  $R^S$ , uses another portion for raising its legal and general reserves,  $K^{LR}$ , and the rest is transferred to the central government,  $R^G$ . Thus, we may write:

$$R_{B,t}^G = I_{B,t-1(2)} + I_{B,t(1)} - R_{B,t}^S - \Delta K_{B,t}^{LR}. \quad (\text{A.12})$$

Revenue distributed by FEFSa in fiscal year  $t$  is:

$$R_{E,t} = I_{E,t-1}. \quad (\text{A.13})$$

In contrast to BOJ, the distribution of FEFSa revenue is not determined by a binding rule. Therefore, how much of the revenue is left in the account for FEFSa reserves and paid-in capital ("funds"),  $K^R$ , is at the discretion of the Ministry of Finance.

$$R_{E,t} = R_{E,t}^G + \Delta K_{E,t}^R, \quad (\text{A.14})$$

where:  $R_{E,t}^G = I_{E,t-1} - \Delta K_{E,t}^R$

Summing equations (A.11) and (A.13) yields total revenue as

$$R_t = I_{E,t-1} + I_{B,t-1(2)} + I_{B,t(1)}. \quad (\text{A.15})$$

and the government's share as

$$R_{B+E,t}^G = R_t - R_{B,t}^S - (\Delta K_{B,t}^{LR} + \Delta K_{E,t}^R) . \quad (\text{A.16})$$

Next we write the flow balance sheets of BOJ and FEFSa. Adding coins in circulation to both sides of BOJ's balance sheet, it can be written in first differences as:

$$\begin{aligned} \Delta A_{B,t}^G + \Delta FEF_{B,t} + \Delta A_{B,t}^P + \Delta A_{B,t}^F + \Delta \text{Coin}_t &= \Delta M_t + \Delta D_{B,t}^E + \Delta K_{B,t} \\ \text{where: } \Delta K_{B,t} &= I_{B,t} - R_{B,t}^G - R_{B,t}^S + \Delta K_{B,t}^A . \end{aligned} \quad (\text{A.17})$$

The four major types of assets are: government debt, net of government deposits,  $A^G$ , private debt,  $A^P$ , foreign assets net of liabilities to the IMF and SDRs allocated,  $A^F$ , and the portfolio of FEF bills. With other assets (net of other liabilities) eliminated for notational convenience, a final item on the left-hand side of equation (A.17) is the change in the circulation of coins.<sup>12</sup>

On the right-hand side we have changes of base money stock  $M$ , of working balances held by FEFSa,  $D^E$ , and of total capital  $K$ . Note that the definition of the change in total capital accounts allows for the fact that the total amount of revenue distributed in period  $t$  differs from net income earned.

The flow balance sheet of FEFSa can be written as:

$$\begin{aligned} \Delta A_{E,t}^{TF} + \Delta A_{E,t}^F + L_{E,t} + \Delta D_{E,t}^B &= \Delta FEF_t^T + \Delta K_{E,t} , \\ \text{where: } \Delta L_{E,t} &= -\Delta e_t (A_{E,t-1}^F / e_{t-1}) , \\ \Delta K_{E,t} &= I_{E,t} - R_{E,t}^G \begin{matrix} \geq \\ < \end{matrix} L_{E,t} . \end{aligned} \quad (\text{A.18})$$

Liabilities consist of outstanding FEF bills,  $FEF^T$ , and reserves,  $K$ , including paid-in capital (a constant amount), the "funds". On the asset side, apart from foreign assets and loans to the Trust Fund Bureau, FEFSa holds working balances with BOJ,  $D^B$ . Note that a current book loss on foreign assets,  $L$ , shows up explicitly, due to the practice of keeping these losses on the balance sheet; see discussion in Section III .

Consolidating the two flow balance sheets implies that FEFSa deposits with BOJ

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<sup>12</sup> Note that BOJ acts as the agent of the government as regards coin distribution. It buys newly produced coins at face value from the government and credits the government's account accordingly. The coins are distributed on demand, inducing a reduction of total assets matched by a reduction in the deposits held by commercial banks. Withdrawal of worn out coins, in contrast, is debited to the government's deposits and credited to the banks' deposits.

and its borrowings from BOJ by emitting FEF bills net out.<sup>13</sup> Thus, we have:

$$\begin{aligned} \Delta A_t^G + \Delta A_t^P + \Delta A_t^F + L_{E,t} + \Delta Coin_t^T &= \Delta M_t + \Delta K_t, \\ \text{where: } \Delta A_t^G &= \Delta A_{B,t}^G + \Delta A_{E,t}^{TF}, \\ \Delta K_t &= I_{B+E,t} - R_{B+E,t}^G - R_{B,t}^S + \Delta K_{B,t}^A. \end{aligned} \quad (\text{A.19})$$

It remains to introduce the definition of fiscal seigniorage from the sources side:

$$s_t^G = (\Delta A_t^G + R_t^{Coin} + R_{B+E,t}^G + T_{B,t} - i_t^G A_{B,t-1}^G - i_t^{TF} A_{E,t-1}^{TF}) / p_t. \quad (\text{A.20})$$

In comparison to equation (A.6), we now have taxes paid by BOJ,  $T_B$ , as an additional source of fiscal seigniorage. Being treated as a source of fiscal seigniorage, it is not part of total taxes  $T$  in text equation (12). Counting BOJ's tax payment as a source of seigniorage is appropriate, because, in the absence of this tax obligation the revenue transferred by BOJ to the government would be correspondingly higher; for this reason, in most countries central banks are exempted from taxation.

To derive the solution for total seigniorage, we substitute equations (A.10) and (A.20) into equation (A.19) and solve for the change in base money stock. This yields:

$$\begin{aligned} \Delta M_t &= s_t^G p_t + C_t^{Coin} + C_{B+E,t} + R_{B,t}^S + \Delta A_t^P + \Delta A_t^F \\ &\quad + L_{B+E,t} - i_t^P A_{t-1}^P - i_t^F e_t A_{t-1}^F - G_t^R. \end{aligned} \quad (\text{A.21})$$

Finally, using the definition of gross seigniorage, as given by equation (A.1), yields the solution:

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<sup>13</sup> The assumption that BOJ's stock of foreign exchange fund bills matches the total sold by FEFS is not literally true for all periods. On occasion insignificant amounts have been sold to the market. In the empirical analysis in Section IV, this is taken care of by adjusting the government's total borrowing from BOJ plus FEFS.

$$\begin{aligned}
s_t &= s_t^C + s_t^G + s_t^O + s_t^{NI} + s_t^{RI}, \\
\text{where: } s_t^C &= (C_t^{Coin} + C_{B+E,t}) / p_t, \\
s_t^G &= [R_t^{Coin} + (T_t^B + R_{B+E,t}^G - i_t^G A_{t-1}^G) + \Delta A_t^G] / p_t, \\
s_t^O &= R_{B,t}^S / p_t, \\
s_t^{NI} &= (\Delta A_t^P + \Delta A_t^F) / p_t, \\
s_t^{RI} &= L_{B+E,t} / p_t.
\end{aligned} \tag{A.22}$$

The solution is fully comparable with the solution for the case of Germany, equation (A.7).

*Manfred J.M. Neumann: Professor and Director, Institute for International Economics, University of Bonn, Germany*

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