Studies on Swedish Banking 1870–2001

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Studies on Swedish Banking 1870–2001

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Dissertation for the Degree of Doctor of Philosophy, Ph.D, in Economics, Stockholm School of Economics, 2005

Abstract

A novel set of long-term data on Swedish commercial banks in 1870–2001 is used to shed new light on some long-standing issues in money and banking. Essays 1 and 2 explore long-term changes in the leverage and profitability of the Swedish banking system, and inquire into the causes of their change. In particular, it is investigated whether inflation and high corporate taxes were the causes behind the increasing leverage of Swedish banks in the 20th century. Essays 3 to 5 describe the workings of the Swedish note-banking system in the late 19th century and compare its performance with the central-banking regime after 1904, when the Bank of Sweden gained a note monopoly. How does note monopolisation affect the elasticity of the currency, and how does it affect the size of money and credit cycles? These classical questions are tested empirically for the first time.

ISBN nr 91-7258-680-x

Keywords:

Free banking, Note monopoly, elastic currency, credit cycles, bank leverage, historical banking

Cover design: Charlotte Häggblad

Printed by: Elanders Gotab, Stockholm 2005

Distributed by:

EFI, The Economic Research Institute

Stockholm School of Economics

P O Box 6501, SE 1-113 83 Stockholm, Sweden

www.hhs.se/efi

Acknowledgements

Many persons have contributed to this dissertation. Foremost of them is my thesis advisor, Professor Magnus Henrekson, who has been crucial for seeing this project through. I also thank Professor Tore Ellingsen, who tutored me for two previous degrees, and who ensured my entry into the doctoral program – twice! I am indebted to Nils Karlson and the Ratio Institute for providing office facilities as well as a creative research environment. Dan Klein's entrepreneurial drive was essential for making this project come off ground. I also thank Fredrik Erixon and Timbro, who gave me the opportunity to write two reports that became the groundwork for this dissertation.

I am grateful for financial support from a number of benefactors. These are the Bank of Sweden, the Earhart Foundation, the Atlas Economic Research Foundation, the Jacob Wallenberg Foundation, and the Torsten and Ragnar Söderberg Foundations.

I have received comments and advice from many colleagues. Mikael Stenkula did an outstanding job as discussant on the final seminar. Daniel Waldenström took on a role as formal secondary advisor in the final stage. Niclas Berggren took the time to read and meticulously comment on most of my manuscripts. Dan Johansson has been a constant source of discussion, advice and support. I thank Pirjo Furtenbach, Carin Blanksvärd, Britt-Marie Eisler and Ritva Kiviharju for administrative assistance. Michael Andersson, Henrik Jordahl and Mickael Salabasis taught me some intricacies of econometric modelling. I am indebted to Gunnar Du Rietz for generously providing data on historical corporate tax rates. I also thank Jan Wallander for valuable input on how the world of

banking *really* works. In addition, I have benefited from comments from members of the Section for Historical Economics and Entrepreneurship and of the Institute for Research in Economic History, and from seminar participants at the Bank of Sweden, the Stockholm School of Economics, and the Stockholm Institute for Financial Research.

More generally, I have been stimulated by conversations with colleagues on what's wrong with the world and how to fix it. In addition to colleagues already mentioned, notable names are Fredrik Bergström, Anders Bornefalk, Ann-Charlotte Fridh, and F Mikael Sandström. Most of these conversations took place at fancy lunch restaurants. Lastly I thank my family for providing ultimate support.

Stockholm, July, 2005
Per Hortlund

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I.

Studies on Swedish Banking 1870–2001

This dissertation consists of five essays, comprising two different themes. Essays 1 and 2 explore long-term changes in the leverage and profitability of the Swedish banking system, and inquire into the causes of their change. Essays 3 to 5 describe the workings of the Swedish note-banking system in the late 19th century, and compare its performance with later central banking regimes.

Essay 1. The Long-Term Relationship between Capital and Earnings in Banking

In banking as in any industry, it is common knowledge that higher leverage normally means higher returns (but also greater risk). Yet, two recent studies actually found a *negative* relationship between leverage and returns in banking in the 1980s and early 1990s (Berger 1995, Demirgüç-Kunt & Huizinga 1999). These results are indeed surprising. That leverage increases returns seems to follow directly from the very nature of business. In its strongest form, the "leverage formula" predicts that return-on-equity should increase linearly with the debt-equity ratio. How can this be reconciled with the empirical results? Perhaps the negative correlation between leverage and profitability may reflect special circumstances of the 1980s and early 1990s. Conceivably, successful banks could tend to be both more capitalised and more profitable in the short run, which could obscure the fundamental positive correlation

between leverage and returns. It would therefore be interesting to see whether the reported relationship holds also in the long term. The long-term variation in bank leverage is large – capital-asset ratios were 15–20 percent at the turn of the 19th century, while they are about 5 percent today. Has this development had any influence on bank returns?

This essay uses Swedish bank data for the years 1870–2001 to study this question. The main result is that there is indeed a strong positive long-term relationship between leverage and profitability in banking. In accordance with the "leverage formula", return-on-equity increased linearly with the debt-equity ratio over the period. However, the relationship was not present in the 1980s and 1990s. Thus, while the study reaffirms a long-term "normal" positive relationship between leverage and profitability in banking, the results of the previous studies are supported.

Long-term studies of capital and returns in banking are quite rare. This essay contributes in two ways. First, it develops a way to estimate hidden reserves. Since these were as large as formal equity in the postwar period until the 1990s, the estimation of these reserves is necessary to arrive at realistic figures for leverage and profitability. Second, it is to my knowledge one of the first papers in the literature that quantitatively estimates the long-term (century-long) relationship between leverage and profitability in banking.

Essay 2. Does Inflation and High Taxes Increase Bank Leverage?

In this paper I explore whether two fundamentals of post-WWII macropolicy in many countries – high corporate taxes and inflation – have had the unintended consequence of increasing bank leverage. As shown in Essay 1, the leverage of the Swedish commercial banking system mainly increased during two periods in the 20th century, namely during WWI and in 1940–1980. Both were periods of inflation and high corporate taxes. Banks are special in

that inflation automatically tends to swell bank deposits and hence bank debt. To be able to keep their capital ratios constant, banks must actively add to their equity in step with inflation. However, high corporate taxes put obstacles to capital accumulation. Bank capital ratios will therefore decrease. But decreasing capital ratios means increasing leverage, which means increasing returns. After a while returns become sufficient to uphold capital ratios at constant levels.

The paper presents a formal theory on how inflation and corporate taxes may interact to increase bank leverage, and it confronts the theory with Swedish bank data 1870–2001. Results are supportive. The capital-asset ratio decreased when corporate taxes and inflation were high, in an economically and statistically significant way. Moreover, the theory can explain the stability of the capital-asset ratio since the early 1980s, despite the fact that inflation and corporate taxes continued to be high in 1980–1990. The combination of high corporate taxes and inflation was estimated to account for half of the postwar drop in Swedish bank capital ratios. Since capital ratios were inadequate to cope with the Swedish banking crisis in 1991–1993, it may be asserted that the policy of inflation and high corporate taxes in 1940–1990 contributed to the severity of the crisis.

Essay 3. Clearing vs. Leakage: Does Note Monopoly Increase Money and Credit Cycles?

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 classi-

cal 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.

According to the rival "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.

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 1871–1915 to investigate how money and credit cycles were affected by the note monopolisation.

The empirical evidence reveals that the money cycle became smaller, while the credit cycle became larger, after notes were monopolised by the Bank of Sweden. At the same time, the money multiplier decreased, while the credit multiplier increased. These facts points to a link between the size of multipliers and the size of cycles. How did note monopolisation affect multipliers? Note mo-

nopolisation trades loss of clearing, or base expansion, which increases the multiplier – for leakage, which decreases it. What is the relative size of the clearing and leakage effects? 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. Consistent with data, the multiplier analysis yielded the predictions that the money cycle should decrease post monopolisation, while the credit cycle should increase.

Essay 4. Is the Law of Reflux Valid?

A big issue in the 19th century classical monetary debates was the question of the elasticity of the currency. How should monetary institutions be arranged to make currency supply responsive to the "needs of trade", increasing and decreasing with changes in demand? In the most classical of the debates, the British one, three views emerged known as those of the Currency School, the Banking School and the Free Banking School. The Currency School denied that there was any need for an elastic currency, and it favoured quantitative restrictions on note supply to stop the banks from over-issuing. The Banking School held the opposite view, claiming that restrictions would be harmful since it would make the currency inelastic and unresponsive to needs. It would also be unnecessary, since note-issuing banks – whether many or a single one – could not issue beyond what the public was willing to hold. There was a "law of reflux" at work – unwanted notes would al-

ways be returned to the issuer, either deposited with it or used to repay loans. The note stock would therefore always be demand-elastic. The Free Banking School sided with the Banking School in holding that quantitative restrictions would be harmful to the "needs of trade". However, it argued that it was crucial that there be many issuers, since notes would then be subject to the inter-bank clearing mechanism. Many issuers would speedily redeem each other's notes through the clearing. By contrast, notes of a single issuer would be treated as base money and would therefore not be redeemed: they would either be reissued or deposited with the issuer. Thus, while the Banking School held that notes would be equally demand-elastic whether supplied by many or a single issuer, the Free Banking School held that notes would be less demand-elastic if supplied by a single issuer.

Although the debates of the classical monetary schools have received much scholarly attention, there are few studies that quantitatively test the merits of the claims involved. In particular, there are virtually no studies of how different note regimes affect the elasticity of the currency. An exception is Selgin and White (1994), who show how elastic the note stock of the unrestricted Canadian note banking system was compared to the note stock of the American National Banking system, in the late 19th century. A problem is that competitive note banking regimes often ended before systematic bank statistics were collected. This is the case of Britain where it ended already in 1845, which is probably an important reason why the elasticity claims of the classical monetary schools have rarely if ever been tested.

For this reason, the case of Sweden should be of interest. Data are readily available, and the Swedish experience of competitive note banking ended in the middle of the classical gold standard period 1870–1914, wherefore *ceteris paribus* conditions can be said to apply. I compare the elastic properties of the note stock of the Swedish note banking system in 1878–1901 with those of the re-

gime in 1904–1913, when the Bank of Sweden held a note monopoly. Evidence suggests that notes did not become less elastic after monopolisation, thus lending support to the views of the Banking School.

Essay 5. The Provision of Liquidity in the Swedish Note Banking System

Modern central banks largely emerged as a means to provide liquidity in times of crises. In the 19th century liquidity crises were common, with bank runs and panics. Liquidity crises were most famously a problem in England and in the United States. In England, the Peel's Act imposed a 100 percent marginal gold reserve requirement on Bank of England notes, which created an inelastic note stock unable to accommodate increased demands for currency in 1847, 1857 and 1866, when runs and panics occurred. From these events the Bank of England eventually evolved into becoming a central bank-lender of last resort. Likewise, in the United States the 110 percent bond collateral requirement on National Bank notes created an inelastic note stock unable to meet peak demands for currency, for example in the falls during "crop moving season". The Federal Reserve System was created in 1913 with the set purpose to furnish an elastic currency. In the United States some reformers pushed for what they called an asset currency (Selgin and White 1994). To provide an elastic currency, the National Banks should be allowed to back their notes with any assets they saw fit, as in Canada, where banks were unrestricted to expand and contract their note volumes with the "needs of trade", and where runs and panics did not occur.

Since central banks were largely set up to provide liquidity in times of need, the alternative – unrestricted note banking systems able to provide "asset currencies" – should be of interest. However, although the last two decades has seen a renewed interest in the theory and practice of "free banking", there are to this date virtu-

ally no quantitative studies of how historical "asset currencies" really worked. That is: how exactly were unrestricted banks able to provide liquidity and accommodate the "needs of trade"? This paper provides a quantitative examination of the workings of the asset currency provided by the Swedish note banking system in 1878–1901. This is done by describing how the volume of notes varied over the year, and how other balance sheet items co-moved with them.

Summary conclusion

Essays 3–5 show that with regard to the issue of free vs. central banking, their relative performance was more or less equal. No great differences can be detected before and after note monopolisation, neither in the elasticity of the note stock, nor in the size of cyclical movements. When the monetary system is on the gold standard, and when the central bank is committed to the "rules of the game", the question of note monopoly appears to be of second order – at least for small open economies such as the Swedish one. However, as essays 1–2 show, macroeconomic stability was greater during the pre-WWI gold standard regime compared to the rest of the 20th century. Despite strong constitutional guarantees, the gold standard was suspended only ten years after notes were monopolised by the Bank of Sweden. An overall lesson of this thesis is therefore perhaps that the benefit of free banking is that it works as a commitment device that keeps the economy firmly on the gold standard. Thereby, the free banking system can insulate an economy from the twin evils that haunted economies of the 20th century, namely inflation and large-scale banking crises.

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II.

The Long-Term Relationship between Capital and Earnings in Banking[+]

Contrary to received wisdom, some recent studies report a negative relationship between leverage and profitability in banking in the 1980s and early 1990s. This study presents new data on the leverage and profitability of Swedish commercial banks in 1870–2001, and explores the sign of the relationship in the long term. In the studied period, the capital-asset ratio decreased by a factor four, while return-on-equity more than doubled. The "leverage formula" postulates a positive linear relationship between return-on-equity and the debt-equity ratio. A strong positive linear relationship was found over the period 1871–1980, but not in 1980–2001. Thus, while supporting the results of the previous studies, a long-term "normal" positive relationship between leverage and profitability is also reaffirmed.

JEL codes: G21 N23 N24

Keywords: Return-on-equity, Leverage, Bank capital

[+] Financial support from the Jacob Wallenberg Foundation and the Torsten and Ragnar Söderberg Foundations is gratefully acknowledged. I have benefited from comments by Niclas Berggren, Magnus Henrekson, Dan Johansson, Henrik Jordahl, Håkan Lindgren, Mikael Stenkula, and Jan Wallander.

1 Introduction

In banking as in any industry, it is common knowledge that higher leverage normally means higher returns (but also greater risk). Yet, two recent studies actually find a *negative* relationship between leverage and returns in banking. Berger (1995) reports a statistically significant positive relationship between return-on-equity (ROE) and the capital-asset ratio (CAR, the inverse of leverage) among American banks in the 1980s. Likewise, Demirgüç-Kunt and Huizinga (1999) study 80 countries in the years 1988–1995, and they also report a statistically significant positive relationship between capital and returns.

These results are indeed surprising. That leverage increases returns seems to follow directly from the very nature of business. In its strongest form, the "leverage formula" predicts that return-on-equity should increase linearly with the debt-equity ratio (DER). How can this be reconciled with the empirical results? Berger (1995) suggests that more capitalised banks were able attract higher earnings because of lower expected bankruptcy costs, which enabled them to pay lower interest on uninsured debt. In a similar vein, Flannery and Rangan (2002) also report a capital build-up among US banks in 1986–2000, and they attribute this build-up to an increasingly competitive environment in the last two decades, promoting banks to hold capital beyond legislative needs (market discipline). Another possibility is that the negative correlation between leverage and profitability could reflect special circumstances of the 1980s and early 1990s. The 1980s was a decade of financial liberalisation, and the early 1990s was a time of financial turmoil. In one decade there is small variation in banks' leverage. The difference in leverage among banks, at least in Europe and in North America, is small. Conceivably, successful banks could tend to be both more capitalised and more profitable

in the short run, which could obscure the fundamental positive correlation between leverage and returns.

It would therefore be of interest to see whether the reported relationship holds also in the long term. The long-term variation in bank leverage is large – capital-asset ratios were 15–20 percent at the turn of the 19th century, while they are about 5 percent today. Has this development had any influence on bank returns?

This paper uses industry-level data for Sweden in the years 1870–2001 to study this very question. The main result is that there is indeed a strong positive long-term relationship between leverage and profitability in banking. In accordance with the "leverage formula", return-on-equity increased linearly with the debt-equity ratio over the period. However, the relationship was not present in the 1980s and 1990s. Thus, while the study reaffirms a long-term "normal" positive relationship between leverage and profitability in banking, the results of the previous studies are supported.

Studies of the long-term (century-long) relationship between leverage and profitability in banking are rare. With regard to leverage, Berger *et al.* (1995) present data on the CAR of the US banking system in 1840–1990. Likewise, Saunders and Wilson (1999) compare changes in the CAR of the banking systems in Canada, the United States and the United Kingdom, 1893–1992. Capie and Billings (2001a, 2001b) report returns as well as capital-asset ratios for major English banks in 1920–1968. Their work is further discussed below.

This paper contributes in two ways. First, it contributes to the methodological discussion initiated by Capie and Billings (2001a, 2001b) on how to measure capital in the presence of hidden reserves. Second it quantifies and tests the long-term relationship between leverage and profitability in banking, something that – to my knowledge – has previously not been done.

2 Measuring bank capital

The data are taken from the Summary of the Bank Reports (*Sammandrag af bankernas uppgifter*). Chartered banks were required to report monthly balance statements to the Swedish Bank Supervisory Authority (*Bankinspektionen*). I use aggregated income statements and end-of-year balance statements, for the years 1870–2001. Two problems make it difficult to get accurate and comparable measures of bank capital for the whole period. First, the Summary Reports do not show hidden reserves, and reservations made to them, particularly in the period 1948–1968. Second, corporate tax rates varied, from almost zero in the 19th century, to over 50 percent in the 1970s. How should profits and hidden reserves be "taxed" over the whole period? These two problems are discussed in this section.

2.1 Estimating hidden reserves

Capie and Billings (2001a, 2001b) discuss how to measure true profits and capital of the six major British banks in 1920–1968. The measurement problems of British banks were similar to those of the Swedish ones, both in scope and in time. In Britain before 1969 (the year of "disclosure"), hidden reserves did not show up in official reports, since they were either netted away or hidden within deposit accounts. Similarly, in Sweden before 1968, Write-offs and Reservations (*Avskrivningar och Avsättningar*) were not separated in official reports. Before 1948, banks made reservations to so called delcredere accounts, which were hidden within ordinary deposit accounts. In 1948, banks instead started to make reservations to so called Valuation Reserve Accounts, VRAs. Before 1968, these were hidden in the reports within a large entry called Sundry Accounts. From 1968 they show up separately. From 1983 they are called Untaxed Reserves. The problem with these hidden reserves is a serious caveat. It becomes impossible to accurately cal-

culate actual capital, as well as actual operating profits, and therefore impossible to calculate both leverage and profitability accurately. Since these reserves at the end of the 1960s were as large as reported equity, estimations of the CAR and ROE may be misleading. To get the actual values of reserves and reservations, as opposed to reported ones, it would be necessary to consult the internal accounts of each bank. To do this for the whole banking system is at worst impossible, and at best a Herculean effort beyond the time limits of this study. I will instead estimate reserves and reservations (and losses) for the years 1948–1968, as explained below. But before that, I discuss some previous estimates of hidden reserves in Swedish banking.

Delcredere accounts prior to 1948: Svenska Handelsbanken

An indication of the size and use of delcredere accounts may be had from Hildebrand (1971), who publishes various balance sheet data for Svenska Handelsbanken, one of the largest Swedish banks, for the period 1871–1970. Concerning write-offs, there are two periods when transactions to and from delcredere accounts are reported. In 1919–1920, report notes indicate that reservations were made to delcredere accounts, which were resolved in 1922. In 1936–1937, report notes indicate that sums from delcredere accounts were resolved. Although these notes cannot be said to be an exhaustive report of the use of delcredere accounts by the Svenska Handelsbanken, they nevertheless could be indicative. For banks with a dispersed set of owners, in particular joint stock banks like Svenska Handelsbanken, hidden reserves possibly did not play a large role until the time before and after the crises of 1922 and 1932. Hidden reserves were also probably depleted during these crises. Reservations to delcredere accounts may have increased in the immediate aftermath of the crises, but were partly resolved after some years when the crisis was thought to be over. The Summary Reports in the 1930s contain entries for "income

from previously written-off claims" that indicate this. Reservations to delcredere accounts were probably more sporadic and less systematic than those made later to the valuation reserve accounts.

Hidden reserves 1945–1969: Stockholms Enskilda Bank

In Sweden, the only attempt at calculating hidden reserves is Olsson (1986, p. 216), who calculates hidden reserves for selected years 1945–1969 for Stockholms Enskilda Bank, one of the largest Swedish commercial banks. Olsson's method is to compare the book value of the asset portfolio with its market value. The difference is treated as hidden reserves. Olsson thus incorporates potential, unrealised profits into the measure of capital. By this method, he finds that hidden reserves were about as large as visible equity for the whole period.

There are a number of reasons why it could be inappropriate to use Olsson's estimates as a measure of the hidden reserves of the banking system. First, the case of Stockholms Enskilda Bank can be said to be atypical. The Stockholms Enskilda Bank had a larger share of foreign business compared to other banks, which created greater opportunities to undervalue foreign assets (Olsson 1986). Also, this bank was exceptional in that it was much more of an old-fashioned banker's firm, rather than a modern joint stock bank (Lindgren 1987). It was controlled by one family and bookkeeping could therefore be more informal. In addition, as Olsson (1986, p. 226) writes, the Stockholms Enskilda Bank's policy of consolidation through hidden reserves was very much an outcome of the personality of Jacob Wallenberg, who was the bank's CEO in 1927–1946. According to Olsson, it was during this period that the hidden reserves were mainly accumulated.

Second, Olsson's method of incorporating unrealised profits into capital may be questioned. Capie and Billings (2001a, 2001b) reject this method. First, unrealised profits are hypothetical. Second, banks may not regard unrealised profits as part of their capi-

tal. Furthermore, unrealised profits calculated on the basis of market prices of assets may be deceptive. To assess a bank's financial safety, the most relevant measure should be the liquidation value of the asset portfolio. In case of default, the liquidation value of a large bank's assets may be substantially lower than what is indicated by their market value during "normal" times. For these reasons, Capie and Billings adopt a "flow" concept of profits that excludes unrealised profits. Correspondingly, only actually existing reserve accounts, and not unrealised profits, are treated as hidden reserves.

Summing up, since hidden reserves prior to 1948 cannot be estimated in a meaningful way, I will follow the path of Capie and Billings (2001a, 2001b) and not try to give numbers to reserves that cannot be meaningfully estimated. I will also follow their methodology and not include potential, unrealised profits in the measure of capital. Hidden reserves before 1948 will therefore be assummed to be zero. Hence, reserves prior to 1948 are probably underestimated. This fact should however not interfere with the main finding of this paper, namely that of a secular decline in bank capital over the period 1870–2001. On the contrary, if capital in the early half of the studied period is underestimated, then "true" figures would act to enforce the secular decline.

Estimating VRAs 1948–1968

The valuation reserve accounts, or VRAs, were zero in 1947. Since they are reported in the Summary Reports from 1968 and onwards, aggregate credit losses (depreciation on financial assets) for 1948–1968 may be calculated by the formula

$$\text{Credit Losses}_{1948\text{–}68} = \text{Write-offs}_{1948\text{–}68} - \text{VRAs}_{1968}. \qquad (1)$$

The Summary Reports contain specific entries for the write-offs of claims, bonds and stocks. VRAs exist for bonds, claims and currencies. Two complications make the use of formula (1) less straight-

forward. First, write-offs and VRAs do not match – how should write-offs on stocks be matched with VRAs for currencies? Second, there is the question of how to measure reserves in bonds. In the Summary Reports from 1968 and onwards, total reserves are calculated as VRAs for claims and currencies, plus *the excess value of the bond portfolio*. This entity is calculated as *market value* – (*nominal value* – VRA *for bonds*). The bond portfolio is in its turn reported "net" in the assets column of the balance statement, that is, in nominal value minus VRA for bonds.

This method has two shortcomings. First, it includes into the books *potential* but non-realised losses on bond sales. This would seem to distort the measure of operating profits. Second, reserves and thus book capital become sensitive to the market fluctuations of the bond portfolio. Since the market value of the bond portfolio is sensitive to the interest rate, book capital would become sensitive to the interest rate. This may create swings in ROE that may not reflect operating profitability.

I will therefore use the more straightforward method to treat the VRAs for bonds as hidden reserves. In the calculation of the CAR below, the gross measure of assets will consequently be used, that is, reported assets plus the VRA for bonds. Table 1 shows VRAs, write-offs and estimated losses, 1948–1968.

Table 1 VRAs, write-offs and estimated losses 1948–1968 (MSEK).

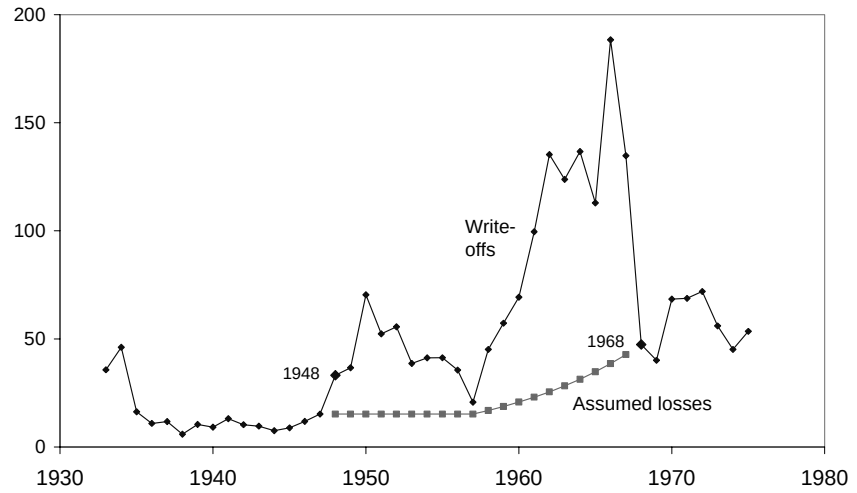
	Claims	Bonds	Stocks	Currencies	Aggregate
VRAs 1968	1390	824	-	126	2341
Write-offs 1948–68	1733	853	83	-	2669
Losses 1948–68	474	29	83	–126	460

Source: Summary of the Bank Reports. Losses 1948–68 = Write-offs 1948–68 minus VRAs 1968. VRA 1968 for claims include inflow 1948–1968 of previously written-off claims, 132 million SEK.

Aggregate losses were approximately equal to the losses on claims. Losses on stocks and bonds could then approximately be set to zero. Write-offs on bonds and stocks may be treated as reservations made to the VRA for currencies. As a first approximation, then, aggregate losses are equal to the losses on claims.

The problem then becomes how to assess the time pattern of these losses. This act must necessarily be more or less arbitrary.[1] One possible pattern is given in Figure 1, where write-offs and estimated losses in 1933–1975 are shown:

Figure 1 Write-offs and assumed losses on claims, 1933–1975 (MSEK).



Source: Summary of the Bank Reports. Write-offs 1968–1975 = "acknowledged losses" (*konstaterade förluster*).

Losses have been calculated so that aggregate write-offs in 1948–1968 minus aggregate losses in 1948–1968 will equal VRA for claims in 1968. I assume that losses were constant until the middle of the

[1] Since credit losses were very small, small fluctuations in their time pattern should not affect the results.

1950s, and then they started to rise to the reported value of "acknowledged losses" in 1968.

2.2 Tax rates on profits and reserves

How should hidden reserves be treated from a fiscal point of view, that is, how much of them should be regarded as equity, and how much as unpaid taxes? In a long-term study of this kind, the question becomes important, since tax rates varied from zero at the turn of the 20th century, to almost 60 percent in the 1970s. Depending on assumptions, capital could drastically change from one year to another if the tax rate is radically changed. For example, the corporate tax rate was raised from 16 to 40 percent in 1940. Historic Swedish corporate tax rates are presented in Hortlund (2005, Chapter III of this volume).

There is no definite answer to the question. One view is to treat untaxed reserves simply as deferred tax payments, wherefore they should be "taxed" at the going rate. According to a second view, untaxed reserves should not be "taxed" at all, since they will typically never be dissolved for taxation. In practice, they would only be dissolved to cover losses when profits are negative, in which case the tax rate would be zero. A third view takes a middle road between the two extremes. It acknowledges that reserves should not be fully "taxed", since they will never in practice be fully taxed. On the other hand, they should be somewhat "taxed", since the funds are not at the free disposal of the owners, and thus not at par with equity. Untaxed reserves could therefore be taxed at a rate that is lower than the going rate.

In this study, all three approaches will be used. I use numbers for operating profits and reserves where they have been "taxed" at a three different rates, namely at the rate of zero, at the going rate, and at a uniform rate of 30 percent. With a uniform tax rate, oper-

ating profitability can be compared over time. 30 percent is chosen because it is roughly the current Swedish corporate tax rate.[2]

The diagrams presented below show return-on-equity and capital ratios where untaxed reserves and profits have been "taxed" with a uniform tax rate of 30 percent. However, regressions were also made with return-on-equity and capital ratios calculated on the basis of untaxed as well as going-rate taxed profits and reserves. It turns out that the results were not affected. In fact, as Table 4 below shows, the relationship between leverage and profitability seems to be even stronger for the latter two specifications.

3 Leverage and profitability of the Swedish commercial banks, 1870–2001

This section presents figures for the leverage and profitability of the Swedish commercial banks, 1870–2001. Figures for the capital-asset ratio, return-on-equity, and the (average) debt-equity ratio are presented. Variables are defined as in Table 2.

[2] At the time of writing (November 2004), it is 28 percent.

Table 2 Definitions of variables.

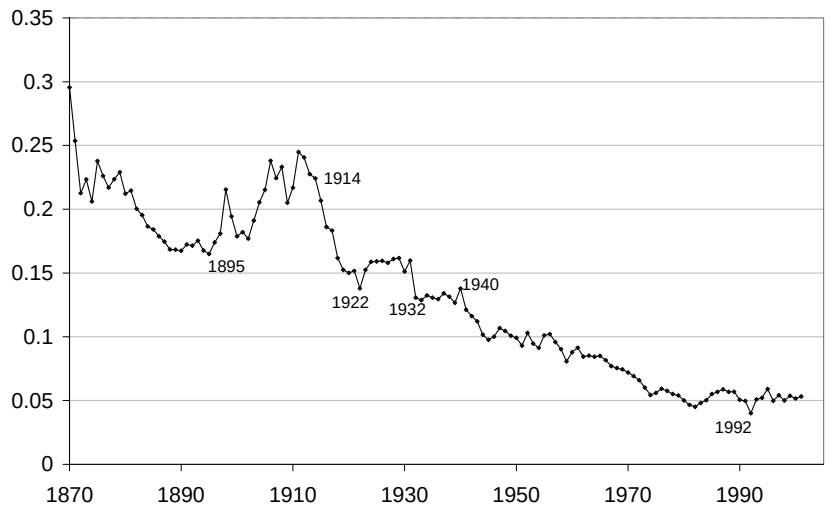
Variable		Definition
Untaxed Reserves		1948–1982: VRAs 1983– : reported values
Capital	C	Equity + 70 percent of Untaxed Reserves
Assets	A	Reported assets + VRA for bonds
Profits	P	70 percent of operating profits (revenues – costs – credit losses)
Capital-asset ratio	CAR_t	C_t / A_t
Return-on-equity	ROE_t	P_t / C_{t-1}
Debt-equity ratio	DER_t	$((A_t + A_{t-1}) / 2) / C_{t-1} - 1$

Note: VRAs and credit losses are estimated for 1948–1968.

3.1 The capital-asset ratio

Figure 2 shows the capital-asset ratio for the Swedish commercial banks in the period 1870–2001:

Figure 2 Capital-asset ratio of the Swedish commercial banks, 1870–2001.



Source: Summary of the Bank Reports.

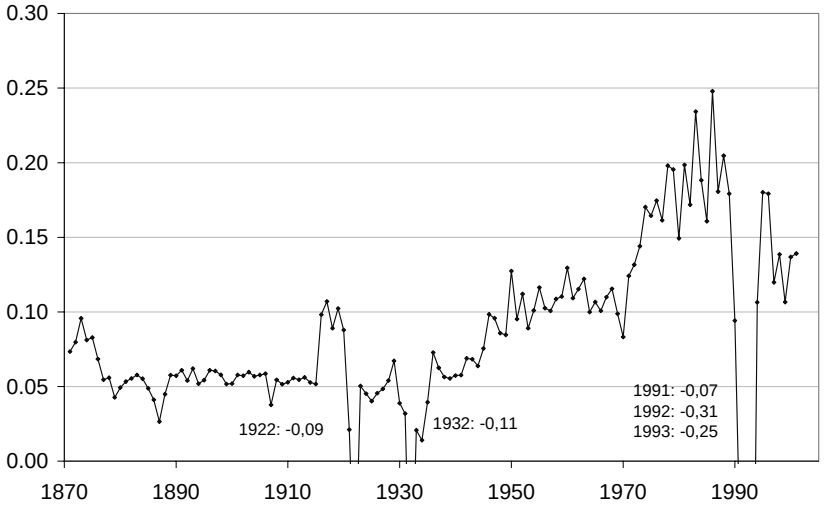
In 1870–1895 the CAR decreased. This was a period when deposit banking rapidly expanded. Then an upward trend started that peaked in 1911. From 1895 to 1910, the number of banks grew from 45 to 80. The upward trend in the CAR therefore probably reflects an inflow of equity into the banking sector. From 1911, the CAR started to drop. It declined rapidly during WWI, reaching a minimum in the post-war recession in 1922. It then remained remarkably stable during the new gold period in 1924–1931. The CAR then sharply dropped in 1932 – the year of the Kreuger crash, when gold was abandoned and the Swedish crown was devalued. But after this one-time drop, the CAR again remained stable through the rest of the 1930s. Then a period of secular decline followed that started in 1940. In this year, inflation took off, corporate taxes were raised, and foreign-exchange controls were imposed. The CAR dropped steadily between 1940 and 1980. Since the early 1980s, it has remained rather stable at about 6 percent.

One may compare Figure 2 with the figures of the CAR for the US, UK and Canada presented by Berger *et al*. (1995) and Saunders and Wilson (1999). The CAR of the Swedish commercial banks conforms to the pattern in these countries of a secular downward trend, with a particularly sharp drop during WWI. The upward trend in 1895–1911 seems unique for Sweden, however. Also, the long secular drop in 1940–1980 appears to be special for Sweden – the CARs of the other countries were stabilised after WWII.

3.2 Return-on-equity

Figure 3 depicts return-on-equity of the Swedish commercial banks for the years 1871–2001.

Figure 3 Return-on-equity of the Swedish commercial banks, 1871–2001.



Source: Summary of the Bank Reports.

The stability of the ROE during the classical gold standard – particularly in 1890–1914 – is eye-catching. During WWI there was a sharp rise in profitability, ending in a recession in 1922 when profits for the first time turned negative. Profitability then recovered to pre-war levels. Sweden readopted the gold standard in 1924–1931. Notice the increase in profits during tha latter half of the 1920s, peaking in 1929. From that date they dropped. In the ill-fortuned year of 1932 profits turned negative for the second time. Beginning in 1942, ROE began to increase secularly. It nearly doubled in the Bretton Woods period, compared to the levels of the classical gold standard. After Bretton Woods from 1971, ROE rose sharply – it doubled again. This era ended in 1991, when the largest banking crisis ever hit the banks. After the crisis profits have dropped to levels more reminiscent of those during the Bretton Woods period.

Return-on-equity and inflation

Figure 3 shows returns in "nominal" terms, that is, disregarding inflation. It is widely held that inflation affects profits and this

should be adjusted for. Table 3 shows average return-on-equity for selected time periods in "nominal" terms and in "real" terms, when the change in the Consumer Price Index have been deducted from ROE.

Table 3 Average "real" and "nominal" return-on-equity for the Swedish commercial banks, 1871–2001.

	1871-1915	1945–1970	1971–1990	1995–2001
Price inflation	1%	4%	8%	1%
"Real" ROE	5%	7%	13%	13%
"Nominal" ROE	5%	11%	22%	14%

Sources: Summary of the Bank Reports, Statistics Sweden.

Even in "real" terms, ROE was 160 percent higher in 1970–2001 than it was during the classical gold standard, and about 90 percent higher than during the period of the Bretton Woods system.

4 Return-on-equity and the debt-equity ratio

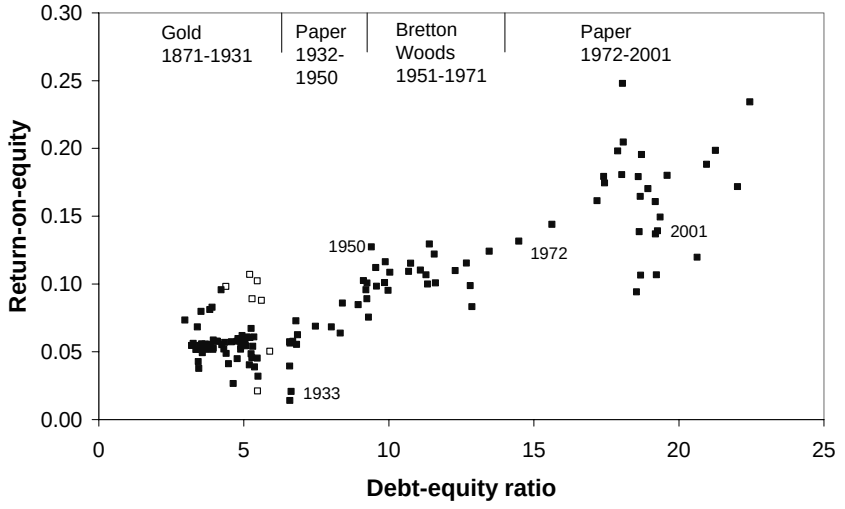
Now for the main event. Figures 2 and 3 revealed that in the period 1870–2001, ROE more than doubled, while the CAR decreased by more than half. This points to a positive long-term relationship between leverage and returns. The "leverage formula" states that there should be a positive *linear* relation between return-on-equity and the debt-equity ratio, according to the expression

$$ROE = l + (l - b) \cdot DER\,, \qquad (2)$$

where l is return-on-assets, and $(l - b)$ is the rate gap (or margin) between return-on-assets and return-on-debt b.[3] Figure 4 shows ROE and the DER for the Swedish commercial banks, 1871–2001.

[3] See for example Brealey and Myers (2000, p. 481).

Figure 4 Return-on-equity and the debt-equity ratio of the Swedish commercial banks, 1871–2001.



Source: Summary of the Bank Reports. White dots mark WWI paper regime, 1915–1923. Negative returns in 1922, 1932, 1991–1993 not shown.

A linear pattern can be discerned. Because the DER increased rather steadily through time, it is possible to classify the dots as belonging to certain monetary regimes. For a period of sixty years 1870–1930, points are clustered around profit levels of 6 percent and debt-equity ratios between 3 and 5 (disregarding some high-ROE points in the first half of the 1870s and during the WWI paper regime). Following the Kreuger crash in 1932, the DER jumps to a new level. In the early 1940s ROE begins to increase linearly with the DER. The trend continues when the Bretton Woods system is adopted in 1951. The trend continues also when the system is abandoned in 1971. Because of high leverage, the period 1972–2001 saw large fluctuations in ROE and the DER.

Estimation

The following model is estimated:

$$dROE = \beta_1 dDER + \beta_2 dPRICE + [crisis\ dummies] + u \ , \quad (3a)$$

where

$$u_t = \rho_1 u_{t-1} + \rho_2 u_{t-2} + \varepsilon_t \ . \quad (3b)$$

Dependent variable is dROE, the change in return-on-equity. Independent variable is the change in the debt-equity ratio (dDER). The change in the inflation rate (dPRICE) is used as a control variable, in the spirit of section 3 – *ceteris paribus* an increase in the inflation rate should tend to increase the rate of returns. Also, dummy variables for financial crisis years (1922, 1932, 1991–1994) are used. Crisis years are defined as years with negative profits (1922, 1932, 1991–1993). Since the crisis of 1993 will heavily affect the difference between ROEs in 1993 and 1994, a dummy for the year 1994 is also included. The crisis dummies are necessary for there to be a statistically significant relationship between leverage and returns.

Regressions are performed on differences rather than on levels. This is because the augmented Dickey-Fuller test for unit roots reveals that while ROE is stationary on levels, the DER is non-stationary. Both variables are stationary on differences. Moreover, because both autocorrelation and heteroscedasticity can be detected, I estimate the model (by maximum likelihood) with two lags in the disturbance term, and where Huber-White standard errors are used.

Table 4 shows regression results. It turns out that they are sensitive to the specification with regard to the dummies for 1991–1994. More exactly, whether a dummy for 1993 (CR93) is included

or not. Although returns were strongly negative in this year (–0.25 percent), the difference in returns compared to those of 1992 is actually small. Although the coefficient for CR93 is statistically insignificant, its inclusion or exclusion affects the statistical significance of the coefficient for dDER. Therefore, regressions with and without CR93 is reported.

Table 4 Maximum likelihood estimation on differenced return-on-equity.

	Dependent variable dROE							
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
Tax rate	0%	Going	30%	30%	30%	30%	30%	30%
dDER	**0.012**	**0.006**	0.007	***0.008***	0.004	***0.008***	0.004	***0.013***
	(0.049)	(0.040)	(0.055)	(0.002)	(0.15)	(0.000)	(0.55)	(0.002)
dPRICE	**0.21**	0.15	**0.15**	**0.15**	–0.11	–0.019	**–0.91**	0.15
	(0.015)	(0.059)	(0.011)	(0.013)	(0.22)	(0.78)	(0.028)	(0.13)
CR93	0.035	0.025	0.018		0.029	(o.s.)		(o.s)
	(0.53)	(0.44)	(0.67)		(0.69)			
AR (1)	**–0.50**	0.45	**–0.53**	**–0.53**	***–0.68***	***–0.61***	***–0.98***	–0.39
	(0.046)	(0.16**)**	(0.017)	(0.020)	(0.000)	(0.005)	(0.003)	(0.38)
AR (2)	–0.30	0.27	–0.31	–0.24	–0.35	–0.32	–0.46	–0.27
	(0.17)	(0.24)	(0.12)	(0.10)	(0.14)	(0.19)	(0.051)	(0.34)
Sample	1872–2001	1872–2001	1872–2001	1872–2001	1940–2001	1940–1980	1980–2001	1872–1980
Obs.	130	130	130	130	62	41	22	109
DW	2.04	2.02	2.03	2.03	2.01	1.83	1.91	1.96

Note: Huber/White standard errors. *p*-values in parentheses. Bold denotes statistical significance on the five-percent level, and bold-italics on the one-percent level. Dummies for the years 1922, 1932, 1991, 1992, 1993 (reported), and 1994. (o.s.) = "out of sample".

Columns (i–iii) show results for the basic full-sample regression with different tax rates on profits and reserves. Results are not greatly affected by the choice of tax rate – in fact, the relationship between ROE and the DER is slightly stronger both when profits and reserves are taxed at the going rate as well as when they are not taxed, compared to when they are taxed at 30 percent. Regres-

sions (iii–iv) illustrate how the result is affected by CR93. Including the variable in the full-sample regression makes the coefficient of dDER well-nigh statistically significant at the 5 percent level: excluding it makes the coefficient significant at the 1 percent level. This suggests that a positive long-term relationship between leverage and profitability can be found – but the relationship does not seem to be robust. However, regressions (v–viii) reveal how the result depends on the years 1980–2001. Regression (v) establishes that the dDER is not significant when the sample is 1940–2001. However, it *is* significant when the years 1980–2001 are excluded, as regression (vi) shows. Indeed, no relation between dROE and dDER can be found in 1980–2001 (regression vii). Regression (viii) drives home the point: when regressing on the almost full sample 1872–1980, the dDER is statistically significant at the 1 percent level.

In sum, a strong positive correlation between return-on-equity and the debt-equity ratio was found in 1872–1980. However, the correlation was not present in 1980–2001. In this sense, this study supports the previous results of Berger (1995), and Demirgüç-Kunt & Huizinga (1999). But these latter results could possibly reflect special conditions of the 1980s and 1990s. In the long term, the "normal" positive relationship between leverage and profitability holds, and does so strongly.

5 Conclusion

Two recent studies surprisingly found a negative relationship between leverage and profitability in banking. This study presented new data on the Swedish commercial banks in 1870–2001, and explored the sign of the leverage-profitability relationship in the long term. The capital-asset ratio decreased from levels around 20 percent at the turn of the 19th century, to levels around 5 today. The drop occurred particularly during WWI and in 1940–1980. In the same period, return-on-equity more than doubled, from about 5 to about 13 percent in "real" terms. The "leverage formula" postulates a positive linear relationship between return-on-equity and the debt-equity ratio. This was formally tested. Indeed, a strong positive linear relation was found to exist over the period 1871–1980, but not in the 1980s and 1990s. Results are therefore supportive of those of the previous studies. At the same time, a long-term positive relationship between leverage and profitability in banking is reaffirmed. Over the centuries, at least, the economic laws seem to be working.

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Summary of the Bank Reports [*Sammandrag av bankernas uppgifter*].

III.

Do Inflation and High Taxes Increase Bank Leverage?[+]

Does the combination of inflation and high corporate taxes explain the increase in bank leverage in the 20th century? Inflation automatically increases bank debt, while high corporate taxes hinder capital accumulation. Capital ratios therefore drop, until leverage-induced returns are sufficient to uphold them at constant levels. This theory was confronted with Swedish bank data 1870–2001. Bank capital ratios dropped when inflation and corporate tax rates were high, during WWI and in 1940–1980. The theory can explain the sinking bank capital ratios during these periods, but also their relative stability since the early 1980s. High corporate taxes and inflation were estimated to account for half of the drop in Swedish bank capital ratios since WWII.

JEL Codes: E44 E52 G28 G32 H25 N23 N24
Keywords: Bank leverage, Capital-asset ratio, Inflation, Corporate taxes.

[+] Financial support from the Jacob Wallenberg Foundation and the Torsten and Ragnar Söderberg Foundations is gratefully acknowledged. I have benefited from comments from Niclas Berggren, Magnus Henrekson, Dan Johansson, Henrik Jordahl, Mickael Salabasis, Mikael Stenkula, Jan Wallander, and seminar participants at the Stockholm School of Economics and at the Stockholm Institute for Financial Research. I am indebted to Gunnar Du Rietz for generously providing data on historical corporate tax rates.

1 Introduction

For any country, the leverage of its commercial banking system is a point of concern. Because banks are central to the financial system and to the whole economy, an inadequately capitalised banking sector may become a source of instability that could provoke serious financial harm. Low capital levels arguably contributed to the severity of the banking crises in Asia and Europe in the 1990s. In Sweden, bank capital was barely able to sustain the credit losses of the crisis years in 1991–1993, in such a way that practically the whole commercial banking system was balancing on the verge of bankruptcy. For this reason, substantial effort both in academia and in practical policy-making is devoted to devising rules and systems that will ensure that capital ratios of banks are adequate. A recent example is when major countries endorsed the new Basel Capital Accords (Bank for International Settlements 2004).

In view of this, there are surprisingly few studies on what drives long-term changes in bank leverage. Berger *et al* (1995) present data on the capital-asset ratio (CAR) of the US banking system in 1840–1990. They find a secular drop through the whole period. The drop is particularly sharp during the periods 1914–1920 and 1933–1940. The authors suggest that these drops may have been due to the introduction of the Federal Reserve System in 1914, and the invention of federal deposit insurance in 1933. Both these inventions lowered banks' need for precautionary capital. Saunders and Wilson (1999) compare changes in the CAR of the banking systems in Canada, the United States and the United Kingdom. They report a particularly sharp drop in the CAR of Canadian and British banks between 1900 and 1920 – a period of rapid consolidation when the number of banks substantially decreased. By contrast, the drop in the CAR in the US started later, after 1933, and they link this drop to the invention of federal deposit insurance. Kroszner

(1999) instead suggests that the secular drop in the CAR may be a consequence of increasingly more liquid financial markets, as a result of financial innovation.

In this paper I explore an alternative hypothesis, namely whether two fundamentals of post-WWII macropolicy in many countries – high corporate taxes and inflation – have had the unintended consequence of increasing bank leverage. At the end of WWII, Gunnar Myrdal wrote an essay entitled "High Taxes and Low Interest Rates" (Myrdal 1944). The subject was postwar policy. In countries like the US, the UK and Sweden, interest rates had dropped while corporate taxes had been raised to "previously unthinkable" levels in the decade preceding and during the war. Although this development had been more or less unplanned, the process was ultimately driven by the growth of government. Myrdal analysed how low interest rates and high taxes depended on each other, and argued that both must be maintained after the war (along with the wartime regulatory system, such as credit regulations and foreign-exchange controls), if the political demands of the time were to be met. Influential interests in farming, housing, business and government demanded low interest rates. However, the main function of the interest rate was to act as a regulator of investment. A below-equilibrium interest rate would set in motion a Wicksellian cumulative process – therefore, high corporate taxes were needed to "fill the shoes" as a regulator of investment demand. Conversely, high corporate taxes were needed to meet political goals of equalising incomes and aid in the expansion of government. However, to keep after-tax profits at acceptable levels to business owners, low interest rates were required as compensation.

The eight-page essay, published in a *Festschrift* to Eli F. Heckscher on his 65th birthday, was to have a large influence. Short, concise, intelligible, it seemed to suggest how all policy goals could simultaneously be attained. According to Krister Wickman,

former Governor of the Bank of Sweden, Myrdal's analysis became the intellectual basis for Swedish monetary policy after the war (Wickman 1958, Jonung 1990). This policy was instituted in the so-called Interest Rate Regulation Act (*räntereglerings*lagen), in 1951.

However, did the analysis miss something? Could the combination of low interest rates and high taxes have unintended consequences on bank leverage? Low interest rates normally mean monetary expansion and inflation. Banks are special in that inflation automatically tends to swell bank deposits and hence bank debt. To be able to keep their capital ratios constant, banks must actively add to their equity in step with inflation. However, high corporate taxes hinder capital accumulation. Bank capital ratios will therefore decrease. But decreasing capital ratios means increasing leverage, which means increasing returns. After a while these become sufficient to uphold capital ratios at constant levels.

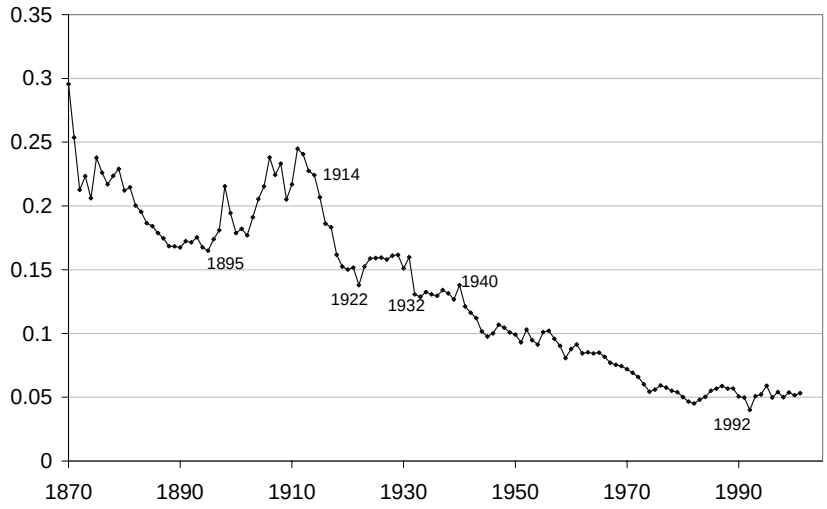
As shown in Hortlund (2005), the leverage of the Swedish commercial banking system mainly increased during two periods in the 20th century, namely during WWI and in 1940–1980. Both were periods of inflation and high corporate taxes. Do inflation and high taxes increase bank leverage? This question is here confronted with Swedish bank data 1870–2001. Over the period 1882–2001, the combination of high corporate taxes and inflation, which is here called excess inflation, was found to be a statistically significant factor for the decrease in the CAR. For smaller sample periods excluding WWI, the relationship was statistically weaker. With regard to economic significance, excess inflation could have accounted for half of the postwar drop in Swedish bank capital ratios, or even more. Since capital ratios were inadequate to cope with the Swedish banking crisis in 1991–1993, it may be asserted that the postwar macropolicy of inflation and high corporate taxes (within a framework of regulations) contributed to the severity of the crisis.

To my knowledge, there is as yet no study that investigates the long-run effects of high corporate taxes and inflation on bank leverage. These two should be of interest as potential factors behind decreasing bank capital ratios also in countries like the US, the UK and Canada. The period 1895–1920 was a period of worldwide monetary expansion – in particular 1914–1920, when the international gold mechanism became inoperative, and governments made use of the printing presses to finance wartime needs. Inflation may therefore be an alternative to consolidation in explaining a particularly rapid decrease in the CAR during this period. Likewise, the year 1933 saw the invention of federal deposit insurance in the US, but also the abandonment of the gold standard, and governments thereafter engaged in monetary expansion – particularly after 1940 when again wartime financial needs became imperative.

2 Leverage, inflation and corporate taxes, 1870–2001

To render credible the idea that inflation and high corporate taxes might increase bank leverage, this section presents figures on bank leverage, corporate tax rates, and inflation, in Sweden 1870–2001. Figure 1 shows the capital-asset ratio (CAR) of the Swedish commercial banks in 1870–2001.

Figure 1 Capital-asset ratio of the Swedish commercial banks, 1870–2001.



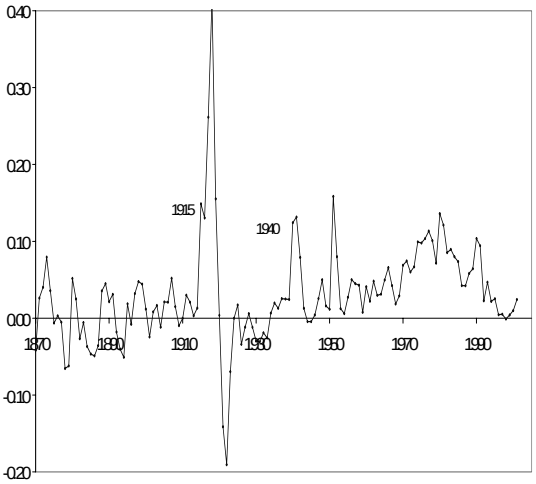
Source: Summary of the Bank Reports. Hortlund (2005).

Data are taken from the Summary of the Bank Reports. The calculation of the CAR is explained in Hortlund (2005). In 1870–1890 the CAR dropped substantially, although there was no inflation in this period. The reason was rather a rapid expansion of the deposit business. People were now increasingly depositing their savings with the banks. From 1895 to 1910 the CAR *increased*. The reason was a large entry of new banks, and hence the infusion of new equity capital into the banking system – new banks start with equity, but have not yet acquired debt. The number of banks increased from 45 in 1895 to 81 in 1909 (Summary of the Bank Reports). Then a rapid decline in the CAR followed, particularly during and after WWI, 1915–1920. After the war in 1921–1922 there was a recession, caused by a contractionary monetary policy. In 1922 bank profits for the first time turned negative, which explains the large drop in the CAR in this year. The CAR was then highly stable in the 1920s. The next large drop occurred in 1932, the year of the Kreuger crash, and the year after Sweden left the gold standard. For the second time bank profits turned negative – the CAR

again spectacularly dropped. For the rest of the 1930s, the CAR was very stable. In 1940 a secular decline in the CAR begins, which lasts until the beginning of the 1980s. In 1991–1993 Sweden experienced its most severe bank crisis ever. For the third time in history, profits turned sharply negative, The CAR dropped in 1992, but not in 1991 and 1993. After the crisis, the CAR has been exceptionally stable.

The drops during WWI and in 1940–1980 are of particular interest. That these were times of high inflation is shown in Figure 2.

Figure 2 Annual percentage change in the Consumer Price Index, 1870–2001.



	Mean	S. D.
1870–1914	0.6	3.4
1915–1920	19	14
1924–1939	–0.2	2.2
1940–1950	4.1	5.0
1950–1960	4.4	4.4
1960–1970	4.1	1.7
1970–1980	9.0	2.4
1980–1990	8.2	3.0
1990–2000	3.1	3.6
1940–1980	5.5	4.2

Source: Statistics Sweden.

Before WWI, average inflation was almost zero, although volatility was quite high.[1] Then came the high inflation period of WWI, with

[1] Price-indices before WWI are not wholly commensurate with those of later periods, however. Because they were constructed on the basis of a smaller number of goods, they tended to fluctuate more. See Romer (1986), Bergman and Jonung (1988), Bohlin (2003).

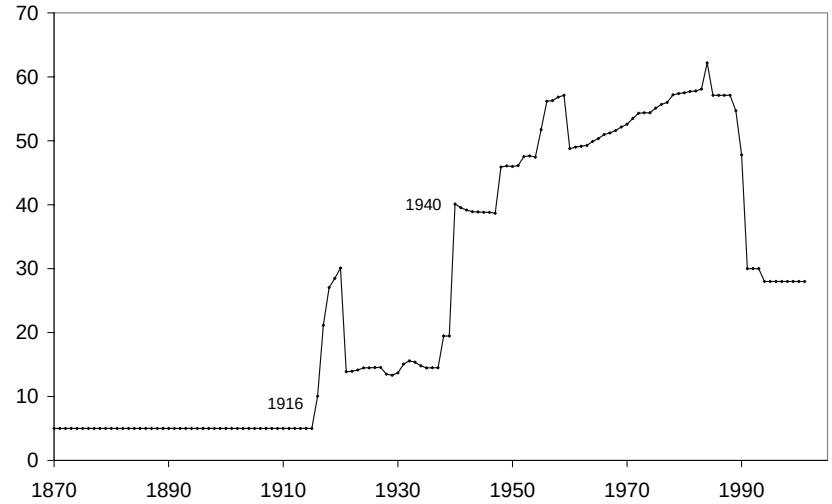
a rate of 19 percent on average in 1915–1920. This coincides with the large drop in the CAR, which decreased from 22 to 15 percent in 1914–1920. In the 1920s and 1930s, inflation was again non-existent. From 1940 until 1990, inflation has been consistently high, at least compared to the situation before WWI. Between 1940 and 1970 it was about 4 percent (Bretton Woods), and in 1970–1990 it was about 8–9 percent. In 1993, it became official monetary policy to keep inflation at 2 percent. Since then, inflation has been low.

The periods of falling CAR thus seem to coincide with periods of high inflation. It is interesting that Lars-Erik Thunholm, one of the most influential Swedish bankers in the 20th century, has suggested that inflation was the main cause behind the decreasing CAR of the Swedish banks:

> [The 20 percent capital requirement of the Bank Law of 1911] has since then repeatedly been subject to change, mainly due to a continuous inflationary development that has caused bank deposits to expand, while it has not been possible to increase equity at the same rate (Thunholm 1962, p. 78).

The periods of decreasing capital ratios were not only periods of inflation, but also of high corporate tax rates. This is seen in Figure 3.

Figure 3 Corporate tax rate in Sweden, 1870–2001.



Sources: 1915–1920: Summary of the Bank Reports (taxes paid). 1921–2001: calculations by Gunnar Du Rietz (Johansson and Du Rietz, 2005).

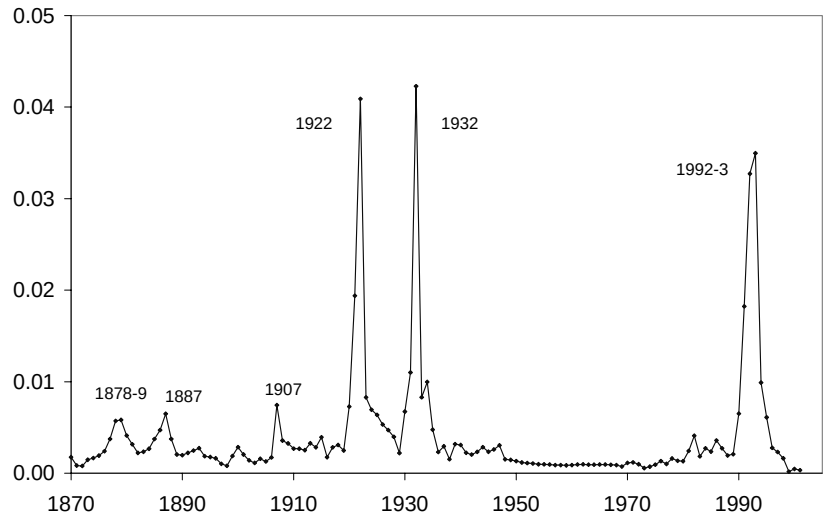
Before WWI, corporate taxes were low. Joint stock corporations paid income taxes to the local municipalities. They were 5 percent on average (Rodriquez 1980, pp. 46–47). During the war, so called "war-boom taxes" were imposed, whereby banks paid taxes of about 30 percent. After the war, corporate taxes became a permanent feature, although at relatively low levels. The tax rate was stable until WWII, when taxes were raised to 40 percent. Tax rates were from then on high. They exceeded 50 percent most of the time after the war, until a tax reform in 1990 lowered them to 30 percent, and then to 28 percent, which is the current level.

Did high leverage aggravate the 1990s crisis?

We saw that postwar capital ratios dropped from levels around 13 percent in 1940 to levels around 5 percent in the 1980s, and that inflation and high corporate taxes potentially contributed to this development. One may ask if sinking capital ratios was and is a problem. Could not on the contrary the development have en-

hanced economic efficiency, since banks may have previously been capitalised in excess of modern-day needs? While capital ratios above 10 percent were suitable at the turn of the 20th century, perhaps 5 percent is fully adequate at the end of it? However, figures for historic credit losses 1870–2001 indicate that postwar capital ratios dropped to levels that were too low from a stability point of view. Although credit losses in the 1990s crisis were not particularly high historically, the low capitalisation made them dangerous to the whole banking system. Figure 4 shows credit losses (including realised losses on sales) as a percentage of assets for the Swedish commercial banks in 1870–2001.

Figure 4 Credit losses as a percentage of assets for the Swedish commercial banks, 1870–2001.

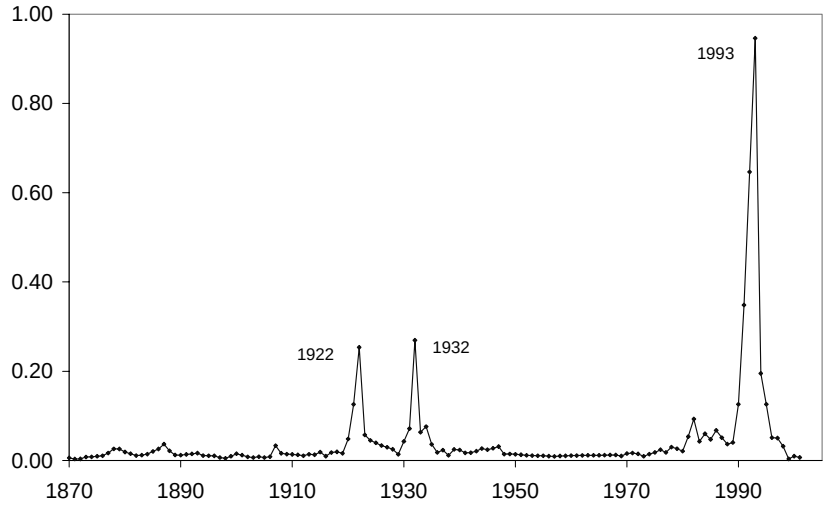


Source: Summary of the Bank Reports. Average assets over the year.

As a percentage of assets, losses in "normal" times were lower after WWII than they were before WWI. Swedish banking has suffered three great crises, namely in 1921–1922, 1932 and 1991–1993. Figure 4 shows that losses as a percentage of assets were actually higher in 1922 and 1932 than they were in 1992–1993. The losses in

the 1990s were not particularly high historically – although one could argue that this crisis was special in that there were more crisis years (with two years when losses were extremely high, compared to one year each in the crises of the 1920s and 1930s). However, if we look at losses as a percentage of equity, the picture becomes different, as Figure 5 shows:

Figure 5 Credit losses as a percentage of equity for the Swedish commercial banks, 1870–2001.



Source: Summary of the Bank Reports.

In "normal" times, credit losses as a percentage of equity were slightly higher after WWII than they were prior to WWI. Most importantly, the losses during crisis years were much higher. These losses were at all time high in 1993 – a staggering 90 percent of equity. Even if one disregards this "extra-year", losses were about 70 percent of equity in 1992, which is more than twice the amount of the crises in 1922 and 1932. Because of high leverage, the 1990s crisis became the most severe in the history of Swedish banking. The aggregate equity of the whole banking system was in danger of being wiped out. The credit losses materialised when the over-

heated economy of the 1980s was radically brought to a halt. Factors were: 1) a major change in the tax code, where interest subsidies were slashed from 80 to 30 percent; and 2) a change in the goal of monetary policy, from full employment to low inflation. Combined, these factors increased real interest rates from negative numbers to positive ones of 5–10 percent. An additional factor was: 3) the financial turmoil of the ERM crisis in the autumn of 1992, during which the Bank of Sweden raised its "margin rate" to 500 percent. On the roots and consequences of the Swedish banking crisis, see Englund (1999).

3 Other explanations

This section discusses some alternative explanations to secular increases in bank leverage. Some of these will be used as control variables in the regression analysis below.

Financial innovation

A powerful argument holds that bank capital has secularly dropped because of financial innovation (Kroszner 1999). Financial markets are deeper and more diversified today than was the case in the 19th century, wherefore banks' need for precautionary capital has decreased. Ögren (2003) studies the Swedish commercial banks in 1834–1913, and suggests that the note-issuing activity of the Swedish Enskilda banks created liquid financial markets which lowered the need for precautionary capital. Taking a "functional" approach, Merton (1995) sees equity as a historically conditioned instrument whose task is to guard against uncertain events. With financial innovation, new instruments emerge that offer companies better opportunities to hedge against risk, and the historic role of equity decreases.

Frame and White (2004) argue that despite the fact that financial innovation is prominently discussed in the modern literature,

there is relatively little empirical testing of the claims involved. Surveying the empirical literature on financial innovation, they find only 24 such studies, most of them conducted after the year 2000. There seems to be no empirical studies of the long-term (century-long) role of financial innovation on bank performance.

In any case, financial innovation seems incapable of explaining the decreasing capital ratios of the Swedish banks after WWII. There was a well-functioning financial market in the 1920s and 1930s. At the outbreak of WWII financial markets virtually stopped working. Heavy regulations and foreign-exchange controls were in place 1940–1980. There was no money market, and the stock exchange lived a slumbering existence. So called emission controls prohibited firms from issuing bonds. Deregulation started in the early 1980s, and financial markets revived. New instruments were introduced. An option exchange started. Thus, data do not support the financial innovation hypothesis. Bank capital ratios were stable in the 1920s and 1930s when financial markets were active, decreased in 1940–1980 when financial markets were shut down, and once again stabilised in the early 1980s when financial markets revived. The financial innovation hypothesis predicts the opposite: bank capital should have decreased in the 1920s and 1930s, stabilised or increased in 1940–1980, and decreased from 1980 and onwards.

Market substitution

A more promising argument is that the revival of financial markets in the early 1980s may have stabilised the CAR because financial markets are a substitute to banks. In the regulated environment of the period 1940–1980, firms and investors were restricted to banks for funding. With the reactivation of financial markets, investors could raise capital directly on the market – this should tend to lower the market share of banks and hence their asset volumes, and put upward pressure on the CAR.

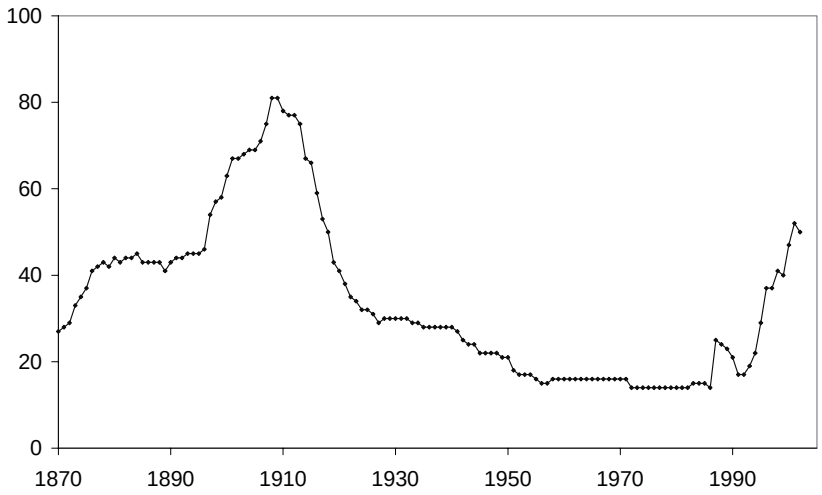
Market discipline

Market discipline is increasingly emphasised as an important mechanism that discourages banks from taking excessive risks. It has recently been incorporated as the "Third Pillar" of the new Basel Capital Accord (Bank for International Settlements 2004). The deregulated, increasingly competitive environment since the early 1980s could possibly have imposed market discipline on the Swedish banks and thus stabilised their capital ratios. In a competitive environment, financial strength becomes a means for banks to attract customers. The views of international credit rating agencies matter. Flannery and Rangan (2002) show that bank capitalisation increased in the US in the latter half of the 1990s, beyond the capital requirements stipulated by the Basel accords. They attribute this extra-regulatory capitalisation to market discipline: banks with higher default risk need higher capital ratios to convince investors. The market discipline argument can potentially explain the 20th century movement in the CAR of the Swedish banks.

Consolidation

Consolidation may affect leverage in two ways. First, new banks start with equity but have not yet acquired debt. A time of "deconsolidation" when new banks enter the market should therefore see an increase in the aggregate CAR. Second, consolidation means that banks may take advantage of economies of scale. A larger bank can diversify assets and thus decrease overall portfolio risk. These scale effects may however rapidly decrease and become negligible beyond a certain size. Saunders and Wilson (1999) suggested consolidation as the prime mover behind increasing leverage in the Canadian and British banking systems in the early 20th century. It could be of importance also in the Swedish case, as Figure 6 reveals:

Figure 6 Number of commercial banks, 1870–2001.



Source: Summary of the Bank Reports, Statistics Sweden.

The number of banks rose in the early 1870s, but was then stable in 1876–1896. In the boom period of the late 19th and early 20th century, the number of banks grew rapidly. In 11 years they doubled, peaking in 1908. A time of consolidation then started, coinciding with the new Bank Law of 1911 and accelerating during WWI. The downward trend bottomed in 1927. In the 1930s the number of banks was stable. Then in 1940 a new period of consolidation started that lasted until 1957. The number of banks then remained stable until 1986, when deregulation and a more liberal chartering policy saw new banks, domestic and foreign, enter the market. The number of banks has increased substantially during the last decade and banks are now as many as they were in the 1890s.

Comparing with the UK and Canada, the increase in Swedish banks 1896–1908 seems to be unique. The consolidation in Sweden 1910–1920 also seems to have been more rapid – perhaps in part a consequence of the previous bank boom.

Obviously, there appears to be a close connection between changes in the CAR and the number of banks. Figure 6 may be

compared to Figure 1. The rise in the number of banks in the late 1890s coincides with the increase in aggregate CAR. The rapid decrease in aggregate CAR in the period 1910 to 1925 coincides with the rapid decline in the number of banks. Both the CAR and the number of banks are stable in the 1930s. The CAR and the number of banks decline slowly together 1940–1980.

Legal restrictions: deposit insurance

Deposit insurance is widely held to increase bank leverage (Berger *et al* 1995, Saunders & Wilson 1999). Deposit insurance creates moral-hazard incentives for banks to lower their capital ratios. The literary prominence of the deposit-insurance argument is largely due to the American experience of the 1930s with the founding of the Federal Deposit Insurance Corporation in 1933. But deposit insurance is largely an American phenomenon. Most other countries did not have deposit insurance before the 1990s, and hence deposit insurance cannot explain sinking post-WWII capital ratios in the world outside the US. This is the case of Sweden, where deposit insurance did not exist before 1996.[2]

Capital requirements

Legal capital requirements entered for the first time with the Bank Law of 1911. According to this law, equity had to be at least 20 percent of deposits. The capital requirements were consistently lowered whenever banks were in trouble of not fulfilling them. The 20 percent rule was suspended during WWI. From 1921, the equity ratio for large banks was 12.5 percent – from then on, the capital requirement was lower for large banks. In 1923–1925, debenture loans were accepted as eligible capital. From 1938, deposits backed by cash (giro accounts at the Bank of Sweden) were ex-

[2] However, Ljungqvist (1995) argues that an "implicit" insurance existed before that date.

empted from capital requirements. With the new Bank Law of 1955, "riskless deposits" – deposits backed by cash and government and other eligible bonds – were exempted from requirements. In 1968 new principles for calculating capital requirements were adopted. From then on, capital would have to be sufficient relative to assets, rather than to deposits. Assets were weighted by their relative riskiness, where cash and government- and equivalent bonds were perceived as riskless and excluded from capital requirements. Capital requirements were again modified and lowered in the 1980s, when debenture loans were allowed as eligible capital (Wallander 1994, p. 137).[3]

Since the Bank Supervisory Authority would always be willing to modify the rules in times of trouble, capital requirements imposed from 1911 and onwards cannot be said to have been binding. Binding capital requirements emerged for the first time with the Basel accords in 1988. However, since the capital requirements from 1921 were lower for larger banks, the legislation may have enforced the movement towards consolidation.

The Bank of Sweden regulations

The period of decreasing CAR in 1940–1980 occurred in a time when financial markets were almost completely regulated. As mentioned in the introduction, Swedish credit markets were heavily regulated at the outbreak of WWII. The regulations were temporary wartime measures, but were *de facto* continued after the war. They were abolished in the 1980s. The main instrument of postwar regulations was the so-called Interest Rate Regulation Law (*räntereglerings*lagen), which was passed in November 1951. It was an "enabling act" that gave the Bank of Sweden the option to control the emission of bonds, and to regulate interest rates. Empow-

[3] On bank legislation and legal requirements from 1880 and onwards, see Frits (1988), Larsson (1988) and Söderlund (1978).

ered by this act, the Bank of Sweden was able to make "voluntary" agreements with the commercial banks (known as the "Bank of Sweden regulations"). At monthly meetings, so called liquidity ratios were agreed upon, which meant that cash plus government- and construction bonds should be a certain percent of deposits. The purpose of the liquidity ratios was to facilitate fiscal policy, and to channel credit into the public sector and into housing construction. The largest banks were required to have a higher liquidity ratio. In February 1952 the liquidity ratio was set to between 15 to 33 percent (the latter for the largest banks). The liquidity ratios increased by time; in 1959 to an interval of 20 to 40 percent, and in 1960 to an interval of 25 to 45 percent. In addition to liquidity ratios, the Bank of Sweden controlled the emission of bonds, which in practice meant that firms outside the construction sector were prohibited to issue them. In addition, the Bank of Sweden at times imposed lending ceilings to control the credit policies of the banks.

In the late 1970s the government sector ran large budget deficits. It became increasingly difficult to finance these through the banking system, wherefore a market for government bonds was created, which revived financial markets that had been dormant since the end of WWII (Henrekson 1995). The government also began to lend abroad, and this lending tended to weaken the effectiveness of the foreign-exchange controls. In addition, there was an international trend that favoured deregulation of financial markets. In the early 1980s, financial markets in general and the banking sector in particular were rapidly deregulated. In September 1983 the liquidity ratios were abolished. In November 1985 lending ceilings and bond emission controls were abolished. Foreign ownership of banks was allowed, and new banks chartered. Finally, in 1989 the foreign exchange controls were abolished.

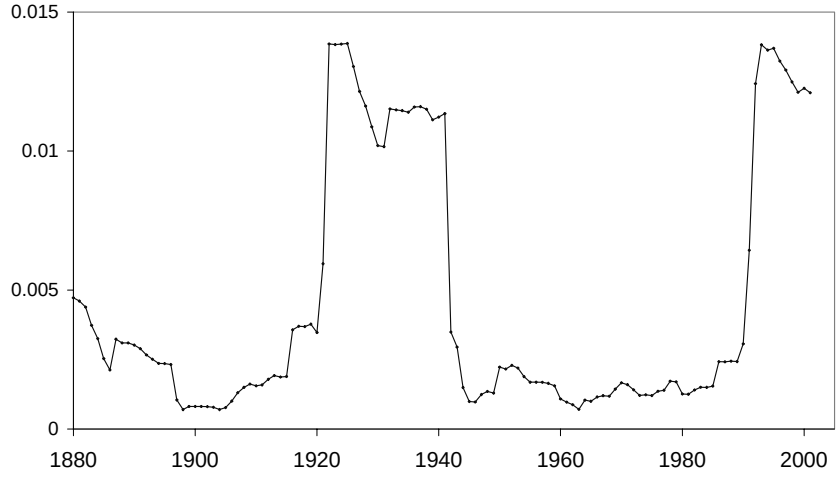
It is interesting that the regulation period coincides with the period of decreasing CAR, from 1940 to the early 1980s. This suggests that a regulated environment may have been necessary for

inflation and high corporate taxes to effectively cause changes in bank leverage.

Risk

Decreasing risk can potentially explain increasing leverage particularly in 1940–1980, when banks were shielded from competition and government bonds became their main asset. How should historical bank risks be measured? The standard practice in economics is to model agents as maximising their risk-return trade-off, where risk is taken to mean the volatility of returns. Volatility is normally measured by the standard deviation. Figure 7 shows the standard deviation of the profit margin (operating profits divided by assets) for ten-year periods (the value for 1980 is thus the standard deviation for profit margins in 1970–1979).

Figure 7 Profit volatility of the Swedish commercial banks, 1880–2001.



Source: Summary of the Bank Reports.

Measured in this way, profit volatility decreased from 1880 to 1900, but then it started to increase. It increased even more during WWI, and particularly in the crisis year 1922. From 1942 it de-

creased rapidly. This pattern is due to the ten-year window. The crisis years with large negative returns in 1922 and 1932 will have large effects on the standard deviation, and the effect lasts ten years. In the 1950s and 1960s, profit volatility dropped slightly. It then increased in the 1980s, to rise sharply after the crisis in 1991–1993. Overall, the pattern for profit volatility seems to correlate with the pattern for the CAR in Figure 1. The variable seems to have explanatory power.

4 Tax-inflation-leverage dynamics

This section presents a formal model on how inflation and high corporate taxes may interact to increase bank leverage. Inflation automatically increases bank debt, while high corporate taxes make it hard for banks to increase equity in step with inflation. This means that the CAR will drop (i.e., leverage increase). However, increasing leverage also means higher returns (on equity). After a while they become high enough for banks to add to their equity in step with inflation, and thus uphold a constant capital-ratio. Thus, the tax-inflation logic can explain not only why the CAR began to drop in 1940, but also why it stabilised around 1980. The logic may be illustrated by a numerical example. Imagine a bank with the following balance sheet at the beginning of the year.

Table 2 A bank balance sheet, beginning of year.

Assets	1100	Deposits	1000
		Equity	100

At the beginning of the year the bank has a debt-equity ratio $D/E \equiv L$ equal to 1000/100 = 10, and a capital-asset ratio equal to 100/1100 ≈ 9.1 percent. During the year an inflationary development takes place. There is a monetary expansion, and some of the new money is deposited with the bank. At the end of the year,

deposits have increased by 100 to 1100. The bank lends at a (fixed) lending rate l = 0.05, and borrows at a (fixed) borrowing rate b = 0.04. In accordance with the "leverage formula", the bank's return-on-equity should increase linearly with the debt-equity ratio according to the expression

$$r = l + (l - b) \cdot L . \qquad (1)$$

Calculated with the average debt-equity ratio over the year, return-on-equity in our numerical example is equal to 0.05 + (0.05–0.04) * 10.5 ≈ 0.16. The banks pay corporate taxes at a rate t = 50 percent. The after-tax return is thus 0.50 * 16 percent = 8 percent. In order to keep leverage constant, the bank must increase its equity by 10. However, after taxes it has only got 8 left to increase equity with. The bank is therefore unable to keep its leverage constant out of retained earnings. Moreover, it might be the case that stock owners require a certain dividend to be paid each year. Assume that they require an annual dividend d = 0.05. Then only 8–5 = 3 will be available for the purpose of increasing equity. At the end of the year, the banks balance sheet will then be the following.

Table 3 A bank balance sheet, end of year.

Assets	1203	Deposits	1100
		Equity	103

The debt-equity ratio has increased from 10 to 1100/103 ≈ 10.7. Corollary, the capital-asset ratio has decreased from 9.1 percent to 103/1203 ≈ 8.6 percent. In our numerical example, the combination of inflation and high corporate taxes led to a development where bank leverage increased. The example rested on the following implicit assumptions:

1. Lending and borrowing rates were exogenously determined in that they were
   a. not dependent on the rate of inflation; and
   b. not dependent on the corporate tax rate.

2. Banks increase equity only through retained earnings (and not through new issues of shares).

Relaxing these assumptions would tend to weaken the link between inflation, corporate taxes, and bank leverage.

An operational model.

It would be of benefit to present an operational model that can be quantitatively tested. The logic is that if leverage is to be kept from increasing, after-tax returns must be greater or equal to the sum of debt-inflation and required dividends. Inflation, it has been said, is always and everywhere a monetary phenomenon. Since newly printed money is normally deposited with the banking system, a monetary-driven inflationary process tends to swell bank deposits, and hence increase their debt. Assume that bank debt D increases percentually at the rate of inflation p:

$$\dot{D} = p\,. \tag{2}$$

With regard to dividends, it is of interest to know the motives behind banks' dividend policy. [4] Do actual dividends paid reflect deliberate risk-return trade-offs, or are they paid because they are a form of "cost of capital" that banks must pay in order to stay in business? The latter kind of dividends would tend to make leverage more sensitive to changes in inflation and corporate taxes. Thus, assume that total dividends d paid may be divided into two parts: one "required" part $d_f + ap$, and one part d_r reflecting risk-

[4] A survey of the literature on various motives behind dividend policy is Allen and Michaely (2003)

return trade-offs. The quantity d_f is the *minimum* dividend rate that banks must pay – dividends actually paid may be larger (which are paid according to risk-return trade-offs). d_f may also be zero. In addition to d_f, bank owners want compensation for inflation ap, where p is inflation and a is a number equal to or greater than zero. If $a = 0$ then bank owners only care about nominal dividends; if $a = 1$ then bank owners want a full "real" dividend. Total dividends paid are thus: $d = d_f + ap + d_r$.

If banks shall be able to keep leverage constant and at the same time pay the cost of capital, then after-tax returns must be sufficient to pay both the required dividend and add to the capital at the rate of inflation. For leverage not to increase, the following condition must hold:

$$\dot{L} \le 0 \Leftrightarrow \dot{E} \ge \dot{D} \Rightarrow (1-t)r \ge d_f + ap + \dot{D}, \tag{3}$$

which may be written

$$p \le p^m \equiv \frac{(1-t)r - d_f}{1+a}. \tag{4}$$

p^m (p-max) represents the maximum value that inflation is allowed to take if leverage is to be held constant. p^m is increasing in r [in l, (l–b) and L], and decreasing in t, d_f and a. For leverage not to increase, a *necessary* condition is that actual inflation p must be smaller than p^m. If p is larger than p^m, leverage will increase, that is,

$$p > p^m \Rightarrow \dot{L} > 0. \tag{5}$$

Asymmetry

We saw that if leverage is to be kept from increasing, actual inflation p must be smaller than the threshold value p^m. One may ask: is the relation symmetric? If p is smaller than p^m, will leverage then *decrease*? That is, does the following hold:

$$p < p^m \Rightarrow \dot{L} < 0 \; ??$$

$p < p^m$ means that returns are sufficient to pay required dividends and add to equity in step with inflation. Depending on their risk-return trade-offs, the banks choose how much of after-tax returns to pay in dividends, and how much to add to equity. If actual dividends d paid is equal to the minimum d_f required by owners, that is, if $d = d_f$, then leverage will decrease in the case of negative excess inflation ($p - p^m$). On the other hand, if the whole of after-tax returns is paid in dividends, that is, if $d = (1–t)r$, then leverage will actually *increase* (if price-inflation and hence debt-inflation is positive). Thus, symmetry does not necessarily apply – it depends on the dividend policy of the banks. As long as some part of the "extra-returns" are paid as dividends (d_r), the quantitative effects on leverage from positive and negative "excess inflation" ($p–p^m$) would be asymmetric: leverage would increase relatively more from positive excess inflation of a given size, than it would decrease from negative excess inflation of equal size.

The plot

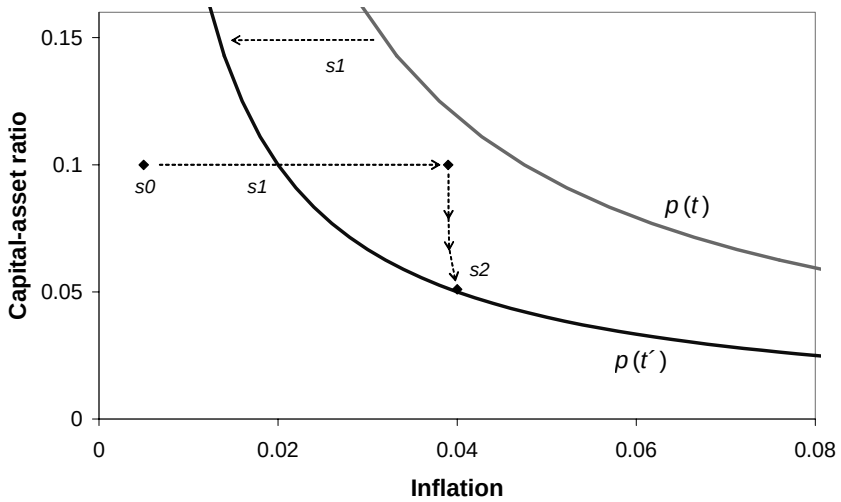
For given values of l, ($l–b$), d, a, and t, we may plot p^m as a function of leverage L. This is done in Figure 8, but with the CAR instead of L as the (inverse) measure of leverage. The relationship

$$L = \frac{1}{CAR} - 1 \qquad (6)$$

is thus used. Parameter values deemed reasonable from data have been chosen. l is assumed to be constant and not affected by inflation. An alternative specification would be to assume that inflation is fully reflected in interest rates, such that $l' = l + p$. It can then be shown that the threshold value will be $p^{m\prime} = (1/t) * p^m$. Thus, leverage would become less sensitive to inflation, and more sensitive to changes in the corporate tax rate, but the logic of the theory would

not be affected. For the regulation period 1940–1983, when interest rates were set by the authorities, and "real" interest rates were low or negative (Ståhl 1980), it is probably not reasonable to assume that a change in the inflation rate causes a one-for-one change in the interest rate. However, after deregulation in 1983 bank rates became more endogenous to market forces, and the assumption might be valid. Since in the regression analysis below actual returns are used, this discussion does not affect the empirical results.

Figure 8 Tax-inflation-leverage dynamics.



Note: $l = 0.05$, $g = 0.01$, $d_f = 0.04$, $a = 0$, $t = 0.05$, $t' = 0.60$.

The two curves depict the threshold value p^m as a function of the CAR, for two different tax rates $\{t,t'\}$. l and g are constant and thus not sensitive to the tax rate, which means that the p^m-curve shifts to the left when the corporate tax rate is raised. This means that corporate taxes cannot be perfectly passed on to lenders and borrowers. For the regulation period in 1940–1983, when interest rates were administratively determined by the authorities, this is reasonable. Time is denoted by the letter s. Points to the left of the p^m-curve might be stable or not, depending on the dividend policies

of the banks. We might assume that they are stable. However, points to the right of the p^m-curve are definitely unstable. For a given CAR, if inflation is larger than p^m, the CAR will decrease. Figure 8 schematically describes the possible post-WWII interaction between bank leverage, corporate taxes and inflation. At time s_0 the banking system is at the point represented by s_0. The corporate tax rate is t. Since s_0 is to the left of $p^m(t)$, the banking system is at rest. At time s_1, two things happen. First, inflation goes up (from 0.5 to 4 percent). In itself, this change would have no effect on the CAR, since the banking system would still be at a point to the left of $p^m(t)$. However, the tax rate has now also increased, from t to t'. Thereby the p^m-curve shifts to the left. The banking system is then at a point to the right of $p^m(t')$. The CAR decreases. While the CAR decreases, leverage and hence returns increase. At a certain point, returns are sufficient to uphold a stable CAR. This occurs at point s_2. The banking system is once more at rest.

5 Determining required dividends

The previous section developed a model on how inflation and taxes may interact with leverage. In the next section the model will be confronted with real-world data. But first, the size of the dividend requirement needs to be assessed. The parameter values for d_f and a must be determined. We are interested in required dividends in relation to equity. The estimation of these is complicated by the existence of hidden reserves. Since a substantial part of equity after 1940 was in the form of hidden reserves, the question how equity owners looked upon these funds becomes important. Therefore, the dividend and capitalisation policies of the banks over the studied period are briefly reviewed. The section draws on talks with Jan Wallander, CEO and board chairman of major Swedish banks, 1960–1991.

During the time of the classical gold standard, things were relatively simple. Banks did not systematically increase their capital. There was no inflation, no corporate taxes and no hidden reserves. Net profits were almost completely paid out in dividends – about 7 percent on average in 1870–1914 (see Figure 9 below). With the advent of inflation and high corporate tax rates, banks started to increase their capital through retained earnings. This became important from 1940 and onwards. Up until the 1970s, stock ownership was controlled by a relatively small group of families. With the Kreuger crash in fresh memory, and with high income taxes on top of the high corporate taxes, they favoured consolidation – particularly in the form of transfers to untaxed reserves – over dividends. Stock owners did not much concern themselves with dividends in relation to equity, but were happy as long as they got a nominal dividend raise. For these reasons, banks tried to stow away as much profits as possible into hidden reserves, the so called valuation reserve accounts. The limit to these operations was set by the tax authorities.[5] Since, credit losses were small, the capital ratio was not of great concern. Although there were formal capital requirements, these were in practice not binding, since the Bank Supervisory Authority (*Bankinspektionen*) would always modify the rules so that the banks would be formally able to comply with them.

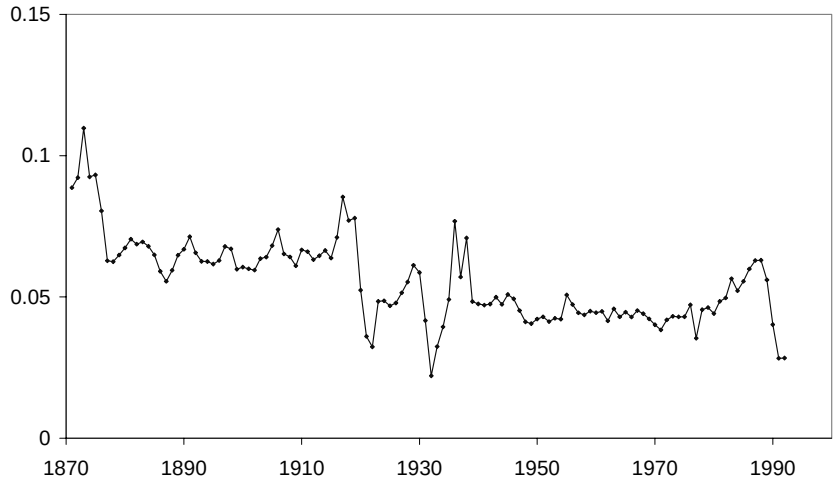
At the beginning of the 1980s, the business environment changed. Stock ownership became more widespread. The foreign-exchange controls became less effective. Banks increasingly raised funds abroad, and the ratings of international credit rating agen-

[5] High corporate taxes could in this way tend to *increase* capitalisation, by a form of "substitution effect". However, if the reservation possibilities set by the tax authorities are restrictive, the "income effect" of high corporate tax rates should dominate the substitution effect, such that higher corporate tax rates causes capitalisation to decrease.

cies became important, wherefore capital ratios became a concern. Finally, from 1988, the Basel accords put binding capital requirements on the banks.

Despite these observations, data suggest that the banks followed a policy of paying dividends at a constant ratio to their capital. It is "as if" the banks paid a fixed (nominal) dividend-equity rate, where equity is book equity plus 70 percent of untaxed reserves. This is seen in Figure 9.

Figure 9 Dividends-to-equity ratio, 1871–1992.



Source: Summary of the Bank Reports.
Note: Equity = book equity plus 70 percent of untaxed reserves.

Despite the growth in untaxed reserves, dividends were stable in the period 1940–1980 at around 4.5 percent of total equity in nominal terms. In real terms, dividends decreased over the period. From 1980 dividends increased, perhaps reflecting a changed environment where stock owners demanded higher compensation for inflation. In view of Figure 9 it seems reasonable to set the "floor" on dividends at 4 percent. Dividends fell below this floor only in

the crisis years in the 1920s, 1930s and 1990s. Thus, d_f is set to 0.04 and a is set to 0.

6 Testing the model

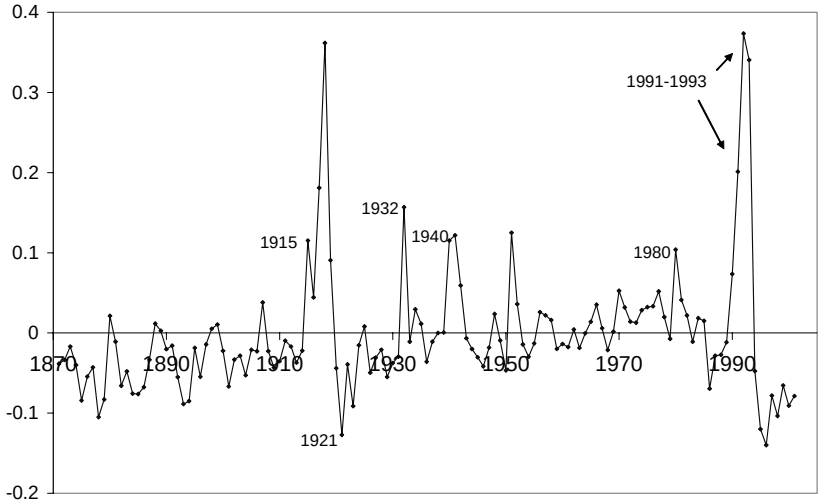
Excess inflation

Define the excess inflation x as the actual inflation p minus the maximum inflation p^m:

$$x = p - p^m. \tag{7}$$

p^m is defined by formula (4). Figure 10 depicts excess inflation for the years 1871–2001.

Figure 10 Excess inflation, 1871–2001.



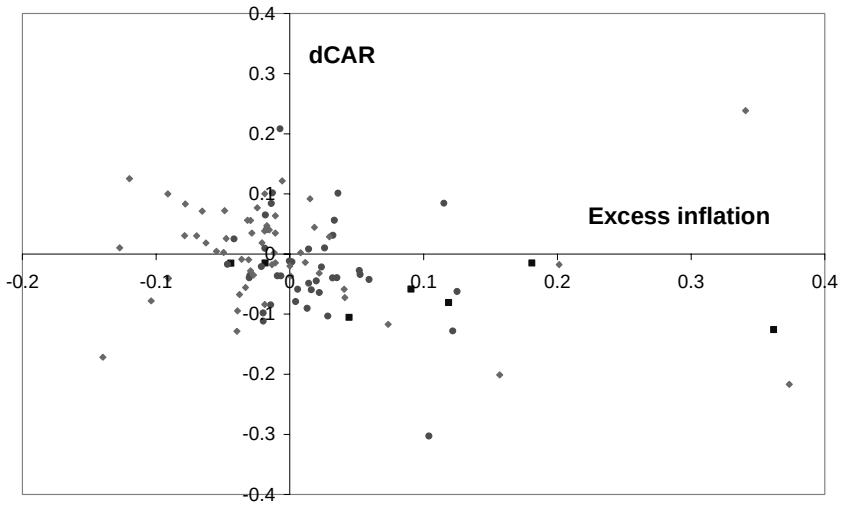
Source: Summary of the Bank Reports.

There was virtually no excess inflation in 1871–1914, as should be expected. But during WWI, excess inflation skyrocketed. In the interwar period 1920–1939, excess inflation was again negative. In 1940–1980, excess inflation was 1.6 percent on average. Peaking in 1980, excess inflation was brought down in the beginning of the

1980s. From 1983 – the year of deregulation, when liquidity ratios were abolished – excess inflation was mostly negative, especially in the boom years in the latter half of the decade. Excess inflation was high in the crisis years in 1932 and in 1991–1993 (but not in 1922). This is natural: negative profits means that banks are unable increase their equity even if inflation is zero. From 1994, excess inflation has been well below zero – probably a reflection of lower corporate taxes and a low-inflation policy.

Figure 10 suggests that excess inflation was positive in the years when the capital-asset ratio decreased, at least in the 20th century. Figure 11 plots dCAR, the change in the logged CAR, with excess inflation, in the years 1871–2001.

Figure 11 Change in logged CAR, and excess inflation, 1871–2001.



Source: Summary of the Bank Reports. *Note*: Squared dots for the years 1914–1920, round dots for the years 1940–1980.

The tax-inflation-leverage dynamics predicts two things. First, when excess inflation is positive, the CAR should decrease. This means that points in the right side of the diagram should tend to be centred in the lower square. Indeed, this seems to be the case. In

particular, the dots of WWI are clearly recognisable. Second, if asymmetry is present, then when excess inflation is negative, the CAR should not necessarily increase, but rather be stable, or at least increase at a low rate. This means that dots in the left side of the diagram should be more fairly spread in the upper and lower squares. From eye-ball econometrics it is not clear whether this is the case. Formal testing is called for.

Regressions

The following model is estimated:

$$dCAR_t = \beta_0 + \beta_1 X_t + \beta_2 dPROFVOL_t + \beta_3 dNUMBER_t + \\ + \beta_4 BASEL_t + \beta_5 REGUL_t + [crisis\ dummies] + u_t \quad , \quad (8)$$

where

$$u_t = \rho u_{t-1} + \varepsilon_t \, . \quad (9)$$

The variables are the following:

dCAR: The change in the log of the capital-asset ratio
X: Excess inflation
dPROFVOL: The change in the log of the profit margin
dNUMBER: The change in the log of the number of banks
BASEL: A dummy variable for the Basel accord, 1990–2001
REGUL: A dummy variable for regulations, 1940–1983

The variable X has been defined as in formula (4), with $d_f = 0.04$, and a = 0. *dPROFVOL* is calculated as in section 3, namely as the standard deviation of ten-year returns.[6] With regard to the Basel

[6] Regressions were also performed with *dPROFVOL* calculated on the basis of 5 and 15 year returns. The coefficients for these variables were statistically insignificant. The value and significance of the x-coefficient was marginally affected by the choice of time period for *dPROFVOL*. Also, since consolidation should affect the CAR over several years, and not only in

dummy, 1990 is chosen as the starting year. Although the agreement was made in 1988, it did not come into effect until two years later (Flannery and Rangan 2002). The year 1983 is chosen as the end year for the regulation dummy. This was the starting year of the deregulation process, when the liquidity ratios were abolished. In addition, dummy variables for the crisis years 1922, 1932, 1991–1993 are used.

Regressions are performed on differenced variables rather than on levels, for three reasons. First, the underlying theory expressed in Figure 8 is inherently a theory of differences: the CAR should decrease if the inflation rate is larger than a certain threshold value. Second, the augmented Dickey-Fuller test for unit roots reveals that the variables *CAR*, *NUMBER* and *PROFVOL* are non-stationary on levels, but stationary on differences. Third, the x-variable, the difference between the inflation rate and its threshold value, cannot easily be expressed in terms of levels. Both autocorrelation and heteroscedasticity can be detected. To grind out these, regressions are performed with one lag in the disturbance term (by maximum likelihood), and with Huber-White standard errors.

Testing for asymmetry

The tax-inflation-leverage dynamics of Figure 8 suggests that the effect of excess inflation on the capital-asset ratio should be asymmetric, in that while positive excess inflation should mean that the CAR decreases, negative excess inflation should not necessarily mean that the CAR increases. Figure 10 also indicates that this may have been the empirical case. Therefore, asymmetry is formally tested. This is done by splitting the x-variable into two variables; one that takes the value of x for positive x-values and zero other-

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the year of occurrence, regressions were performed with lagged values of *dNUMBER*. These lags were statistically insignificant, however. Results are available upon request.

wise, and one that takes the value of x for negative x-values and zero otherwise. In other words, the following two variables are defined:

$$XPOS = X \; if \; X > 0 \; and \; XPOS = 0 \; if \; X \leq 0$$
$$XNEG = X \; if \; X \leq 0 \; and \; XNEG = 0 \; if \; X > 0 \qquad (10)$$

The variables are then regressed in the same regression. If asymmetry is present, then the coefficient for *XPOS* should be statistically significant and negative, while the coefficient for *XNEG* should be neither economically nor statistically significant. Moreover, a *t*-test should reveal that the coefficients are not equal.[7] Table 4 shows regression results for both the unsplitted and splitted specifications of x. The CAR decreased mainly during WWI and in 1940–1980. Three sample periods are therefore chosen: one "full sample" period 1882–2001, one period 1920–2001 that excludes WWI, and a postwar period 1940–2001. That the starting year is 1882 in the full sample period is due to the ten-year window for the volatility variable *dPROFVOL*.

[7] The method has previously been employed for example by Nannestad and Paldam (1997), who use it to test for asymmetries in voter preferences.

Table 4 Regression results.

	Dependent variable: dCAR					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
X	***–0.29***	–0.33	–0.45			
	(0.000)	(0.080)	(0.055)			
XPOS				***–0.49***	–0.64	–0.66
				(0.000)	(0.067)	(0.078)
XNEG				0.21	0.070	0.012
				(0.37)	(0.80)	(0.98)
XPOS=XNEG				(0.023)	(0.16)	(0.35)
dPROFVOL	**7.8**	***9.8***	10.3	**9.0**	***10.8***	9.9
	(0.039)	(0.009)	(0.16)	(0.024)	(0.005)	(0.14)
dNUMBER	0.063	0.004	–0.056	0.055	0.001	–0.032
	(0.36)	(0.96)	(0.57)	(0.44)	(0.98)	(0.70)
BASEL	0.029	0.033	**0.057**	0.002	0.009	0.029
	(0.19)	(0.081)	(0.037)	(0.93)	(0.68)	(0.37)
REGUL	–0.010	–0.017	–0.037	–0.019	–0.019	–0.038
	(0.36)	(0.17)	(0.10)	(0.14)	(0.14)	(0.098)
CONSTANT	–0.034	–0.031	–0.034	0.010	0.005	0.004
	(0.10)	(0.13)	(0.11)	(0.70)	(0.84)	(0.93)
AR (1)	–0.22	**–0.34**	–0.34	–0.24	**–0.32**	–0.32
	(0.086)	(0.044)	(0.052)	(0.064)	(0.041)	(0.073)
Sample	1882–2001	1920–2001	1940–2001	1882–2001	1920–2001	1940–2001
DW	2.03	2.12	1.99	2.04	2.10	1.94
Obs.	120	82	62	120	82	62

Note: Dependent variable: dCAR. Dummies for crisis years 1922, 1932, 1991–93. Huber-White standard errors. *p*-values in parentheses. Bold-italics and bold denote statistical significance on the one-percent and on the five-percent levels, respectively.

In the unsplitted regressions (i–iii), the *X*-coefficient is of the expected sign. It is statistically significant at the one-percent level in the full-sample regression, but only at the ten-percent level when regressed on the smaller samples. In the splitted regressions (iv–vi), *XPOS* is of the expected sign. It is statistically significant at the

one-percent level in the full-sample regression, but only at the ten-percent level with the smaller samples. The coefficient value increases in these regressions, from –0.49 to –0.64 (–0.66). Thus, while statistically less significant when the time before and during WWI is excluded, the economic significance of the variable increased.

As predicted, the variable *XNEG* is close to zero and not statistically significant in any regression. The coefficient values of *XPOS* and *XNEG*, and associated *p*-values, indicate that asymmetry might be present. Asymmetry also passes the *t*-test at the five-percent level in the full sample regression. However, the effect is not strong enough to pass the test in the smaller sample regressions.

With regard to the other variables, the coefficient for *dPROFVOL* is of the expected sign, and statistically significant at the one-percent level for the sample 1920–2001, and at the five-percent level for the full and postwar samples. That *dPROFVOL* is more significant for the 1920–2001 sample than for the full sample is due to the fact that volatility was decreasing at the end of the 19th century, when the CAR was increasing. This increase should reasonably be due to an increase in the number of banks in this period. However, *dNUMBER* is far from being statistically significant. Contrary to the suggestions of Saunders and Wilson (1999), consolidation appears to have performed a limited role in the decrease of the CAR of the Swedish commercial banks. With regard to the dummy variables, the *BASEL*-coefficient is of the expected sign, and statistically significant at the five-percent level for the 1940–2001 sample. The coefficient for *REGUL* is of the expected sign, but not statistically significant. Neither is the constant statistically significant. Its value in regression (i) indicates a trend by which the CAR has decreased secularly by three percent per year in the period 1882–2001.

Economic significance

It could be of interest to try to estimate the economic significance of the x-coefficients, particularly for the period since WWII. In 1940–1980, the CAR dropped from 13 to 5 percent, which is a decrease of about 60 percent. How much of this drop may be attributed to excess inflation? The coefficient value of the unsplitted X is –0.53 for regression (vi) with sample period 1940–2001. In this period, excess inflation was 1.6 percent on average. Because of excess inflation, the CAR should have dropped by 41*1.6*0.45 percent ≈ 30 percent. Since the CAR actually dropped 60 percent in 1940–1980, about half of the postwar drop may be attributed to excess inflation. One may also use the coefficients of the splitted regression. In 1940–1980 there were 24 years with positive excess inflation, which was 4.1 percent on average. Using the coefficient for *XPOS* in regression (vi), the CAR should have decreased by 24*4.1*0.66 ≈ 65 percent in 1940–1980. According to this calculus, virtually the entire decrease in the CAR after 1940 could be attributed to excess inflation. In sum, depending on which regression coefficients are used, excess inflation could have decreased the CAR in 1940–1980 with 30 (60) percent, which is about 50 (100) percent of the actual decrease in this period. These numbers could be considered economically significant.

7 Conclusions

The paper explored whether inflation and high corporate taxes had the unintended effect of increasing the leverage of the Swedish banking system in the 20th century. By a simple logic, inflation automatically increases bank debt, while high corporate taxes make capital accumulation difficult. Bank capital ratios will therefore tend to drop, until leverage-induced increasing returns become sufficient to uphold them at constant levels. This tax-inflation-leverage theory was confronted with Swedish bank data

for 1871–2001. The theory seems capable of explaining the sinking capital ratios of the Swedish banks during WWI and in 1940–1980. The theory also seems capable of explaining the relative stability of the CAR since the early 1980s. Regression analysis showed excess inflation to be a statistically significant variable. However, the variable was not as statistically strong in smaller samples excluding WWI. Another statistically significant variable was changing risk, as measured by the change in profit volatility. As predicted by theory, asymmetry between positive and negative excess inflation was detected – while positive excess inflation decreased the capital-asset ratio, negative excess inflation did not necessarily increase it. With regard to economic significance, it was estimated that about half of the postwar drop in the CAR of Swedish banks, or even more, may be attributed to excess inflation.

Which way forward? One path would be to improve the quantitative analysis. More refined variables for risk and consolidation could be employed. In particular, it would be interesting to see if bank concentration measured by a concentration index can significantly explain the decreasing CAR in the 20th century. Another venue would be international comparisons. Swedish bank leverage increased during periods roughly similar to those of the US, the UK and Canada. Swedish postwar policy was not radically different from that of those countries. The world in general experienced the philosophy of state control over the banking system and monetary expansion through the Bretton Woods system. It would be of interest to investigate whether the causal agents of this study – inflation, corporate taxes and regulations – have explanatory power also for other countries. A third road would be to study more closely the impact of deregulation. Excess inflation turned negative in the 1990s when inflation was brought down from 10 percent to 2 percent, and corporate tax rates were slashed from 60 to 30 percent. An additional factor may have been the deregulation itself. In a deregulated environment, inflation may be more easily

transmitted to interest rates, which would raise bank returns and hence weaken inflation's detrimental effect on leverage. How detrimental to bank leverage is inflation in a deregulated environment?

The last question should be of relevance to contemporary policy discussions. With the benefit of hindsight, Swedish postwar bank capital ratios dropped to levels that were inadequate to sustain the credit losses of the early 1990s, in such a way that the whole banking system was balancing on the verge of bankruptcy. Leijonhufvud (1981, 2000) has argued that the costs of inflation has been underestimated in economic theory. Overleveraged banks could be an additional item on the list of unrecognised inflation costs. If the calculus is correct that excess inflation accounted for over half of the postwar drop in the CAR, then analysis of this kind could profitably be incorporated into monetary and fiscal policy, in order to guard against large-scale, system-threatening banking crises in the future.

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IV.

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

The effects of note monopolisation on the amplitude of money and credit cycles are studied. Swedish bank data for 1871–1915 reveal that the money cycle became smaller, but the credit cycle larger, after the Bank of Sweden gained a note monopoly in 1904. At the same time, the money multiplier decreased, while the credit multiplier increased. 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 money multiplier decreases. That the credit multiplier simultaneously increased is attributed mainly to an increasing time-demand deposit ratio, which increased the credit capacity of the banking system.

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

[+] Financial support from the Earhart Foundation, the Jacob Wallenberg Foundation, and the Torsten and Ragnar Söderberg Foundations is gratefully acknowledged. I have benefited from comments by Magnus Henrekson, Michael Andersson, Niclas Berggren, Mikael Stenkula, Daniel Waldenström and Eugene N. White.

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 inter-bank 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]

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[1] On the classical monetary debates see Smith (1936), White (1995), Schwartz (1995). On the modern controversy see Goodhart (1988), Bordo and Schwartz (1996), and Selgin (1994, 2001).

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 1871–1915 to investigate how money and credit cycles were affected by the note monopolisation. Data show that the money cycle became smaller and the credit cycle larger after the Bank of Sweden gained a note monopoly in 1904. At the same time, the money multiplier decreased, while the credit multiplier increased. These facts points to a link between the size of multipliers and the size of cycles. How did note monopolisation affect multipliers?

Note monopolisation trades loss of clearing, or base expansion, which increases the multiplier – for leakage, which decreases it. What is the relative size of the clearing and leakage effects? It is shown that if the central bank's reserve ratio is larger than that 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 actually the case, and this effect dominated the other effects such that the credit multiplier increased. Thus, the multiplier analysis yielded the predictions that the money cycle should have decreased post monopolisation, while the credit cycle should have increased – a result that is consistent with data.

2 Money and credit cycles 1871–1915

This section describes the empirical evidence. Using Swedish bank data for the period 1871–1915, 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. The transfer of the note stock of the Enskilda banks to the Bank of Sweden occurred in 1901–1904. However, 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" 1871–1897, a "transition period" 1897–1904, and a "note monopoly period" 1904–1915.

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 in 1914 at the outbreak of WWI. The cycles sample is therefore small, with 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 1904–1915.[2]

[2] An alternative would be to extend the data set to include the period 1915–1935. Since Sweden re-adopted the gold standard in 1924–1931, one more cycle for note monopoly on gold would then be available. I have

Hence, it is not possible to draw definite conclusions regarding the effects of note monopolisation on money and credit cycles. There are no degrees of freedom left to control for external events, nor is it possible to perform statistical tests. The investigation should nevertheless be of value, since – to my knowledge – it is the very first empirical study of how note monopoly affects money and credit cycles.[3] 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

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. Cycle amplitude is thus measured as follows:

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calculated cycles for this extended sample. However, these cycles are not presented here, since it is generally agreed that macro variables fluctuated more in the interwar period than they did prior to WWI, wherefore *ceteris paribus* conditions do not apply (see for example Englund *et al* 1992). The extended-sample results actually reinforce those of the smaller sample, namely that the money cycle decreased after monopolisation, while the credit cycle increased (results available upon request).

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

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).

2.1 Money

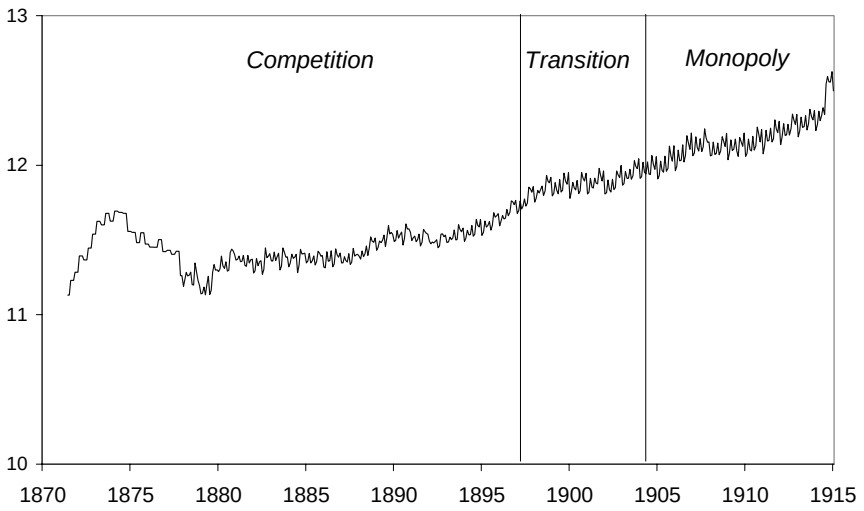
Two measures of money are examined: notes and fiduciary money.

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 include 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 1871–1915 is presented in Figure 1. For the period 1871–1878, quarterly data are used.

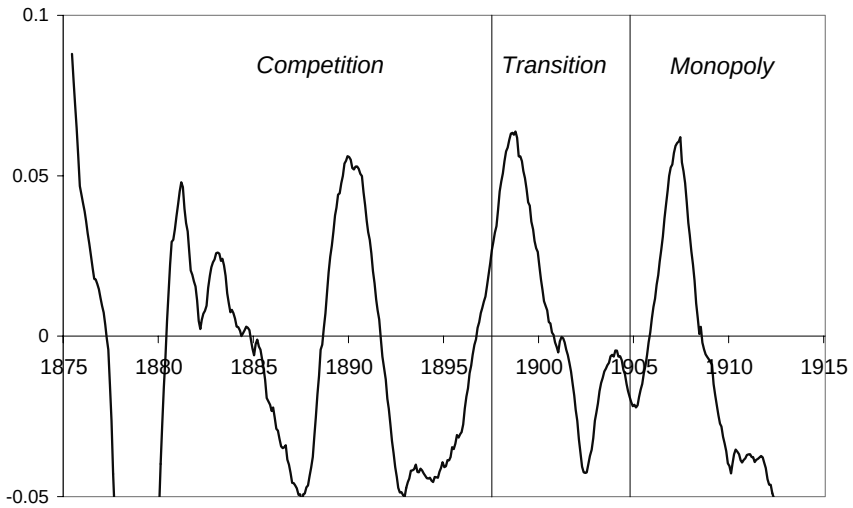
Figure 1 Log of notes of the Swedish banks, 1871–1915



Source: Summary of the Bank Reports.

There was a sharp increase in the quantity of notes in 1871–1874, in the boom years following the Franco-Prussian war. The subsequent decline could partly be due to the new bank law that was promulgated in 1874, by which Bank of Sweden notes were no longer legal tender for the note-issuing banks. Henceforth, the Enskilda bank notes were to be redeemed into gold coin only. There is also 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 the note cycle did not increase after monopolisation. This is confirmed by Figure 2, which shows the cyclical component of logged notes for 1875–1915.

Figure 2 Cyclical component of log of notes, 1875–1915.

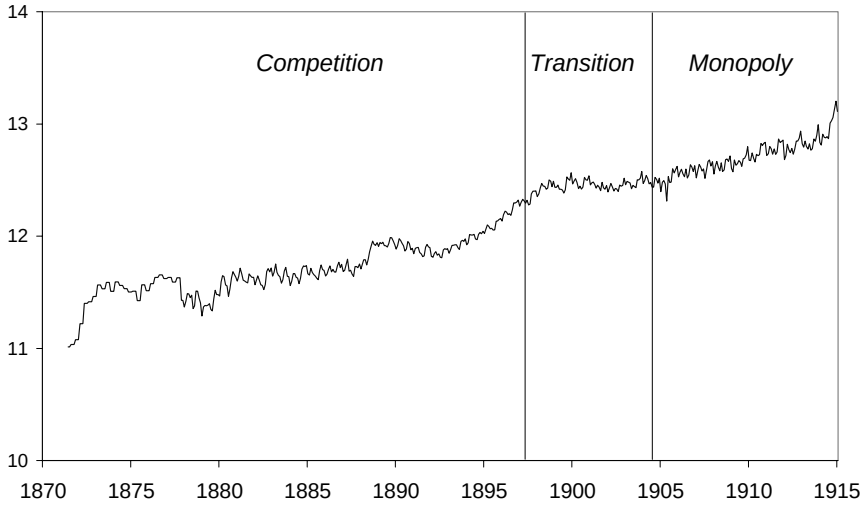


Source: Summary of the Bank Reports.

The amplitude of the notes cycle was hardly affected by note monopolisation. The three cycles before, during and after transition have amplitudes that are more or less similar. By contrast, when it comes to fiduciary money, there is a clear tendency towards a

smaller cycle after monopolisation. Figure 3 shows the log of fiduciary money in 1871–1915.

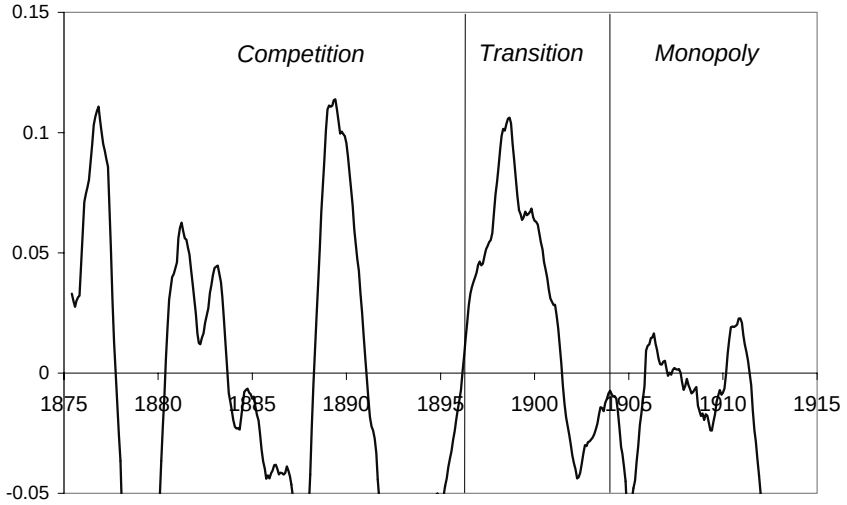
Figure 3 Log of fiduciary money, 1871–1915.



Source: Summary of the Bank Reports.

The period 1904–1915 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 4 confirms that the fiduciary money cycle became smaller after note monopolisation.

Figure 4 Cyclical component of log of fiduciary money, 1875–1915.

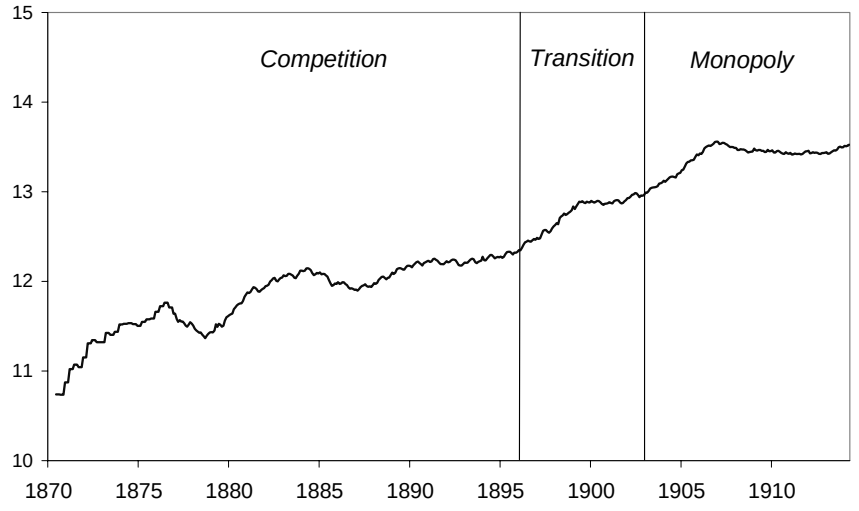


Source: Summary of the Bank Reports.

2.2 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 (2005b), 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. Figure 5 shows the log of total bank bills (commercial banks plus the Bank of Sweden) in 1871–1915.

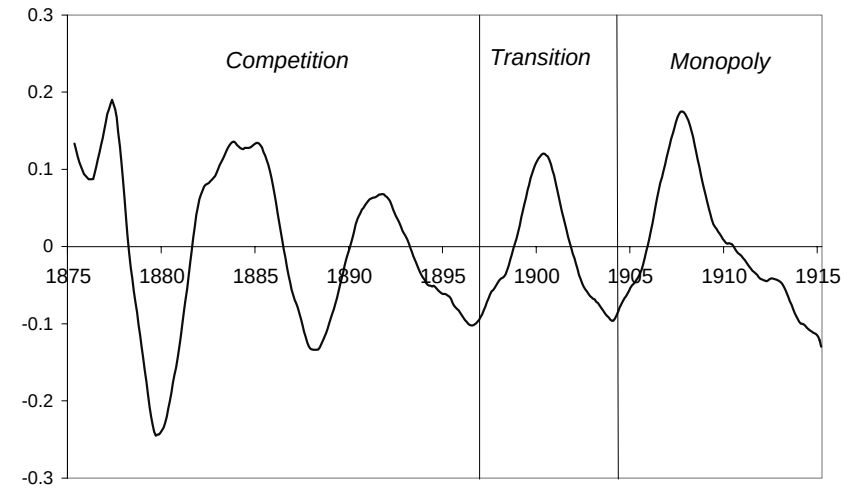
Figure 5 Log of total bank bills, 1871–1915.



Source: Summary of the Bank Reports.

The volume of bills varied cyclically with remarkable regularity. Calculation of the cyclical component indicates that the cycle amplitude increased after monopolisation. This is shown in Figure 6.

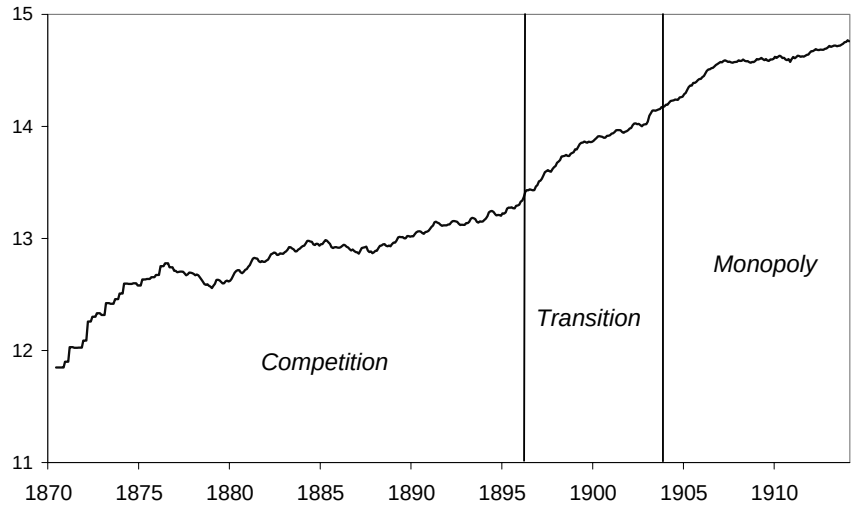
Figure 6 Cycle amplitude for log of bank bills, 1875–1935



Source: Summary of the Bank Reports.

In the competition period there is a steady downward trend in cycle amplitude. Starting in the transition period, the trend turns upwards. Compare the 1907–1908 bills cycle with the cycle of fiduciary media in the same period. Whereas the bills cycle is large and sharp, the fiduciary money cycle is virtually non-existent in this period. For total lending, the trend towards larger cycles is even more manifest. Figure 7 pictures the log of total bank lending in 1871–1915.

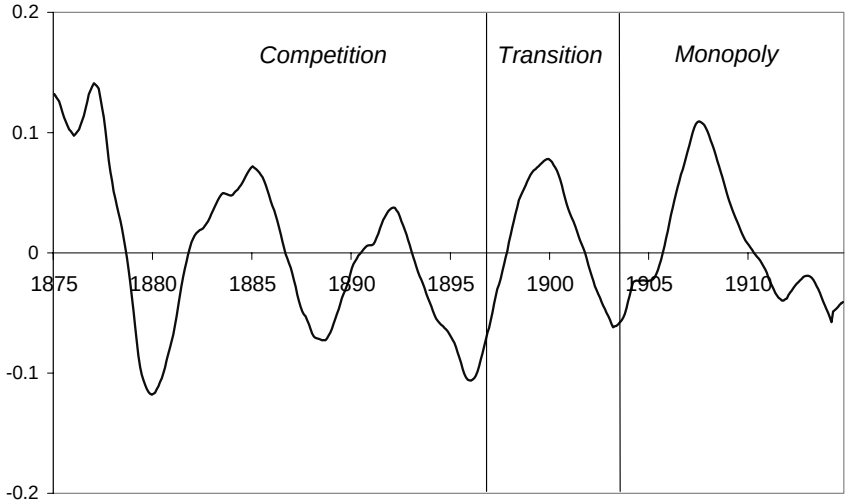
Figure 7 Log of total bank lending, 1871–1938.



Source: Summary of the Bank Reports.

Note the strong seasonality in lending during the classical gold standard period. The amplitude of the lending cycle is pictured in Figure 8. The same pattern as the one for bills is present, only even more pronounced. The tendency is for the cycle to decrease until the transition period, after which the cycle becomes larger.

Figure 8 Cyclical component of the log of lending, 1875–1915.



Source: Summary of the Bank Reports.

3 Clearing vs. Leakage: the model

The empirical evidence revealed that after note monopolisation in 1904, the money cycle became smaller, while the credit cycle became larger. This section analyses whether this result can be attributed to the note monopolisation itself. This is done by comparing money and credit multipliers before and after monopolisation. If it is the case that larger (smaller) cycles are associated with larger (smaller) multipliers, then the question of how note monopolisation affects money and credit cycles may be indirectly assessed by analysing how monopolisation affects the corresponding multipliers. Although causation from note monopolisation to cycles cannot be established by this approach, at least consistency with data can be achieved.

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:

$$\Delta M = m \cdot \Delta B \qquad (1)$$

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.

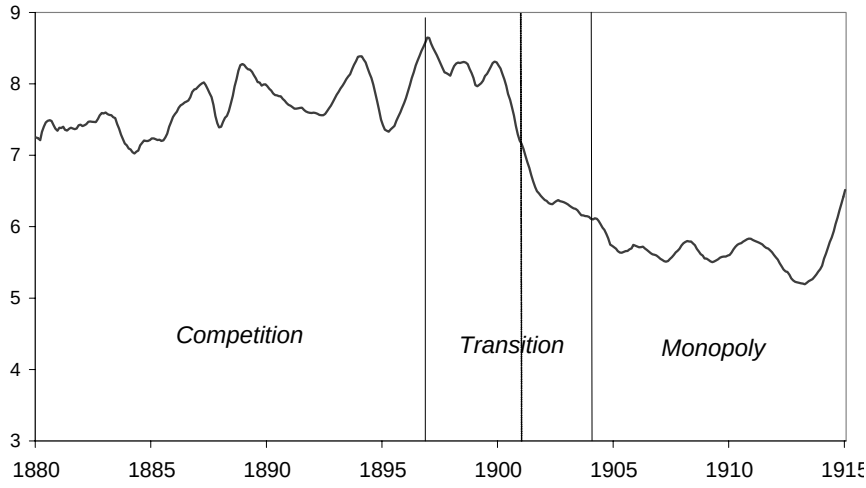
This kind of mechanical multiplier approach has been criticised for being unrealistic as a description of the money supply process in the real world (Goodhart 1988). Although this critique may be valid, the purpose here is not to describe the money supply process, but to use the multiplier approach as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

Intuitively, the multiplier may be regarded as a measure of how "leveraged" the fractional reserve banking system is. A larger mul-

tiplier means a larger lever, which should translate into larger swings in volumes. Indeed, this seems also to have been the case in Sweden for the period of study. Figure 9 shows the money-to-gold ratio (MGM) of the Swedish banking system, 1880–1915.

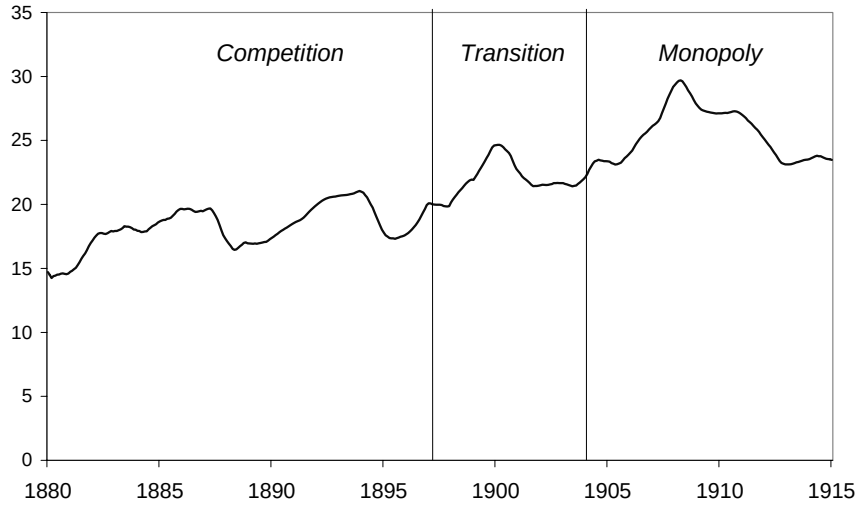
Figure 9 Money-to-gold ratio of the Swedish commercial banking system, 1880–1915.



Source: Summary of the Bank Reports.

The money-to-gold ratio clearly decreased after note monopolisation in 1901–1904. When it comes to the credit-to-gold ratio (CGM), the opposite tendency is present. This is seen in Figure 10.

Figure 10 Credit-to-gold ratio of the Swedish banks, 1875–1939.



Source: Summary of the Bank Reports.

Besides being more cyclical than the money-to-gold ratio, the credit-to-gold ratio steadily increased. In sum, there is a coincidence between the size of cycles and the size of multipliers. The money cycle decreased after note monopolisation, and the money multiplier became smaller. The credit cycle increased after monopolisation, and the credit multiplier became larger. The indirect approach is therefore warranted.

The money multiplier

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

Table 1 Bank balance sheet, note competition.

Reserves	**N**otes
Credit	**D**emand deposits
	Time deposits

The bold faced letters will be used as abbreviations. Also, subscripts "cb" and "b" will be used to distinguish variables of the central bank from those of the commercial banks. Aggregate variables have no subscript. Likewise, the prime sign will be used (when necessary) to denote variables under note monopoly. Thus, the variable x_{cb} is a variable of the central bank in the competition period, while y_b' is a variable of the commercial banks in the monopoly period.

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 "pure" note-competitive banking system, where no bank's demand liabilities are used as reserves by other banks, 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.

Conditions of the pure note-competitive banking system:

$$\begin{aligned} &1.\ I = N_b + D_b = M \\ &2.\ B = R_b = G \end{aligned} \tag{2}$$

Let us further define the following two ratios:

$$r_b = \frac{R_b}{I_b} \tag{3}$$

and

$$c = \frac{N}{D}. \tag{4}$$

That is, the reserve ratio of the banks and the currency-deposit ratio of the public. These are thought of as behavioural constants.

Assume that all banks have the same reserve ratio r_b. The money-to-gold multiplier (MGM) may then be calculated as follows:

$$\frac{M}{G} = \frac{M}{B} = \frac{M}{R_b} = \frac{M}{r_b I_b} = \frac{1}{r_b}\frac{N+D}{N+D} = \frac{1}{r_b} \equiv m\,. \tag{5}$$

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. An increase in the demand for notes relative to demand 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 its notes and demand deposits become base money. The demand deposits of the central bank become equal to the reserves of the commercial banks, R_b. 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:

$$\begin{aligned} &1.\ R_{cb} = G \\ &2.\ B = N_{cb} + R_b \\ &3.\ I = D_b \end{aligned} \tag{6}$$

We then form the money-to-gold multiplier (with prime signs on reserve ratios):

$$\frac{M}{G} = \frac{N_{cb} + D_b}{R_{cb}} = \frac{(c+1)D_b}{r'_{cb}B} = \frac{1}{r'_{cb}} \frac{(c+1)D_b}{(c+r'_b)D_b} =$$

$$= \frac{1}{r'_{cb}} \frac{1+c}{c+r'_b} \equiv \frac{1}{r'_{cb}} \cdot m' \tag{7}$$

The MGM of note monopoly consists of two items: the money multiplier m' 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 under note monopoly. If the MGM is to *decrease* after note monopolisation, the following must hold:

$$\frac{1}{r_b} > \frac{1}{r'_{cb}} \frac{c+1}{c+r'_b} \tag{8}$$

or

$$r'_{cb} > r_b \cdot \frac{c+1}{c+r'_b} = r_b \cdot m' , \tag{9}$$

Formula (8) expresses the essential trade-off of note monopolisation. Monopolisation creates base expansion, equal to the inverse of r_{cb}. But it also installs leakage which lowers the money multiplier from m to m' (c is added to both the nominator and the denominator of $1/r_b$). We saw that the MGM actually decreased after the bank of Sweden gained a note monopoly in 1904. An intriguing question is whether this fact may be attributed to the relative size of the leakage and clearing effects. Under what conditions will the leakage effect dominate the base expansion effect, such that the money-to-gold multiplier decreases? First, consider the case when the central bank's reserve ratio is equal to that of all the other

banks, and when the reserve ratio of the commercial banks is unaffected by the monopolisation. That is, we have that

$$r_{cb} = r'_{cb} = r_b = r'_b \tag{10}$$

This condition would apply for example if one bank was given a note monopoly, and this act did not alter the bank's reserve ratio. From inequalities (8) and (9) we see that m must then be equal to one if the total multiplier is to remain unchanged, or smaller than one, if the total multiplier is to decrease:

$$\frac{c+1}{c+r'_b} \leq 1\,. \tag{11}$$

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 proposition:

> **Proposition 1** *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.*

Now consider the case when the central bank's reserve ratio is different from the reserve ratio of the commercial banks, and where reserve ratios are unaffected by the monopolisation. In this case we have:

$$\begin{aligned} r_{cb} &= r'_{cb} \neq r_b \\ r &= r'_b \end{aligned} \tag{12}$$

With note competition, the money stock will be

$$M = M_{cb} + M_b = \frac{(1-a)B}{r_{cb}} + \frac{aB}{r_b}, \tag{13}$$

where a is the share of base money held by the commercial banks. For the MGM to decrease after monopolisation, the following must hold:

$$\frac{(1-a)}{r_{cb}} + \frac{a}{r_b} > \frac{1}{r'_{cb}} \frac{(c+1)}{(c+r'_b)}. \tag{14}$$

Since it is assumed that $r_{cb} = r_{cb}'$, we may solve for r_{cb} to get

$$r_{cb} > \frac{r_b}{a}\left(\frac{(c+1)}{(c+r'_b)} - (1-a)\right). \tag{15}$$

Compare (15) with (9). If $a = 1$, then all base money prior to monopolisation was held by the commercial banks (the central bank did not exist prior to monopolisation, or it operated with the same reserve ratio as other banks). A prominent example would be the inauguration of the Federal Reserve System in 1913. In this case, (15) reduces to (9). On the other hand, if $a = 0$, that is, if all base money was held by the central bank prior to monopolisation, then the right-hand side would become infinite. Since r_{cb} can at most be equal to one, this means that the MGM could not decrease after monopolisation. Thus, in order for the MGM to decrease, it is not only necessary that the central bank's reserve ratio be sufficiently large compared to the reserve ratio of the commercial banks. In addition, the base money share of the commercial banks prior to monopolisation must be sufficiently large. Stated explicitly:

> **Proposition 2** *If the money-to-gold multiplier is to decrease post monopolisation, then (i) the central bank's reserve ratio must be higher than that of the commercial banks, and (ii) the base money share of the commercial banks prior to monopolisation must be sufficiently large.*

Whether the MGM will decrease or not thus depends on the numerical relation between r_{cb}, r_b, r_b', c and a, in accordance with for-

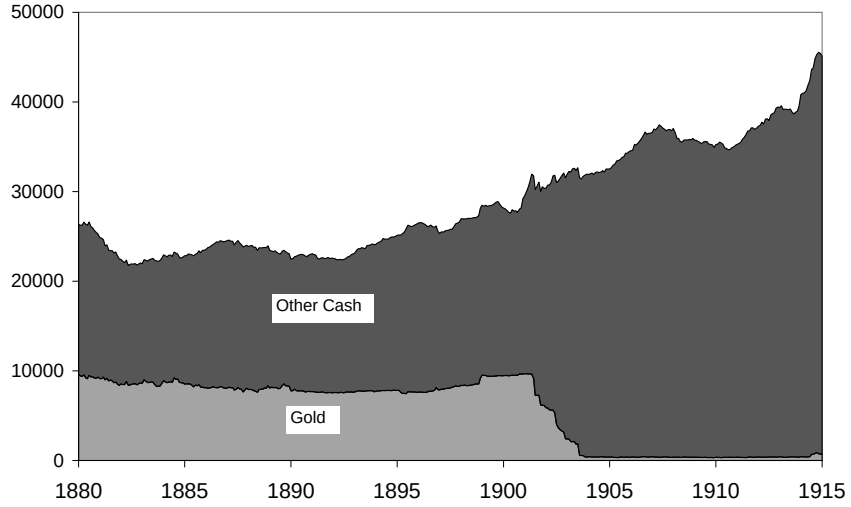
mula (15). The multiplier will decrease more the larger a, r_{cb}, r_b' and c are, and the smaller r_b is.

The reserve role of Bank of Sweden notes

So far we have discussed a "pure" note banking system where base money is gold, and where the demand liabilities of the central bank is in no way used as reserves by other banks prior to note monopolisation. Unfortunately, this condition was not present in Sweden prior to 1901. In order to get an operational model it is necessary to discuss the reserve role of Bank of Sweden notes prior to monopolisation.

The Summary Reports report banks' cash balances under three headings: "Swedish gold coin", "Other gold", and "Silver, copper and bronze coin, and Bank of Sweden notes". The last item was changed in January 1900 to include also "Giro accounts at the Bank of Sweden". In the following, total cash balances ("Cash") will be divided into "Gold" and "Other Cash". It turns out that Other Cash for the commercial banks was quite large – about twice the amount of Gold. This is seen in Figure 11.

Figure 11 Gold and Other Cash of Swedish commercial banks, 1880–1915.



Source: Summary of the Bank Reports. Other Cash (1880–1899): "Silver, copper and bronze coin, and Bank of Sweden notes"; (1900–): also including "Giro accounts at the Bank of Sweden".

The quantity of gold held by the commercial banks was more or less constant, whereas the quantity of other cash fluctuated more. In 1901 virtually the whole gold stock was transferred to the Bank of Sweden (BoS) in exchange for giro accounts at the bank. It is probable that the major part of Other Cash consisted of BoS notes – the banks should have had little incentive to hold large quantities of coin (other than gold). This means that the Swedish note banking system was not a pure "free banking" system, and the reserve role of BoS notes will have to be incorporated into the model.

Denote by N_r BoS notes held as reserves by the commercial banks. Define $N_r = xaG$, that is, BoS notes held as reserves are said to be a fixed share of the commercial banks' gold holdings (which in the light of Figure 11 seems reasonable). Bank reserves can then be written

$$R_{cb} = (1-a)G$$
$$R_b = aG + N_r = aG + xaG = (1+x)aG \tag{16}$$

The total quantity of money will then be:

$$M = M_{cb} + M_b = \frac{1}{r_{cb}} \cdot (1-a)G - N_r + \frac{1}{r_b} \cdot (aG + N_r)\,. \tag{17}$$

The BoS notes held as reserves by the commercial banks must be subtracted from the total money stock, but added to the stock of reserve money held by the commercial banks. The total money-to-gold multiplier may be written

$$\frac{M}{G} = \frac{1}{G}\left(\frac{1}{r_{cb}} \cdot (1-a)G - xaG + \frac{1}{r_b} \cdot (aG + xaG)\right) =$$
$$= \frac{(1-a)}{r_{cb}} + \frac{(1+x)a}{r_b} - xa \tag{18}$$

To get the trade-off between the central bank reserve ratio and the currency-deposit ratio, we substitute (18) into (14) to get:

$$r_{cb} > H \cdot \left(\frac{(c+1)}{(c+r_b')} - (1-a)\right), \tag{19}$$

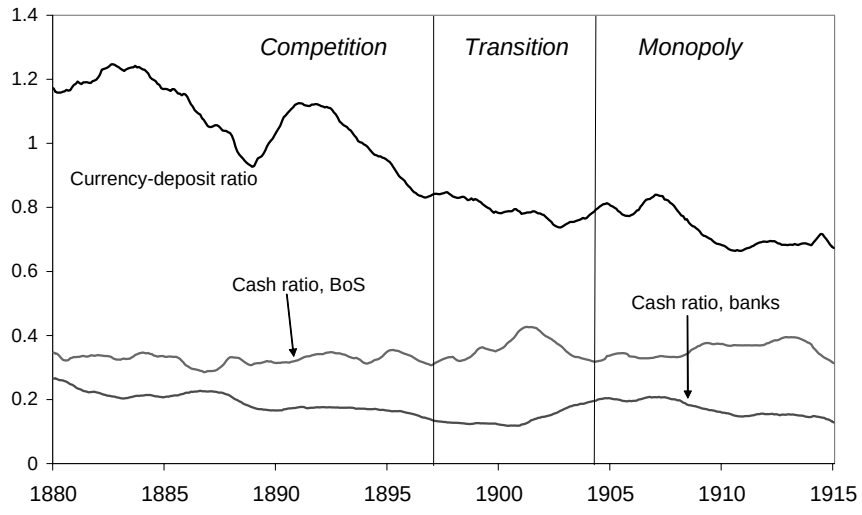
where

$$H = \left(\frac{(1+x)a}{r_b} - xa\right)^{-1}. \tag{20}$$

Formula (19) differs from (15) with regard to the constant H. If x = 0, then H reduces to the ratio r_b/a and (19) and (15) will be equal. However, if $x > 0$ then H will be greater than this ratio. BoS notes used as reserves increase the monetary base and hence the multiplier.

We are now ready to operationalise the model. Figure 12 shows the reserve ratios of the commercial banks and the Bank of Sweden, as well as the currency-deposit ratio, in 1880–1915.

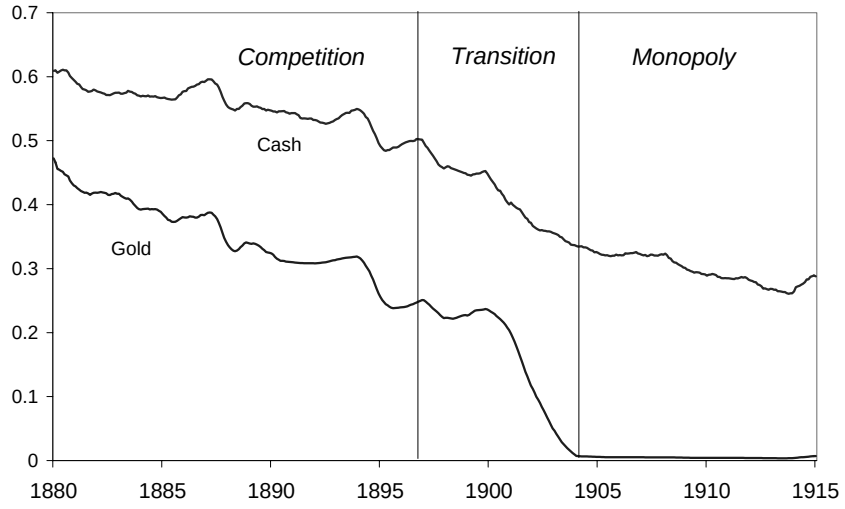
Figure 12 Reserve and currency-deposit ratios, Sweden 1880–1915.



Source: Summary of the Bank Reports.

The cash ratio of the Bank of Sweden was highly stable prior to monopolisation, about 0.33. It was not greatly affected by monopolisation. The cash ratio of the commercial banks was 0.17 at the beginning of the transition period, and 0.20 at the end of it. There is a clear increase in the ratio when notes were transferred to the Bank of Sweden in 1901–1904 – the commercial banks were thus not able fully to substitute their loss of notes for deposits. The currency-deposit ratio was about 0.8 at the time of transition, both before and after. Figure 13 shows the base money share a of the commercial banks in 1880–1915. Figures are presented both for a calculated on the basis of Gold, as well as on Cash.

Figure 13 Base money share of commercial banks, 1880–1915.

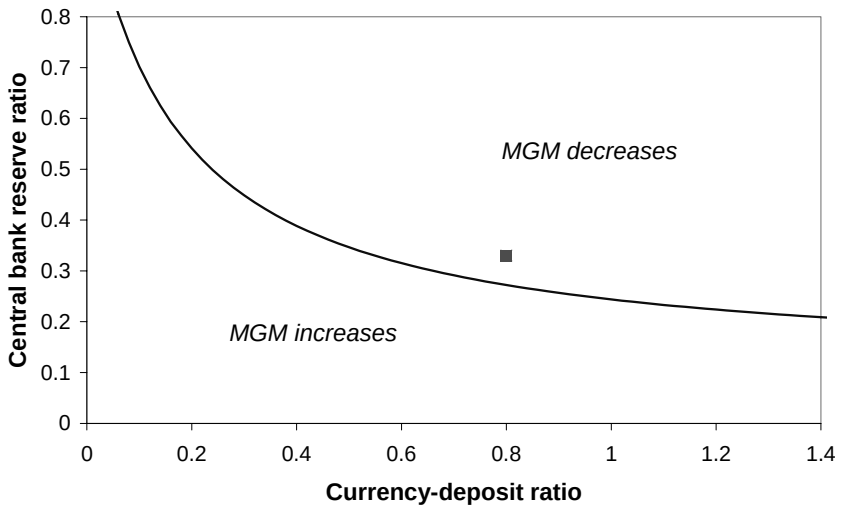


Source: Summary of the Bank Reports.

For both measures the base money share of the commercial banks tended to drop through the whole period. The share of the gold stock was nevertheless more than 30 percent until 1894, when it dropped because the Bank of Sweden increased its gold stock. It then decreased to zero in the transfer period 1901–1904.

Figure 14 depicts the essential trade-off between loss-of-clearing (base expansion), represented by the central bank's reserve ratio – and leakage, represented by the currency-deposit ratio. This trade-off is expressed by formulas (19) and (20). The parameters are: $r_b = r_b' = 0.17$, $a = 0.33$, and $x = 2$.

Figure 14 Break-even central bank reserve ratio as a function of the currency-deposit ratio.



Note: $r = r' = 0.17$, $a = 0.33$, $x = 2$.

The line represents points where (19) holds with equality. Points above and to the left of this line are combinations of r_{cb} and c where the MGM will decrease – the leakage effect dominates the loss-of-clearing effect. Conversely, points to the left of and below the line are combinations of r_{cb} and c that for current parameters will cause the multiplier to increase – the loss-of-clearing effect then dominates the leakage effect. Figure 12 shows that reasonable values for r_{cb} and c are 0.33 and 0.8. This point is marked in Figure 14, and it lies above the line. The conclusion is therefore that the MGM should have decreased post monopolisation. This is confirmed by calculating MGMs before and after monopolisation, using formulas (18) and (7). The MGM prior to monopolisation is

$$\frac{0.67}{0.33} + \frac{3 \cdot 0.33}{0.17} - 2 \cdot 0.33 = 7.2\,, \tag{21}$$

while the MGM after monopolisation is

$$\frac{1}{0.33} \cdot \frac{1.8}{0.97} = 5.6. \tag{22}$$

This is a decrease of about 20 percent, and is roughly consistent with the numbers of Figure 9.

The credit multiplier

With Thunholm it was argued that the credit capacity of the banking system was determined by the bank reserve ratio and the size of the reserves leakage 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, 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 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 the credit of the commercial banks C_b is equal to

$$C_b = N_b + D_b + T_b \tag{23}$$

Define the time-demand deposit ratio t as

$$t = \frac{T_b}{D_b}. \tag{24}$$

As was the case with c and r_b, t is treated as a behavioural constant. With regard to the central bank, we assume that it does not have time deposits. Before monopolisation, the time deposits of the Bank of Sweden were small: The Summary Reports reveal that while the commercial banks had a time-demand deposit ratio of

around 6 in the 1880s, the ratio for the Bank of Sweden was below 1. After monopolisation time deposits disappeared completely. The central bank's credit is therefore

$$C_{cb} = I_{cb} - R_{cb}. \tag{25}$$

Total credit may be calculated as

$$\begin{aligned} C = C_{cb} + C_b &= (I_{cb} - R_{cb}) + (N_b + D_b + T_b - R_b) = \\ &= (I_{cb} - R_{cb}) + (c + 1 + t) \cdot D_b - R_b = \\ &= \left(\frac{1}{r_{cb}} - 1\right) \cdot R_{cb} + \left(\frac{(c+1+t)}{r_b(c+1)} - 1\right) \cdot R_b \end{aligned} \tag{26}$$

Using (16), the total credit-to-gold multiplier CGM becomes

$$\begin{aligned} \frac{C}{G} &= \left(\frac{1}{r_{cb}} - 1\right) \cdot (1-a) + \left(\frac{(c+1+t)}{r_b(c+1)} - 1\right) \cdot a(1+x) = \\ &= \frac{1}{r_{cb}} \cdot (1-a) + \frac{(c+1+t)}{r_b(c+1)} \cdot a(1+x) - (1+xa) \end{aligned} \tag{27}$$

Under note monopoly, the CGM is

$$\begin{aligned} \frac{C}{G} &= \frac{C_b + C_{cb}}{G} = \frac{D_b + T_b - R_b + N + R_b - R_{cb}}{R_{cb}} = \\ &= \frac{1}{r'_{cb}} \frac{(1 + t' + c)}{(c + r'_b)} - 1 \end{aligned} \tag{28}$$

If the CGM is to remain constant after monopolisation, then (28) must be equal to (27). Assume that $a = 1$, and $x = 0$, that is, all base money is held by the commercial banks in the competition period (all banks are alike), and no BoS notes are held as reserves by the commercial banks. As mentioned, a good example of this situation

is the one of the founding of the Federal Reserve System in 1913. In addition, under the condition that t is constant, that is, $t = t´$, then if (28) equals (27) it means that

$$r_{cb} = r_b \cdot \frac{(c+1)}{(c+r_b')}. \tag{29}$$

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 increased (decreased). By observing a decreasing money multiplier, we can predict that credit cycles should become smaller. We can state the following:

> **Proposition 3** [Prior to monopolisation the gold share of the central bank is zero, and the commercial banks do not hold central bank notes as reserves:] 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.

However, in the Swedish case, a was smaller than one and x was larger than zero, wherefore Proposition 3 does not necessarily hold. Under what conditions will a decreasing money multiplier be associated with an increasing credit multiplier? This question is here addressed by means of a numerical example. The strategy is to calculate the CGM using parameter values that ensure that the MGM decreases. Could the credit multiplier simultaneously increase? The parameter values are the realistic ones that were used above: $r = r´ = 0.17$, $a = 0.33$, $r_{cb} = 0.33$, $c = 0.8$, and $x = 2$. These parameters ensured that the MGM decreased. If $t = t´ = 5$ (see Figure 15 below), the CGM before monopolisation becomes (by formula 27)

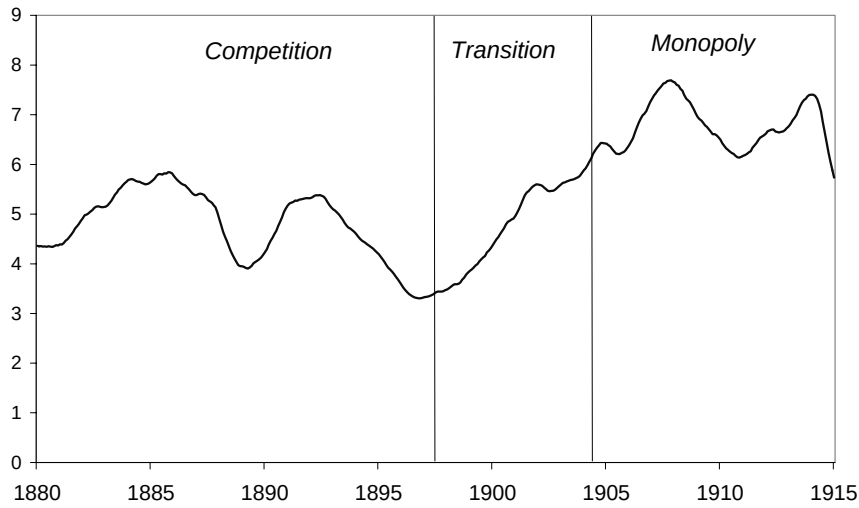
$$\frac{1}{0.33} \cdot 0.67 + \frac{3 \cdot 6.8}{0.17 \cdot 1.8} \cdot 0.33 - 1.67 = 20\,. \tag{30}$$

After monopolisation it becomes (by formula 28)

$$\frac{6.8}{0.33 \cdot 0.97} - 1 = 22 \qquad (31)$$

While the money multiplier decreased, the credit multiplier simultaneously increased, although the latter increase is small, about 10 percent. This may be too small a number to be empirically relevant. However, the calculus was made on the assumption that the time-demand deposit ratio was not affected by the monopolisation. It turns out that this assumption is not warranted. This is seen in Figure 15.

Figure 15 Time-demand deposit-ratio, 1880–1915.



Source*: Summary of the Bank Reports.*

Clearly, the time-demand deposit ratio increased after monopolisation, from levels around 5 in the competition period, to levels around 7 in the monopoly period. It is interesting that monopolisation was associated with such a clear increase in the time-demand deposit ratio. Calculating the post-monopolisation credit multiplier with $t' = 7$ yields a value of

$$\frac{8.8}{0.33 \cdot 0.97} - 1 = 26 . \qquad (32)$$

This represents a substantial increase in the credit multiplier, about 30 percent. As mentioned, the intuition is that an increase in the time-deposit ratio increases the credit capacity of the banking system, since less bank reserves are tied up.

4 Conclusions

This paper investigated the quantitative effects of note monopolisation on money and credit cycles. 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 and credit multipliers. Empirical evidence showed that the money cycle decreased after notes were monopolised by the Bank of Sweden in 1904, while the credit cycle increased. At the same time, the money-to-gold multiplier decreased, while the credit-to-gold multiplier increased. This opened up for an investigation of how note monopolisation affected multipliers. Three results were reached:

1. If the central bank's reserve ratio is equal to the reserve ratio of the commercial banks, the money-to-gold multiplier will increase post monopolisation.

2. If the money-to-gold multiplier is to decrease post monopolisation, then (i) the central bank's reserve ratio must be higher than that of the commercial banks, and (ii) the base money share of the commercial banks prior to monopolisation must be sufficiently large.

In addition, if it is the case that prior to monopolisation the gold share of the central bank is zero, and the commercial banks

do not hold central bank notes as reserves (the Fed scenario), the following proposition holds.

3. 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.

However, these conditions were not fulfilled in the Swedish case. In particular, the time-demand deposit ratio increased after monopolisation, ensuring that the credit multiplier increased while the money multiplier decreased.

Although the multiplier analysis was capable of generating theoretical results consistent with the data, the smallness of the empirical sample puts a question mark over the generality of the results. To be able to reach more definite conclusions, it would 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.

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V.

Is the Law of Reflux Valid?*

In the classical monetary debates, the Banking School held that notes would be equally demand-elastic whether supplied by many or a single issuer. The Free Banking School held that notes would be less demand-elastic if supplied by a single issuer. These assertions have rarely, if ever, been subject to more stringent statistical testing. In this paper I compare the elastic properties of the note stock of the Swedish note banking system in 1880–1895 with those of the regime in 1904–1913, when the Bank of Sweden held a note monopoly. Evidence suggests that notes did not become less elastic after monopolisation, thus lending support to the views of the Banking School.

Keywords: Banking School, Free Banking School, Elastic currency, Clearing mechanism, Needs of trade, Law of Reflux, Real bills doctrine.
JEL codes: B12 E42 E51 E58 N13 N23.

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* Financial support from the Bank of Sweden and the Earhart Foundation is gratefully acknowledged. I have benefited from comments by Niclas Berggren, Magnus Henrekson, Nils Karlson, Dan Johansson, Mikael Stenkula, Daniel Waldenström, Eugene N. White, and seminar participants at the Stockholm School of Economics and the Bank of Sweden.

1 Introduction

A big issue in the 19th century classical monetary debates was the question of the elasticity of the currency.[1] How should monetary institutions be arranged to make currency supply responsive to the "needs of trade", increasing and decreasing with changes in demand? In the most classical of the debates, the British one, three views emerged known as those of the Currency School, the Banking School and the Free Banking School. The Currency School denied that there was any need for an elastic currency, and it favoured quantitative restrictions on note supply to stop the banks from over-issuing. The Banking School held the opposite view, claiming that restrictions would be harmful since it would make the currency inelastic and unresponsive to needs. It would also be unnecessary, since note-issuing banks – whether many or a single one – could not issue beyond what the public was willing to hold. There was a "law of reflux" at work – unwanted notes would always be returned to the issuer, either deposited with it or used to repay loans. The note stock would therefore always be "demand-elastic", that is, supply would always conform to demand.[2] The law of reflux would be particularly effective, if the issuer adhered to the "real bills doctrine", and only discounted commodity bills – bills drawn in exchange for commodities – of short maturity.

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[1] On the 19th century monetary debates, see Smith (1936), White (1995), Glasner (1992), Selgin and White (1994a), Schwartz (1995). On the modern theoretical literature on free banking, see the survey article by Selgin and White (1994b), and references therein.

[2] In the following, the expression "demand-elasticity" is used in the sense of the monetary literature of the studied period, namely that note *supply* is responsive to changes in demand. It should thus not be confused with the idea that demand is elastic.

The Free Banking School sided with the Banking School in holding that quantitative restrictions would be harmful to the "needs of trade". However, it argued that it was crucial that there be many issuers, since notes would then be subject to the inter-bank clearing mechanism. Many issuers would speedily redeem each other's notes through the clearing. By contrast, notes of a single issuer would be treated as base money and would therefore not be redeemed: they would either be reissued or deposited with the issuer. In the latter case notes would continue as a demand liability and be part of the banks' reserves, which could trigger a credit expansion. Moreover, banks would have no incentives to repay loans if their borrowing rate (at the central bank) was below their lending rate – it would then be more profitable to re-issue the notes.

Hence, demand-elasticity required many issuers. Unrestricted discretion would enable banks to accommodate peak demands for currency and hence make note supply "upward elastic". Competition would ensure active redemption and hence make note supply "downward elastic". With a single issuer (a central bank) demand-elasticity would instead depend on the prudence of the central bank in its open market operations. Even if the central bank increased supply during peak demands, notes would not automatically be withdrawn through the clearing once demand subsided. Crucially, the speed of redemption would increase. Historically, a note circulated on average for 10 days in the Scottish free banking system, while a Bank of England note would circulate on average for 150 days (Agardh 1845, Gilbart 1834). Moreover, while in a competitive note banking system a note returned was a note redeemed, this was not so with a single issuer, since it could also be deposited and hence re-issued. For a single issuer, the "speed of reflux" would be greater than the "speed of redemption", wherefore notes would be upward elastic, but imperfectly downward elastic.

The debates of the classical monetary schools have received much scholarly attention. However, there seems to be few studies that quantitatively test the merits of the claims involved. In particular, there are virtually no studies of how different note regimes affect the elasticity of the currency. An exception is Selgin and White (1994a), who show how elastic the note stock of the unrestricted Canadian note banking system was compared to the note stock of the American National Banking system, in the late 19th century. A problem is that competitive note banking regimes often ended before systematic bank statistics were collected. This is the case of Britain where it ended already in 1845, which is probably the reason why the elasticity claims of the classical monetary schools have – to my knowledge –not been tested.[3]

For this reason, the case of Sweden should be of interest. In the late 19th century, about twenty-five commercial banks called Enskilda banks issued notes, competing with the Bank of Sweden, until this bank gained a note monopoly in 1901–1904. The case of Sweden is of interest for three reasons. First, data are readily available: all commercial banks were required to compile monthly balance statements to the Swedish Bank Supervisory Authority. Second, the Swedish experience of competitive note banking ended in the middle of the classical gold standard period 1870–1914, wherefore *ceteris paribus* conditions can be said to apply. Third, the Swedish system contained a peculiarity in the "return discount rate". Banks could rediscount bills with the Bank of Sweden at a rate half a percentage point lower than the official discount rate.

[3] With regard to free banking, there is a growing empirical literature. Dowd (1992) surveys 60 historical instances of free banking. Recent negative assessments of historical free banking performance (in Australia and Switzerland) are presented in Hickson and Turner (2002) and Neldner (2003). On free banking in Sweden, see Ögren (2003), and Lakomaa (2004).

Banks had therefore potential access to a "money machine" that should have impaired the efficiency of the law of reflux.[4] Moreover, the Bank of Sweden adhered to the real bills doctrine in its discount policy, in that it would "avoid loan and accommodation bills", and only discount bills with at most 45 days of maturity. All the classical doctrines of the Banking School – needs of trade, law of reflux, real bills – were thus represented in the Swedish case, and their effects can be quantitatively assessed.

This paper investigates the relative merits of the claims of the Banking School and Free Banking School. Does the law of reflux work equally well with a single issuer, as it does with many? This is investigated by comparing the elastic properties of the note stock of the unrestricted note banking system in 1880–1895 with those in 1904–1913, when notes were supplied exclusively by the Bank of Sweden. Did the note stock become less elastic after monopolisation, and particularly, less downward so? If the Banking School was right, and the law of reflux is always effective, then there should be no difference in note elasticity before and after monopolisation. If on the other hand the Free Banking School was right, then the note stock should become less elastic after monopolisation.

2 Institutional background

This section briefly reviews the institutional framework relevant to the Swedish money and banking system in 1880–1913. In the latter half of the 19th century two types of institutes issued notes. *Enskilda banks* (Private banks) were commercial banks with unlimited liability. *The Bank of Sweden* was the bank of the parliament, which also acted as a commercial bank. Bank of Sweden notes were legal

[4] Brisman (1931, p. 218) claims that the return discount rate was unique to Sweden.

tender by the Swedish constitution of 1809. There were about 25 Enskilda banks, and they held a dominant position in the financial system. Their share of the note market was over 50 percent.

The Enskilda banks were regulated by the Bank Law of 1874. The law stated cash and capital requirements that were linked to the note-issuing rights.[5] Enskilda bank notes were to be redeemed only into gold coin (and not into Bank of Sweden notes).

The note-issuing rights of the Bank of Sweden were based on a "contingency system". The bank was allowed to issue notes equal to its reserves (specie + foreign exchange) plus a fixed "contingency". During the note competition period the contingency was highly stable: in 1880–1887 it was 35 million, and in 1888–1898 it was 45 million. With note monopolisation it rose steadily each year, particularly in the boom period of WWI.

The clearing function of the Swedish banking system was peculiar. In 1856 the Stockholms Enskilda Bank was started. It immediately began to act as a clearing bank for other note-issuing banks. However, the Skandinaviska Kreditaktiebolaget, a non-issuing bank, largely took over the clearing function in the 1860s, mainly because it offered better terms. There were thus two clearing banks in the period 1880–1901, one of which did not issue notes.

In 1897 a new bank law was promulgated that prescribed the monopolisation of notes by the Bank of Sweden. The transfer of the Enskilda banks' note stock to the Bank of Sweden occurred

[5] To issue notes, gold reserves had to be at least 10 percent of paid-in capital. Enskilda bank notes were to be redeemed only into gold coin. The volume of notes outstanding could not exceed the sum of the bank's holdings of: Collateral for capital; Claims up to fifty percent of paid-in capital; and Gold exceeding ten percent of paid-in capital.

between January 1901 and January 1904. Clearing was now also taken over by the Bank of Sweden.

Monetary policy of the Bank of Sweden, 1880–1913

During the whole of the 19th century Sweden suffered from so called "transfer crises", that is, external drains in times of liquidity crises abroad. The traditional policy of the Bank of Sweden during these crises was known as the "strangle system". When an external drain occurred, the bank would contract it's lending, not raise interest rates – a policy that caused sharp fluctuations in the volume of credit. The policy was to have a fixed discount rate. From 1890, however, the strangle system was abandoned for a more modern discount rate policy, when the Bank of Sweden began to adjust the discount rate rather than lending volumes to cope with external drains. Also, foreign exchange rather than gold was used to clear debts.

According to Brisman (1931, p. 211), the Bank of Sweden held a position in the 1880s that was unique in the world. Whereas in most other countries the state bank had developed into a modern central bank – with a monopoly on notes, setting interest rates and acting as a bankers' bank and a lender of last resort – the Bank of Sweden was still largely a commercial bank competing with other banks. It did not rediscount the bills of other banks. Mostly for commercial reasons (the Bank of Sweden could not compete with the Enskilda banks in the market for commercial loans), this policy was to change.

In 1878/1879 the Bank of Sweden began to rediscount bills and extend bond-secured loans to banks that did not issue notes. In 1893 the right to rediscount was extended to all banks. Commercial loans were from now on no longer extended. In 1897, after the promulgation of the new bank law prescribing monopolisation, rediscounting grew in importance. In 1901 the Bank of Sweden declared that it would rediscount all acceptable bills presented

by the commercial banks. In September 1905 it declared that it would only rediscount bills with less than forty-five days of maturity. It would also "avoid accommodation and loan bills" (Simonsson 1931, p. 39). This was an adherence to the real bills doctrine, according to which a central bank should only discount bills drawn in exchange for commodities.

3 Note elasticity before and after monopolisation

The merits of the claims of the classical monetary schools are tested by formulating "conjectures" regarding the consequences of note monopolisation that are implicit in the doctrines of the Free Banking School, and confronting them with data.

3.1 Conjectures

The Free Banking School held that note supply should be more demand-elastic in an unrestricted note banking system, than in a central banking regime. Note monopolisation trades interbank clearing for central bank prudence. Due to "the information problem", clearing is more efficient than prudence.[6] The note stock might become upward inelastic if the central banker responds inadequately to increased currency demands.[7] Even more likely, the note stock might become less downward elastic. Because the speed

[6] Selgin (1988, p. 89).

[7] The most famous instance is perhaps the Federal Reserve System, whose failure to act as a lender of last resort in the face of increased currency demand, it has been argued, led to the debt-deflation crisis in 1932–1933 (Friedman and Schwartz 1963, Timberlake 1993). Likewise, Miron (1986) attributes the absence of panics in 1915–1928 to Fed open market prudence in accommodating seasonal demands for loans and currency, while the panics in 1929–1933 is attributed to the Fed's incomplete accommodation of those demands.

of redemption would decrease, notes would linger in circulation after an expansion, unless the central banker prudently acts to withdraw the surplus notes. Even if notes are returned to the Bank of Sweden, they might become deposited rather than redeemed, and hence continue "in circulation" as a demand liability – call this *liability inelasticity*. In sum, free banking theory suggests that note monopolisation could have the following consequences:

1. The note stock might become less upward elastic.
2. The note stock might become less downward elastic.
3. The demand liabilities of the Bank of Sweden might become less elastic.

3.2 Measuring demand-elasticity

This paper intends to measure the demand-elasticity of the note stock. Obviously, greater monthly changes in the note stock does not necessarily reflect that it has become more demand-elastic. To measure the latter, knowledge of demand, a non-observable quantity, would be needed. An indirect way to measure demand-elasticity would be to look at interest rates. Miron (1986) measures call loan rates at the New York stock exchange in 1890–1928, and argues that their smaller post-WWI seasonal variation reflects that currency supply became more demand-elastic after the Federal Reserve system was founded. Likewise, Rich (1988) presents data on call loan rates in Montreal, showing that they fluctuated less than those in New York in the late 19th century, particularly in October. In view of the figures for the seasonal variation in the Canadian and American note stocks of this period presented by Selgin & White (1994a), the smaller Canadian seasonal variation in call loan rates can credibly be attributed to the greater demand-elasticity of the Canadian note stock. Unfortunately, these kinds of market rates do not seem to be readily available for Sweden. What is available is the official loan rates of the banks. These are re-

ported monthly and are included in the Summary Reports. However, they tended to be fairly stable over the year, and did not exhibit seasonal variation. From the 1880s they also followed the discount rate of the Bank of Sweden (Brisman 1931, p. 187). A small seasonal variation in the official loan rates therefore does not necessarily indicate a demand-elastic note supply.[8]

A "third best" way is to measure the quantitative change in the note stock. As shown in Hortlund (2005), the note stock varied seasonally with the known (qualitative) demands of agriculture and industry. It is plausible to assume that these demands did not greatly alter in the few years after note monopolisation in 1901–1904. Reasonably, if the seasonal quantitative elasticity of the note stock *decreased* after monopolisation, then this should indicate that the note stock became *less* demand-elastic, and hence that the law of reflux and/or central bank prudence is inferior to the clearing mechanism of unrestricted note banking. What if the quantitative elasticity were to *increase* after monopolisation? Should this be interpreted as greater demand-elasticity, or perhaps as excessive elasticity – the note stock overshoots and fluctuates more than what is dictated by demand? Without knowledge of demand, this question is not possible to answer. It may however be argued that "excess elasticity" would not be harmful if the note stock became as excessively downward elastic as it became excessively upward elastic. For this reason, the liability elasticity test is perhaps the most important test, which shows whether the law of reflux

[8] On the other hand, Brisman (1931, p. 188) claims that the discount rate in the 1880s fluctuated less in Sweden than it did in England and Germany. Whereas the Swedish discount rate was changed on average one time per year in the 1880s, it changed on average 6 ½ times per year in England, and 3 times per year in Germany. This fact could be interpreted as greater stability and demand-elasticity of the Swedish note banking system, compared to the note-monopolistic ones of England and Germany.

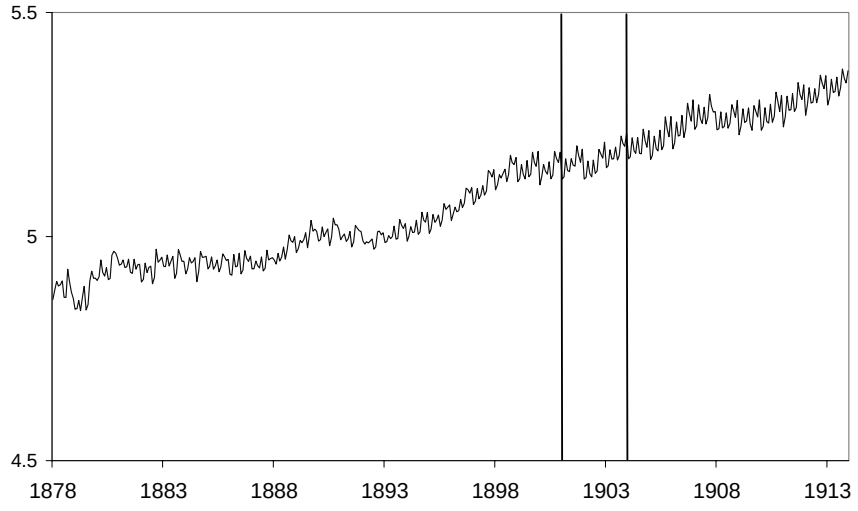
and/or central bank prudence were as efficient at mopping up excess liquidity as was the clearing mechanism.

It may also be pointed out that the tests can falsify but not confirm the efficiency of the Law of Reflux, since greater elasticity after monopolisation could be due to other causes. Prudence has already been mentioned – greater elasticity may be explained by the Bank of Sweden becoming more professional in its operations around the time of monopolisation. Before, the organisation was more bureaucratic in its decisions, with little regard for market-conforming policies (Brisman 1931). Also, the banking system became more organised at the turn of the 20th century. Banks had more branches, and deposits grew in importance – people would deposit cash balances rather than holding on to them.

3.3 The data

Data are from the Summary of the Bank Reports (*Sammandrag af bankernas uppgifter*). These were monthly balance statements that all commercial banks were required to report to the Bank Supervisory Authority (*Bankinspektionen*). Figure 1 shows the logged total note stock of the Swedish banking system (Bank of Sweden and Enskilda bank notes), 1878–1913.

Figure 1 Log of the Swedish note stock, 1878–1913.

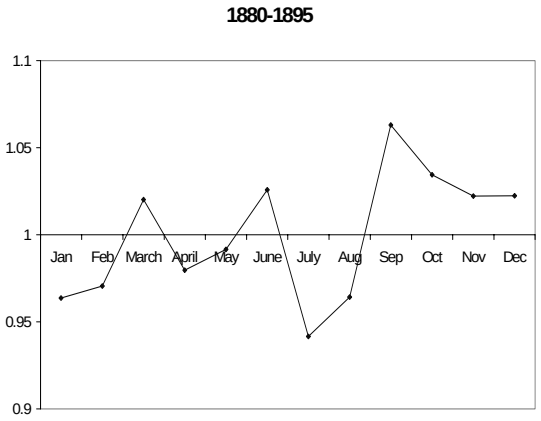


Source: Summary of the Bank Reports.
Note: Monopolisation occurred in 1901–1904.

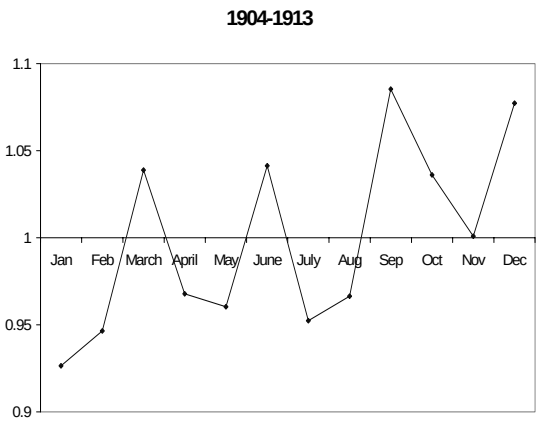
Monopolisation did not radically alter the behaviour of the note stock. Its path seems continuous with regard to trend, cycle and season. If anything, Figure 1 suggests that the note stock may have become more elastic around the time of monopolisation. This is supported by Figure 2, which shows seasonal averages of the total note stock for the years 1880–1895 and 1904–1913, respectively.[9] Seasonal averages have been calculated by means of maximum likelihood on the differenced logged note stock, with monthly dummies and four lags in the disturbance term. Seasonal averages have been normalised to express a month's circulation as a ratio of the average (monthly) annual circulation. Specification is provided in the Appendix. Regression results are available on request.

[9] More precisely, from January 1880 to January 1896, and from January 1904 to January 1914.

Figure 2 Average monthly note stocks, 1880–1895 and 1904–1913.



	Δ	*p*
Jan	–0.059	0.000
Feb	0.007	0.24
Mar	0.050	0.000
Apr	–0.040	0.000
May	0.012	0.030
Jun	0.034	0.000
Jul	–0.084	0.000
Aug	0.023	0.000
Sep	0.099	0.000
Oct	–0.029	0.000
Nov	–0.012	0.13
Dec	0.000	0.77



	Δ	*p*
Jan	–0.16	0.000
Feb	0.020	0.001
Mar	0.092	0.000
Apr	–0.071	0.000
May	–0.007	0.58
Jun	0.081	0.000
Jul	–0.089	0.000
Aug	0.014	0.002
Sep	0.12	0.000
Oct	–0.049	0.000
Nov	–0.035	0.000
Dec	0.076	0.000

Source: Summary of the Bank Reports.

Figure 2 strongly suggests that notes became more elastic after monopolisation. The note stock expanded more in the expansion months (March, June, September and December) in 1904–1913 than it did in 1880–1895. It also contracted percentually more in the contraction months (January, April, July, October–November). This indicates that the note stock became both more upward and downward elastic after monopolisation. This is formally tested next.

3.4 *t*-tests

The means of the monthly changes in the periods 1880–1895 and 1904–1915 are compared by way of *t*-tests. Monthly changes are expressed as the difference in the logged note stock. Upward elasticity is tested in the months of expansion (March, June, September and December). Likewise, downward elasticity is tested in the months of contraction (April, July, October and January). In the same way, it is investigated whether the demand liabilities of the Bank of Sweden became less elastic.

Upward elasticity

Table 1 confirms that the note stock actually became more upward elastic after note monopolisation.

Table 1 *t*-test of upward elasticity.

			Δ Log Notes		
		Obs.	*Mean*	*S. D.*	*p*
March	1880–95	16	0.053	0.027	
	1904–13	10	0.097	0.0080	
	Difference		0.044		0.0000
June	1880–95	16	0.036	0.018	
	1904–13	10	0.083	0.014	
	Difference		0.047		0.0000
September	1880–95	16	0.095	0.021	
	1904–13	10	0.12	0.017	
	Difference		0.025		0.0036
December	1880–95	16	0.0079	0.019	
	1904–13	10	0.077	0.030	
	Difference		0.069		0.0000

Note: *p*-values for two-sided test of zero difference.

In the months of expansion, the difference in means is positive in every month. The difference is largest in December, and smallest

in September. The difference is statistically significant at the one percent level for all four months.

Downward elasticity

The note stock also became more downward elastic after monopolisation, as Table 2 shows.

Table 2 *t*-test of downward elasticity.

			Δ Log Notes		
		Obs.	*Mean*	*S. D.*	*p*
April	1880–95	16	–0.039	0.019	
	1904–13	10	–0.072	0.0054	
	Difference		–0.033		0.0000
July	1880–95	16	–0.078	0.021	
	1904–13	10	–0.090	0.012	
	Difference		–0.012		0.088
October	1880–95	16	–0.031	0.022	
	1904–13	10	–0.049	0.013	
	Difference		–0.018		0.013
January	1880–95	17	–0.061	0.026	
	1904–13	11	–0.15	0.023	
	Difference		–0.087		0.0000

Note: *p*-values for two-sided test of zero difference.

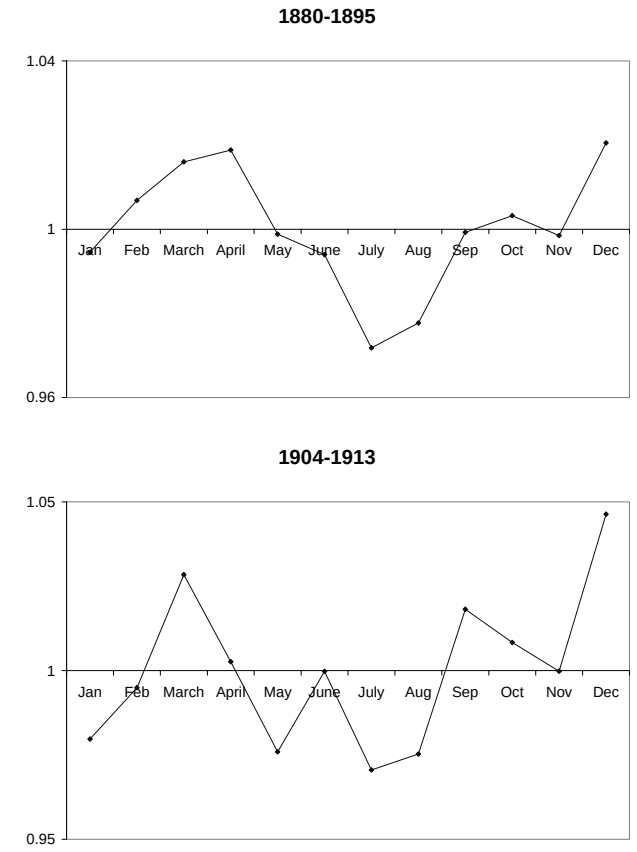
The difference in means is negative for all four months. The difference is largest in January, and smallest in July. The difference is significant at the one percent level in every month except July.

Liability inelasticity

Figure 3 shows the seasonal variation in the demand liabilities of the Bank of Sweden, 1880–1895 and 1904–1913. Demand liabilities are defined as the sum of the notes and the folio account (from

1904 called the giro account). Seasonal averages have been calculated in the same way as with notes.

Figure 3 Seasonal variation in demand liabilities of the Bank of Sweden, 1880–1895 and 1904–1914.



Source: Summary of the Bank Reports.

Figure 3 strongly suggests that demand liabilities of the Bank of Sweden did *not* become less elastic after monopolisation. Most conspicuous are the months of March–April and September–October. Before monopolisation, aggregate demand liabilities actually *increased* in April and October, when the note stock decreased. This suggests that notes were deposited with the Bank of

Sweden, swelling the folio account, instead of being redeemed. That liability elasticity actually increased after monopolisation is confirmed by Table 3, which shows test results for upward and downward elasticity.

Table 3 *t*-tests of upward elasticity: change in the log of Bank of Sweden demand liabilities, 1880–1895 and 1904–1913.

		Upward elasticity			
		Obs.	*Mean*	*S. D.*	*p*
March	1880–95	16	0.034	0.060	
	1904–13	10	0.092	0.032	
	Difference		0.059		0.0036
June	1880–95	16	–0.021	0.039	
	1904–13	10	0.061	0.031	
	Difference		0.082		0.0000
September	1880–95	16	0.044	0.029	
	1904–13	10	0.094	0.017	
	Difference		0.050		0.0000
December	1880–95	16	0.059	0.035	
	1904–13	10	0.12	0.037	
	Difference		0.061		0.0005

Source: Summary of the Bank Reports.

Table 4 *t*-tests of downward elasticity: change in the log of Bank of Sweden demand liabilities, 1880–1895 and 1904–1913.

		Downward elasticity			
		Obs.	*Mean*	*S. D.*	*p*
April	1880–95	16	0.0097	0.048	
	1904–13	10	–0.055	0.011	
	Difference		–0.064		0.0001
July	1880–95	16	–0.034	0.040	
	1904–13	10	–0.071	0.022	
	Difference		–0.038		0.0053
October	1880–95	16	0.0042	0.042	
	1904–13	10	–0.019	0.011	
	Difference		–0.023		0.051
Jan	1880–95	17	–0.050	0.042	
	1904–13	11	–0.17	0.021	
	Difference		–0.12		0.0000

Source: Summary of the Bank Reports.

Table 3 confirms that demand liabilities became more upward elastic in the expansionary months. The difference in elasticity is positive and statistically significant at the 1 percent level. Demand liabilities also became more downward elastic. The difference is negative in all contraction months. It may be noted that demand liabilities actually increased in April and in October, in 1880–1895.

4 Discounted bills and loans of the Bank of Sweden, 1878–1914

The Bank of Sweden allowed the commercial banks to borrow in two ways: by rediscounting bills and by extending bond-secured loans. Since the Bank of Sweden's policy after 1905 was to rediscount only commodity bills with less than 45 days of maturity, it would be interesting to see whether any difference in the demand-

elasticity of the two assets can be detected. According to the real bills doctrine, commodity bills should be more closely correlated with the "needs of trade" for payments media, than should other forms of credit. This is because the paying merchant would later resell the commodities and hence redeem the bill. Commodity bills were therefore thought to be self-liquidating. Although the doctrine has been influential among bankers (Thunholm 1962, p. 88), and also been a guiding principle of monetary policy, it has been branded a fallacy by economists (Mints 1945, p. 25, Humphrey 1986, Timberlake 1993, p. 259). Figure 4 shows the log of the sum of bills and loans, 1878–1914.

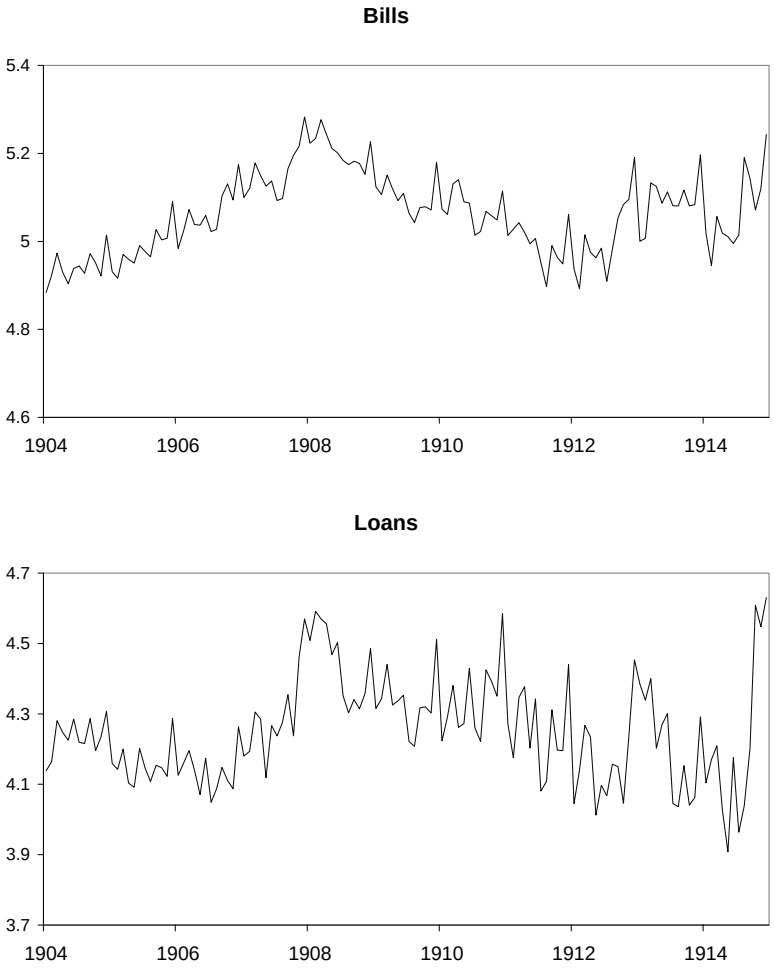
Figure 4 Log of loans and bills of the Bank of Sweden, 1878–1914.

Source: Summary of the Bank Reports.

The aggregate volume of bills and loans exhibit a clear structural break at the time of the new bank law in 1897. Before that time, there was little cyclical or seasonal movement. Bills and loans became much more cyclical and seasonal after monopolisation in 1904. Was the Bank of Sweden's volume of bills more closely correlated with the seasonal fluctuations in notes and demand liabili-

ties, than was the volume of loans? Figure 5 provides "close-ups" of bills and loans presented separately, for the period 1904–1914.

Figure 5 Log of bills and log of loans of the Bank of Sweden, 1904–1914.



Source: Summary of the Bank Reports.

Both bills and loans exhibit clear seasonal movements that seem to correlate highly with the movements in payments media. To test which one was the strongest co-mover, I compare the correlations of the differenced logs of bills and loans with those of notes and

demand liabilities. Table 5 presents correlations and also partial correlations for the periods 1880–1895 and 1904–1913.[10]

Table 5 Correlations of differenced logs of notes, demand liabilities, bills and loans of the Bank of Sweden, 1880–1895 and 1904–1913.

		Correlations		Partial correlations	
		Bills	Loans	Bills	Loans
1880–1895	Notes	0.28	0.39	0.19	0.33
	Liabilities	0.33	0.28	0.26	0.21
1904–1913	Notes	0.80	0.75	0.58	0.44
	Liabilities	0.87	0.78	0.73	0.46

Source: Summary of the Bank Reports.
Note: All coefficients are significant at the 1 percent level.

As expected, correlations were lower in 1880–1895 than they were after monopolisation. Loans were then actually more correlated with the note stock, than were bills. The period 1904–1913 is more interesting, since the Bank of Sweden then pursued monetary policy in accordance with the real bills doctrine. Indeed, in this period bills were more correlated with both notes and demand liabilities than were loans. Loans were more correlated with notes in 1880–1895, when the Bank of Sweden did not restrict discounting to commodity bills of short maturity. But in 1904–1913, when this was the case, bills moved more closely with the "needs of trade" for payments media, than did bond-secured loans. This result may be interpreted as support to the view of the Banking School and the real bills doctrine.

[10] Partial correlations attempts to estimate the correlation between two variables if the other variables are held constant. See Greene (2000, p. 233).

5 Conclusions

This paper compared the elastic properties of the Swedish note stock before and after notes were monopolised by the Bank of Sweden in 1901–1904, in light of the doctrines expounded by the classical schools of monetary thought. The investigation warrants the following conclusions.

1. The note stock did not become less elastic after monopolisation. Data show that note supply became more upward elastic in the expansion months of March, June, September and December, as well as more downward elastic in the contraction months of April, July, October and January.

2. Neither did the demand liabilities of the Bank of Sweden become less elastic. Before monopolisation, demand liabilities actually increased in the contractionary months of April and October. This suggests that Bank of Sweden notes were deposited rather than redeemed in this period. Demand liabilities became more elastic after monopolisation.

3. In addition, when the Bank of Sweden acted in accordance with the real bills doctrine and only discounted commodity bills of short maturity in 1904–1913, bills varied more closely with the volumes of notes and demand liabilities. This suggests that real bills are more correlated with the "needs of trade" for payment media, compared to other forms of credit.

In sum, results seem more conducive to the views of the Banking School, than to those of the Free Banking School. The withdrawal of notes from the interbank clearing mechanism did not have the detrimental effects on elasticity that might be conjectured from the thinking of the Free Banking School. All of the principles of the Banking School – the law of reflux, needs of trade, the real bills doctrine – find support in the Swedish data.

It was mentioned that the development could be due to other causes than to the general efficiency of the Law of Reflux. To see

whether the Swedish development was a general phenomenon or peculiar to it, it would be worthwhile to compare the development of elasticity in countries with and without note monopoly over the whole period of the classical gold standard. For the moment, the Banking School has the upper hand.

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Appendix

Specification of regressions and calculations of seasonal components for notes and demand liabilities.

The following model was estimated:

$$\Delta \, Log \; Notes = \beta_0 Jan + \beta_2 Feb + ... + \beta_{11} Dec + u \, , \qquad \text{(A1)}$$

where

$$u_t = u_{t-1} + u_{t-2} + u_{t-3} + u_{t-4} + \varepsilon_t \, . \qquad \text{(A2)}$$

A value for each month v_i was then calculated as

$$\begin{aligned} v_0 &= 1 \\ v_i &= 1 + \beta_i + \frac{1}{12} \sum_0^{11} \beta_j \end{aligned} \quad . \qquad \text{(A3)}$$

The seasonal component s_i was then calculated as

$$s_i = 1 + v_i - \frac{1}{12} \sum_0^{11} v_j \, . \qquad \text{(A4)}$$

VI.

The Provision of Liquidity in the Swedish Note-Banking System*

The working of the"asset currency" provided by the Swedish note banking system in 1878–1901 is described. Natural and institutional conditions caused the demand for currency to peak in March and September, with troughs in July and January. The paper investigates how the Enskilda banks provided liquidity to solve the problem. This is done by describing how the volume of notes varied over the year, and how other balance sheet items co-moved with them. Strong seasonal co-variation is found particularly between lending and foreign payments media, varying like communicating vessels over the sailing season in May–October (when the sea was ice free and shipments were made).

Keywords: Free banking, Elastic currency, Asset currency, Clearing mechanism, Note competition, Needs of trade, Lender of last resort, Sailing season.

JEL codes: G21 N13 N23

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* Financial support from the Bank of Sweden and the Earhart Foundation is gratefully acknowledged. I have benefited from comments by Magnus Henrekson, Mikael Stenkula, Daniel Waldenström, Eugene N. White, and seminar participants at the Stockholm School of Economics and the Bank of Sweden.

1 Introduction

Modern central banks largely emerged as a means to provide liquidity in times of crises. In the 19th century liquidity crises were common, with bank runs and panics. Received wisdom holds that they ended when central banks acting as lenders of last resort were set up. Yet it can be argued that the crises were actually caused by legal restrictions that hindered banks from responding to increased demands for currency – if the restrictions had not been there in the first place there would have been no need for a lender of last resort.

Liquidity crises were most famously a problem in England and in the United States. In England, the Peel's Act imposed a 100 percent marginal gold reserve requirement on Bank of England notes, which created an inelastic note stock unable to accommodate increased demands for currency in 1847, 1857 and 1866, when runs and panics occurred. From these events the Bank of England eventually evolved into becoming a central bank-lender of last resort, in the spirit of Bagehot (1873). Likewise, in the United States the 110 percent bond collateral requirement on National Bank notes created an inelastic note stock unable to meet peak demands for currency, for example in the falls during "crop moving season". The Federal Reserve System was created in 1913 with the set purpose to "furnish an elastic currency" (Miron 1986). In particular, the new central bank was expected to provide much needed "form-seasonal" elasticity to the money stock, that is, a money stock that was able to change form seasonally (from deposits into notes), particularly in the month of October (Timberlake 1993, p. 254).

In the United States some reformers pushed for what they called an asset currency (Selgin and White 1994). To provide an elastic currency, the National Banks should be allowed to back

their notes with any assets they saw fit. Asset currency reformers looked to Canada as the model to emulate. Canadian banks did not suffer from runs and panics. Since Canadian banks were not subject to binding legal restrictions, they could expand and contract their note issues with the "needs of trade", particularly in October.

Since central banks were largely set up to provide liquidity in times of need, the alternative – unrestricted note banking systems able to provide "asset currencies" – should be of interest. The last two decades have seen an increased interest in the experience of "free banking". Banks in these systems did not face binding legal restrictions on entry, size and branching, and particularly on their issuing of notes. The new research has modified the previously negative assessments of competitive note banking regimes. Dowd (1992) documents about sixty instances of free banking. Most of them occurred in the British dominions. Many other countries, for example Belgium, France, Italy, Spain and Germany, had experience with free banking in the nineteenth century, but during relatively brief periods of time. In view of the combination of country size, freedom of systems, and length of experience, the most important instances were arguably Scotland, Canada and Sweden. However, until now there are no quantitative studies of how these historical "asset currencies" really worked. That is: how exactly were the banks able to provide liquidity and accommodate the "needs of trade"? Selgin and White (1994) show how elastic the Canadian note stock was in contrast to the rigid American one, but do not cover what happened with the rest of the balance sheet. Scottish free banking ended already in 1845 – finding good bank data for the Scottish free banking period may be difficult.

Therefore the Swedish experience is of interest. Between 1831 and 1904, commercial banks called Enskilda banks issued notes. About twenty-five Enskilda banks competed with the Bank of Sweden, until this bank gained a note monopoly in 1901–1904.

From 1878 monthly data from the banks' balance sheets have been collected, with detailed information on balance sheet items. The purpose of this paper is to use this data to provide a quantitative examination of the workings of the asset currency provided by the Swedish note banking system in 1880–1901.[1] The focal question is this:

> What was the liquidity problem of the Swedish economy in the late 19th century, and how did the Enskilda banks act in order to solve it?

The answer is given by investigating the seasonal variation in the stock of bank notes, and how other balance sheet items co-moved with them.

The monthly data used have previously not been presented. To my knowledge this is the first quantitative examination of the inner workings behind the (seasonal) provision of liquidity in an unrestricted note banking system. Ögren (2003) also studies the provision of liquidity in the Swedish note banking system in the 19th century, but with end-of-year data, and with focus on long-term trends.

2 Preliminaries

This section reviews three preliminary issues. First, the liquidity problem faced by the Swedish economy in late 19th century is ad-

[1] Although much research has been done on Swedish banking in the nineteenth century, not much has been done from the free banking perspective. Jonung (1989) and Lakomaa (2004) give comprehensive accounts of the free banking question in Sweden 1830–1903, with focus on the institutional setup and the debates. Ögren (2003) investigates long run trends in money and credit supply during the whole period with note issuing banks 1834-1913, but does not address the elasticity question.

dressed. Second, the institutional background is reviewed. Third, the methodology used to estimate seasonal variation is discussed.

2.1 The liquidity problem

In the 19th century, the annual variations in the demand for currency were larger than they are today. Currency was the dominant medium of payment. Transactions were concentrated to specific times of the year, when currency demand peaked. Two great peaks were set by the forces of nature. Like in other countries, most people worked in agriculture, and payment media were needed during "crop-moving season", in harvest-time, in September–October. Then there were the needs of industry and forestry, which were constrained by "the sailing season". Because the sea was frozen, there was no shipping of goods in the winter period. The sailing season, when the sea was open and exports and imports were made, lasted from May to October. This condition created a liquidity problem for the exporting industry, since they could not receive payment for their products before the sailing season started, but nevertheless would have to pay for inputs. André Oscar Wallenberg, the founder of the Stockholms Enskilda Bank, the most important note-issuing commercial bank, wrote that

> Twice a year the quantity of outstanding notes rise, namely in September–October, when they reach their maximum, due to the needs of agriculture for transactions media to pay for the costs of gathering the harvest, and in March, when the last debentures are extended to the industry before shipment starts. Minimum occurs in July, before harvest. (Wallenberg 1886, p. 25)

In addition to the nature-generated seasonal effects on currency demand, there were those generated by institutional conditions. Traditionally, the "legal moving days" (*lagliga fardagar*) were days

when many contracts were made and paid. The legal moving day for land leases (*jordarrenden*) was the 14th of March. Rental contracts expired on the 1st of April and on the 1st of October. The moving day for servants was the 24th of October, and in Stockholm also the 24th of April. Taxes were paid in June and December. Many companies also paid dividends in June and December.

2.2 Institutional background

Two types of banks issued bank notes. *Enskilda banks* (Private banks) were chartered commercial banks with unlimited liability. *The Bank of Sweden* was the bank of the parliament, which also acted as a commercial bank. The constitution of 1809 granted legal tender status to the notes of the Bank of Sweden. In addition, the commercial banking system was comprised of the *Aktiebolagsbanker* (Joint Stock banks), which had limited liability but did not issue notes.

The Enskilda banks were regulated by *the Bank Law of 1874.* The law stated cash and capital requirements that were linked to the note-issuing rights. To be allowed to issue notes, an Enskilda bank had to hold gold reserves amounting to at least 10 percent of paid-in capital. Enskilda bank notes were to be redeemed into gold coin only. Outstanding notes could not exceed the sum of the bank's holdings of: Collateral for equity; Claims up to fifty percent of paid-in capital; and Gold exceeding ten percent of paid-in capital (SFS 74:44).

In addition to the quantitative rules, the Enskilda banks faced other restrictions. From 1880 Enskilda banks were not allowed to issue five-crown notes, which became a monopoly of the Bank of Sweden. This restriction was important, since small notes were more popular and circulated longer. The loss of the five-crown notes was partly compensated by an increased circulation of ten-crown notes. Wallenberg (1886, p. 19) claims that the Enskilda banks were able to compensate two thirds of their loss of five-

crown notes by issuing ten-crown notes. Another restriction was that the Enskilda bank notes were taxed by 0.5 percent, calculated on the highest circulation during the year.

The note-issuing right of the Bank of Sweden was simpler. The bank was allowed to issue notes up to its reserves (specie + foreign exchange) plus a stipulated quantity. During the note competition period this quantity did not alter much: in 1879–1887 it was 35 million, and in 1888–1898 it was 45 million. By contrast, after note monopolisation it rose steadily each year.

The clearing function of the Swedish banking system was peculiar, in that it was performed by two commercial banks. In 1856 the Stockholms Enskilda Bank was started. It immediately began to act as a clearing bank for other note-issuing banks. However, the Skandinaviska Kreditaktiebolaget, a non-issuing bank, largely took over the clearing function in the 1860s, mainly because it offered better terms. There were thus two clearing banks in the period 1878–1901, one of which did not issue notes.

In 1897 a new bank law was promulgated that prescribed the monopolisation of notes by the Bank of Sweden. The transfer of the Enskilda banks notes to the Bank of Sweden occurred between January 1901 and January 1904. Clearing was now also taken over by the Bank of Sweden. After monopolisation, commercial banks acquired notes mainly by rediscounting bills with the Bank of Sweden.

Was the Swedish note banking system free from intervention?

In 1878–1879 a severe crisis hit the Swedish economy. A boom, fueled by railroad construction and international demand for Swedish iron and timber, turned into a bust when prices fell. The Stockholms Enskilda Bank had invested heavily in railroad bonds. This bank was also more leveraged than other banks – while capital-asset ratios of other banks were around 20 percent, the Stockholms Enskilda Bank was operating on a ratio around 10 percent

(Summary of the Bank Reports). When two ironworks that the Stockholms Enskilda Bank was heavily invested in suspended payments, rumours spread that the bank would become insolvent. In December 1878, there was a run on the Stockholms Enskilda Bank. In February 1879, the finance minister Hans Forsell made pronouncements that government support to the banks would relieve capital markets. In May 1879, a special fund called the Railroad Mortgage Fund was created, administered by the National Debt Office, from which banks could borrow on railroad bonds as security (Lindgren 1994).

This incident, it can been argued, shows that the Swedish note banking system was not able to stand on its own without the government intervening and acting as a lender of a last resort. However, this reading is open to debate. It is important to remember that when the government assumes a role as guarantor of the solvency of the banking system, it does not act as a lender of last resort. The classical lender of last resort provides liquidity to all illiquid but *solvent* banks, in order to quench bank runs and panics. By contrast, the activities of the Swedish government in 1879 was very much about saving one important possibly insolvent bank from bankruptcy, in order to avoid larger damage to the financial system. Apart from the Stockholms Enskilda Bank, banks made marginal use of the fund.[2] The Swedish situation in 1878–1879 was clearly different from the general panics that hit England in 1847, 1857 and 1866, when lender of last resort-response was called for. Apart from limited runs on the Stockholms Enskilda Bank, other banks were not subject to runs or panics. The difficulties of the Stockholms Enskilda Bank did not spill over into a general distrust of the banking system. There is also evidence that bank support for

[2] From a total of 42 commercial banks, 13 made use of the fund. Of the 7.56 million lent, over half (4 million) was borrowed by the Stockholms Enskilda Bank (Ögren 2003, p. 262).

the fund was lukewarm – with the exception of the Stockholms Enskilda Bank, banks did not see themselves in trouble and the fund was therefore not felt to be necessary (Nilsson 1994, p. 288). In sum, it is not clear what contribution the government intervention made to relieve the crisis, and it is conceivable that the banks would have weathered the storm without it.

2.3 Methodology

Seasonal (monthly) averages for balance sheet items were estimated by maximum-likelihood on logged series, with monthly dummies, and four lags as independent variables. The strategy was to test for stationarity by means of the augmented Dickey-Fuller test for unit roots. For variables deemed stationary, seasonal coefficients were estimated by regression on levels.[3] In case of non-stationarity, differenced variables were used.[4] To estimate the significance of the seasonal variation (monthly changes), *p*-values for the regression coefficients were used in the case of differenced variables. In the case of level-variables, Wald tests on the equality of subsequent regression coefficients were performed. Regression and test results are available upon request. Regression specifications are shown in the Appendix.

Seasonal averages were estimated on a sample from January 1880 to January 1896. This period was chosen because *ceteris paribus* conditions were then fairly present. Variables were fairly stationary (an international monetary expansion started in 1896 which also affected Sweden). Also, the period 1878–1879 saw financial turbulence, and the Enskilda banks lost the right to issue five-crown notes. Institutional changes also occurred in 1897 with the promulgation of the new bank law.

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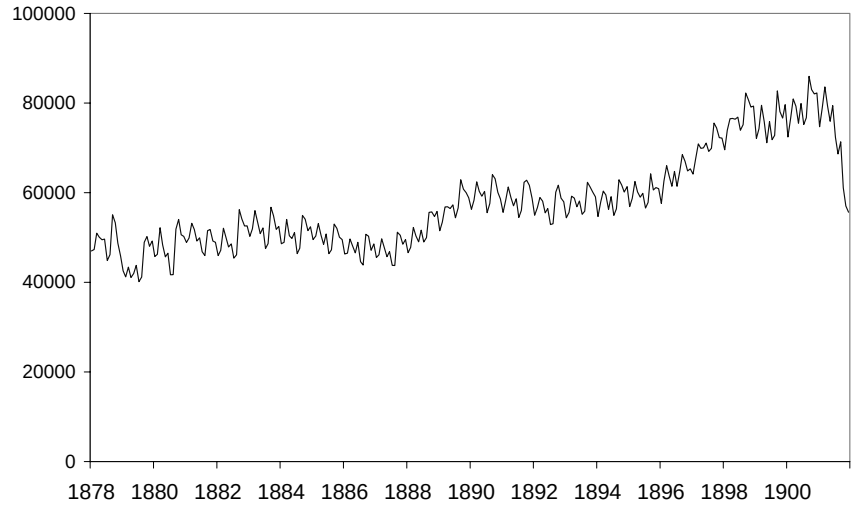
[3] Enskilda Bank Notes, Bank of Sweden Notes, Post Bills, Cash.

[4] Liquid Claims, Bills, Foreign Bills, Cash Credit, Loans, Loans on Commodities, Time Deposits, Demand Deposits.

3 The note circulation

This section describes the annual and seasonal variation in the note stocks of the Enskilda banks and the Bank of Sweden, 1878–1901. Figure 1 depicts the behaviour of the Enskilda bank notes.

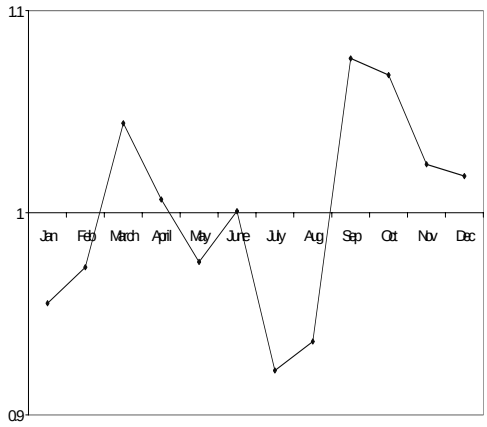
Figure 1 Enskilda bank notes, 1878–1901 (kSEK).



Source: Summary of the Bank Reports.

The note stock seems to move with remarkable seasonal regularity. An exception is perhaps in 1878–1880. There was an industrial crisis in 1878–79. Also, in January 1880 the Enskilda banks lost their right to issue five crown notes. Figure 2 displays seasonal (monthly) averages for the note stock in 1880–1895. Levels have been normalised to show each month's average note circulation as a ratio of the average (monthly) circulation over the year.

Figure 2 Average seasonal note stocks of the Swedish Enskilda banks, 1880–1895.



	Δ	p
Jan	–0.063	0.000
Feb	0.018	0.004
Mar	0.071	0.000
Apr	–0.038	0.000
May	–0.031	0.000
Jun	0.025	0.000
Jul	–0.079	0.000
Aug	0.014	0.028
Sep	0.14	0.000
Oct	–0.008	0.12
Nov	–0.044	0.000
Dec	–0.006	0.23

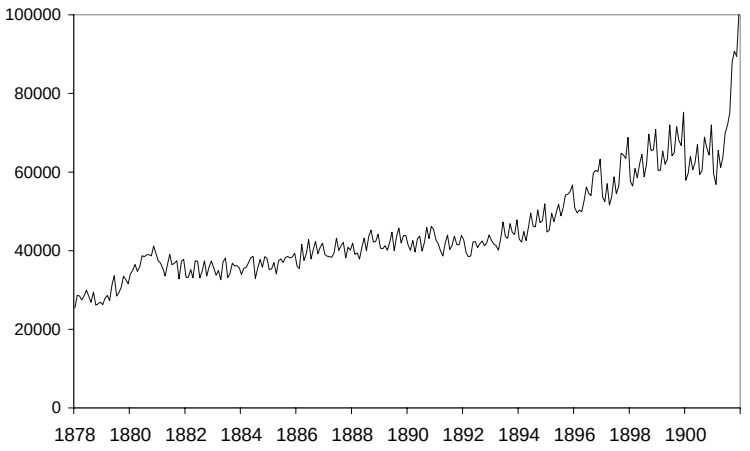
Source: Summary of the Bank Reports.

Demand for notes peaked twice a year, namely in March and in September–October. The biggest troughs were in July and in January. The expansion between August and September is most conspicuous. Then the note stock expanded by about 14 percent. A. O. Wallenberg's description of the seasonal fluctuations quoted above corresponds exactly to the pattern in Figure 2. His comment suggests that the peak in March was related to the needs of industry, whereas the peak in September–October was related to the needs of agriculture. Figure 2 also indicates that the seasonal changes are statistically significant (except for the small contractions in October and December).

The note stock of the Bank of Sweden

The note stock of the Bank of Sweden exhibited a seasonal pattern distinct from that of the Enskilda banks. This is seen in Figure 3.

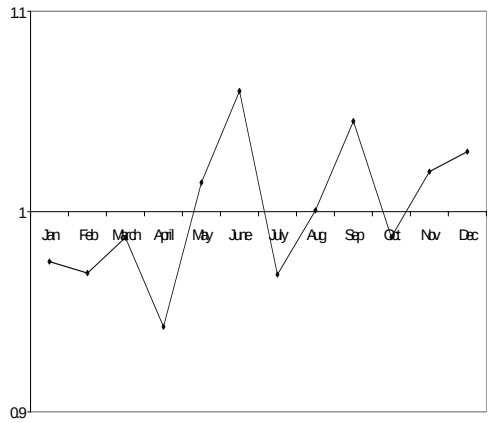
Figure 3 Note stock of Bank of Sweden 1878–1901 (kSEK) .



Source: Summary of the Bank Reports.

Figure 4 pictures the average seasonal note stock of Bank of Sweden, 1880–1895.

Figure 4 Average seasonal note stocks of the Bank of Sweden, 1880–1895.



	Δ	p
Jan	–0.054	0.000
Feb	–0.006	0.53
Mar	0.018	0.038
Apr	–0.044	0.000
May	0.072	0.000
Jun	0.046	0.001
Jul	–0.091	0.000
Aug	0.032	0.006
Sep	0.044	0.004
Oct	–0.057	0.000
Nov	0.033	0.006
Dec	0.009	0.51

Source: Summary of the Bank Reports.

Whereas for the Enskilda banks, the highest peaks occurred in March and September, the notes of the Bank of Sweden peaked in

June, September and (to a lesser extent) December. Also, whereas the Enskilda bank notes had their lowest circulation in July, the Bank of Sweden notes bottomed out in April. Potential causes to the difference have been sketched above. In March the last debentures to the industry before shipment were extended, which increased the demand relatively more for Enskilda bank notes. The Enskilda banks' main task was to provide for the financial needs of the industry, which was not the case with the Bank of Sweden. On the other hand, many companies paid dividends twice a year, at the end of December and June, when taxes were also paid. These transactions were possibly mostly paid in Bank of Sweden notes.

4 Assets of the Swedish asset currency

This section describes the balance sheet of the Enskilda banks, and how its components changed in relation to the note stock. Three questions are addressed:

1. Which items were overall most strongly correlated with the note stock?

2. Which items correlated with the note stock in the months of the greatest expansion and contraction, namely in March and September, July and January?

3. What was the proportion between quantitative and qualitative (or form-seasonal) changes in money demand, that is, how much of the change in note demand was due to a change in the total demand for money, and how much was due to a change in the currency-deposit ratio – particularly in September?

Table 1 shows the aggregated balance sheet of the Enskilda banks in December 1890, in the middle of the studied period.

Table 1 Aggregated balance sheet of the Enskilda banks, December 1890 (MSEK).

Assets	441	Liabilities	441
Cash	12	Post Bills	11
Liquid claims	32	Notes	59
Bonds	31	Demand Deposits	40
Bills	142	Time Deposits	222
Loans	95	Equity	72
Cash Credit	51	Other	38
Other	78		

Source: Summary of the Bank Reports.

On the liabilities side, demand liabilities were about 110 million (post bills, notes and demand deposits). Notes were larger than demand deposits. The cash-to-demand liabilities ratio was about 10 percent, while the liquidity ratio – (liquid claims + cash)-to-demand liabilities – was about 40 percent. On the assets side, bills were the dominant form of credit. Lending (domestic bills, loans, and cash credit) was about 280 million, somewhat larger than deposits, 260 million. Table 2 depicts correlations between monthly changes in balance sheet items and the note stock in 1880–1895.

Table 2 Correlations between monthly changes in Enskilda bank notes and balance sheet items, 1880–1895.

Assets		Liabilities	
Cash	0.19	Post Bills	0.58
Liquid claims	0.36	Demand Deposits	–0.33
Bonds	0.08	Time Deposits	–0.40
Domestic Bills	0.43		
Foreign Bills	0.15		
Loans	0.13		
Cash Credit	0.08		

Source: Summary of the Bank Reports.

Overall, post bills were the item that correlated the most with the note stock. Post bills correlate positively with notes. Balance sheet logic implies that, all else equal, an increase in the volume of notes should be accompanied by an increase in assets, and/or a decrease in other liabilities. Changes in the volume of post bills cannot therefore be considered a "source" of changes in the volume of notes. The correlation with deposits, however, is of the "right" sign. On the asset side, domestic bills hade the strongest correlation with notes, followed by liquid claims.

The big months

Of particular interest is the behaviour of the balance sheet in "the big months" when notes expanded or contracted sharply. Because notes and post bills expanded and contracted together, they are counted together in this section. The greatest expansions of notes and post bills occurred in March and in September. The greatest contractions occurred in July and in January. Table 3 shows mean and standard deviation for monthly changes in (notes + post bills) for the period 1880–1895. It also shows mean and standard deviation for changes in balance sheet items, expressed as a ratio of the change in (notes + post bills). Bonds and Equity are not reported, since they hardly exhibited seasonal varation. Ratios for liabilities are defined so that a change in opposite direction to the change in (notes + post bills) gives a positive sign [thus, for deposits, the ratio is: $-\Delta \textit{Deposits} / \Delta (\textit{Notes} + \textit{Post Bills})$].

Table 3 Mean and standard deviation for the change in (Notes + Post Bills), and for ratios of change in balance sheet items and change in (Notes + Post bills), in March, July, September and January, 1880–1895.

	March		July		September		January	
	Mean	S. D.	Mean	S. D.	Mean	S. D.	Mean	S. D.
Notes + Post Bills	0.076	0.024	–0.085	0.019	0.15	0.040	–0.079	0.015
Cash	–0.10	0.22	0.18	0.17	–0.01	0.07	0.17	0.27
Liquid Claims	–0.27	0.41	–0.08	0.47	0.27	0.22	0.38	0.35
Domestic Bills	0.72	0.41	0.41	0.20	0.17	0.13	0.08	0.36
Foreign Bills	–0.21	0.12	–0.29	0.26	0.16	0.13	0.40	0.28
Loans	0.49	0.25	0.21	0.20	0.02	0.06	–0.21	0.24
Cash Credit	0.13	0.24	0.20	0.18	0.05	0.08	–0.59	0.39
Demand Deposits	0.14	0.36	0.21	0.29	0.16	0.13	0.17	0.15
Time Deposits	–0.05	0.45	0. 29	0.33	0.13	0.17	0.56	0.43
Total	0.86	0.53	1.13	0.45	0.93	0.16	0.99	0.40
Lending	1.35	0.67	0.82	0.34	0.24	0.17	–0.73	0.60
Deposits	0.09	0.49	0.50	0.41	0.28	0.18	0.75	0.49

Note: Ratios for liabilities are defined as: $-\Delta$ *Liability* / Δ (*Notes* + *Post Bills*).

The co-movers differed over the year. The note expansion in March occurred mainly through an expansion of domestic lending – mainly through domestic bills and loans. The contraction in July is on the other hand mostly associated with an expansion of deposits (but domestic bills are also important). The large September expansion is the one where co-movers are most evenly distributed, with liquid claims, domestic and foreign bills, and demand and time deposits taking a relatively equal share. The variance of the co-movers is also smallest in September. In this month, deposits account for about one third of the change in notes. Lending represents a relatively small factor. The relative role of domestic bills and loans expansion was much smaller in the September, compared to their role in the March expansion. In January, increasing time deposits was the largest factor behind the contraction. It is also noteworthy that lending actually expands in this month, de-

spite the fact that notes contract (loans and cash credit expands, while bills slightly contract).

Question 3 aked how much of the note expansion was due to qualitative changes in money demand, particularly in September. Table 3 shows that the role of demand deposits was fairly equal in all the big months. Demand deposits accounted for between 14 and 21 percent of the change in notes. This figure represents the qualitative, or form-seasonal, change in money demand, the change in the relation between currency and demand deposits. The figure may be considered low. However, if we include time deposits, then about one third of the increase in notes and post bills in September was due to a withdrawal of deposits. This quantity could be considered non-negligible, and may explain the historic need for erecting institutions able to provide form-seasonal elasticity to the currency.

Liquid claims and foreign bills seem to co-move in a peculiar manner. They both contract in March, in spite of notes expanding. In July they both expand, in spite of notes contracting. On the other hand they co-move positively with notes in September and in January. This pattern of movement should be related to the sailing season. In the winter period November–March, exporters were short on foreign payments media. The quantities of liquid claims and foreign bills therefore decreased in these months. In the sailing season from May to October, exporters received foreign payment media, which were deposited or discounted with the commercial banks. Liquid claims and foreign bills therefore increased in those months.

Table 3 contains substantial information on how the Enskilda banks were able to solve the liquidity problem of the Swedish economy in the late 19th century. It provides insights into how the co-movements of notes with other balance sheet items were dictated by the needs of industry and agriculture – needs which depended on conditions for sowing and sailing that were set by na-

ture. In March, when exports were low, banks extended currency to the industry by means of domestic lending. In July, currency demand was at its lowest. There was a contraction of notes, associated mostly with an increase in deposits. At the same time the sailing season made the volume of foreign payment media swell. September saw the greatest need for currency. From harvest and exports, income flowed into both agriculture and industry, and the need for loans was therefore limited. Notes were issued with backing from a variety of sources, as well as through the withdrawal of deposits.

5 The co-movers

This section describes the seasonal changes of the co-movers in more detail, as was done with notes in section 2. The following items are covered: post bills, lending (bills, loans and cash credit), deposits (time and demand), liquid claims and cash.

Post Bills

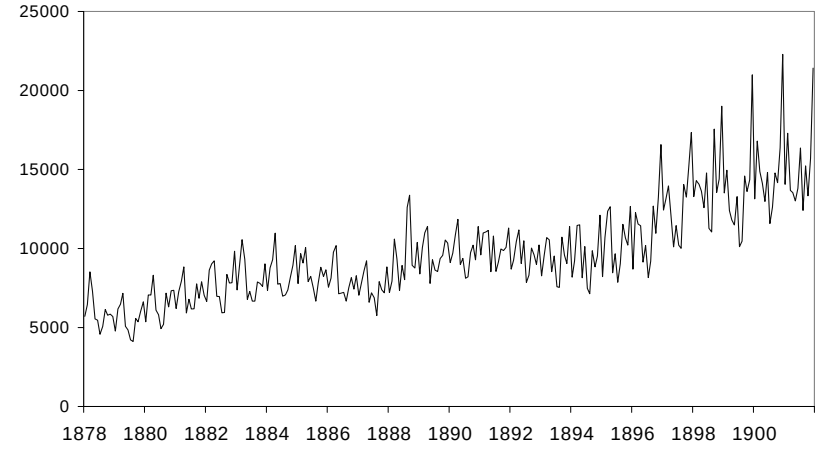
The post bill was a form of cashier's check that was unique to the Swedish payment system. It was invented by André Oscar Wallenberg, the founder of the Stockholms Enskilda Bank, the most important note-issuing bank, which also served as a clearinghouse for the banking system. The post bill was intentionally invented to facilitate the clearing process. The provincial banks held clearing accounts at the Stockholms Enskilda Bank. For out-of-town payments, instead of sending notes by registered mail, a person could buy a post bill at the Stockholms Enskilda Bank free of charge, ordering the Stockholm Enskilda Bank to pay a stipulated sum on demand to the payee. The bill was then sent by regular mail. The receiver would then cash it, again free of charge, at his provincial Enskilda bank, which would pay with its own notes. The provincial bank would then send the post bill to Stockholms

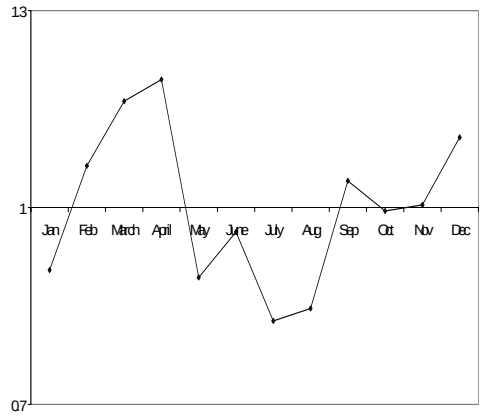
Enskilda Bank, which would credit the provincial bank's clearing account.

All Swedish banks issued post bills free of charge, which were accepted and cashed by all other banks at sight and free of charge. This was in contrast to corresponding bills of foreign banks, which were payable with eight to ten days notice, and bought and sold at a charge. According to Wallenberg (1886), the reason was the Enskilda banks' right to issue notes, by which they could pay out with their own notes instead of using costly reserves. That the freedom to issue notes in this way lowers transaction costs has scarcely been noticed in the free banking literature. Wallenberg (1886, p. 27) claims that it saved one million crowns per year in transaction costs.

The post bill thus filled an important role in the Swedish payments system. Figure 5 shows how the post bills of the Enskilda banks varied.

Figure 5 Post bills of the Enskilda Banks 1878-1901 (kSEK), and average monthly circulation, 1880-1895.





	Δ	p
Jan	–0.20	0.000
Feb	0.16	0.000
Mar	0.10	0.000
Apr	0.033	0.21
May	–0.30	0.000
Jun	0.069	0.003
Jul	–0.14	0.000
Aug	0.019	0.43
Sep	0.19	0.000
Oct	–0.046	0.10
Nov	0.009	0.71
Dec	0.10	0.000

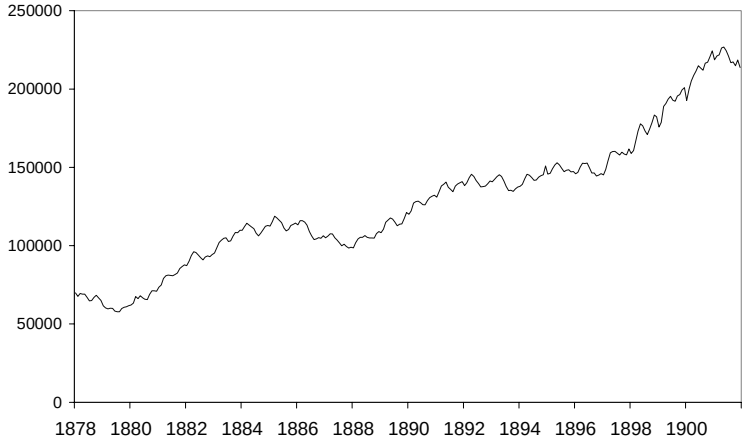
Source: Summary of the Bank Reports.

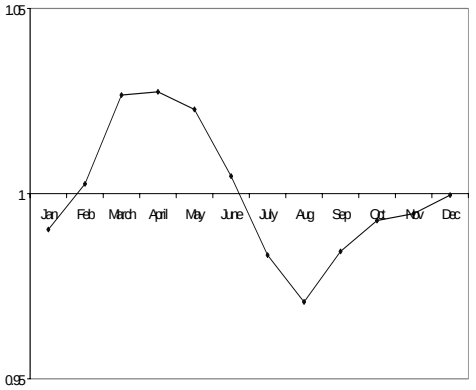
Post bills were a highly elastic payment medium. Figure 8 confirms the strong positive co-movement between notes and post bills. Post bills peaked in March–April, June, September and December, and bottomed in July and in January. In contrast to notes, they increased also in April (although this change is not significant).

Bills

Bills should be of prime interest as a co-mover of notes. First, as Table 1 showed, they were the most important form of credit on the balance sheet, accounting for 30 percent of total assets in 1890. Second, they were the most liquid form of credit. The quantity of domestic bills held by the Enskilda banks is shown in Figure 6.

Figure 6 Domestic bills of Enskilda banks 1878-1901 (kSEK)





	Δ	p
Jan	–0.009	0.092
Feb	0.012	0.000
Mar	0.024	0.000
Apr	0.001	0.20
May	–0.004	0.76
Jun	–0.018	0.000
Jul	-0.021	0.000
Aug	–0.013	0.036
Sep	0.014	0.000
Oct	0.008	0.007
Nov	0.002	0.10
Dec	0.004	0.062

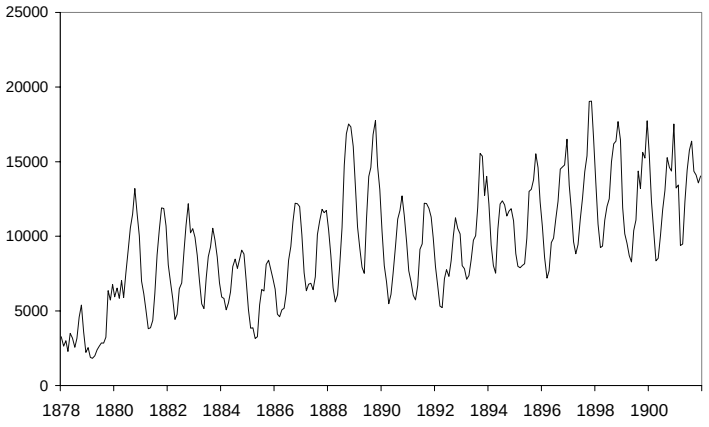
Source: Summary of the Bank Reports.

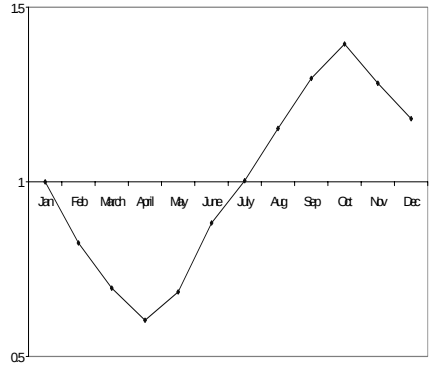
The volume of bills moved with strong cyclical and seasonal regularity. Cyclically, they moved in periods of eight to nine years. The

movement is so regular that it conveys an impression of "econo-rhytms" at work. Seasonally, bills surged in volume at the beginning of the year, to reach a maximum in March–May. They then subsided to reach a low point in August, from which they again increased.

If we look at foreign bills, they moved in seasonal cycles with great regularity and amplitude, in a pattern highly different from that of domestic bills. This is shown in Figure 7.

Figure 7 Foreign bills of Enskilda banks, 1878–1901 (kSEK), and their seasonal average, 1880–1895





	Δ	*p*
Jan	–0.18	0.000
Feb	–0.18	0.000
Mar	–0.13	0.004
Apr	–0.091	0.001
May	0.081	0.004
Jun	0.20	0.000
Jul	0.12	0.000
Aug	0.15	0.036
Sep	0.14	0.004
Oct	0.099	0.002
Nov	–0.11	0.031
Dec	–0.10	0.003

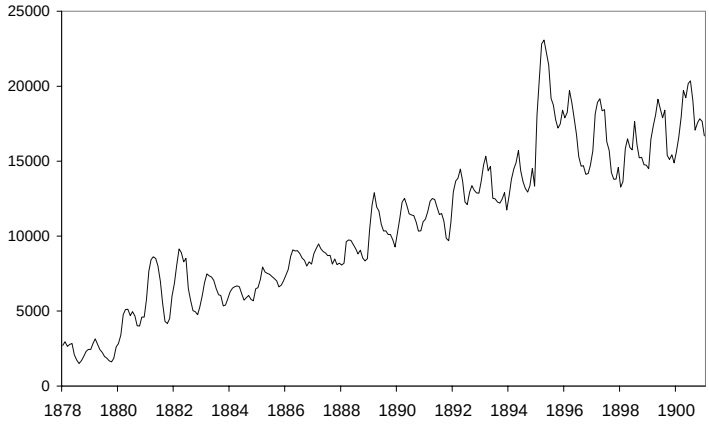
Source: Summary of the Bank Reports.

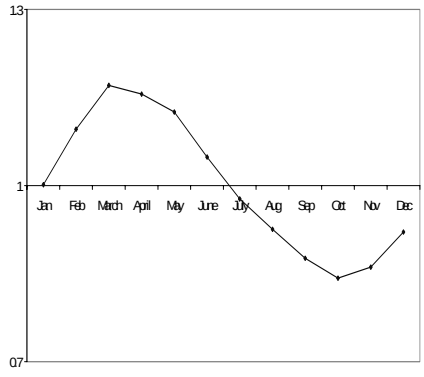
Foreign bills steadily decreased from November until April. They then steadily increased between May and October – during the sailing season. In May–October shipments were made and Swedish exporters received payments in foreign bills. These were discounted with the Swedish Enskilda banks. Likewise, in wintertime when no exports were made, foreign bills were hardly presented for discounting with the banks, wherefore their holdings fell.

Loans

Loans against promissory notes (*reverslån*) were the traditional and most common form of credit in Sweden, even between merchants, before the 1860s, when bills were beginning to be more widely used. In the Summary Reports, loans were divided into six categories, namely loans on (security in): fixed assets; bonds; stocks; commodities; name security; and surety. Of these, loans-on-commodities can be expected to correlate most strongly with the "needs of trade". In fact, this form of loan shows a remarkably stable and accentuated seasonal pattern, as Figure 8 shows.

Figure 8 Loans-on-commodities of the Enskilda banks 1878–1901 (kSEK), and their seasonal averages, 1880–1895.





	Δ	p
Jan	0.080	0.000
Feb	0.094	0.000
Mar	0.074	0.000
Apr	–0.015	0.79
May	–0.030	0.59
Jun	–0.077	0.002
Jul	–0.071	0.001
Aug	–0.052	0.049
Sep	–0.049	0.042
Oct	–0.034	0.28
Nov	0.019	0.21
Dec	0.059	0.000

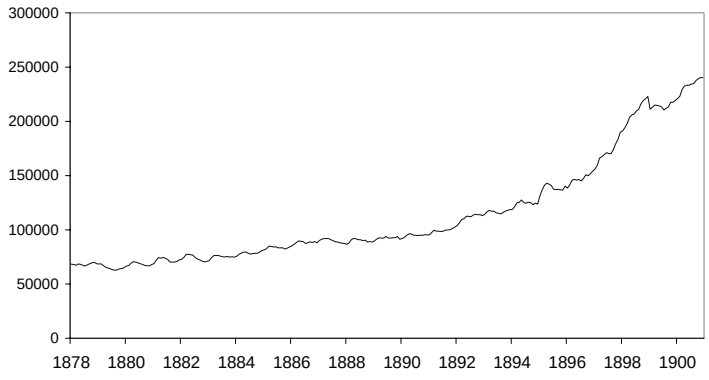
Source: Summary of the Bank Reports.

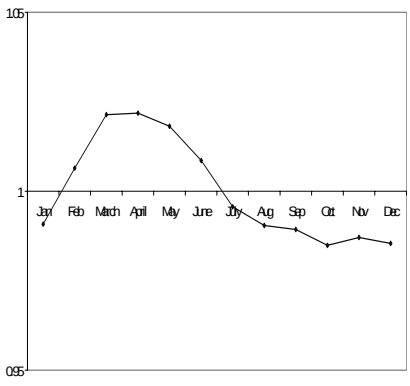
Interestingly, the seasonal pattern for loans-on-commodities is exactly reverse to the one for foreign bills. It is as if loans-on-commodities are the reverse coin of foreign bills, and the seasonal pattern should therefore be related to the sailing season. The volume of loans-on-commodities surged steadily at the beginning of the year, until it peaked in March. It then steadily decreased during the sailing season in May–October, bottoming in this last month. From then it again begin to rise. Loans-on-commodities were likely granted to export manufacturers, who would repay the

loans with foreign bills during the sailing season. Thus, loans-on-commodities seem in a certain sense to be self-liquidating.

Total loans show a pattern that is similar but not as distinct as the one for loans-on-commodities. This is seen in Figure 9.

Figure 9 Total loans of the Enskilda banks 1878-1901 (kSEK), and average seasonal total loans, 1881–1895.





	Δ	p
Jan	0.005	0.005
Feb	0.016	0.000
Mar	0.015	0.000
Apr	0.0	0.20
May	–0.004	0.83
Jun	–0.009	0.033
Jul	–0.013	0.002
Aug	–0.005	0.32
Sep	–0.001	0.68
Oct	–0.004	0.60
Nov	0.002	0.27
Dec	–0.002	0.78

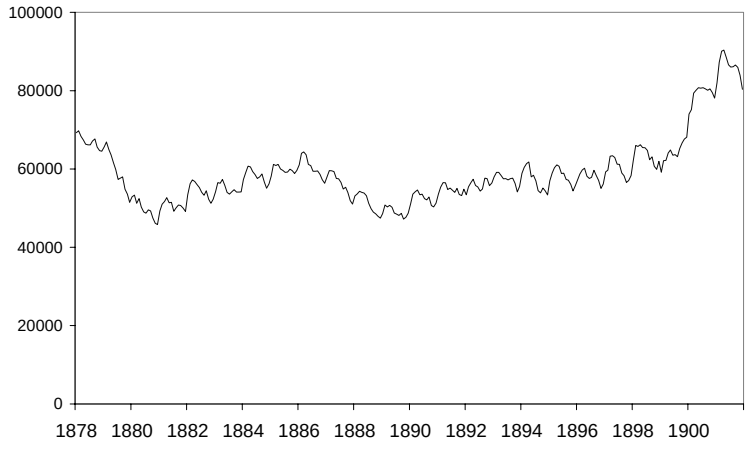
Source: Summary of the Bank Reports

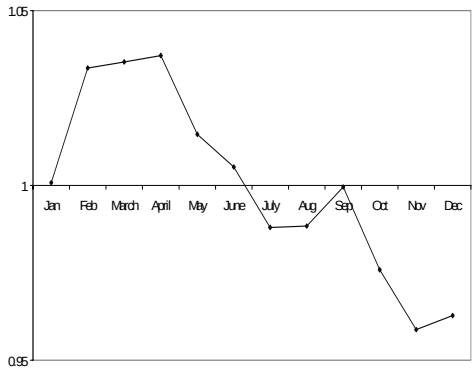
Total loans also increased at the beginning of the year, peaking in March–May. It then steadily dropped in the second half of the year. The changes from August to December are not significant, however.

Cash credit

Cash credit, the third form of lending, shows a similar seasonal variation to loans and bills, in that it increased in the first half of the year and decreased in the second half of it. This is seen in Figure 10.

Figure 10 Cash credit lent by Enskilda banks, 1878–1900, (kSEK), and seasonal averages, 1880–1895.





	Δ	p
Jan	0.038	0.000
Feb	0.033	0.000
Mar	0.002	0.76
Apr	0.002	0.78
May	–0.022	0.000
Jun	–0.009	0.053
Jul	–0.017	0.000
Aug	0.0	0.90
Sep	0.011	0.026
Oct	–0.024	0.000
Nov	–0.017	0.000
Dec	0.004	0.41

Source: Summary of the Bank Reports.

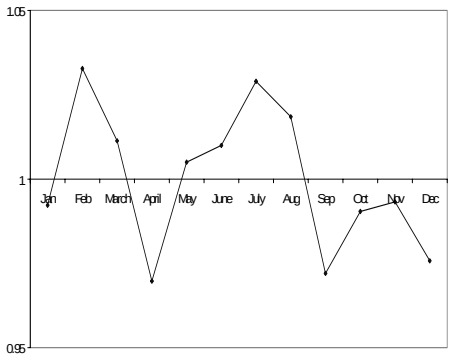
Again, the volume increased at the beginning of the year, peaking in February–April, after which it dropped. Like bills but unlike

loans, cash credit increased in September, thus contributing to the note expansion in this month. It then dropped again to bottom in November–December.

Deposits

Figure 11 depicts the behaviour of demand deposits.

Figure 11 Demand deposits of the Enskilda banks, 1878–1901 (kSEK), and seasonal averages, 1880–1895.



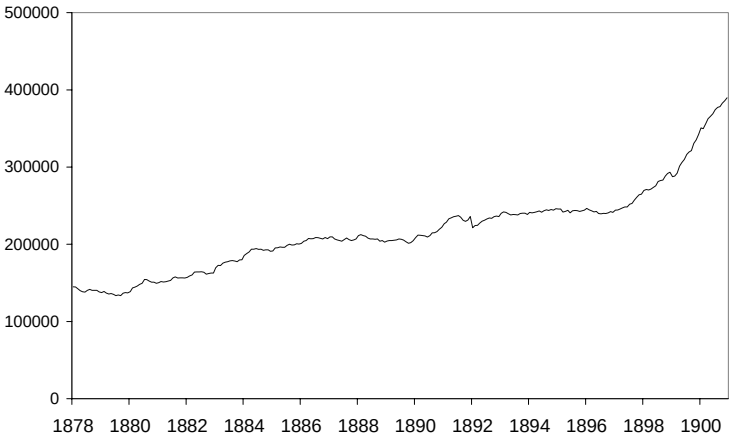
	Δ	p
Jan	0.017	0.064
Feb	0.041	0.000
Mar	–0.021	0.029
Apr	–0.042	0.000
May	0.035	0.000
Jun	0.005	0.32
Jul	0.019	0.007
Aug	–0.010	0.46
Sep	–0.046	0.000
Oct	0.018	0.004
Nov	0.003	0.46
Dec	–0.018	0.044

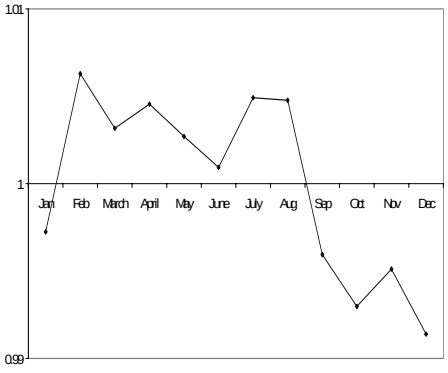
Source: Summary of the Bank Reports.

As expected, demand deposits moved seasonally in a pattern that is inversely related to the one for notes. Demand deposits de-

creased when note demand peaked, in March, June, September and December. Demand deposits peaked in July, when note demand was bottom low. However, a deviation occurs in April, when demand deposits decrease when notes also decrease. Time deposits are depicted in Figure 12.

Figure 12 Time deposits of Enskilda banks 1878-1900 (kSEK), and seasonal averages, 1880–1895.





	Δ	*p*
Jan	0.006	0.000
Feb	0.009	0.000
Mar	–0.003	0.88
Apr	0.001	0.11
May	–0.002	0.85
Jun	–0.002	0.89
Jul	0.004	0.013
Aug	–0.0	0.52
Sep	–0.009	0.099
Oct	–0.003	0.91
Nov	0.002	0.38
Dec	–0.004	0.67

Source: Summary of the Bank Reports.

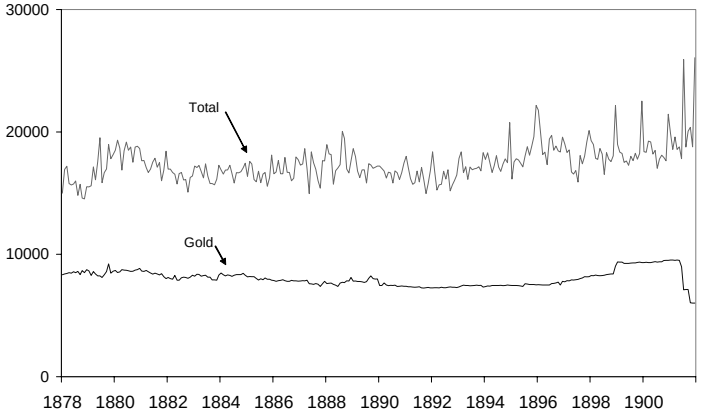
Time deposits rapidly took off in 1897. As in the case of demand deposits, the seasonal pattern correlates negatively quite well with that for notes. Time deposits decreased when notes increased in

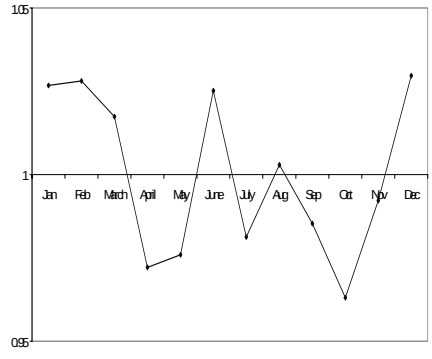
March, June, September and December. Time deposits increased when notes decreased in April and July. However, except for the increases in January–February and July (and weakly, in April), and the drop in September, the changes are not statistically significant.

Cash and Liquid Claims

The Summary Reports divide the banks' cash holdings into four categories: Swedish gold coin; other gold; silver, bronze and copper coin and Bank of Sweden notes held by the Enskilda banks; and Enskilda bank notes. Figure 13 shows total gold holdings, and total cash (excluding Enskilda banks' holdings of other Enskilda banks' notes).

Figure 13 Gold and total cash held by the Enskilda banks, 1878–1901 (kSEK), and seasonal averages for total cash, 1880–1895.



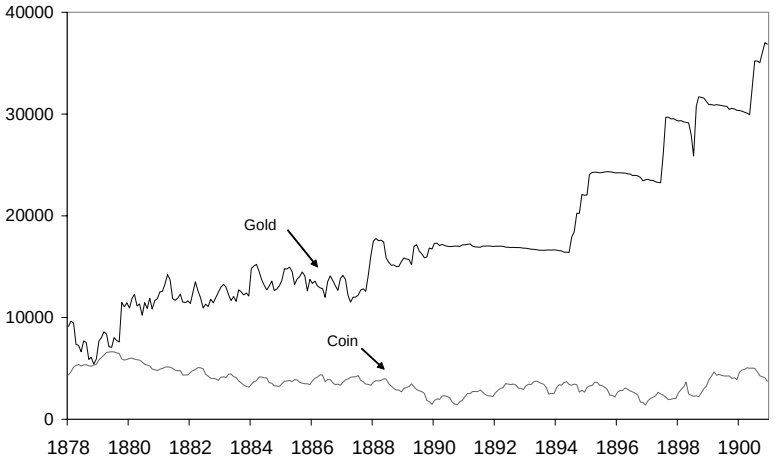


	Δ	*p*
Jan	–0.003	0.83
Feb	0.001	0. 94
Mar	–0.011	0.45
Apr	–0.045	0.010
May	0.004	0.78
Jun	0.049	0.000
Jul	–0.044	0.003
Aug	0.022	0.073
Sep	–0.018	0.23
Oct	–0.022	0.077
Nov	0.029	0.053
Dec	0.038	0.038

Source: Summary of the Bank Reports. Total cash includes gold, silver, bronze and copper coin and Bank of Sweden notes (but not Enskilda bank notes).

Cash holdings were exceptionally stable. Gold holdings did not vary at all. Total cash mostly co-moved negatively with notes. Except for the increase in June, cash decreased in March and in September–October when notes increased. This is probably because coin and Bank of Sweden notes were demanded in those periods, and hence Enskilda cash holdings decreased. The cash of the Enskilda banks may be contrasted with those of the Bank of Sweden. These are shown in Figure 14.

Figure 14 Gold and coin held by the Bank of Sweden, 1878-1901 (kSEK)



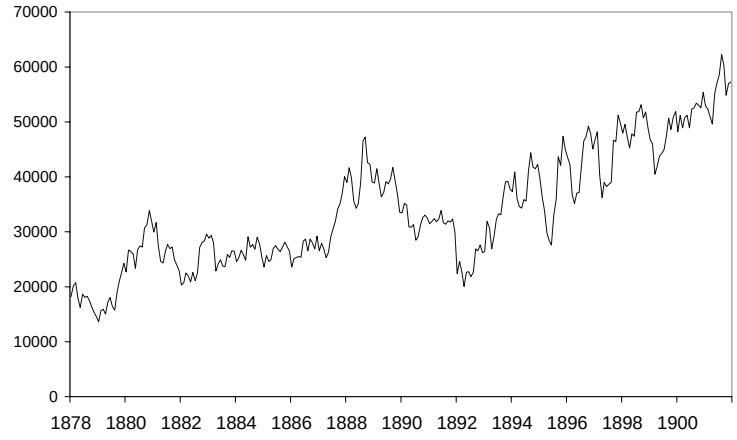
Source: Summary of the Bank Reports.

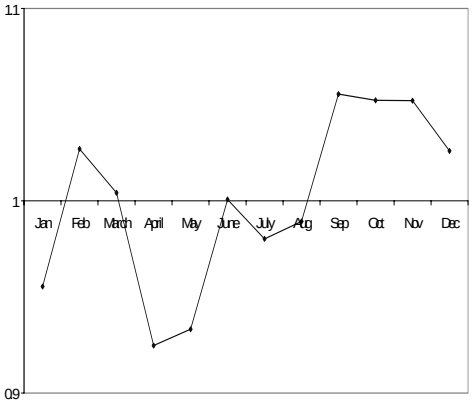
Three things are noteworthy. First, in contrast to the Enskilda banks, gold reserves increased from the mid 1890s. Second, the pattern changed remarkably from 1890. Up until then, gold reserves showed seasonal variability, with a peak in March. After 1890 gold reserves became flat with sudden discrete jumps. This is a reflection of policy changes. From 1890, the Bank of Sweden began to use foreign exchange rather than gold for monetary operations (Brisman 1931, p 185).

Liquid claims

Liquid claims are here defined as the Enskilda banks' holdings of: clearing accounts; accounts at foreign and domestic banks; and foreign notes, checks and bills payable at sight. Figure 15 shows the Enskilda banks' holdings of liquid claims in 1878–1901, and the seasonal average in 1880–1895.

Figure 15 Liquid claims of the Enskilda banks 1878–1901, and average seasonal liquid claims, 1880–1895.





	Δ	p
Jan	–0.07	0.000
Feb	0.071	0.000
Mar	–0.023	0.23
Apr	–0.079	0.000
May	0.008	0.34
Jun	0.067	0.000
Jul	–0.02	0.28
Aug	0.009	0.45
Sep	0.066	0.000
Oct	–0.003	0.97
Nov	0.0	0.85
Dec	–0.026	0.14

Source: Summary of the Bank Reports.

Liquid claims tended to increase from April to October, but tended to decrease during the winter months. They thus show similarities to the seasonal movements of foreign bills. This is not surprising, since they largely consisted of foreign payment media, such as foreign bank accounts, notes, checks and bills payable at sight. These items surely moved with the sailing season.

6 Conclusions

This paper described the workings of the asset currency provided by the Swedish note banking system, and how it solved the liquidity problem of the Swedish economy in the late 19th century. Natural and institutional conditions increased the demand for currency particularly in March and in September-October, while it bottomed in July and in January. The demand for Bank of Sweden notes was somewhat different, peaking in June, September and December, but with little demand in March.

The liquidity needs of industry were to a large extent dictated by the sailing season. In the winter season, currency was supplied by means of domestic lending. In contrast, lending was not needed during the sailing season in May–October, when exporters received foreign payments media, such as foreign bills and liquid claims. These moved inversely to lending, decreasing in the winter season and increasing in spring and summer. In particular, loans-on-commodities seem to have communicated perfectly with foreign bills, suggesting that the former might be self-liquidating.

Overall, domestic bills were the most important instrument used for the supply of notes. They showed a greater elasticity to currency needs than did the other forms of lending. Deposits were particularly important in September, where they accounted for about one third of the note supply, and in the contraction months in July and in January. The role of demand deposits for note supply was fairly stable over the year, accounting for about 14–21 percent of the change in notes in the "big months". This figure represents the qualitative change in money demand. The month of September saw the greatest demand for notes, and a mixture of agricultural, industrial and institutional needs saw the notes supplied from a variety of sources, with liquid claims, domestic and foreign bills, and demand and time deposits contributing roughly equally to the expansion of notes. In this month, withdrawal of deposits

accounted for about a third of the expansion of notes. This figure does not seem trivial, and helps to understand the historic need for institutions able to provide "form-seasonality " to rigid currencies.

The general impression of this study is that the Swedish note banking system was able to provide an elastic currency that responded well to the seasonal "needs of trade". The seasonal demand varied with utmost regularity, and the balance sheet of the Enskilda banks worked like a clockwork to meet it, where various items contributed at different times of the year. The unrestricted discretion of the Enskilda banks to use a variety of assets with which to back their notes was surely necessary to accommodate the seasonal needs. The result of this study complements that of Ögren (2003) who concludes that the note-issuing activity of the Enskilda banks was crucial in providing liquidity to the Swedish capital market in the late 19th century. The experience of the asset currency provided by the Swedish note banking system indicates that central banks-lenders of last resort were not strictly needed to solve the liquidity problems that haunted economies in the late 19th century.

It could be worthwhile to compare the liquidity provision in Sweden with those of the other Nordic countries. External conditions were similar. The Scandinavian countries were also joined in a currency union. However, the other Nordic countries had central banks that enjoyed note monopoly. Were the other Nordic countries as effective in solving the liquidity problems of the late 19th century as was the Swedish note banking system? This should be an interesting topic of future research.

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Appendix

Specifications of regressions and calculations of seasonal components.

The following model was estimated for stationary balance sheet items (here notes):

$$Log\ Notes = \beta_0 + \beta_1 Feb + ... + \beta_{11} Dec + u\ , \tag{A1}$$

where

$$u_t = u_{t-1} + u_{t-2} + u_{t-3} + u_{t-4} + \varepsilon_t\ . \tag{A2}$$

The constant β_0 , representing January was normalised to 0. A value v_i for each month i was then calculated as

$$v_i = 1 + \beta_i\ . \tag{A3}$$

The seasonal component s_i for each month was then calculated as

$$s_i = v_i - \frac{1}{12}\sum_{0}^{11} v_j + 1\ . \tag{A4}$$

For differenced balance sheet items (such as Bills), the regression model was

$$\Delta\ Log\ Bills = \beta_0 Jan + \beta_1 Feb + ... + \beta_{11} Dec + u\ . \tag{A5}$$

A value for each month v_i was then calculated as

$$\begin{aligned} v_0 &= 1 \\ v_i &= 1 + \beta_i + \frac{1}{12}\sum_{0}^{11} \beta_j \end{aligned}\ . \tag{A6}$$

The seasonal component s_i was then calculated as

$$s_i = 1 + v_i - \frac{1}{12}\sum_{0}^{11} v_j \ . \qquad \text{(A7)}$$

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