Compilation of Seigniorage

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INTRODUCTION

Historically, issuing money has been a royal prerogative, one of the reasons being that it generates considerable revenue, called seigniorage. From the sovereign's point of view this could be seen as equivalent to tax revenue. Today the Danmarks Nationalbank Act states that the Nationalbank is responsible for issuing banknotes, while minting is the prerogative of the Treasury under the Coinage Act. Since 1975, the Nationalbank has been in charge of the production and administrative aspects of minting. After allocations, the seigniorage falls to the Treasury via the Nationalbank's allocation of profits. This article discusses the problems related to compiling an exact measure of seigniorage.

SEIGNIORAGE IN A HISTORICAL PERSPECTIVE

From time immemorial gold, silver and copper have been used as means of payment of goods and services. In other cultures other means of payment have been used, typically articles with a certain rarity value. The oldest Danish coins date back to the 9th and 10th centuries, and since the 11th century minting has been a royal prerogative in Denmark.

Originally, the intrinsic value of a coin was equal to its face value, i.e. the purchasing power of the coin corresponded to its metal value. This did not necessarily mean that its value remained stable against other goods, since metal prices fluctuated. However, minters soon realised that if production costs could be lowered in relation to the face value of the coin, i.e. its purchasing power, a profit could be made. This profit, or seigniorage, accrued to the minter, in most cases the sovereign. The intrinsic value of the coin thus diminished and circulation increased in periods when much revenue was needed, typically in connection with wars. Debasing coins is equivalent to imposing an extra tax on the citizens of the country.

One way of debasing coins in circulation was to add e.g. copper to silver coins. If coins of the same face value, but different intrinsic values, are in circulation at the same time, the bad money will drive out the good money, as the latter will be melted down at a profit, exported or

hoarded. This phenomenon was described in the mid-16th century and is known as Gresham's law.

With the introduction of paper money – in Denmark in the 18th century – the seigniorage potential increased, as the gap between the face value and the production costs widened. Initially, the issue of paper money was in the hands of private individuals, but later it was taken over by the Treasury which then collected the seigniorage. Using paper instead of metal as a means of payment is profitable to society as the resources needed for mining and melting down metal are saved.

In the above historical context seigniorage can be defined as the change in the value of the banknotes and coins in circulation, i.e. the purchasing power at the time of issue, minus production costs. We could call this a flow definition of seigniorage (S^1).

Definition 1: $S^1 = \Delta Cu - P$
where Δ Cu = the change in value of the banknotes and coins in circulation, and
P = production costs.

This definition of seigniorage disregards the fact that for centuries issuers of paper money had to promise to exchange their banknotes for precious metal upon request. This guarantee was necessary to ensure that people would accept the banknotes and meant that the issuers had to have precious metal reserves to support the paper money in circulation. This security for the banknotes in circulation is an extra cost which reduces the seigniorage in definition 1.

AN ALTERNATIVE DEFINITION OF SEIGNIORAGE

A newer definition of seigniorage is found in Rovelli (1994)[1]. Here seigniorage is defined as the Treasury's revenue from issuing debt at no interest or a low rate of interest via the central bank. This definition is based on a broader monetary concept, base money. In a Danish context the latter can be defined as the banknotes and coins in circulation plus the banks' current-account deposits with Danmarks Nationalbank[2]. Both are highly liquid.

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[1] Rovelli, R., Reserve requirements, seigniorage and the financing of the government in an economic and monetary union, *European Economy*, Reports and Studies no. 1, 1994.

[2] If financial institutions are subject to statutory reserve requirements, these should be included in the base money. Reserve requirements are a monetary instrument imposing on financial institutions an obligation to deposit liquid funds with the central bank corresponding to a proportion of the deposits they have on their balance sheet. Interest may be paid on these deposits. This instrument is not used in Denmark.

BASE SEIGNIORAGE Box 1

An outline central-bank balance sheet can be set up as follows:

Assets	Liabilities
Foreign-exchange reserve	Circulation of banknotes and coins
Portfolio of domestic bonds	Current-account deposits
Lending	Reserve requirements
	Other liabilities, including equity capital

Assume that the central bank's assets can be divided into those which are counterparts of base money and those which are counterparts of other liabilities of the central bank, i.e. a separate balance sheet can be set out for the activities specifically related to the issue of base money. This is known as earmarking. The relation between base money and its counterparts can be written as:

$$V + B + L = F + R + Cu$$

Where V is part of the central bank's foreign-exchange assets, B is part of the central bank's portfolio of domestic bonds, L is part of the central bank's lending to the banks, F is current-account deposits with the central bank, R is statutory reserve requirements, and Cu is the circulation of banknotes and coins. Base seigniorage (S^2) can then be compiled analytically as follows:

Definition 2: $S^2 = i_V V + i_B B + i_L L - i_F F - i_R R - P$

where i_x is the interest on asset X, and P is the costs of issuing banknotes and coins. In Denmark's case R is zero.

Although the principle of earmarking sounds intriguing from a theoretical point of view, it is difficult to apply in practice. It is thus difficult to see how the counterparts of base money can be divided constructively into foreign-exchange assets, domestic bonds and lending.

Rovelli defines total or Treasury seigniorage as the sum of the base seigniorage and a concept called monetarisation. Base seigniorage is the profit to Danmarks Nationalbank from issuing base money. Banknotes and coins are not interest-bearing, but the Nationalbank can use the proceeds from issuing banknotes and coins to buy interest-yielding securities, i.e. in principle the Nationalbank borrows money at no interest and places it in assets yielding interest. In this case the proceeds from issuing banknotes and coins are not used to buy goods and services, but invested in securities which yield a return. From an analytical point of view, and using this stock approach, the base seigniorage can be com-

piled by assuming that the central bank's assets can be divided into counterparts of, i.e. assets financed by, base money, or counterparts of other liabilities. The base seigniorage is the yield on the relevant assets minus costs, cf. definition 2 in Box 1.

Unlike the historical definition 1, definition 2 reflects how banknotes and coins are actually put into circulation today. That is the case when the banks correspondingly reduce their deposits with or increase their loans from the Nationalbank. It is not a result of the purchase of goods and services by the Nationalbank. One could also say that the issue of banknotes and coins is not final in that the money can return to the Nationalbank at any time if demand falls. The issue of cash is determined purely by demand. Nonetheless, definition 1 is often used in both theoretical and empirical compilations of seigniorage, see Fischer (1982)[1], for example.

Breaking down the Nationalbank's balance sheet by business area may seem rather theoretical and is difficult in practice. Nevertheless, it has a certain historical relevance in view of the fact that the Bank of England was originally divided into an Issue Department (issuing banknotes and coins) and a Banking Department. In that case the compilation of seigniorage would be based on the Issue Department's balance sheet.

As stated above, Rovelli operates with two elements forming the total seigniorage: transfer of the entire base seigniorage or part of it to the Treasury via the allocation of the profits of the central bank; and monetarisation, which can be defined as the increase in base money resulting from the central bank's purchase of government securities or the government's drawing on its current account with the central bank. The central bank's purchase of government securities is regarded as "free" financing for the central government to the extent that the interest payment is ploughed back as part of the central bank's profit, which falls to the Treasury. According to this viewpoint, only government bonds placed outside the central bank are a net burden on the government's budget. The same argumentation can be used when the government draws on its current account with the Nationalbank. It is "free", for although interest is paid regularly, it reverts to the Treasury via the Nationalbank's allocation of profits.

Article 101 of the Amsterdam Treaty prohibits central banks in the EU from granting their governments overdrafts and from buying bonds direct from them. This limits the possibility of monetarisation as defined above, but does not completely prevent it. For instance, in relation to the compilation of total seigniorage it is irrelevant whether the central

[1] Fischer, S., Seigniorage and the case for a national money, *Journal of Political Economy*, no. 90, 1982.

SEIGNIORAGE Table 1

DKK million	Circulation (Cu)	Interest in per cent (i_{u})	$i_u C u$	Costs (P)[1]	S[4]
1993	27,571	9.67	2,666	97	2,569
1994	30,589	6.21	1,900	125	1,775
1995	32,582	6.36	2,072	167	1,905
1996	34,525	4.46	1,540	115	1,425
1997	36,608	4.31	1,578	102	1,476
1998	38,750	4.75	1,841	109	1,732
1999	40,928	3.94	1,613	115	1,498
Average	…	…	1,887	119	1,768

Note: Seigniorage compiled in accordance with definition 4.
[1] The total costs of issuing banknotes and coins are higher as a number of indirect costs are not included.

bank purchases government securities from the government directly or in the market.

The compilation of seigniorage as the sum of a base seigniorage and a monetarisation component is a hybrid between definitions 1 and 2, the base seigniorage being calculated according to definition 2, whereas the monetarisation element resembles definition 1.

If the Nationalbank purchases government bonds or the government draws on its current account, this will lead to expansion of liquidity and thus improve the net position of the banks vis-à-vis the Nationalbank. Under the narrow definition of base money used here this will have little influence on base money – in the form of larger interest-bearing current-account deposits. Therefore in the Danish case it is expedient to disregard the monetarisation component on compiling seigniorage.

EMPIRICAL COMPILATION OF SEIGNIORAGE

Empirical compilation of (base) seigniorage is often based on a consolidated balance sheet between the government and the Nationalbank. It is typically argued that what the government saves by receiving seigniorage is the interest on the government bonds which it no longer needs to issue. Base seigniorage is therefore calculated by multiplying the bond interest rate (i_B) either by banknotes and coins in circulation or by total base money and subtracting the financing and production costs, cf. definition 3.

Definition 3: $$S^3 = i_B[F + R + Cu] - i_F F - i_R R - P$$

The above argumentation does not take into account the actual institutional structure. Initially base seigniorage accrues to the Nationalbank and may be regarded as part of the bank's core revenue, cf. the discus-

sion in Hansen and Ølgaard (2000)[1]. The Nationalbank's assets and liabilities are managed jointly, and how far out on the yield curve the bank wishes to place itself is the result of an independent assessment of risk and yield. If the Nationalbank was not willing to run any material interest-rate risk, all accounts with the government would bear interest at a short-term Danish or foreign rate. Therefore it seems most expedient to compile seigniorage as the Nationalbank's lending rate (a 14-day rate) multiplied by the value of banknotes and coins in circulation minus production costs, definition 4. The lending rate is the rate of interest at which the banks finance their demand for banknotes and coins. The other elements of the base money make only an insignificant contribution to the seigniorage as they accrue interest at a rate close to the lending rate.

Definition 4: $S^4 = i_U Cu - P$

where i_U = the Nationalbank's lending rate.

In Table 1 seigniorage is compiled on the basis of definition 4. The average value of banknotes and coins in circulation is multiplied by the average lending rate in the respective years.

The costs of producing banknotes and coins are sourced from the Nationalbank's annual accounts. In the 1990s seigniorage averaged just over 0.2 per cent of annual GDP, reflecting falling interest rates and an increase in banknotes and coins in circulation. It is important to bear in mind that seigniorage is a theoretical concept which is not identical to the Nationalbank's accounting surplus, albeit constituting an important part of it.

SEIGNIORAGE IN THE EURO AREA

The compilation and allocation among the euro area member states of seigniorage or monetary income has been determined in principle. Under Article 32 of the Statute of the European System of Central Banks (ESCB) the sum of the participating national central banks' (NCB) monetary income shall be allocated to the individual NCBs in proportion to their paid-up shares in the capital of the European Central Bank (ECB).

Up to the introduction of physical banknotes and coins on 1 January 2002 a temporary scheme will be in operation, viz. calculation of monetary income by multiplying base money by a chosen rate of interest. This temporary method resembles definition 4. It is based on the cen-

[1] Hansen, I. and C. Ølgaard, Danmarks Nationalbank's Risk Management, Danmarks Nationalbank, *Monetary Review,* 2nd Quarter 2000.

tral-bank balance-sheet liabilities, in contrast to the previously described method, which is based on assets (counterparts of the base money). Furthermore, a very narrow definition of base money, which does not include banknotes and coins, has been chosen in the transition phase. The base money in the interim period consists mainly of the minimum reserves. It is multiplied by the rate of interest on main refinancing operations, i.e. a 14-day rate, and the rate of interest on the minimum reserves is deducted. As the rate of interest on the minimum reserves is equivalent to the 14-day rate, the monetary income during the transition period is close to zero. This will be changed on the introduction of physical euro banknotes and coins in 2002, as they will be included in the base money. At the same time, or perhaps after a transition period, the counterpart approach to the calculation of monetary income will be adopted. This will require explicit earmarking of the counterparts of base money, cf. definition 2. This will always involve a certain element of arbitrariness.

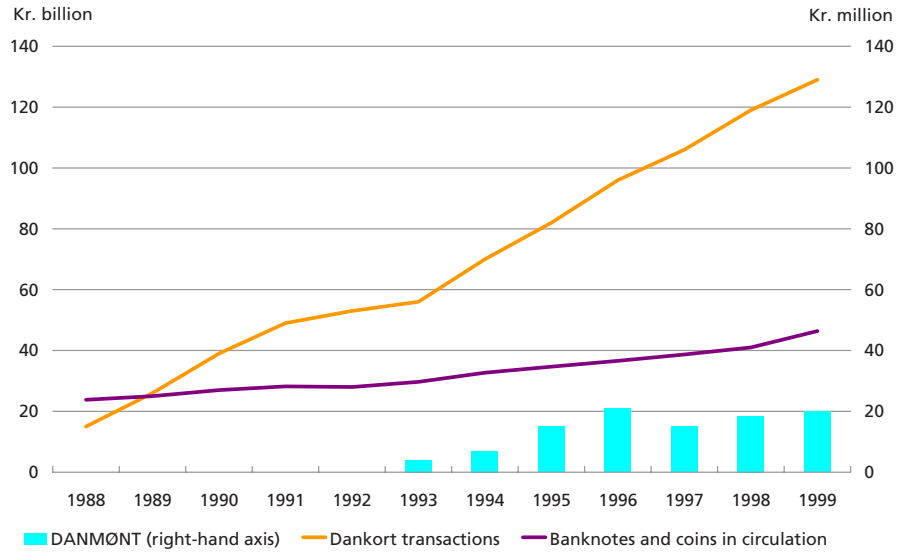
In addition to the pooled monetary income from the national central banks' issue of banknotes, the ECB will have independent revenue, mainly from the yield on its own portfolio (the counterpart of the NCBs' paid up capital shares). The ECB's surplus after allocation to the reserves – and in exceptional cases cover of losses – will be allotted to the participating NCBs. Collectively, the NCBs do not suffer specific losses or gain extra revenue by participating in the Eurosystem.

SEIGNIORAGE AND NEW PAYMENT TECHNOLOGIES

The seigniorage generated at the central bank is ultimately determined by the conditions affecting the private sector's demand for base money. One factor which – theoretically at any rate – affects this demand is new developments in electronic payment technology. The new electronic payment methods include a number of products (smart cards, chip cards or electronic purses) based on electronic storage of value. Examples in Denmark are the DANMØNT card or telephone cards, as well as various electronic transaction systems (Dankort and credit cards, home banking services, payments services or Internet payments) based on computer networks.

The influence of the new payment technologies on base money and thereby on the seigniorage generated at the central bank is expected mainly to be from the banknote and coin component, as the banks' accounts with the Nationalbank are determined mainly by the terms of the banks' payments and equalisation of liquidity variations. Card-based electronic money may be seen as an electronic alternative to minor cash

CIRCULATION OF BANKNOTES AND COINS AND ELECTRONIC PAYMENTS Chart 1



Note: Different scales are used on the left- and right-hand axes. Furthermore, the circulation of banknotes and coins and outstanding Danmønt cards are stock figures, whereas the value of Dankort transactions shows turnover.

transactions, so that greater use of these cards will have a very direct impact on circulation of banknotes and coins. The use of actual multi-purpose electronic money is not yet widespread in Denmark, however, and is limited to the DANMØNT card. In Denmark use of the Dankort debit card and of electronic payment systems in general is of far greater importance to households' settlement of their payments. For example, the number of Dankort transactions has multiplied many-fold over the last 10 years. Contrary to expectations it has, however, not been possible to demonstrate a statistical connection between the development in total banknotes and coins in circulation and the number of electronic payments, cf. Chart 1. Presumably this is partly because most of the large-value electronic transactions were not previously cash transactions, but e.g. cheque transactions. At the same time, the increase in the number of Dankort terminals has made cash more readily available. Finally, the low inflation during the last 10 years has, all else being equal, reduced the costs of holding cash[1].

At an academic level it is discussed whether the increased use of electronic money will make central banks superfluous in the long run, or rather whether the central banks will lose their influence on short-term interest rates if base money diminishes[2]. There are not many indications

[1] See also Erik Haller Pedersen and Tom Wagener, Circulation of Notes and Coins in Denmark, Danmarks Nationalbank, *Monetary Review,* November 1996.

[2] See e.g. Benjamin Friedman, The Future of Monetary Policy, *International Finance*, November 1999.

that this will be the case in the immediate future. Firstly, as stated above, the impact of electronic money and payments on base money has been surprisingly small. In the long run, however, a certain degree of undermining of base money and thereby a decline in the earnings potential of the Nationalbank cannot be ruled out. Secondly, even if base money were to disappear entirely it could be argued that by borrowing and lending electronic money the Nationalbank will retain its influence on short-term interest rates[1]. Strictly speaking, the opportunities to pursue monetary policy are not related to the issue of banknotes and coins, but to the fact that the banks wish to hold accounts with the Nationalbank. These accounts are risk-free and of practical use in connection with settlement of payments and equalisation of liquidity in the money market.

[1] See Charles Goodhart, *International Finance* (forthcoming).