Clearing vs. Leakage: Does Note Monopoly Increase Money and Credit Cycles?

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Clearing vs. Leakage: Does Note Monopoly Increase Money and Credit Cycles? [+]

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The effects of note monopolisation on the amplitude of money and credit cycles are studied. Note monopolisation trades clearing for leakage. If the central bank's reserve ratio is larger than that of the commercial banks, and if the currency-deposit ratio is sufficiently large, the leakage effect could dominate the loss-of-clearing effect (base expansion), such that the credit capacity of the banking system decreases. This was the case when the Bank of Sweden gained a note monopoly in 1904. Money and credit cycles should therefore have become smaller. Swedish bank data for 1871–1938 reveal that money cycles became smaller, but credit cycles larger. The latter is attributed to an increasing time-demand deposit ratio, which increases the credit capacity of the banking system.

Key words: Clearing mechanism, Credit expansion, Currency-deposit ratio, Fiduciary money, Free banking, Leakage, Money multiplier.
JEL codes: E32 E42 E51.

1 Introduction

Modern fractional reserve banks can extend credit by issuing fiduciary money – payment media not covered by base money. By this power, the banking system can potentially create large swings in the volumes of money and credit. A question of longstanding controversy is this: Are money and credit cycles smaller when notes are supplied competitively by many banks, or when notes are supplied monopolistically by a central bank? Ever since the classical monetary debates of the 19th century, two views have stood opposed.

In the "free banking view", note competition is the necessary remedy against credit expansion, since the interbank clearing mechanism will then check the banks – banks that overexpand will suffer reserve losses in the clearing, which will rapidly force them to contract. By contrast, a note monopolist (a central bank) is not constrained by the clearing mechanism, since its demand liabilities will be treated as base money by other banks and hence be used as reserves. Money and credit cycles will therefore be larger under note monopoly.

In the opposite "currency view", the clearing mechanism cannot prevent overexpansion if the banks expand in concert, since no bank will then suffer net reserve losses in the clearing. The only automatic check against overexpansion is through leakage of reserves from the banking system – eventually, through an external drain, but also (in the case of note monopoly) arising from the public's demand for currency. Money and credit cycles will therefore be larger under note competition.[1]

Although the literature on this subject goes back over a century, it has until now been limited to theoretical speculation, with little or no empirical backing. This paper moves to fill the lacuna. In late 19th century Sweden, about 25 commercial banks called Enskilda banks issued notes, competing successfully with the Bank of Sweden, until this bank gained a note monopoly in 1904. This paper uses Swedish bank data from 1871–1938 to investigate how money and credit cycles

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[1] On the classical monetary debates see Smith (1936), White (1984), Schwartz (1992), Selgin and White (1994a). On the modern controversy see Goodhart (1988), Laidler (1992), Bordo and Schwartz (1996), and Selgin (2001).

were affected by the note monopolisation. Below, the effects of note monopolisation on the banking system's credit capacity are operationalised and quantified. What is the relative size of the clearing and leakage effects? This question is addressed by comparing multipliers of money and credit before and after monopolisation. It is shown that if the central bank's reserve ratio is larger than the reserve ratio of the commercial banks, and if the public's preferred currency-deposit ratio is sufficiently large, then the leakage effect may dominate the clearing effect, such that the money multiplier (and hence the banking system's credit capacity) may decrease after monopolisation. This was the case when the Bank of Sweden gained a note monopoly in 1904. However, the credit capacity is also increased if the public's preferred time-demand deposit ratio increases. This was shown to be the case, and this effect dominated the other effects such that the credit multiplier increased. Thus, the multiplier analysis yielded the predictions that money cycles should decrease post monopolisation, while credit cycles should increase. Confrontation with data yielded this very result. While money cycles became smaller, credit cycles became larger.

2   Clearing vs. Leakage: the model

Following Thunholm (1962, p. 239), the "credit capacity" of the banking system is governed by two items: the quantity of precautionary reserves that banks want to hold in relation to their (demand) liabilities, and the size of the reserves leakage that arises from a credit expansion. Note monopolisation does two things. First, it withdraws the demand liabilities of the central bank from the range of the clearing mechanism. Thereby the monetary base is expanded, which enhances the credit capacity of the banking system. Second, it transforms currency into base money. This installs leakage, which constrains the credit capacity of the banking system.

If the credit capacity of the banking system can be measured by the money multiplier, it is possible to quantify the two effects. From standard textbooks (e.g. Dornbusch and Fischer 1990) we learn that the quantity of money M may be regarded as a function of the banking system's money multiplier m times the quantity of base money B. With m fixed, an exogenous change in the quantity of base money

would cause a change in the quantity of money according to the expression:

$$\Delta M = m \cdot \Delta B \tag{1}$$

If the money multiplier were to decrease, then a given change in the quantity of base money would cause a smaller change in the quantity of money.

This kind of mechanical multiplier approach has been criticised for being unrealistic as a description of the money supply process in the real world (Goodhart 1988). Although this critique may be valid, the purpose here is not to describe the money supply process, but to use the multiplier approach as a heuristic device to convey relative magnitudes of the clearing and leakage effects. For our purposes it is enough that the following premise is reasonably valid:

> **Premise**. *A larger money (credit) multiplier is associated with larger swings in the volume of money (credit).*

We will now formalise and quantify these effects.

The money multiplier

In the competitive note banking system, all banks have the following schematic balance sheet:

Table 1 Balance sheet of bank in a note-competitive system

Reserves	**Notes**
Credit	**Demand deposits**
	Time deposits

The bold faced letters are used as abbreviations. The money stock *M* consists of notes and demand deposits. Denote inside money by *I*, that is, the money generated within the commercial banking system that are redeemable into base money *B*. In the competitive note banking system they are notes and demand deposits. The note-competitive banking system is characterised by three conditions. First the money stock consists exclusively of inside money. Second and corollary, base money is exclusively used as reserves. Third, base money is gold G. This may be written in the following way:

Conditions of the note-competitive banking system:

1. $I = N + D = M$
2. $B = R = G$

$$(2)$$

Let us further define the following two ratios:

$$r = \frac{R}{I} \qquad (3)$$

and

$$c = \frac{N}{D}, \qquad (4)$$

that is, the reserve ratio and the currency-deposit ratio. These are thought of as behavioural constants. All banks are asumed to have the same reserve ratio. To calculate the money-to-gold multiplier (MGM) we write:

$$\frac{M}{G} = \frac{M}{B} = \frac{M}{R} = \frac{M}{rI} = \frac{N+D}{r(N+D)} + \frac{(c+1)D}{r(c+1)D} = \frac{1}{r} \equiv m_{nc}. \qquad (5)$$

With note competition, the money-to-gold multiplier is equal to the money-to-base multiplier, or money multiplier for short. We see that the money multiplier is the inverse of the reserve ratio, a result previously derived by Selgin (1994). The currency-deposit ratio plays no role in the money multiplier of a note competitive banking system. An increase in the demand for notes relative to deposits would only exchange one type of inside money for another, with no effect on the total volume of money.

As previously stated, note monopolisation does two things. By giving a central bank monopoly on notes, it withdraws the demand liabilities of the central bank from the range of the clearing mechanism, wherefore notes and demand deposits of the central bank become base money. The demand deposits of the central bank are equal to the reserves of the banks, *R*. Denote by R_{cb} and r_{cb} the reserves and the reserve ratio of the central bank, where $r_{cb} = R_{cb}/B$. Note monopoly is characterised by the following conditions:

Conditions of the note-monopolistic system:

1. $R_{cb} = G$

2. $B = N + R$ (6)

3. $I = D$

We then form the money-to-gold multiplier:

$$\frac{M}{G} = \frac{N+D}{R_{cb}} = \frac{(c+1)D}{r_{cb}B} = \frac{(c+1)D}{r_{cb}(c+r)D} = \frac{c+1}{r_{cb}(c+r)} \equiv \frac{m_{nm}}{r_{cb}}. \tag{7}$$

The MGM of note monopoly consists of two items: the money multiplier m_{nm} of standard textbooks, divided by the central bank's reserve ratio. In contrast to the case of note competition, the money multiplier of note monopoly is affected by a change in the currency-deposit ratio. A larger c means more leakage of reserves, which forces the banks to contract. The money multiplier is therefore smaller. If MGM is to remain unchanged after note monopolisation, the following must hold:

$$\frac{1}{r} = \frac{c+1}{r_{cb}(c+r)} \tag{8}$$

or

$$r_{cb} = \frac{r(c+1)}{c+r} = \frac{m_{nm}}{m_{nc}} \tag{9}$$

The central bank's reserve ratio must be equal to the ratio between the money multipliers of note monopoly and note competition. Monopolisation installs leakage which lowers the money multiplier from m_{nc} to m_{nm}. But it also creates base expansion, equal to the inverse of r_{cb}. Under what conditions will the leakage effect dominate the base expansion effect, such that the money-to-gold multiplier decreases?

First, consider the case where the central bank's reserve ratio is equal to that of all the other banks, that is, $r_{cb} = r$. Assume further that the reserve ratios are not affected by monopolisation. From equations (8) and (9) we see that m_{nc} must then be equal to one if the total mul-

tiplier is to remain unchanged, or smaller than one, if the total multiplier is to decrease:

$$\frac{c+1}{c+r} \leq 1. \tag{10}$$

The money multiplier can at most be equal to one, and this occurs if the banks hold 100 percent reserves, or if c is infinitely large. In practice this never happens. This yields the following propositions:

Proposition (i): *If the central bank's reserve ratio is equal to the reserve ratio of the commercial banks, then the money-to-gold multiplier will increase post monopolisation.*

Proposition (ii): *If the money-to-gold multiplier is to decrease post monopolisation, then the central bank's reserve ratio must be higher than that of the commercial banks.*

Now consider the case when the central bank's reserve ratio is different from the reserve ratio of the commercial banks,

$$r_{cb} \neq r_b. \tag{11}$$

With note competition, the money stock will then be

$$M = M^{cb} + M^b = \frac{(1-a)B}{r_{cb}} + \frac{aB}{r_b}, \tag{12}$$

where a is the share of base money held by the commercial banks. Now define

$$\frac{r_b}{r_{cb}} \equiv g. \tag{13}$$

Substituting (13) into (12) yields

$$M = \frac{(1-a)B}{\dfrac{r_b}{g}} + \frac{aB}{r_b}, \tag{14}$$

or

$$\frac{M}{B} \equiv m_{nc} = \frac{(1-a)g + a}{r_b}. \tag{15}$$

For the MGM to be unchanged after monopolisation, the following must hold:

$$r_c = \frac{r_b(c+1)}{((1-a)g+a)(c+r_b)} \, . \qquad (16)$$

Compare (16) with (9). If $g = 1$, the reserve ratio of the central bank is equal to that of the commercial banks, and (16) reduces to (9). However, if $g > 1$, then the right-hand side could conceivably be smaller than r_{cb}, and hence the total multiplier could decrease after monopolisation. Whether that will happen depends on the values of a, g and c. The multiplier will decrease more the smaller a is, and the larger g and c are. Figure 18 shows the reserve ratios of the commercial banks and the Bank of Sweden, as well as the currency-deposit ratio, in 1875–1938.

Figure 1 Reserve and currency-deposit ratios, Sweden 1875–1938.
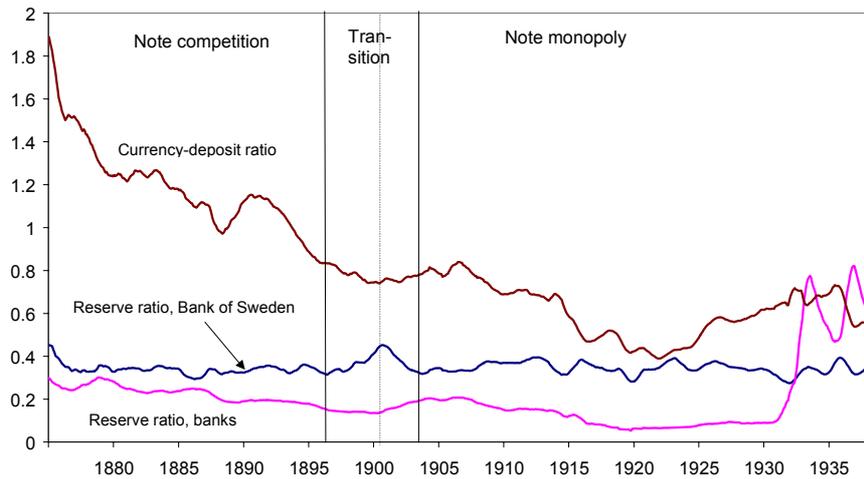
|	c	r_b	r_{cb}	a	g
1897	0.84	0.16	0.32	0.52	2
1904	0.78	0.19	0.32	0.34	1.68

Source: Summary of the Bank Reports.

The reserve ratio of the Bank of Sweden was highly stable. For the whole 60-year period 1878–1938, the mean reserve ratio was 0.35, with a standard deviation 0.037 (11 percent). It was not affected by note monopolisation. The reserve ratio of the commercial banks was 0.16 at the beginning of the transition period, and 0.19 at the end of it. From 1908 to 1920 it declined to below 10 percent. The currency-

deposit ratio was about 0.8 at the time of transition. It declined during WWI, to increase again to over 0.6 in the middle of the 1920s.

Figure 1 shows that r_{cb} was larger than r_b both before and after monopolisation. The currency-deposit ratio also seems large, at least compared to contemporary figures. These two facts make it possible that the total multiplier decreased post monopolisation. In Figure 2, the values of r_{cb}, r_b, and g at the end of the transition period have been plugged into equation (9). a was set to 0.50. The graph shows the multiplier ratio m_{nc} / m_{nm} as a function of the currency-deposit ratio.

Figure 2 Multiplier ratio as a function of the currency-deposit ratio
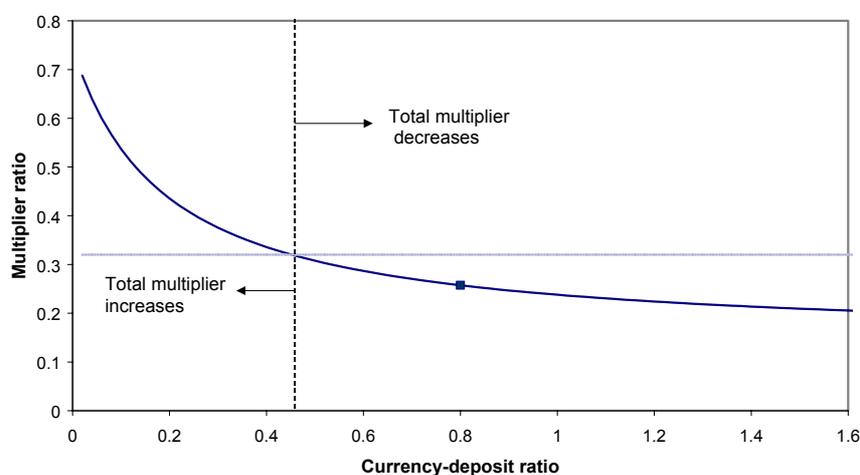
Note: Parameters: r_{cb} = 0.32, r_b = 0.19, a = 0.50, g = 1.68.

The multiplier ratio is a negative function of the currency-deposit ratio. A larger currency-deposit ratio results in a smaller note monopoly multiplier, and hence a smaller multiplier ratio. Figure 2 marks a line for r_{cb} = 0.32. If the multiplier ratio is below this line the total multiplier will decrease after monopolisation. For the parameters r_{cb} = 0.32, r_b = 0.19, a = 0.50, and g = 1.68, the currency-deposit ratio must be greater than 0.46 for the money-to-gold multiplier to decrease post monopolisation. The currency-deposit ratio was about 0.8 – well above the required value. Because r_b and a decreased while g increased, and since r_{cb} remained stable, the required currency-deposit ratio decreased even further over time. It is therefore highly likely that the total multiplier decreased post monopolisation. Indeed,

this was also what happened. Figure 3 shows the money-to-gold ratio of the Swedish banking system, 1875–1938.

Figure 3 Money-to-gold ratio of the Swedish commercial banking system, 1878–1938
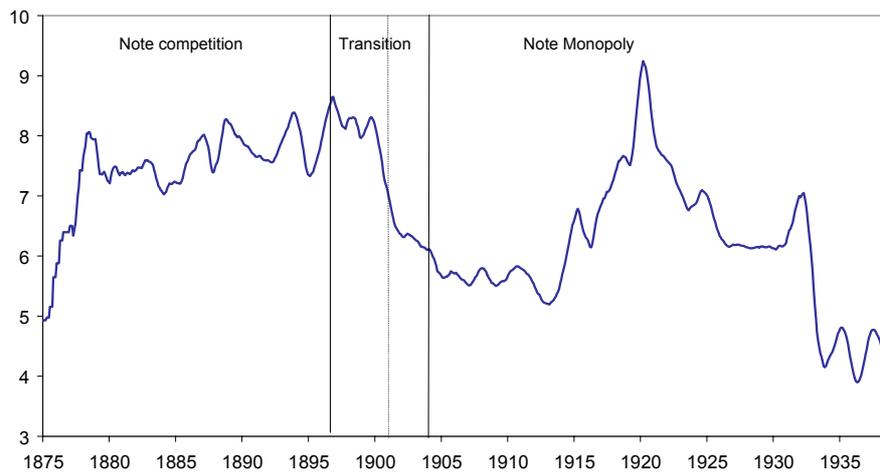
Source: Summary of the Bank Reports.

The money-to-gold ratio clearly decreased post monopolisation. Except for the WWI period, the money-to-gold ratio was lower after 1904 than it was during the note competition period.

The credit multiplier

It was argued that the credit capacity of the banking system was determined by the reserve ratio of the commercial banks, and the size of the leakage of reserves that arises from a credit expansion. Hence, the credit capacity could be measured by the money multiplier. However, a third item is also of importance to the banks' credit capacity, namely the public's preferred time-demand deposit ratio. If the public wants to hold more time deposits relative to demand deposits, then this would enhance the banks' credit capacity, since less demand deposits means that less reserves are tied up. The money multiplier is therefore a valid measure of the credit capacity only under the assumption that the time-demand deposit ratio remains unchanged.

To see this, we calculate the "credit multiplier" in a note competitive banking system, in the same way as we did with the money multiplier. From the balance sheet of Table 1 we see that

$$C = I + T - R. \tag{17}$$

Define the time-demand deposit ratio t as

$$t = \frac{T}{D}. \tag{18}$$

As was the case with c and r, t is treated as a behavioural constant. We can then form the credit-to-gold multiplier (CGM) as

$$\frac{C}{G} = \frac{N + D + T - R}{R} = \frac{c + 1 + t}{r(c+1)} - 1 \tag{19}$$

This multiplier will be compared to the one of note monopoly. When we form the credit multiplier for the note monopoly system, we assume (realistically) that the central bank has no time deposits. The central bank's credit is thus

$$C = N + R - R_{cb} \tag{20}$$

The credit-to-gold multiplier thus becomes

$$\frac{C}{G} = \frac{C_b + C_{cb}}{G} = \frac{D + T - R + N + R - R_{cb}}{R_{cb}} = \frac{1 + t + c}{r_{cb}(c+r)} - 1. \tag{21}$$

If the CGM is to remain constant after monopolisation, then it must be that

$$\frac{c + 1 + t}{r(c+1)} - 1 = \frac{1 + t + c}{r_{cb}(c+r)} - 1, \tag{22}$$

Under the condition that t is constant, (22) reduces to

$$r_{cb} = \frac{r(c+1)}{c+r}. \tag{23}$$

This is the same condition as the one that pertained to the MGM in (9). This means that an increase/decrease in the MGM means an equal increase/decrease in the CGM, and a sign that the credit capacity of the banking system has inceased/decreased. By observing a decreasing money multiplier, we can predict that credit cycles should become smaller. We can state the following:

> **Proposition**: If the time-demand deposit ratio is constant, then a decrease in the money multiplier means a decrease in the credit multiplier, and hence a decrease in the credit capacity of the banking system.

Unfortunately, the assumption of a constant time-demand deposit ratio is not warranted for the period in question. This is seen in Figure 4.

Figure 4 Time-demand deposit-ratio, 1878–1938.
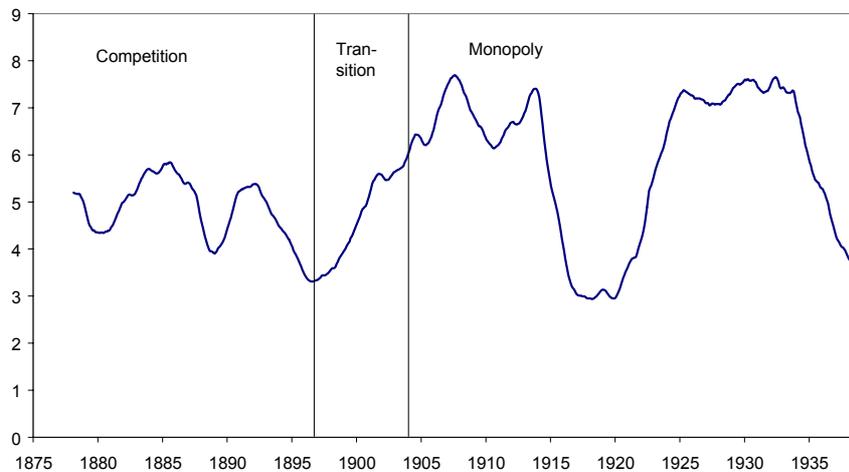
Source: Summary of the Bank Reports.
Note: 12 month moving average.

Clearly, the time-demand deposit ratio increased after monopolisation, from levels around five in the competition period, to levels around seven in the monopoly period (except during WWI, when it dropped drastically). This represents a substantial increase in the credit multiplier. Calculating the multiplier in (21) with *t* equal to 5 and 7 yields multiplier values of 20 and 26 – an increase of about 30 percent.

3 Money and credit cycles 1871–1938

It was argued that if the central bank's reserve ratio is larger than the reserve ratio of the commercial banks, and if the currency-deposit ratio is sufficiently large, then the total money multiplier (MGM) might decrease post monopolisation. This was also shown to be the

case. Further, if the premise is accepted that a smaller MGM is associated with smaller money cycles, then smaller cycles are to be expected after notes were monopolised by the Bank of Sweden in 1904. Further, the multiplier analysis showed that the smaller MGM should mean a smaller CGM and hence a smaller credit capacity of the banking system, wherefore smaller credit cycles are to be expected. However, the time-demand deposit ratio also increased, which increased the credit capacity of the banks. This effect increased the CGM by about 30 percent. Despite a decreasing money multiplier, credit cycles should therefore be expected to increase after monopolisation. Explicitly stated, the multiplier analysis yields the following two predictions:

> **Predictions:** *Money cycles should have become smaller, and credit cycles larger, after notes were monopolised by the Bank of Sweden in 1904.*

These predictions are here confronted with Swedish bank data for the period 1871–1938. The amplitude of money and credit cycles before and after note monopolisation in 1904 is examined. The data are from the Summary of the Bank Reports [*Sammanfattning af bankernas uppgifter*]. These are data from the bank balance sheets collected by the Bank Supervisory Authority [*Bankinspektionen*]. For the Bank of Sweden there exists quarterly data for 1871–1877, and monthly data from January 1878. For the commercial banks there exists quarterly data for 1871–1874, and monthly data from March 1875. Since note monopoly was prescribed in the Bank Law of 1897 and the Bank of Sweden thereafter began to act like a central bank (for example by rediscounting bills of other banks, the period under study may be divided into three periods: a "note competition period" 1878–1897, a "transition period" 1897–1904, and a "note monopoly period" 1904–1938.

Problem of a small sample

Because note monopolisation occurred in 1904, Sweden is fortunate in being one of few countries where it is possible to compare the relative performance of note competition versus note monopoly in the period of the classical gold standard. Unfortunately, there were only ten years with note monopoly before the demise of the classical gold

standard occurred in 1914 at the outbreak of WWI. The cycles sample is therefore very small. There are three cycles in the note competition period 1871–1897, one cycle in the transition period 1897–1904, and one cycle in the note monopoly period 1904–1914. Hence, there are no degrees of freedom left to control for external events, nor is it possible to perform statistical tests. To increase the sample for the note monopoly period, the data set is extended to the year 1938. Sweden re-adopted the gold standard between April 1924 and September 1931. The extension brings one more cycle to the "note monopoly on gold"-sample. For the sake of completeness, it is of value to document the entire series of money and credit cycles during the gold regime. An objection is that the interwar period in 1920–1939 is incommensurable with the pre-WWI period. Internationally, macro variables tended to fluctuate more in the interwar period compared to what they did before the war. This was the case also in Sweden (Englund *et al.* 1992). However, this fact would tend to weaken the value of the investigation if it was predicted that money and credit cycles unambiguously increased post monopolisation. In such a case, a discovered increase in cycle amplitudes could credibly be attributed to exogenous events rather than to a change in note regime. The problem here is somewhat more complicated, since it is predicted that money cycles should *decrease*. If this were found to be the case, the underlying theory would be strengthened by a preconception of larger interwar volatility.

The investigation should also be of value, since – to my knowledge – it is the very first empirical study of how note monopoly affects money and credit cycles.[2] Although the material is insufficient for a final statement on the question of how note monopoly affects money and credit cycles, it should provide a valuable first word on it, perhaps providing groundwork for future comparisons of countries with and without note monopoly during the classical gold standard.

Methodology

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[2] Some related studies are Ögren (2003), who investigate long-term trends in money and credit in Sweden 1834–1913, and Miron (1986) and Hortlund (2005), who study the *seasonal* effects of note monopolisation in the US and Sweden, respectively.

To measure cycle amplitude, moving averages (of logged variables) are used. Centred 12-month moving average (MA) series are used to filter out seasonal effects, and centred 8-year moving average series are used to filter out the trend component. An 8-year period is chosen because this was the approximate cycle length (from peak to peak) over the sample period (except during the exceptional circumstances in 1914–1924). Cycle amplitude is thus measured as follows:

Cycle amplitude = 12 month MA – 8 year MA.

Alternatively, cycles were also calculated for cycle periods of 7 and 9 years. The results were not affected (available upon request).

3.1 Money

Two measures of money are examined: Notes and fiduciary money.

Notes include all notes issued by the Bank of Sweden and the Enskilda banks. Notes held by other banks as cash are included.

Fiduciary money includes all demand liabilities used as means of payment, minus cash. *Demand liabilities* consist of notes, post bills and demand deposits held by the Bank of Sweden, the Enskilda banks and the Joint Stock banks. *Cash* includes gold, other coin, bank notes and, after January 1900, balances on giro accounts at the Bank of Sweden.

The log of notes in 1871–1938 is presented in Figure 5. For the period 1871–1878, quarterly data are used.

Figure 5 Log of notes of the Swedish banks, 1871–1938
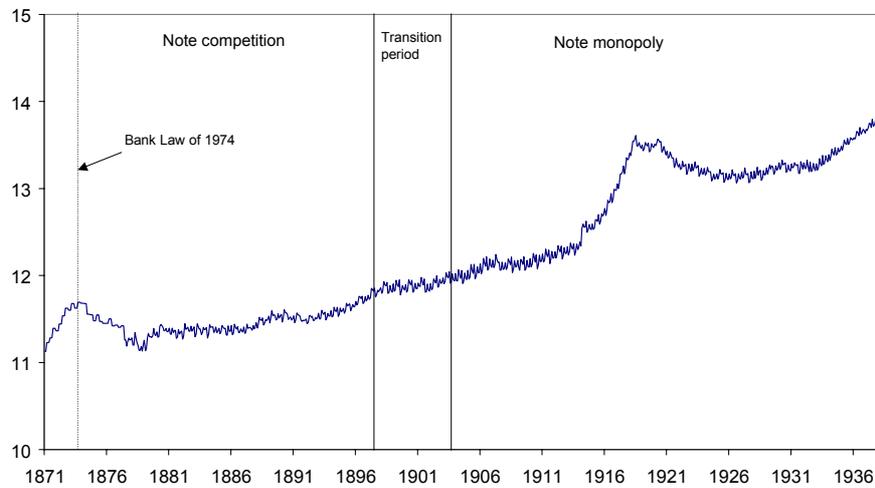
Source: Summary of the Bank Reports.

There is a sharp increase in the volume of notes at the beginning of the period that peaks in March 1874. The peak coincides with a new bank law that prescribed that Enskilda bank notes could no longer be redeemed into Bank of Sweden notes, but only into gold coin. This stands in contrast to the situation before, when Bank of Sweden notes were legally equal to specie as a redemption medium. Before 1874, the Bank of Sweden notes were therefore legally base money to the Enskilda banks, and the Bank of Sweden had substantial power over the credit capacity of the banking system. The subsequent decrease in the note stock could reflect the diminishing reserve role of Bank of Sweden notes. There is then a sharp drop at the end of 1877. This drop could reflect imperfections in the data, particularly the transition from quarterly to monthly data in January 1878. The overall impression is that note cycles did not increase after monopolisation, apart from the boom-bust episode of WWI. This is confirmed by Figure 6, which shows the cyclical component of logged notes for 1875–1935. Note that the WWI cycle has been excluded.

Figure 6 Cyclical component of log of notes, 1875–1935
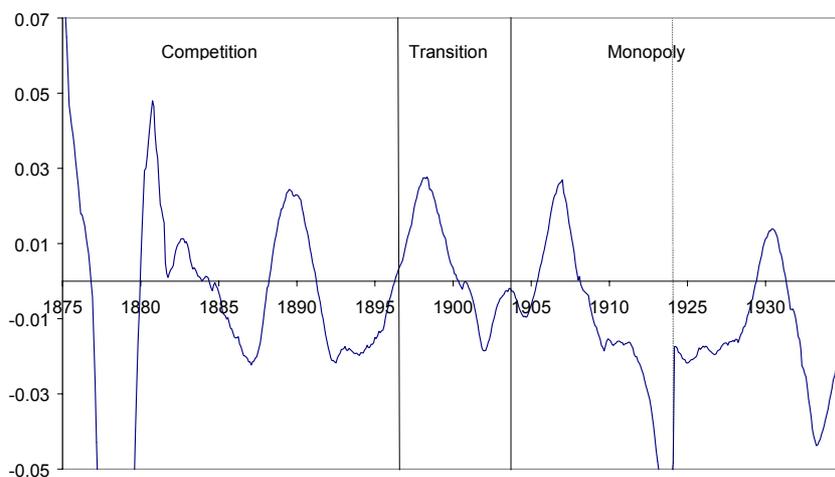
The amplitude of the notes cycle did not increase after note monopolisation. Apart from the first two cycles in the 1870s and early 1880s, the three cycles before, during and after transition have amplitudes that are more or less similar. The last cycle at the end of the gold standard period in 1931 is distinctly smaller.

When it comes to fiduciary money, there is a clear tendency towards smaller cycles post monopolisation. Figure 7 shows the log of fiduciary money of the Swedish banks in 1871–1938.

Figure 7 Log of fiduciary money, 1871–1938.
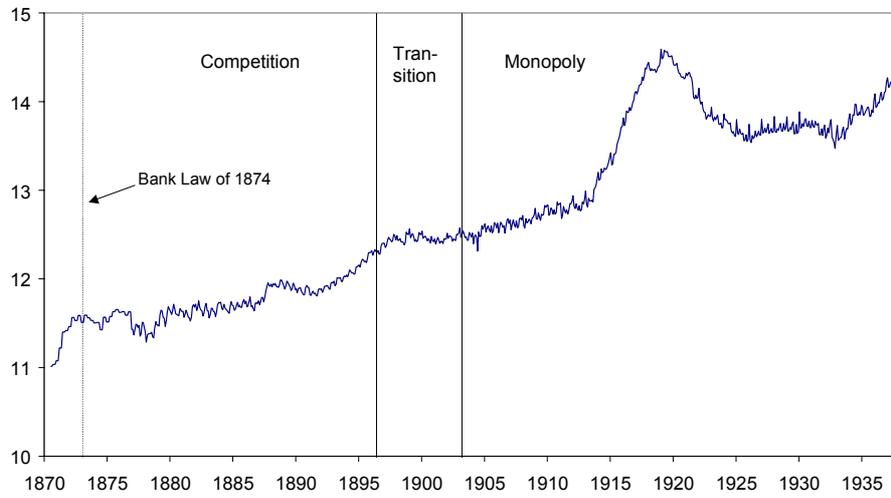
Source: Summary of the Bank Reports.

The period 1904–1914 is particularly interesting. In this period, a large and sharp credit cycle occurred that peaked in 1907–1908, as will be seen below. But the graph for the stock of fiduciary money is virtually flat during this period. Figure 8 confirms that fiduciary money cycles became smaller after note monopolisation.

Figure 8 Cyclical component of log of fiduciary money, 1875–1935.
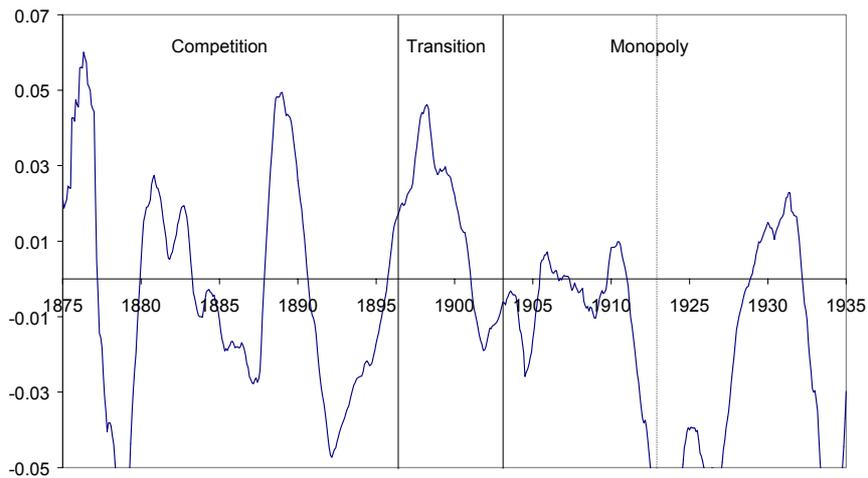
Source: Summary of the Bank Reports.

With regard to fiduciary money, the cycle became distinctly smaller post monopolisation.

3.2 Credit

Two measures of credit are studied: bills, and total lending (bills, cash credit and loans). Bills are worth looking at separately for three reasons. First, as shown in Hortlund (2005), the discounting of bills was the main vehicle by which the commercial banks issued their notes. Second, bills were the most elastic form of credit and thus the most cyclical one. Third, the discount rate was the prime interest rate that was the benchmark for all other rates. Bills were thus the main instrument of monetary policy both before and after note monopolisation, until 1932 (when government bonds became the main instrument). Figure 9 shows the log of total bank bills (commercial banks plus the Bank of Sweden) in 1871–1938.

Figure 9 Log of total bank bills, 1871–1938.
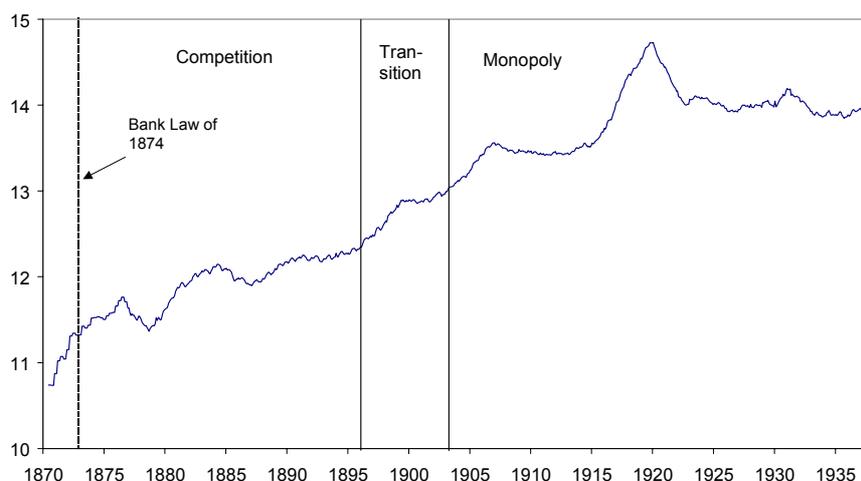
Source: Summary of the Bank Reports.

The volume of bills varied cyclically with remarkable regularity, particularly during the gold standard period. Calculation of the cyclical component indicates that the cycle amplitude increased after monopolisation. This is shown in Figure 10.

Figure 10 Cycle amplitude for log of bank bills, 1875–1935
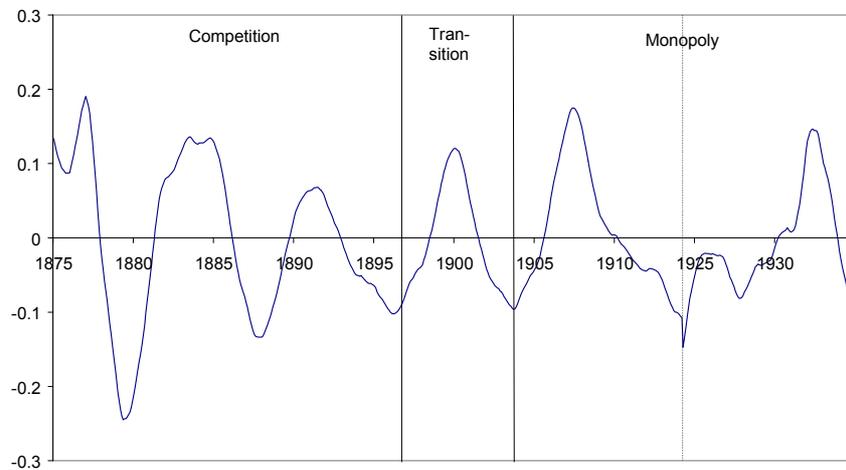
Source: Summary of the Bank Reports.

In the competition period there is a steady downward trend in the cycle amplitude. Starting in the transition period, the trend turns up-wards. Disregarding the first cycle of the competition period, the mean cycle amplitude of the monopoly period is larger than the one of the competition period. Compare the 1907–1908 bills cycle with the cycle of fiduciary media in the same period. Whereas the bills cycle is sharp, the fiduciary money cycle is virtually non-existent in this pe-riod. Note also that the interwar cycle of 1931–1932 is smaller than the prewar cycle of 1907–1908.

With regard to total lending, the trend towards larger cycles is even more manifest. Figure 11 pictures the log of total bank lending in 1871–1938.
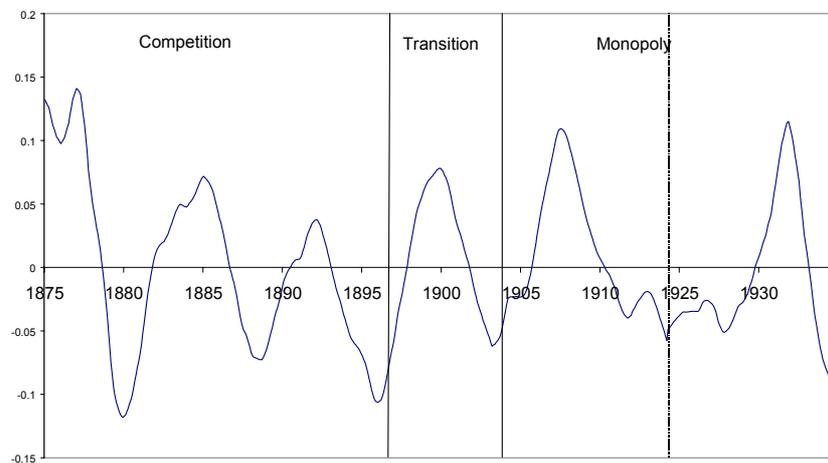
Figure 11 Log of total bank lending, 1871–1938.
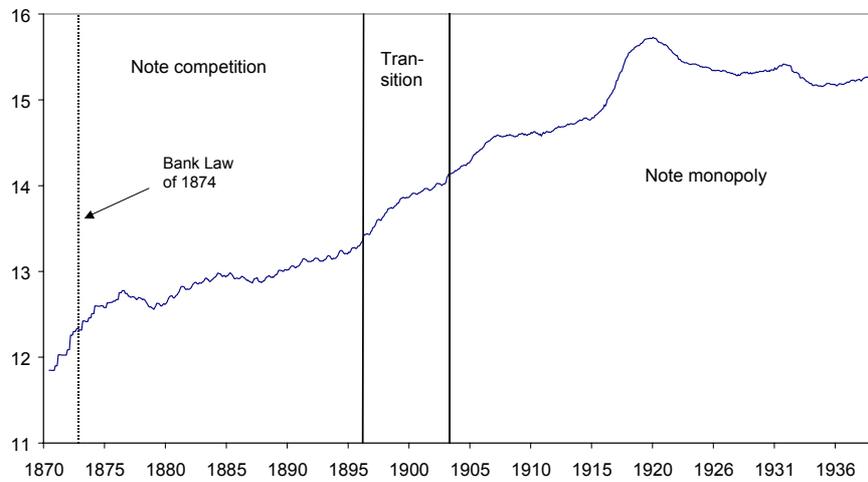
Source: Summary of the Bank Reports.

Note the strong seasonality in lending during the classical gold standard period. Lending cycles became larger after monopolisation, as Figure 12 shows.

Figure 12 Cyclical component of the log of lending, 1875–1935

Source: Summary of the Bank Reports.

Clearly, the amplitude of the lending cycle increased after note monopolisation.

4 Conclusions

This paper investigated the quantitative effects of note monopolisation on money and credit cycles. In particular, it quantified the effects of leakage and clearing. Note monopolisation trades clearing for leakage. Loss of clearing causes a base expansion effect that increases the credit capacity of the banking system. By transforming currency into base money, monopolisation also installs leakage, which curbs the credit capacity. The relative magnitudes of these two effects were evaluated through an analysis of money multipliers. Three results were reached, the first one theoretical:

1. If the central bank's reserve ratio is larger than the reserve ratio of the commercial banks, and if the currency-deposit ratio is sufficiently large, then the total money multiplier will decrease post monopolisation.

This was shown to be the case. If a smaller total multiplier is associated with smaller money and credit cycles, then, predictably, money and credit cycles should have decreased after monopolisation in 1904. However, with regard to credit, a smaller money multiplier will lead to smaller credit cycles only if the time-demand deposit ratio is constant. Since this ratio increased post monopolisation, thus increasing the credit capacity of the banks, credit cycles should be expected to have increased post monopolisation. These two propositions were confronted with Swedish bank data for 1871–1938. The confrontation yielded the following results:

2. With regard to money, the amplitude of the notes cycle slightly decreased after monopolisation, while the fiduciary-money cycle definitely became smaller, thus confirming predictions.

3. With regard to credit, cycles became larger after monopolisation, thus confirming predictions.

The multiplier analysis thus seems quite successful in explaining the effects of note monopolisation on money and credit cycles. The smallness of the sample is a problem. To what extent were changes in cycle amplitude due to the effects of note monopolisation? In particular, two external events potentially explain the incrementally larger credit cycle from 1890 to 1910. The period 1895–1910 was accompanied by an international monetary boom; and there was a deep inter-

21

national crisis in 1907. It would therefore be of interest to compare money and credit cycles for countries with and without note monopoly in the period of the classical gold standard. Hopefully, this paper has provided some groundwork for such future studies.

References

Bordo, Michael and Schwartz, Anna (1996) "The Performance and Stability of Banking Systems under 'Self-Regulation': Theory and Evidence." *Cato Journal*, Vol. 14, No. 3, pp. 453–479.

Brisman, Sven (1931) *Den stora reformperioden 1860–1904.* in Brisman, Sven, ed: *Sveriges Riksbank 1668-1918: bankens tillkomst och verksamhet.* Vol. 4. Stockholm: Norstedt & Söner.

Dornbusch, Rudiger and Fischer, Stanley (1990) *Macroeconomics.* 5th Ed, New York: McGraw-Hill.

Englund, Peter, Persson, Torsten and Svensson, Lars E.O. (1992) "Swedish Business Cycles 1861–1988." *Journal of Monetary Economics*, Vol. 30, No. 3, pp. 343–371.

Goodhart, Charles (1988) *The Evolution of Central Banks.* Cambridge, Mass.: MIT Press.

Heckscher, Eli F. (1931) *Sveriges penningpolitik. Orientering och förslag.* Stockholm: Norstedt & Söner.

Hortlund, Per (2005) "The Provision of an Elastic Currency in a Classical Free Banking System: Sweden 1878–1901." Essay 5 in this volume.

Miron, Jeffrey A. (1986) "Financial Panics, the Seasonality of the Nominal Interest Rate, and the Founding of the Fed." *American Economic Review*, Vol. 76, No. 1, pp. 125–140.

Schwartz (1995) "Currency School, Banking School, Free Banking School." In *New Palgrave Dictionary of Money and Finance*. London: Macmillan.

Selgin, George (1994) "Free Banking and Monetary Control." *Economic Journal*, Vol. 104, No. 4, pp. 1449–1459.

Selgin, George (2001) "In-Concert Overexpansion and the Precautionary Demand for Bank Reserves." *Journal of Money, Credit, and Banking*, Vol. 33, No. 2, pp. 294–300.

Simonsson, K. G. (1931) *Riksbanken som centralbank 1904–1924.* In Brisman, Sven, ed: *Sveriges Riksbank 1668-1918: bankens tillkomst och verksamhet.* Vol. 4. Stockholm: Norstedt & Söner.

Smith, Vera (1936) *The Rationale of Central Banking*. London: P. S. King & Son.

White, Lawrence H. [1984] (1995) *Free Banking in Britain. Theory, Experience and Debate 1800–1845.* London: Institute for Economic Affairs.

Ögren, Anders (2003) *Empirical Studies in Money, Credit and Banking.* Doctoral Dissertation. Stockholm: Institute for Research in Economic History at the Stockholm School of Economics.