

The Highs and the Lows: Bank Failures in Sweden through inflation and deflation, 1913-1927

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ABSTRACT

In 1920-22, Sweden witnessed its most acute crisis of the last 150 years. While several well described factors coincided to cause and aggravate the 1920s crisis, the classic question remains, ‘what were the reasons that some banks failed and others survived?’ For this paper, we have constructed a unique database consisting of relevant balance sheet ratios of all Swedish commercial banks for the period 1913-27. We have documented and classified distressed and non-distress banks and employ survival analysis (logit regression) to ‘predict’ their subsequent fates. Our tests find that liabilities with increasingly shorter maturities were a significant predictor of failure. We also find, in line with Fisher’s debt deflation theory, those banks that had expanded lending most during the inflationary wartime period, were most likely to succumb in deflation of the 1920s. Finally, we show that extensive pre crisis foreign borrowing was a significant determinant of failure in the 1920s crisis.

Keywords: Banking Crisis; Sweden; Survival Analysis; Early Warning Indicator; Debt Deflation; Maturity Mismatch

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Introduction

The Covid-19 pandemic and the crisis which has resulted from it represent a major exogenous shock to the world's economy. The subsequent fate of the household, firm and government sectors in every country differs based upon a number of pre-existing characteristics unique to their economies and balance sheets before the pandemic. Undoubtedly, the coordinated international policy response has served to rescue many otherwise solvent firms, which through no fault of their own, have been shook by the consequences of the pandemic. As yet, it is difficult to distinguish those firms from weaker entities that may, in a counterfactual, have gone into liquidation owing to their own unique positions *ex-ante*. The banking sector represents one area where support from the authorities was forthcoming to protect depositors and the payments system. The speed of events made it difficult for the authorities to determine which banks' risk profiles were more likely to have exposed them to failure, because of their own prior decision-making. It is unlikely that any bank would have emerged unscathed, but pre-crisis risk taking has understandably not yet become a feature of the discourse.

In this scenario, it is exceedingly difficult to separate the macroeconomic effects of a banking crisis from the economic shock that preceded it, as recent studies have attempted.³ This line of research has generally found that banking crises have negative and persistent effects on the macro economy. In this paper, we exploit a comparable exogenous shock to the financial system, by revisiting the fate of Swedish commercial banks over the turbulent period 1913-27. The Swedish financial system endured an international war, a post war depression and a volatile exchange rate over the period. In line with recent research, this paper instead takes a forward-looking approach and attempts to explain *ex-ante* the underlying balance sheet determinants of bank failures during the 1920s crisis after the war.

Until 1992, no banking crisis in Sweden over the previous one and a half centuries had matched the banking crisis of 1920-2 in terms of lost output.⁴ The existing literature on the 1920s crisis accounts for the external events leading to the boom as well bringing about the subsequent bust. The standard chronology typically stresses the inflation that had resulted from the inflow of funds during the war, extensive intervention in the form of subsidy provisions to industry, and bank trading on the stock markets as the key drivers of the expansion phase. This narrative

³ Jalil (2015); Kenny et al (2020)

⁴ Hagberg and Jonung (2009)

attributes the Swedish downturn to a combination of the sudden loss of important export markets (eg Russia in 1917), restrictive monetary policy to readopt the gold standard from 1919, the international depression and the fire sales of stocks, goods and raw materials that culminated in severe deflation.⁵ There are important case studies of specific banks during the crises, but these concern the experiences of major banks and may not be illustrative for the banking system in general.⁶ Until now, the issue of what distinguished banks that survived from those that failed has remained largely conjectural.

This oversight is further puzzling, considering that the crisis occurred amidst what must rank among the extreme monetary trend reversals in the previous two centuries. In 1918, the prevailing inflation rate was as high as 47 percent. However, within the space of two years, it had contracted into a deflationary rate of 19 percent in 1921 and 17 in 1922.⁷ This price trend reversal was linked to both the international post-war depression in the demand for Swedish tradables and Sweden's early return to the Gold Standard at the pre-war parity in April 1924.⁸ Such profound monetary reversal represents a unique real interest rate shock which domestic banks were forced to cope with.

In this paper, we revisit this unique phase in monetary history and collect appropriate balance sheet data for the full population of Swedish commercial banks over the period 1913-26.⁹ Building on methods employed elsewhere for crises during the same period, we construct ratios and appropriate measures from this data to “predict” which banks were most likely to fail given the composition of their assets and liabilities through the entire turbulent period of inflation (1914-19) to deflation (1920-26).¹⁰ Our questions considers the comparative behavior of banks during the inflationary period with respect to their asset and liability management. We find that Irving Fisher's (1933) ‘Debt Deflation Theory of Great Depressions’ written almost a decade after the Swedish crash, offers a useful paradigm for judging the outcomes of the 1920-2 crisis in Sweden. Whilst the U.S. depression and the widespread failures it left in its wake occurred as it tried to

⁵ Lönnborg, Ögren and Rafferty (2011) pp.234-5; See also Glete, J. (1981), Larsson, M. (1992), Larsson, M., & Olsson, U. (1992) and Östlind, A. (1945).

⁶ For instance Hildebrand, K.-G. (1971) and Söderlund, (1978).

⁷ Edvinsson and Söderberg (2010).

⁸ Bernanke and James (1991)

⁹ These are gathered from Statistics Sweden. (1913–26). Statistiska meddelanden: Uppgifter om bankerna [Statistical messages: Information about the banks]. Stockholm: Statistics Sweden.

¹⁰ Colvin et al (2015); Grodecka et al (2020); Postel-Vinay (2016)

remain on the gold standard, Sweden's depression and banking crisis of a decade earlier occurred as the country tried to *return* to the Gold Standard. Fisher (1933) later wrote that "the infectiousness of [the Great] depression internationally is chiefly due to a common gold monetary standard".

During World War 1, Sweden as a neutral, became a reluctant destination of unprecedented gold inflows. Despite the Swedish currency strengthening considerably, the price level also trebled with double digit negative real interest rates prevailing. According to Fisher's (1933) theory, such a "disturbance" would create "new opportunities to invest" and lead to "a great volume of over indebtedness". Eventually, this process would culminate in "attempts to liquidate," resulting in "falling prices". The theory continued that "liquidation does not really liquidate but actually aggravates the debts and the depression grows worse instead of better". A core plank of the piece was that money interest on *unsafe* loans rises making them the most vulnerable assets in any downturn. As deflation sets in, real interest rates would tend to rise and hurt borrowers who would subsequently default on their banks. In this environment, "the more debtors pay, the more they owe" as the real value of debt rises when "the mass effect of the stampede to liquidate swells each dollar owed."

Fisher's (1933) piece also placed emphasis on the maturity of liabilities, or "the distribution in time of the sums coming due". This was later augmented by Minsky's (1986) three chronological stages of instability, determined by the general composition of firms' liability structures in the macroeconomy (hedge financing, speculative financing and Ponzi financing). During wartime (1914-18) inflation, deposits were not the preferred destination of Swedish savings as funds were deployed to higher yielding assets such as equities, securities and property. With this in mind, we analyse the banking sector's liability structure to examine how it financed its expansion during the inflationary period. In this vein, we draw upon research on the destabilizing role of non-core liabilities (NCLs), i.e. all liabilities that are not in the form of equity or deposits.¹¹ In the wake of the great financial crisis of 2008, some in the policy debate have suggested that macro prudential regulation should target NCLs due to their suspect role in over the period 2003-7.¹² While the share of such liabilities may not have been a determinant of subsequent individual

¹¹ Hahm, Shin and Shin (2013); Shin (2009); Laeven and

¹² Shin (2011);

bank distress, our analysis finds that the shortening maturities of bank liabilities was. Nonetheless, the Swedish commercial banking system had almost doubled the share of non-core liabilities in its aggregate balance sheet by the conclusion of the war, conveying a systemic vulnerability that materialised in the form of the 1920-2 banking crisis.

Armed with the theories above, we use logit regressions (survival analysis) to “predict” subsequent bank failures based upon ex-ante balance sheet characteristics. Following similar approaches to Grodecka et al (2020), Postel-Vinay (2016) and Colvin et al (2015), we find that bank distress in the 1920s can be attributed to higher shares of “unsafe loans” (borrower name as weakest security) in Fisher’s (1933) terminology. When both nominal and real interest rates rose on this loan category, a wave of defaults followed on those banks, which had more of this “name security” class of lending. Holding to the debt deflation theory, we also find evidence that stronger increases in portfolio risk (loans/assets) over the wartime period were associated with sharper subsequent contractions in lending as these banks “stampeded to liquidate” their loans. Indeed, this was a significant determinant of subsequent bank failure in the post war period, as Fisher’s (1933) theory would predict.

Banks with higher maturity mismatch ratios (shorter-term deposits to longer-term loans) were more likely to succumb to distress as deposits contracted during the crisis. Shorter-term liabilities enabled creditors to withdraw funds quickly from increasingly vulnerable banks who liquidated their long-term assets in “fire sales” in order to honour their short-term liabilities. The problems relating to shortening maturities extended beyond deposits, as we find that higher shares of broader shorter-term liabilities (including non-core liabilities) were significant predictors of subsequent bank failure.

Our paper also considers an overlooked dimension of the crisis of the Swedish banking system in the 1920s. Few historiographies have emphasized the role of the Swedish krona, which had appreciated substantially during the war period. This would have encouraged borrowing abroad in foreign currency (another non-core liability) as deposits (core liabilities) declined. With this in mind, our tests reveal that those banks that had engaged in more foreign borrowing during wartime were more likely to succumb to distress in the 1920s, as foreign currencies began recovering against the krona and the value of Swedish bank debt abroad rose considerably. In this

sense, it draws support from the literature emphasising the role of foreign debt and short-term liabilities in creating vulnerability.¹³

The paper is structured as follows. First we review the development of the Swedish banking system in the first quarter of the twentieth century. Next, we describe the wartime inflationary boom in Sweden and the subsequent deflation induced depression. Within this historiography, we nestle existing theories of financial crises, which we believe offer a useful paradigm from which to proceed to testing in the case of Sweden 1913-27. We then move on to our data construction, analysis and results before concluding.

The Development of the Banking system before the 1920s

The Swedish commercial banking system underwent some important changes in the period leading up to WWI. In the mid-1890s, a wave of bank establishments increased the total population of banks from 46 in 1895 to 86 in 1908, though it faced permanent decline as it consolidated after the 1907 crisis.¹⁴ The crisis catalyzed a movement of banking consolidation through mergers and acquisitions that was encouraged by the 1911 Banking Act. The legislation stipulated that banks with larger equity bases were allowed to operate with lower reserve requirements.¹⁵ This marked the beginning of the branch-based banking system. While the number of banks continued to decline as a result of this M&A wave, the number of bank branches increased rapidly from an average of 5 per bank at the turn of the century to more than 35 per bank in the early 1920s.¹⁶ The 1921 crisis started as the decline in the number of banks began to plateau (Figure 1).

<<FIGURE 1 HERE>>

The 1920s Crisis- Wartime Inflation and Post War Deflation

In order to understand the 1920s crisis, it is important to document the events that paved the way for it. Unlike the belligerent economies, Sweden as a neutral experienced a massive export boom during World War 1 and could not offset the unprecedented volume of exports with home demand for foreign imports. In this scenario, on a fixed exchange rate regime, prices would tend to rise as

¹³ Bordo and Meissner 2010; Bordo 2008

¹⁴ Grodecka, Kenny & Ögren 2020

¹⁵ Larsson & Jungerheim 2013; Ögren 2019

¹⁶ Ögren 2019, p.15

payments flow in. If instead, currencies were floating, the exchange rate should appreciate to dampen foreign demand for Swedish goods and increase Swedish demand for foreign goods, reducing the current account surplus. In this scenario, the exchange rate instead of prices would form the principal means of adjusting the trade balance. However, in Sweden's unique case, both forces prevailed concurrently. Even though the Swedish krona appreciated considerably against its European peer group, prices trebled during the War, as the neutral experienced even higher inflation rates than belligerents such as the UK during the period.¹⁷ The inflow of gold was so profound that the Swedish authorities unsuccessfully attempted to make the belligerents pay for their imports of Swedish goods with their own goods, enforcing a kind of 'no gold clause'.¹⁸ These extraordinary gold flows and the accumulation of reserves that they engendered had distortionary effects on Sweden's economy. Fisher (1933) later wrote that "the gold supply, which is especially important" was always linked with "over indebtedness".

<<FIGURE 2 HERE>>

Figure 2 presents the accumulation of reserves over the period. It is evident that from the outbreak of the War until its conclusion, foreign exchange reserves effectively trebled, similar to the price increases witnessed over the relevant period. The real discount rate, calculated as the *Riksbank's* discount rate minus inflation, fell precipitously from 4.4 percent in 1913 to minus 40 percent in 1918. Subsequently, the real discount rate spiked to 25 percent in 1921, representing a 65 per cent swing in three years.¹⁹ Official commercial bank deposit and lending rates never mirrored this development and as a result, the economic rationale for deposits was removed and the incentive for customer borrowing became attractive. For instance, commercial bank nominal interest rates on bills of exchange moved from 6 percent in 1913 to 7.5 percent in 1918 falling back to 6 percent during the peak deflationary years in 1921 and 22. Deposits followed this pattern from 4.5 percent in 1913 to 5.5 percent in 1918 ending at 4 percent in 1921-2.²⁰ With the incentive structures altered considerably, asset prices soared in nominal terms and so did the demand for credit.

¹⁷ Lennard & Ögren (2014) "The Central Banks of a Belligerent and Neutral: The Bank of England and the Swedish Riksbank during the Great War" Unpublished paper presented at Banque de France 13 November 2014

¹⁸ Lennard & Ögren 2014

¹⁹ Lennard and Ögren (2014)

²⁰ Statistics Sweden 1913, 1918, 1921, 1922

<<FIGURE 3 HERE>>

Another interesting effect during the boom period is the increasing gap between deposits and lending during some periods. Evidently, the commercial banks were able to find other sources than deposits for their lending. Recent research has considered the importance of the size of the share of non-core liabilities in banks' balance sheets as an indicator of increasing systemic fragility.²¹ This literature can trace its roots to Hyman Minsky's three stages of capitalist finance outlined in his classic, *Stabilizing an Unstable Economy*.²² In the first stage, there is a predominance of *hedge financing* firms and debt commitments tend to be long term in which cash available to pay off both the interest and principal. In the second *speculative* phase, the maturity of new liabilities becomes increasingly shorter and requires continuous refinancing, often from abroad. In the latter part of the speculative phase, firms become vulnerable to short-term changes in creditor sentiment. Future cash flows are now "expected" to cover principal and interest payments, based upon increasingly optimistic estimates, as debt levels rise. If the expected cash flows ever materialize, they cover only interest payments. The final *Ponzi* stage witnesses the predominance of shorter term debt with a low margin of safety as cash for interest and principal payments is not available. It can, the reasoning goes, be borrowed against assets and so at this stage, climbing asset prices become a requirement for any debt servicing.

Figure 4 shows the share of non-core liabilities in Swedish banks through the war period until 1919. There appears to be little difference between the distressed banks and the full population in terms of debt composition. There is a sustained rise through the War years of an increasing share of non-core liabilities, which were increasingly sought to finance activities.

<<FIGURE 4 HERE>>

The 1920s Crisis

Many complementary narratives explain the manifestation of the crisis of the 1920s in Sweden.²³ Similar to the previous crisis of 1907, the view is widely shared that the crash of the 1920s was triggered by international factors. Largely due to unprecedented gold inflows during

²¹ Minsky (1988)

²² Shin (2011);Hahm, Shin and Shin (2013)

²³ See Hagberg and Jonung (2009) and Lönnborg, Ögren and Rafferty (2011) for summaries

wartime, which the *Riksbank* did not sterilize, Sweden experienced a temporary stock market boom over the period 1914-17 when it grew by 50 per cent (Figure 5). As Fisher's (1933) theory outlined, this "disturbance" led to rapid growth in credit and further fueled other asset price rises. It appears that inflation eroded the real gains of share prices.

<<FIGURE 5 HERE>>

After World War 1, demand for Swedish exports contracted, turning firm profits into losses and an international depression aggravated the depression in trade. A wave of defaults hit the Swedish banking sector, which consequently experienced its own crisis. In addition to these difficulties, strict deflationary monetary policy was pursued by the Swedish authorities, as was the case elsewhere in 1919, with the declared aim of returning to the gold standard at pre-war parity in 1924.²⁴ International deflation combined with restrictive domestic monetary policy have been credited as representing the "prime cause" of the slump and the krona reached its pre-war parity as early as 1922.²⁵

While this narrative is well established in the literature, no systematic empirical analysis has been conducted to determine the predominant cause of individual bank failures during the 1920s crisis. This is even more surprising considering the devastating economic consequences that transpired from the event. Over the period 1919-26, no less than 22 commercial banks experienced distress. Five of these banks were reconstructed and seventeen were taken over at a discount. During the crisis, Sweden experienced the sharpest contraction in real GDP (-9.6 per cent) and industrial production (-19 per cent) and the largest rise in unemployment (8.4 per cent) of all recorded crises over the period 1877-2007.²⁶ The extent of the problems in the banking sector was such that in April 1922 a specific Toxic Asset Program – *AB Kreditkassan* – was officially launched with the specific objective of saving one bank, *Sydsvenska Kredit AB*, at a cost of 5 million SEK. It quickly became apparent that this was scale was insufficient and within one year, 83 million SEK was deployed in other rescue operations.²⁷ A variant of this 'bad bank' solution was employed again in 1992.

²⁴ Lönnborg, Ögren & Rafferty (2011)

²⁵ Hagberg and Jonung (2009)

²⁶ Hagberg and Jonung (2009)

²⁷ Ögren (2018, pp. 63-65)

In addition to the factors outlined above, legislation played a significant role in fuelling the boom. Before the outbreak of World War 1, the most recent banking crisis had occurred in 1907. The event had ushered in a permanent decline in the number of commercial banks operating in Sweden.²⁸ During that crisis, the number of commercial banks reached its highest plateau and began a permanent decline (Figure 1). The 1911 Banking act was a direct response to 1907 and stipulated that larger banks, or rather banks with more equity, could operate with less reserves, as larger banks were deemed more stable.²⁹ This legal discrimination was motivated by the contemporary perception that small banks had been a prominent force in causing the 1907 crash. After the 1911 Banking Act throughout the next decade, consolidation of the banking system occurred through a number of mergers and acquisitions that generally resulted in a smaller number of larger banks. The 1911 law also granted commercial banks the right to own and trade shares, effectively transforming them from retail banks into universal banks.³⁰ Prior to the Act, banks could only hold shares as collateral for loans and as part of their equity capital. During the WWI boom, the banks' engagement in trading shares contributed to a buoyant stock market.

Moreover, the 1911 Act had regulated deposits, restricting them to a factor of five times total equity capital. The growth of deposits in nominal terms during the war (Figure 3) would require further capital injections where this ceiling was breached. As lending was provided in large part through deposit creation, in May 1917 at the peak of the boom, banks with equity of more than 5 million SEK were exempted from this requirement as a result of lobbying, further skewing the system towards larger banks. This exemption was revoked in January 1921 at the height of the crisis.³¹

The prelude to the 1920s crisis rhymed with those of the crises of 1907, 1931 and 2008. The first phase of the crisis was the collapse of the stock market, which was driven by the rapidly falling prices of industrial firms' stocks (Figure 5). The shock to the banking system was aggravated and further transmitted through firm bankruptcies that affected the commercial banks' strategic vehicles. These units were bank-owned limited liability corporations, were publicly listed

²⁸ Grodecka et al (2020)

²⁹ Karlsson et al (2019); Larsson, M. (2010). The state and the financial system—Regulation and regime change around 1900. In: Ögren, A. (Ed.) *The Swedish Financial Revolution*. Basingstoke, United Kingdom: Palgrave Macmillan.

³⁰ Larsson 2010 p. 178, SFS 1911:74

³¹ SFS 1917:199, SFS 1920:210; Håkansson, Larsson and Lilja (2007)

and specialized in investing in a variety of industrial firms. Such shadow banks operated under the name ‘Emission corporations’ (*Emissionsbolag*) and were in all respects similar to the bank owned investment corporations so synonymous with the 1930s crisis in the US.³²

While the international economic depression and the consequent shock to demand was not the only reason for the severity of the crisis, Swedish commercial banks were highly leveraged. All commercial banks were faced with a massive real interest rate shock. Inflation was as high as 47 percent in 1918 and contrasts starkly with the prevailing deflation of 19 percent in 1921 and 17 in 1922.³³ To illustrate, real interest rates moved from significantly negative territory during the war – minus 10 percent in 1915, minus 8 in 1916, minus 20 in 1917 and minus 40 in 1918 – to considerably high positive rates in the post war period – plus 5 percent in 1920, 25 percent in 1921, 22 percent in 1922 and 11 percent in 1923.³⁴

The depression and crisis may have had their origins in trade conditions abroad and a return to the ill-fated interwar gold standard. Relatedly, Schön (2010, p. 248) claimed “the turn around from inflation to deflation led to a major banking crisis”. However, this simplification neglects the fact that there were idiosyncratic endogenous structural weaknesses in the Swedish banking system that have remained overlooked. Some banks avoided distress with a more risk averse approach. Did the end of the Scandinavian Monetary union in 1924 place any additional strain on Swedish banks?³⁵ What balance sheet characteristics made the distressed banks more vulnerable to these shocks than the non-distressed cases? More specifically, using the contemporary map provided by Fisher (1933) on debt deflation and augmenting it with Minsky’s (1986) emphasis on the shortening of liability maturities, can we find evidence that banks which followed the behavioral patterns of those models were more likely to fail? In what follows, we construct the balance data in a way that enables us to test these hypotheses.

Data and Analysis

The principal source drawn upon for the financial data in this paper was the *Uppgifter om Bankerna* (1913-34) series, or ‘Bank Activities’. These combined the published monthly balance

³² Broberg (2006); Rockoff (2018)

³³ Edvinsson and Söderberg (2012)

³⁴ Edvinsson and Söderberg (2012); Sveriges Riksbank (1931)

³⁵ For a summary of the Scandinavian Currency Union, see Jonung (2007)

sheets of every Swedish commercial bank for scrutiny by the acting supervisory authority, *Bankinspektionen* (The Bank Inspectorate). This source was the successor to the *Sammandrag af bankernas uppgifter* (1865-1911) or ‘Summary of Bank Activities’, which was altered in 1912 due to significant regulatory changes in 1911. In reality, the alterations were primarily cosmetic in nature, as the categories and disaggregation of assets and liabilities remain overall, identical. The documents represent the entire population of Swedish commercial banks.

It was first necessary to clean and standardize the data within the original source material. For instance, we adjust the names of both balance sheet items and the banks to account for changes in classifications that had occurred over the period. The latest extant bank name is the name applied in this paper. In total, we trace the fortunes of 49 banks in our analysis that were in existence at the conclusion of the War- November 1918. Of these, we include 18 distressed banks in our restricted sample. 5 distressed banks were formed after November 1918 and are not considered reliable for testing for our purpose, as they had no wartime record to consider. These are listed in the Appendix.

In the crisis period of interest, 1918-27, as many as 34 mergers took place. However, of those banks which were acquired, it was necessary to distinguish those mergers that were undertaken for mutual advantage in the course of ordinary business, from those that were distressed takeovers. In order to this, it was necessary to comb primary sources in addition to *Uppgifter om Bankerna* for evidence on the nature of the adjustment. Contemporary newspapers proved very useful in this case, as well as historical works such as those of Ernst Söderlund (1978). Furthermore, we draw on the minutes of the *Riksbank* and *Bankinspektionen* where these refer to takeovers directly. In total, of the 34 mergers, we show that 17 were distressed takeovers.

Having crosschecked the totals of the balance sheets with our inputs, we subsequently generate series of balance sheet ratios at the level of individual banks. Additionally, at the end of each calendar year, a *Bokslut* (year end), was appended to *Uppgifter om Bankerna*, which provided supplementary information relating to profit and loss items for each commercial bank. From these, it was possible to generate a series of performance ratios for each bank in the sample, including measures of profitability, efficiency and shareholder items.

Table 1 presents a simple difference in means test between non-distressed and distressed banks using the average of the last 12 months of World War 1 (December 1917-November 1918). Unless otherwise stated, this periodization is that used for the stationary variables in our testing. Using the Debt Deflation theory and the financial instability hypothesis emphasising the structure of liabilities, we group the ratios according to asset composition, liquidity and maturity and risks in the balance sheets. The t-values on the right-hand side report whether the differences are statistically significant.

<<TABLE 1 HERE>>

Before moving towards more formal econometric testing, it is evident from Table 1 that a number of ratios point to significant differences in the characteristics of survivor and failure banks. In the first place, maturity profile differences are apparent. Distressed banks tended to have higher shares of short-term deposits, both against long term loans and as a share of deposits. In addition, in line with Fisher's (1933) emphasis on interest switches on "unsafe loans", it is apparent that banks with higher shares of loans "against name" (the lowest form of collateral, representing the customer signature) tended to end up in the distressed category. They also tended to have larger shares of their liabilities in foreign currency.

Table 2 reports the changes that occurred over the period 1 in selected ratios. The most significant result is that distressed banks tended to increase their lending as a share of assets by a large order of magnitude, compared with non-distressed banks. Non-distressed banks had more long-term loans in their portfolio, which may have alleviated short-term distress faced by their borrowers. Distressed banks tended to grow their poor collateral loans at a faster rate than non-distressed banks through the war. Distressed banks tended to grow their lending against commercial bills during wartime, making them vulnerable to downturns in trading conditions.

<<TABLE 2 HERE>>

The data do not support the suspicion that shares were synonymous with failure as the summary statistics below convey that non-distressed banks tended to have more of their portfolios concentrated in shares and share lending than distressed banks. In the testing that follows, the multivariate regression affirms this scepticism. Distressed banks tended to have expanded their

lending/assets ratios and lower quality loans during the ‘boom’, or period of wartime inflation. The summary statistics convey a message that maturity profiles consistently mattered. Both shorter-term liabilities and shorter term lending were more prominent among the distressed banks. Combining these two concurrent trends, one can consider that higher shares of shorter term liabilities placed significantly more pressure on those banks that had over extended lending during the boom. Fisher (1933) described how “the stampede to liquidate swells each dollar owed,” as the real value of short term debt increases dramatically in the deflationary period.

In Figure 6, we scatter plot the relationship between the growth of lending assets in the pre-crisis period (December 1913-November 1918) against the growth of the same ratio during the subsequent period (December 1918-December 1923). It conveys a picture of banks which had over extended during the boom years (x-axis), “stampeding” to liquidate during the post war slump (y axis). The relationship is statistically significant ($p=0.10$) with a coefficient of -0.48 when we exclude the small and large banks. In the next section we present our model and the results before concluding.

<<FIGURE 6 HERE>>

Results

Until now, our analysis has focused upon explaining the crisis as it unfolded. However, the aim of our paper is to use the novel high-frequency data on bank outcomes and characteristics to identify early warning indicators. In what follows, we take a forward-looking approach following Grodecka et al (2020) and test whether Swedish banks' distress in the 1920s could have been predicted by pre-crisis balance sheet characteristics. Specifically, we apply a set of variables that would be best suited for that purpose drawing on the debt deflation theory outlined above and more recent work on the fragility of the debt structures of banks.

We estimate the following logistic regression:

$$\ln \frac{\pi_i (Distress)}{1 - \pi_i (Distress)} = \alpha + x_i' \beta$$

where α is a constant and x is a vector of bank-specific variables. The coefficients β represent the contributions of chosen bank-specific variables to the probability of bank distress.

Negative coefficients imply that a lower value of the chosen variable increases the probability of distress, while positive coefficients indicate that higher values increase the distress probability.

We employ the logistic regression in order to test which groups of variables observed over the war period are most associated with subsequent bank distress. We split the subsequent distress period into 1918-24 and 1918-27 to allow for any adverse consequences that may have emerged after the fall of the Scandinavian Monetary Union in 1924. We focus our attention on variables linked to the debt deflation theory (Fisher, 1933) and Minsky's (1986) three stages of instability, looking at the behavior of assets of interest, comparative growth rates of selected variables, and the composition and maturity profile of liabilities. Table 3 presents the ratios we construct for the logistic regression from the balance sheets of 49 Swedish commercial banks in our sample.

<<TABLE 3 HERE>>

Table 4 presents the results of our primary exercise. Our logistic regressions largely corroborate what the summary statistics conveyed based upon our a priori suspicions regarding debt deflation, growth in non-core liabilities and a shortening of maturities. In addition, our testing reaffirms our hypothesis that despite wartime inflation, a strengthening krona encouraged borrowing abroad in foreign currency leaving a multitude of banks vulnerable to the post war reversal.

<<TABLE 4 HERE>>

Schön (2010, pp. 252-3) provides an elegant description of the characteristics of “winners” and “losers” of the crisis of the 1920s. While his discussion related to firms rather than banks, his conclusions offer us a potentially useful paradigm for viewing the fate of distress and non-distress banks during the period. According to the argument, the winners of the crisis were those that went into the 1910s with debts that were eroded by wartime inflation. “In the final stage of the inflation cycle, they had remained liquid and invested their assets in safe instruments such as Swedish government bonds...using their newly won liquidity to exploit the increase in monetary value

during the deflationary crisis.”³⁶ The interpretation is supported from our testing, which finds that those banks that had grown their loans as a share of assets (reduced their more liquid assets) were more likely to fail. These banks had not “invested their assets in safe instruments”, instead tending to increase their lending. Moreover, one consistent feature of distressed banks was their appetite for lending against “name” collateral. Such loans could be payable at the option of the creditor (bank). According to Fisher’s theory, “debt embarrassment is great for call loans” and the defaults of customers consequently materialized in mounting losses for banks.

The “losers” according to Schön (2010, p. 252) were those who saw the value of their savings eroded during wartime and went into the 1920s with debt following the inflation cycle. During the “deflationary crisis”, as “markets disappeared, the real value of their debts rose and additional credit became unavailable”.³⁷ Such firms had “built their positions on borrowed money in the 1910s”.³⁸ Fisher (1933) emphasized the “distribution in time of debts coming due” and in no uncertain terms declared that in a deflationary environment “debts due at once are more embarrassing than debts due years hence”. In line with these observations, our results suggest that shorter maturities on liabilities were a consistent determinant of bank distress during the period. Those banks that had refrained from shortening maturity structures to finance their expansion were not exposed, avoiding falling victim to the temptations synonymous with the end of Minsky’s (1986) instability hypothesis. Though these survivor banks had to adopt restrictive practices for a certain period, their long-term positions strengthened.³⁹ Similarly, recent research has found that over the period 1921 to 1927, efficiency in the Swedish banking sector was reached a highpoint over the period 1912-1938.⁴⁰ However, this pattern is not limited to the 1920s and 1930s. In a summary of the literature on the Global Financial Crisis of 2007-9, it was affirmed that failed banks had grown “by funding themselves increasingly for short term and in wholesale markets rather than traditional deposits.”⁴¹

Until recent research refined our interpretation of the 1907 crisis, it was widely claimed that foreign borrowing played a prominent role in the demise of the banks that collapsed in its

³⁶ Schön (2010, p. 252).

³⁷ Schön (2010, p. 253)

³⁸ Schön (2010, p. 253)

³⁹ Schön (2010, p. 253)

⁴⁰ Karlsson et al (2020)

⁴¹ Laeven and Valencia (2013)

wake.⁴² This is questionable for two reasons. First, the majority of banks did not borrow from foreign sources and second, on the gold standards exchange rate risk was not a significant concern. In contrast, over the period 1913-27, exchange rate risk was very real as the gold standard was largely abandoned during the First World War. The Swedish commercial banks in operation had never experienced a floating currency arrangement with their major trading partners. This element of the 1920s crisis has been overlooked. This is understandable to some extent, as despite Sweden's inflation exceeding that of the U.K.'s, the krona appreciated against most of its major trading partners (Figure 7).

<<FIGURE 7 HERE>>

It is evident from the chart that there are two distinctive phases of the krona's post war depreciation. The first phase is the strengthening of the British and U.S. currencies. Indeed, even the German mark recovers at a great deal at the beginning of 1918 with the spring offensive testing allied resources. The second phase of the weakening of the krona occurs after the abortive attempt to return to the Scandinavian monetary union with Denmark and Norway's currencies strengthening considerably against the Swedish krona after 1924.

Table 5 reports the magnitude of the swings and their periodization between peaks and troughs. While the Swedish exchange had grown by 34 per cent of its prewar rate with the British pound, over the course of the following two years it had fallen by 53 per cent from its peak value in 1917. In the space of six months, the German mark had strengthened by 61 per cent against lowest trough in October 1917. The Norwegian krona's value had grown 93 per cent from its 1924 trough by the end of 1927. Any such swings, occurring in a relatively short period of time would have placed significant strain on banks that had borrowed heavily during the wartime heyday of the Swedish krona. Our tests show that this feature was a predictor of distress in both the shorter and longer sample of bank failures.

<<TABLE 5 HERE>>

⁴² Grodecka, Kenny and Ögren (2020)

Conclusion

In this paper, we have exploited a unique monetary disruption in economic history to add to the extensive early warning signal literature on banking crises.⁴³ We exploit a unique exogenous shock to the Swedish banking system (1913-27) to uncover balance sheet weaknesses that made banks more vulnerable to demise when deflation hit the financial sector. We have collected the relevant balance sheet data from the full universe of Swedish banks over the period in order to distinguish the financial characteristics of survivor banks from distressed banks during the crisis of 1920-2. In a recent survey of the literature, it was observed that banking crises are often preceded by prolonged periods of high credit growth and are often associated with large imbalances in balance sheets, such as maturity mismatches or exchange rate risk, that ultimately translate into credit risk for the banking sector.⁴⁴ While the observation was related to 2007-9, it could equally have described the crisis of the 1920s, despite the extreme monetary changes that the latter period endured.

Over the period of interest (1913-27), wartime inflation was followed by an era of sustained deflation which placed a considerable strain on the Swedish banking system. The contractionary policy pursued by the Swedish authorities resulted in the krona reaching its pre-war parity to gold as early as 1922, two years before it re-adopted the gold standard in April 1924. Our question considers the extent to which individual banks that took advantage of the inflationary ‘boom’ during wartime were able to adapt to the changing conditions during the post war era of deflation. Which balance sheet characteristics *ex ante* determined the survival of extant banks to this external shock? While all banks experienced the highs and the lows of inflation and deflation, some survived while others failed. To answer this question we use logit regressions (survival analysis) drawing on the balance sheets data we construct Swedish commercial banks.

Our findings do not support the traditional view that emphasises the role of the stock market in causing commercial banks’ demise. While banks had traded extensively in shares, making them especially vulnerable to downturns in industrial stock prices, we find that this explanation is at best an over simplification. Instead, in line with Minsky’s (1986) financial instability hypothesis, we observe that throughout the war the banking system’s liabilities became increasingly funded

⁴³ Demirgüç-Kunt, A., Detragiache, E (1998); Colvin et al (2015); Postel Vinay (2016); Grodecka et al (2020)

⁴⁴ Laeven and Valencia (2013)

from non-depositor sources with shortening maturities, including both domestic and foreign borrowing. At the end of the war, shorter maturity liabilities were especially vulnerable to deflation, as banks with higher shares of these had less time to adjust to creditor demands. While the role of non-core liabilities was not a significant factor behind individual bank's distress, it represented a broader systematic problem of fragility. Our tests confirm both Fisher's (1933) emphasis on "the distributions of the sums coming due" and Minsky's (1986) characterisation of the final stages of a boom where shortening of maturity profiles were more likely to culminate in a mass of bank failures. The composition of liabilities in failure banks was such that further asset price rises were required to service the debt. Our finding that maturity mismatch was a prominent cause of bank distress adds a new cause to the narrative, which had not been a prominent feature of previous historiographies. Our findings emphasize the vulnerability to exogenous shocks that shorter maturity profiles and hard currency debt can engender.⁴⁵

The data we construct allow us to distinguish between various loan types. The lowest quality of collateral lending was "against name" (the borrower's signature). Fisher (1933) anticipated that it was upon such "unsafe" loans that real interest rates would rise the sharpest and that these would be a prominent culprit for causing bank demise in a period of debt deflation. Our testing corroborates this view, as another predictor of subsequent distress was the magnitude by which banks had expanded their lending (as a share of assets) during the inflationary period. We observe the trend predicted by Fisher (1933) that these banks were more inclined to liquidate more aggressively in the "stampede" than their competitors did during the deflationary period and were subsequently more likely to fail.

Our study also exploits the uniqueness of Sweden's monetary experience during the period of both an appreciating currency and a threefold rise in wartime prices. Our observation that non-core liabilities increased during the war as a share of the total meant that banks borrowed from less traditional sources. The balance data we construct allow us to isolate foreign borrowing in our tests. Wartime appreciation of the krona implied that it was cheaper to borrow in foreign currency. When Sweden's trading partners began pursuing post war monetary policies to return their currencies to the gold standard, the value of Swedish bank debt abroad began increasing. Our tests

⁴⁵ Demirgüç-Kunt and Detragiache(1998)

give foreign borrowing a prominent role in explaining the bank failures of the 1920s, as subsequent work on the cause of financial crises have emphasized.⁴⁶

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⁴⁶ Bordo (2008); Bordo and Meissner (2010)

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Table 1: Summary Statistics (average ratios between Non-Distressed and Distressed Banks)

Variables	Non-distressed banks N=31			Distressed banks N=18			t_value
	Median	Mean	St. dev.	Median	Mean	St. dev.	
Asset composition (per cent)							
Total asset (log)	17.06	17.22	1.61	17.44	17.53	2.01	-0.6
Total loan to total asset %	110.95	112.75	13.97	109.75	114.86	17.53	-0.45
Capital to Asset ratio %	18.99	21.45	10.21	18.03	25.56	17.69	-1.05
Liquidity and Maturity (per cent)							
Cash ratio	1.43	1.63	0.90	1.41	1.49	0.73	0.55
Liquidity ratio	1.77	2.19	1.33	1.85	2.24	1.41	-0.15
Maturity Matching	23.53	24.15	10.03	34.36	36.42	25.64	-2.4**
Long-term Loan ratio	298.88	291.18	90.08	316.78	270.90	119.42	0.65
Short-term Loan ratio	259.61	253.76	109.76	303.67	272.61	110.11	-0.6
Risks (per cent)							
Loan on name ratio	16.12	18.03	8.18	21.25	25.08	14.26	-2.2**
Foreign Asset ratio	0.62	3.47	5.49	5.69	5.40	6.72	-1.1
Foreign liability ratio	0.01	0.46	1.29	0.10	1.71	3.13	-1.95*
Shares and share-backed loans to total asset	23.99	25.63	11.07	20.08	22.31	10.68	1.05
Property-backed loans to total assets	11.69	14.07	11.33	9.10	11.08	9.58	0.95
Commercial bills to total assets	23.74	24.07	10.52	25.15	26.75	13.80	-0.75
Liability structure (per cent)							
Deposits to total liabilities	90.44	87.37	12.47	89.04	86.63	8.27	0.25
Short-term deposits to total deposits	18.60	21.61	10.15	28.83	28.19	15.43	-1.8*
Short-term deposits to total liabilities	16.52	18.64	9.14	23.21	24.06	13.29	-1.7*
Long-term deposits to total deposits	81.40	78.39	10.15	71.17	71.81	15.43	1.8*
Long-term deposits to total liabilities	72.39	68.73	14.35	61.58	62.57	17.18	1.35
Short-term borrowings to total liabilities	1.27	2.08	2.56	0.51	2.33	3.71	-0.3
Long-term borrowings to total liabilities	1.63	5.01	12.62	2.47	2.88	2.56	0.7
Note: (1) Significance levels for the two-tailed t-statistics are indicated as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.							
(2) There are six banks that were established between April 1918 and October 1918.							
Their averages are taken from the months they were established to Nov. 1918.							

Table 2: Summary Statistics (Changes in Ratios between Non-Distressed and Distressed Banks)

Variables	Non-distressed banks N=31			Distressed banks N=18			t value
	Median	Mean	St. dev.	Median	Mean	St. dev.	
	Changes in ratios between 1914 and June 1918 (per cent)						
Total loan to total asset	-6.26	-7.56	6.78	2.50	0.93	6.29	-2.9***
Capital to Asset ratio	-4.16	-4.93	5.25	-3.98	-2.57	5.88	-1
Cash ratio	0.05	0.03	0.48	0.01	-0.05	0.33	0.45
Liquidity ratio	-0.02	-0.07	0.61	-0.02	-0.17	0.44	0.4
Maturity Matching	8.37	11.11	13.18	6.28	11.83	11.58	-0.15
Reserve and Disposition Fund ratio	5.19	5.08	4.59	6.10	5.80	4.05	-0.35
Long-term Loan ratio	92.96	74.90	64.91	-29.95	5.69	101.62	2.1**
Short-term Loan ratio	20.61	24.11	130.43	59.86	60.02	73.00	-0.7
Loan on name ratio	-4.20	-4.70	8.67	2.45	1.13	3.22	-1.7*
Foreign Asset ratio	0.00	2.13	4.33	0.58	4.49	9.55	-0.9
Foreign liability ratio	0.00	-0.11	1.26	0.00	0.09	3.29	-0.25
Shares and share-backed loans to total asset	9.36	10.13	10.22	1.46	2.27	9.07	1.8*
Property-backed loans to total loans	-8.69	-9.81	5.90	-14.60	-11.64	7.26	0.65
Property-backed loans to total assets	-12.14	-12.89	6.34	-14.96	-13.04	8.56	0.05
Commercial bills to total loans	-2.53	-2.88	4.44	0.89	1.36	2.39	-2.4**
Commercial bills to total assets	-4.06	-5.29	6.88	0.19	1.99	3.97	-2.65**
Deposits to total liabilities	-0.16	2.07	13.42	-2.89	-2.95	8.08	0.95
Short-term deposits to total deposits	7.46	8.58	9.13	5.56	7.66	6.98	0.25
Short-term deposits to total liabilities	6.79	7.42	7.37	4.90	6.28	4.32	0.4
Long-term deposits to total liabilities	-5.65	-5.35	15.50	-6.10	-9.23	10.47	0.6
Short-term borrowings to total liabilities	0.00	-2.41	11.12	0.00	-0.13	3.68	-0.55
Long-term borrowings to total liabilities	-2.13	-2.43	5.00	0.00	0.01	4.08	-1.15

Note: (1) Significance levels for the two-tailed t-statistics are indicated as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

(2) There are six banks that were established between April 1918 and October 1918. Their averages are taken from the months they were established to Nov. 1918.

(3) For the changes in ratios, we exclude the banks that acquired other banks between 1914 and Nov 1918,

and banks that were established after January 1914, therefore there were 20 non-distressed banks and 7 distressed banks in these samples.

Table 3: Variables Used in Logistic Regressions

Variables	Unit	Description
<i>Asset Composition</i>		
Capital to asset ratio	%	Paid up capital and reserves/total assets
Total Loans/Total Assets	%	Portfolio Risk (Share of Lending in Assets)
Cash ratio	%	Cash reserves to total assets
Maturity matching	%	Short-term deposits to long-term loans
Loan on name ratio	%	Loan against name collateral/total assets
Foreign asset ratio	%	Foreign assets as a share of total assets
Foreign Liability Ratio	%	Deposits and Borrowing in Foreign Currency/Liabilities
Short Term Borrowing	%	Short Term Borrowing as a share of Liabilities
Short-term loans ratio	%	Short-term loans over equity capital and cash

Source: *Uppgifter om bankerna*. Note: Liabilities net of equity.

Table 4: Logistic Regression Outcomes

	Asset and Liquidity		Risks		Changes over boom period	
	Distress 1919-1927	Distress 1919-1924	Distress 1919-1927	Distress 1919-1924	Distress 1919-1927	Distress 1919-1924
Capital to Asset ratio	0.005 (0.18)	0.02 (0.72)				
Total loans to total assets	0.013 (0.58)	0.018 (0.80)				
Cash ratio	-0.757 (-1.52)	-0.9 (-1.61)				
Maturity Matching	0.062** (2.20)	0.047** (1.97)				
Loan on name ratio			0.066* (1.84)	0.063* (1.76)		
Foreign Asset ratio			0.074 (0.51)	0.141 (0.95)		
Foreign liability ratio			1.904** (2.10)	1.851** (1.97)		
Short-term borrowings to total liabilities			-1.265* (-1.79)	-1.557* (-1.92)		
Growth rate in total assets					0.111 -1.22	0.139 -1.39
Change in "Total loan to total asset"					0.014** -2.27	0.011* -1.82
Change in "Short-term loan ratio"					-0.232 (-0.94)	-0.011 (-0.05)
Change in "Loan on name ratio"					-0.045 (-0.57)	-0.04 (-0.46)
Pseudo R-squared	0.1375	0.1324	0.2934	0.2723	0.2942	0.3401
N	49	49	49	49	38	38

* p<0.10, ** p<0.05, *** p<0.01. T statistics in parentheses

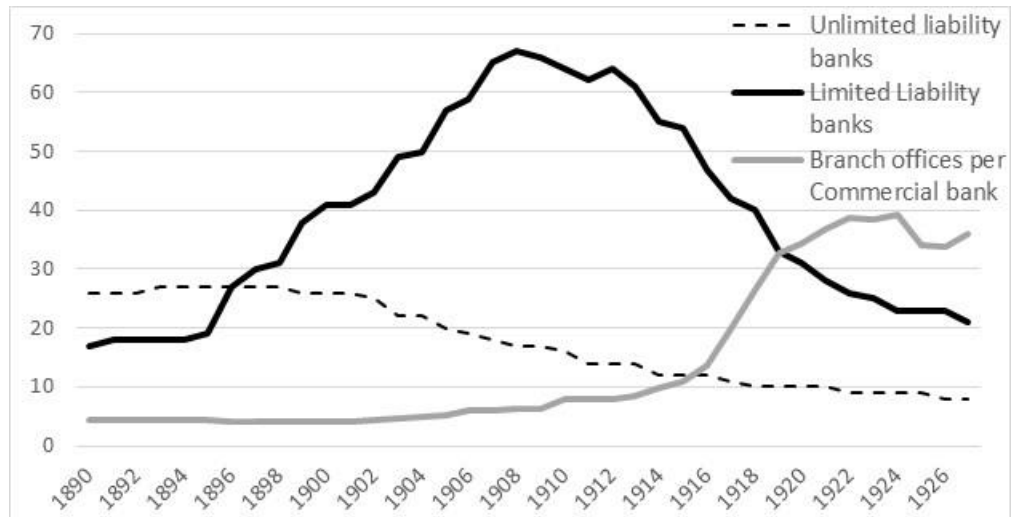
Note: Changes refer to absolute growth in variables since 1914.

Table 5. Absolute changes in the Swedish exchange rate against Trading Partners (1913-27)

	USD	GBP	GER	NOR	DEN
SEK Appreciation	32 per cent	34 per cent	58 per cent	49 per cent	40 per cent
Period	(Jan 1913-Nov 1917)	(Jan 1913-Nov 1917)	(Jan 1913-Oct 1917)	(Jan 1913-Feb 1924)	(Jan 1913-Mar 1924)
SEK Depreciation	-113 per cent	-53 per cent	-61 per cent	-93 per cent	-67 per cent
Period	(Nov 1917- Feb 1920)	(Nov 1917- Feb 1920)	(Oct 1917-Mar 1918)	(Feb 1924-Dec 1927)	(Mar 1924-Aug 1927)

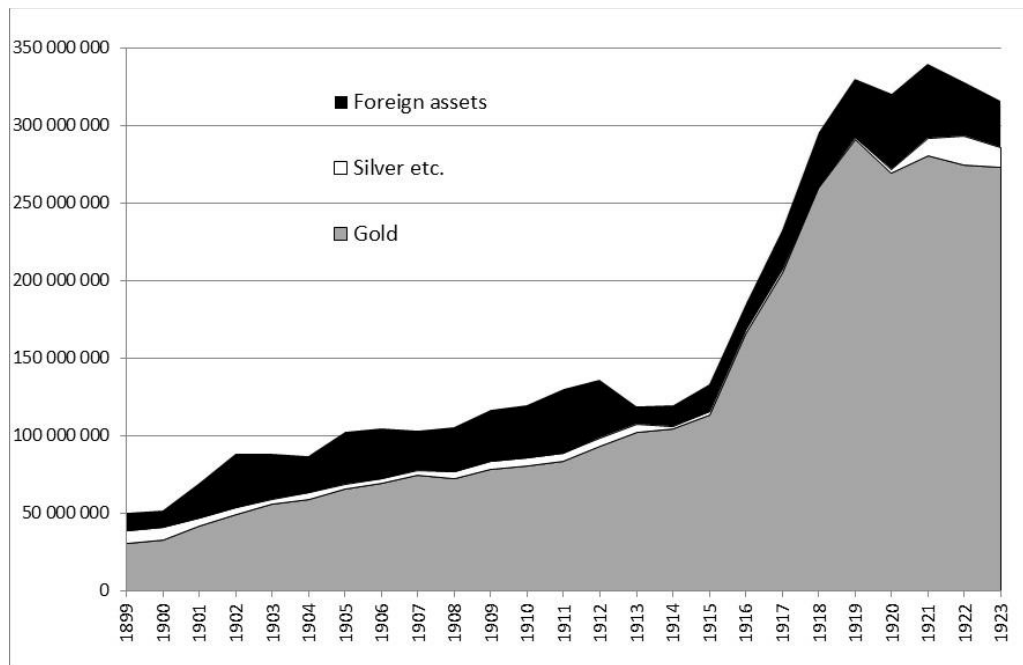
Source: Bohlin (2010). Notes: Germany not considered after March 1918 due to hyperinflation. Authors' calculations.

Figure 1: Commercial Banking population and average number of branches per Commercial Bank in Sweden, 1890-1927



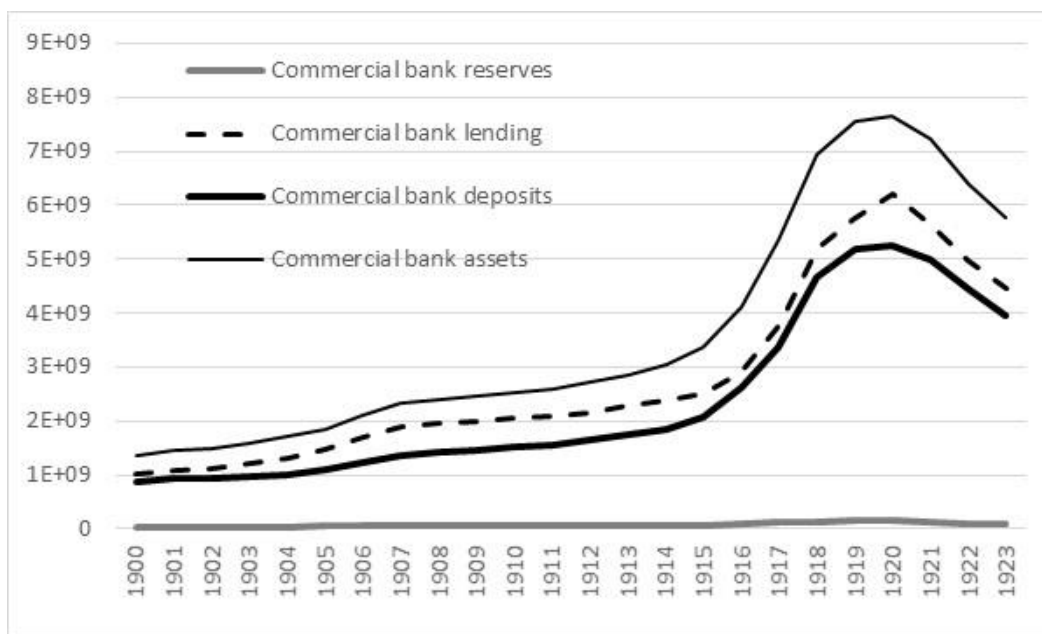
Source: Sammandrag af Bankernas Uppgifter/Uppgifter om Bankerna 1890 - 1927

Figure 2: The Swedish Central Bank (the Riksbank) Foreign Exchange Reserves, 1899 – 1923. SEK.



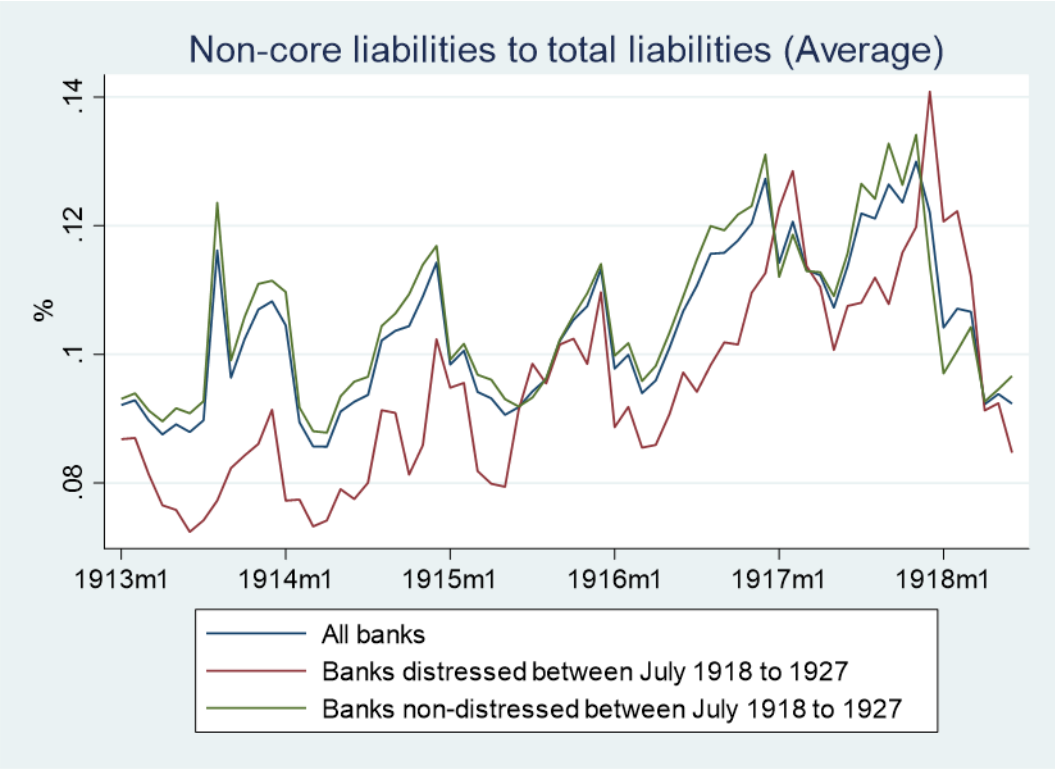
Source: Sveriges Riksbank (1931), pp. 54 – 71

Figure 3: Commercial Banks Reserves, Deposits, Lending and Assets, 1900-1923. SEK.



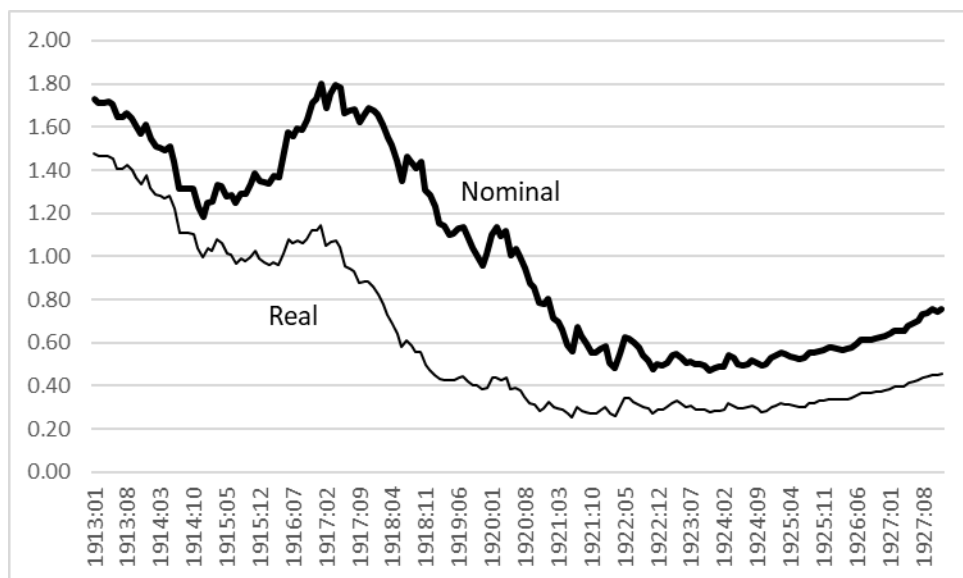
Source: Sammandrag af bankernas uppgifter 1900-1911. Statistics Sweden (1912-26).

Figure 4: The Share of Non-Core Liabilities During World War I



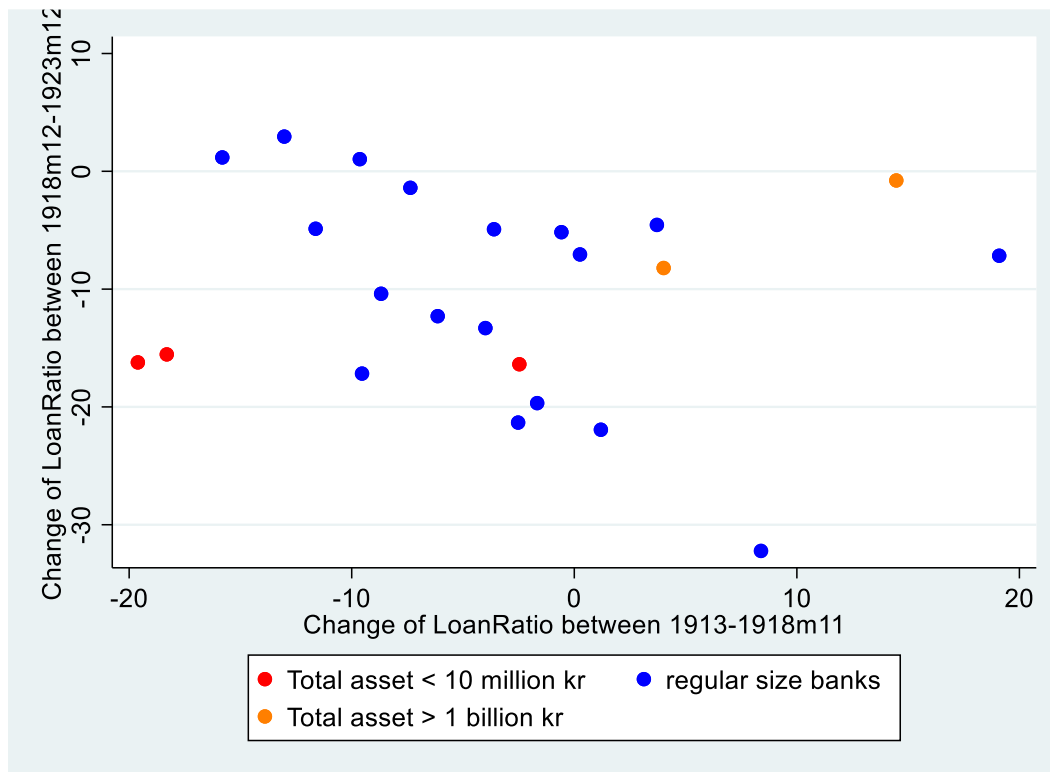
Source: Uppgifter om Bankerna 1913-1919. Note: Authors' Calculations

Figure 5: Stockholm Stock Exchange price indexes (Nominal and Real), 1913 – 1927



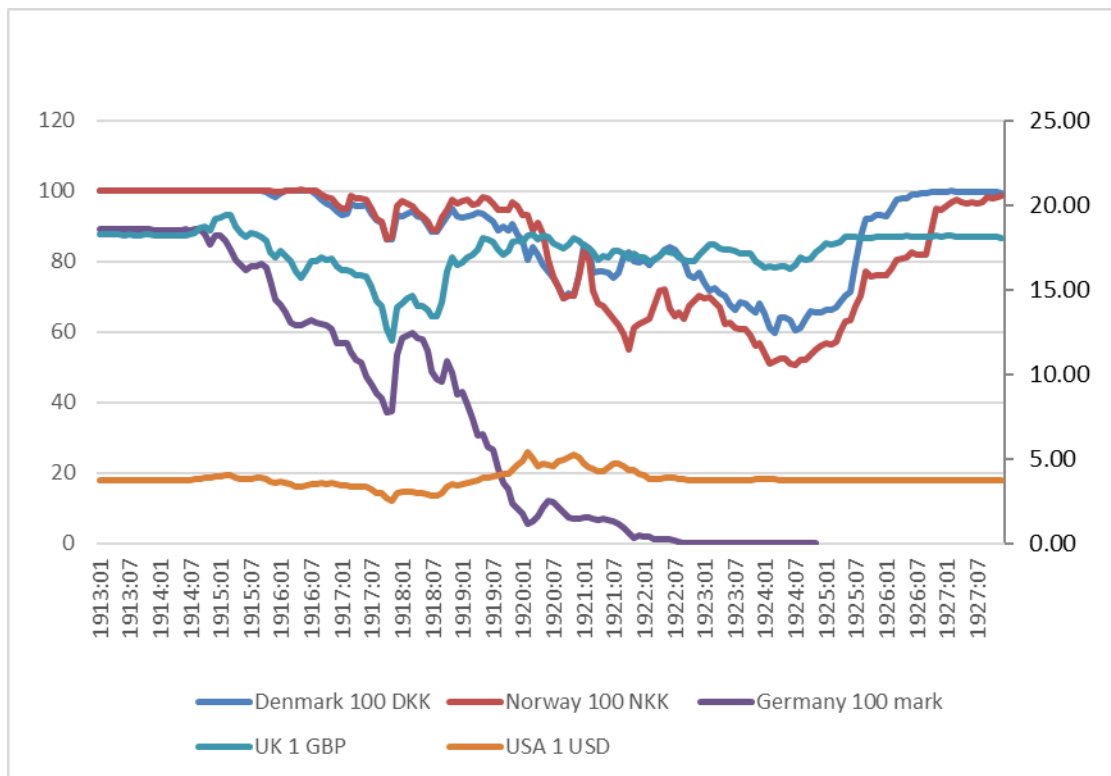
Source: Waldenström 2014. Note: Index 1902= 1.

Figure 6: 'The Stampede to Liquidate' - Growth in lending/assets 1913-18 v 1919-1923



Source: Uppgifter om Bankerna. Note: Authors' Calculations. Sample includes only those banks that existed during entire interval.

Figure 7: Exchange Rates in SEK, 1913-27



Source: Bohlin (2010). Note: GBP and USD on right axis.