Central Bank Liquidity Support, Bank Lending, and the End of Currency Competition [*]

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Private money creation lies at the heart of currency competition due to seigniorage rents that are attributed to shareholders. However, it undermines the role of central bank in money provision, and it was historically linked to episodes of financial instability and is thus a contentious issue. Shifting from private to public money may come at a cost of bank disintermediation, affecting growth. Hence, such a swap should be well-planned to minimize its cost. In this paper, we study the shift from private to public money in a historical context. The 1897 banking law in Sweden granted the note issuance monopoly to the Swedish central bank. The swap was accompanied by preferential central bank liquidity support to affected note-issuing banks. We examine how this transition influenced the private banks and what role the central bank funding played in the process. Our analysis shows that former note-issuing banks saw a profitability decline of about 14%, with no significant evidence of bank disintermediation. Additionally, these banks raised property lending interest rates to offset the profit losses.

Keywords: Money and Banking, Liquidity Support, Inside Money, Outside Money, Central Banks, Bank Profitability, Bank Lending, Banknote Monopoly.

JEL-Classification: E42, E5, G21, G28, N23.

1 Introduction

Private and public money competition have been subject to numerous disputes, both historically, when the central bank note monopoly was established, and in modern times, when the increasing role of inside money and cryptocurrencies (re)launched a debate about the importance of sovereign's money. Recent developments induced central banks to consider the introduction of central bank digital currencies (CBDCs) (Gorton and Zhang, 2022). Most historical discussions related to private vs central bank money focused on the issues of (perceived to be dangerous) governmental control over the supply of money and of financial (in)stability linked to private money provision, inspired by the period of free banking in the U.S. (Rolnick and Weber, 1983; Selgin, 1988). Modern finance literature deals mostly with the problem of bank disintermediation that could lead to lower growth, were part of the inside money be substituted by the central-bank supplied outside money (Brunnermeier and Niepelt, 2019,Andolfatto, 2021, Keister and Sanches, 2022, Chiu et al., 2023a).[1]

In that context, Brunnermeier and Niepelt (2019) derive conditions for the equivalence of private and public monetary systems. The equivalent monetary policy requires central bank funding to insulate the banking sector through transfers that leave the equilibrium allocations unaffected. However, in practice, the conditions required for the equivalence result to hold, as with any irrelevance results, are difficult to fulfill, due to the endogeneity of the monetary policy, existence of collateral constraints, transaction and information frictions. Fernandez-Villaverde et al. (2021), studying the possibility of CBDC, also derive an equivalence result, but given the political-economic forces at play, they conclude that CBDC in the form of central bank deposits would likely lead to a deposit shift from the commercial banking to the central banking sector. A number of theoretical studies examines how the shift to a new central bank currency may affect private banks (Andolfatto, 2021; Chiu et al., 2023b; Whited et al., 2022, Williamson, 2021 and Keister and Sanches, 2022). Chen and Filippin (2024) zoom into collateralized liquidity support by the central bank and show that despite governmental transfers CBDC affects private banks' business models.

In this paper, we examine an example of a shift from private to public money in the presence of preferential central bank transfers to the private banking sector. However, unlike in Brunnermeier and Niepelt (2019), the liquidity support in question is not completely neutral, i.e. it affects the economic outcomes of private banks. In particular, we study the historical episode of the introduction of the Swedish Central Bank's banknote monopoly. Sweden holds a unique place in the monetary history as a country with the longest operating central bank and the inventor of the banknote in Europe. At the turn of the 20th century, the Swedish banking sector underwent substantial changes linked to the fact that the Swedish central bank, Sveriges Riksbank, gained note monopoly, after several decades of coexistence of private and public notes. The banknote monopoly of the Riksbank ended the monetary competition be-

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[1]On the monetary side, questions related to optimum quantity of money under different monetary arrangements are particularly explored (de O. Cavalcanti and Wallace, 1999, Monnet and Sanches, 2015, Fernández-Villaverde and Sanches, 2019).

tween private bank money and the central bank money in Sweden. By stripping the commercial banks of seigniorage revenues, the reform changed banks' present value of the stream of profits - franchise values - and could thus lead to an increase in their risk-taking (Demsetz et al., 1996).

Sweden offers a unique setup to study the effects of a shock to franchise value to the commercial banks, as the discussed changes happened in a tranquil period. Moreover, for the period of interest, we have access to monthly balance sheet and interest rate, as well as yearly return data for the universe of commercial banks in the country. The unique combination of high quality and high frequency historical data on both quantities and prices allows us to draw robust conclusions on the effects of studied regulatory change on commercial banks and their credit provision. We gather monthly bank-level data for all Swedish commercial banks in the period 1894M1-1911M12. In 1890s, the Swedish private banking sector consisted of two comparable bank groups, one of which could issue notes alongside Sveriges Riksbank. We consequently study the effects of the changes in law in a difference-in-difference (DiD) setup.

Regulatory changes related to issuance monopoly of central banks serve as a fruitful laboratory for studying the effects of the private-public money swap on the banking sector. Note issuance has been a historically contentious issue due to the seigniorage revenues. As such, the note monopoly of central banks was often decided after decades of heated discussions. As the timing and specific provisions of laws can be considered exogenous to individual banks, such historical episodes provide a natural experiment to study causal effect of different regulations on the commercial banking sector. Using annual Canadian data to inform the current CBDC debates, Grodecka-Messi and Zhang (2023) show that the loss of note issuance privilege of Canadian chartered banks after the establishment of the Bank of Canada lowered the profitability of commercial banks, but it did not affect their credit provision. Relatedly, using aggregate Swedish data, Ögren (2022) studies the implications of the note monopoly of Riksbank on the provision of base money in the light of current debates on CBDCs. In this paper, we zoom into another aspect of issuance monopoly: private bank outcomes and central bank liquidity support available to former note-issuing banks. In order to compensate commercial banks for the loss of the issuance privilege, the Riksbank provided compliant banks with preferential liquidity support. This liquidity support persisted even if a bank changed its liability status or was merged with or acquired by another bank. It was designed to be withdrawn over time and only part of the banking sector had access to it, which provides an ideal empirical setting to analyse the effect of the swap and associated liquidity support on private banks.

Given the specific nature of the transition from private to public money in Sweden, our paper, apart from contributing to the monetary literature, is also related to research on central bank liquidity support. Rieder (2023) provides an overview of lender-of-last-resort policies and concludes that historically, central bank liquidity support was not only activated during financial crises. Nonetheless, issues related to stigma from using central bank liquidity facilities and moral hazard linked to it, often arised (Gorton and Metrick, 2013; Bordo, 2014; Anbil and Vossmeyer, 2019; Vossmeyer, 2019). Ours is a case of unstigmatized liquidity support: eligible banks could obtain preferential central bank credit that was reliant on their previous note issuance rather than other economic fundamentals. Still, it could potentially lead to moral

hazard. We pose it as an empirical question whether the central bank liquidity support leads to risk taking behavior of banks. The historical context of our study makes it particular interesting in that aspect: In late 1907, an international crisis hit the Swedish banking sector, and the discussed liquidity assistance could have turned into an accidental lender-of-last resort policy.

Empirical evidence on the presence of moral hazard, or an accurate estimation of stigmatization effect is hard to establish, see the literature review of Rieder (2023). The lender-of-last-resort resources are usually available to all banks on request if they can pledge high quality collateral. The design of the liquidity support or bailout policies does not hinge on a pre-determined list of banks. Neither can the central bank discriminate certain banks in the intervention. Consequently, the participation of the central bank liquidity support program is not exogenous, and the group membership between control and treatment is an endogenous decision by the banks. In our study, as the eligibility of the liquidity support is decided based on past cash issuance activities of commercial banks, the assignment of control and treated group membership can be considered as quasi-exogenous. What is more, all banks eligible for the central bank liquidity support program applied and explored the option. It means that the liquidity support program reached the targeted banks and did not seem to raise the stigmatization problem.

We show that while the Riksbank preferential loans helped cushion the losses of former note-issuing banks, the transition to other sources of funding still led to a relative fall in affected banks' profits. On the aggregate, we do not find signs of financial disintermediation, but we find evidence of portfolio re-balancing due to (partially) collateralized central bank liquidity support. Loans from the Riksbank supported mortgage lending, as properties were probably deemed a good collateral. At the same time, lending rates on mortgages and the interest rate spreads of affected banks went up, which may be an indication of increased risk-taking after the shock to banks' franchise value. This increased risk-taking did not have a substantial effect on the share of non-performing loans in the portfolio of previously note-issuing banks, as the collateralized framework targeted 'safe' loans.

While interpreting our results, it is important to be aware of the endogeneity concerns in our empirical strategy. In a classical DiD setup, the group assignment is random. In our case, treated banks were note-issuing unlimited liability banks (ULBs), while control banks were deposit-funded limited liability banks (LLBs), which had implications for the composition of their balance sheets, and possibly, returns. While there may be unobservable characteristics that make the two types of banks different, due to the quality and frequency of the data, we can carefully control for differences in observables and their trends. We address endogeneity concerns by including a range of relevant bank-level controls, time and bank-fixed effects, as well as clustering the errors at the bank level. We also account for changes in control variables after the treatment, which makes our results more robust.

The paper is structured as follows. Section 2 presents the institutional background and aggregate evidence. Section 3 reviews the literature and discusses theoretical underpinnings of our empirical study. In Section 4, we present the data and show preliminary results. Section 6 concludes.

# 2 Institutional Background and Aggregate Evidence

At the turn of the 20th century, both the Riksbank, established 1668 as an official bank of the Swedish parliament (Sveriges Riksdag), and Swedish commercial banks could issue money. In particular, the commercial banking sector consisted of two bank groups: joint stock note-issuing unlimited liability banks (ULBs) called *enskilda banker* (emerged in 1830s) and limited liability joint stock banks (LLBs) called *aktiebanker* (first established in 1864, with no right to issue notes). The Riksbank functioned much like a commercial bank, accepting deposits and issuing credits.

Ögren (2006) and Jonung (2021) provide a detailed account of the period of domestic currency competition in Sweden. Ögren (2006) highlights that through note-issuance, ULBs contributed to the economic expansion in the country, given that Riksbank's note supply was subject to specie-convertibility constraints. However, the private note issuance in Sweden was not an example of a period of free banking, unlike Jonung (2021) claims, because note issuing banks were subject to increasing regulations and taxes. Private note issuance was mostly backed by ULBs capital, that, given the unlimited liability of shareholders, was considered to be safe. In fact, no ULB in Sweden ever defaulted on its obligation to redeem their notes. Before Sweden adopted the gold standard, Riksbank notes, along with commodities (gold, silver), constituted the reserves of commercial banks. Since 1874, when Sweden adopted the gold standard, ULBs had also to hold gold corresponding to 10% of their equity capital in connection to their note issuance (LLBs were not subject to this regulation). The note-backing reserves of ULBs were always higher than issued notes.[2] Riksbank notes circulated as legal tender in the country, while commercial bank notes traded at par and could be redeemed into Riksbank notes (until 1874) and gold (from 1874 on) (Jonung, 2021). Private-note issuance was supported by the Crown and the nobility, but their influence in the Parliament declined over time, leading to more pro-monopolist sentiments.

Legislation bestowing a monopoly of the note issue upon the Riksbank led to its gradual transformation into a modern central bank. The private commercial banks were given the right to tap into the Riksbank liquidity support making it an effective lender of last resort. The Law for the Bank of Sweden (Riksbank) from 12 May 1897 specified that the central bank should have the sole right of issuing banknotes. Private banks retained the right to issue their own notes until the end of 1903, and their already issued (outstanding) notes could remain in circulation until the end of 1906 (Flux, 1910, p. 156-171). Figure 1, based on Ögren and Edvinsson (2014), shows Riksbank's share of notes in public bank note circulation between 1832-1911. It is evident that the law change had a big impact on the currency market.

In return for giving up the note issuance, the ULBs were granted access to favorable Riksbank credit that was available to them from 1899 to 1910, provided that they voluntarily gave up on note issuance before the legally binding deadline of December 1903 and conditional on maintaining their branch offices that were in operation on January 1, 1896. Were a note-issuing

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[2]Over time, deposits increased in importance as a source of financing even for ULBs, as regulation was mostly imposed on note-issuance, but not deposit-generation.
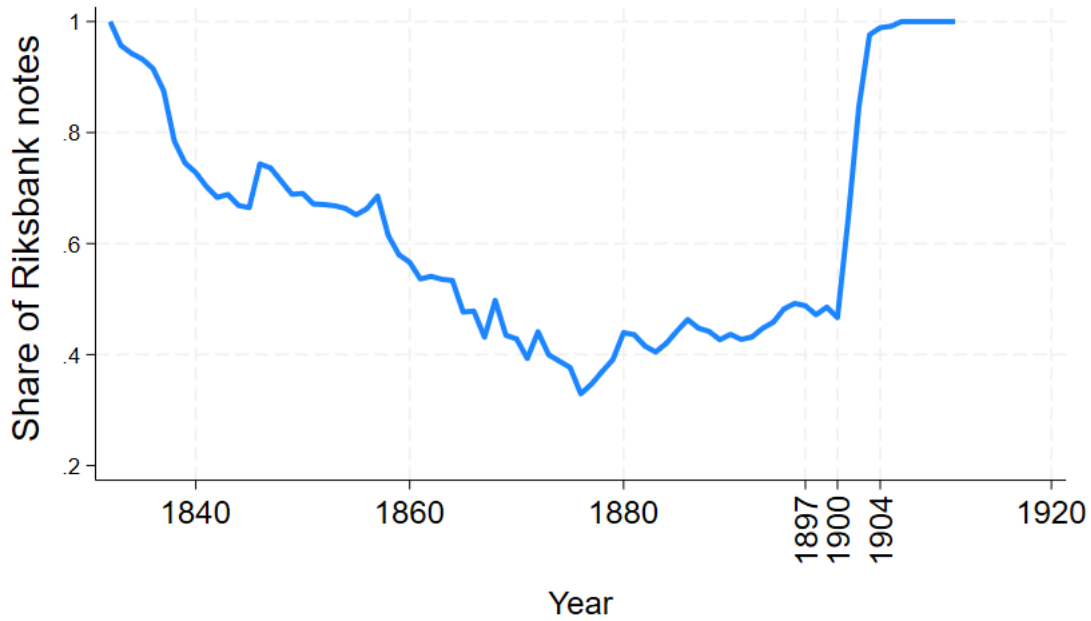
Source: Data published in Ögren and Edvinsson (2014).

Figure 1: Riksbank's note share in public bank note circulation, 1833-1911

bank to change its liability status from ULB to LLB or be taken over by another bank, the continuing bank had access to the liquidity support of the original unlimited liability note-issuing bank (Sveriges Riksbank Law, 1897). Table 1 specifies the details of the liquidity support provided by the Riksbank in relation to the withdrawal of private banknotes depending on the time period considered. In the first period after the law, banks had access to open (collateralized) credit and rediscounting facilities at the Riksbank at preferential rates. The size of liquidity support was a function of banks' outstanding notes as of January 1, 1896. Banks never used the open credit option before 1901, indicating that it was not attractive to them. The 3 May 1901 update introduced a new form of liquidity support: uncollateralized credit. First account of such credit on the Riksbank balance sheet can be found in August 1901 and on the individual banks' balance sheets in October 1901. The liquidity support linked to changes in the currency market was to be gradually withdrawn starting from December 1903 until the end of 1910.[3]

Figure 2 visualises how the number of note-issuing banks changed over time. Panel a) of Figure 2 shows the number of ULBs and LLBs 1894-1911. At first, all ULBs were issuing notes. Over time, as banks began to give up their note issuing privilege, the number of ULBs and banks with note-issue rights diverged. In January 1899, the first bank, Vesterbottens enskilda bank, complied, and restructured as an LLB (Bankaktiebolaget Stockholm-Öfre Norrland), giving up its notes and right to issue them. Other banks started complying after the passage of the May 1901 law. As of December 1903, the legally binding limit, all ULBs lost their right to issue

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[3]We have the individual banks' balance sheet data for the end of each month. Therefore, in order to calculate the maximum available liquidity support by the Riksbank based on January 1 figures, we use the December numbers of the preceding year, i.e. December 1895 and December 1900.

Table 1: Details on liquidity support by the Riksbank due to the 1897 law and its 1901 update

Time period	Available facilities
Jan 1899-May 1901	1. Open collateralized credit[a] for the value up to 50% of banks' notes outstanding on January 1896.[b]
	2. Right to rediscount bills at the Riksbank for the value up to 50% of banks' notes outstanding on January 1896.[c]
June 1901-Nov 1903	1. Open collateralized credit[d] for the value up to 10% of banks' notes outstanding on January 1901.[e]
	2. Right to rediscount bills at the Riksbank for the value up to 25% of banks' notes outstanding on January 1901.[f]
	3. Uncollateralized loan for the value up to 65% of banks' notes outstanding on January 1901.[g]
Dec 1903-Nov 1909	Liquidity support as specified for November 1903 should be reduced each year starting in December 1903 by one-eight part of its original amount.
Dec 1909 onwards	No specific liquidity support.

Notes. Source: Flux (1910). Details are provided in the laws of May 27, 1897 and May 3, 1901. §41 of the Sveriges Riksbank Law (1897) specifies the liquidity support provided to individual note-issuing banks. All liquidity provisions were conditional on banks maintaining their branch offices that were in operation on January 1, 1896.

[a]The collateralized credit was against security approved by Riksbank directors. No more specific information regarding the quality of assets is provided.

[b]The credit had no fee, and an interest rate 2 percent below the current rate for the discount of three-months' bills of exchange (provided the rate is above 2 percent per year).

[c]Rate of discount could not exceed 2/3 of the usual rediscounting rate.

[d]The collateralized credit was against security approved by Riksbank directors. No more specific information regarding the quality of assets is provided.

[e]The credit had no fee, and an interest rate 2 percent below the current rate for the discount of three-months' bills of exchange (provided the rate is above 2 percent per year).

[f]Rate of discount could not exceed 2/3 of the usual rediscounting rate.

[g]Fee and interest as for the open collateralized credit.

notes (yellow dashed-dotted line goes down to zero). However, the majority of ULBs still had outstanding notes (black short-dashed line) that were circulating until August 1906, close to the December 1906 limit imposed by law. As ULBs were losing their note-issuing rights, some of them converted to LLBs (which explains part of the increase in the number of LLBs over time), others continued as ULBs (in 1935 all ULBs converted to LLBs).

Along with note-issuing banks giving up their note privilege, they were getting access to preferential Riksbank loans and Riksbank rediscounting facility. Panel b) of Figure 2 shows that Riksbank loans were increasing until December 1903, after which the limits imposed by the 1901 law were to be regularly lowered, resulting in a step-wise function. The utilization rate of Riksbank loans was oscillating just below 1 for most of the considered period, which suggests that banks were willingly tapping into this cheap source of financing, particularly after Riksbank gained note monopoly in 1904. Lastly, panel (c) of Figure 2 shows rediscounted domestic and foreign bills of Swedish banks. Rediscounted bills were part of Riksbank liquidity support to former note-issuing banks. However, the balance sheet data does not allow us to determine which part of Riksbank (or commercial banks') rediscounted bills is due to the 1901 law, and which bills have other counterparties. Commercial banks were also discounting each other's bills, hence this evidence is mostly suggestive. Rediscounted bills appear on commercial banks' balance sheets even after 1910, when the Riksbank liquidity support finished. We see though that banks started rediscounting bills when their outstanding notes went down to 0. This would suggest that rediscounting bills was a substitute to notes in commercial banks' financing, and at least part of it was cheaper than issuing deposits due to the preferential rates linked to the Riksbank liquidity support.

In the following sections, we relate our paper to the existing literature and formulate testable hypotheses. We then study how the end of private note issuance in Sweden affected the commercial banking sector and what role the central bank liquidity played in that process.

3   Related literature and hypotheses formation

Below we briefly summarize the related literature that helps us to derive testable hypotheses.

Swedish writings   The period of private and public money competition in Sweden has been extensively described in Ögren (2006) and Jonung (2021). The paper most linked to our research is Kenny and Ögren (2021) that focus on the role of different liability regimes of ULBs and LLBs around the 1897 Riksbank Act. The authors argue that rather than being a privilege, note-issuance of ULBs was rather a constraint that limited banks' operations due to obligatory reserves. As such, the 1897 Riksbank Act brought the ULBs closer to LLBs, spurred an increase in ULBs' leverage and increased bank competition.[4] Ögren (2022) looks

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[4] Kenny and Ögren (2021) use a subset of dataset studied in our paper and compare bank-level December data for years 1896, 1900 and 1903 (for banks that existed in 1891). Note that some of our results differ from their due to December 1903 being a particular month for some of studied variables. While Kenny and Ögren (2021) end their analysis in 1903, we continue until 1911 and find most significant changes due to law after 1903.
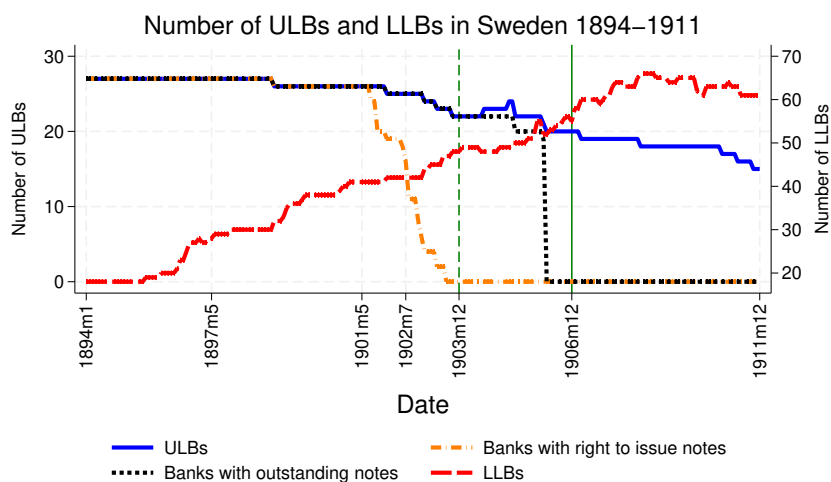
(a) Note-issuing banks in Sweden
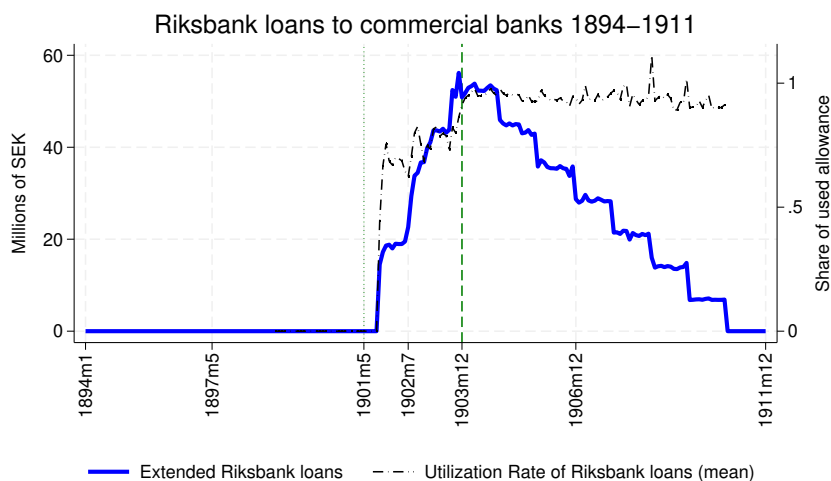
(b) Riksbank loans
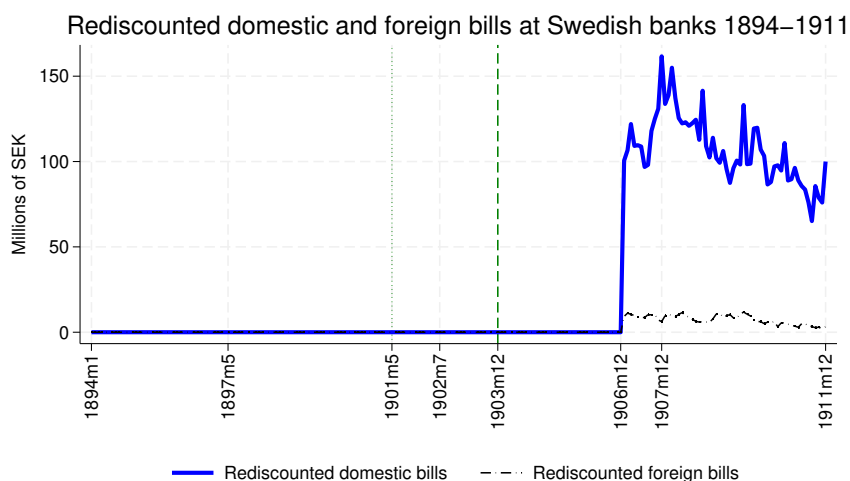
(c) Rediscounted bills

Source: The "Summary of the Banks' Activities, 1894M1-1911M12" (*Sammandrag af Bankernas Uppgifter*).

Figure 2: Private note issuance in Sweden and liquidity support by the Riksbank 1894-1911

at the consequences of the 1897 Riksbank Act for the evolution of the base money and draws lessons from the Riksbank note monopoly for the CBDC introduction. The author observes that the increase in the monetary base in the wake of the monetary reform contributed to an expansion in commercial bank lending and fueled a credit boom that made the 1907 crisis in Sweden worse. This is in line with what happened in Australia at the beginning of the 20th century, as Selgin (1988) describes. Finally, Brave (2005) studied the impact of Riksbank note issuance monopoly on financial intermediation of Swedish banks. The author used annual data and focused on lending, concluding, in line with our findings, that bank intermediation was largely unaffected by the 1897 banking law.

Related empirical studies for other countries: An empirical examination of the effects of arrival of a new form of central bank money on note-issuing commercial banks has been performed in Grodecka-Messi and Zhang (2023). The authors consider the case of Bank of Canada and its monopoly and study how the removal of note issuance privileges affected private banks' returns and their lending. Making an analogy to CBDC discussions, the authors conclude that while introducing a CBDC would likely lead to some bank losses, the financial intermediation would likely remain intact. The Canadian case study is a valid one, but it suffers from limited data availability (due to annual data and the small number of commercial banks), as well as the fact that the Bank of Canada was established in untranquil times, in the period between the Great Depression and 2nd World War. Moreover, note-issuance ban affected all Canadian commercial banks and was linked to a change in their liability status. Studying a related issue in the Swedish context is devoid of these caveats.

Xu and Yang (2024) study real effects of supplying safe private money in a U.S. context. The authors show that moving from unsafe private monies subject to default risk towards safe money in the form of national bank notes has a positive impact on trade, local economic development and innovation. Their results can be applied to today's discussions about stablecoins.

Theory papers: In the theoretical literature, the effects of changes in currency competition and shocks to banks' franchise values often depend on the extent of market competition.

Recent papers on the interplay of outside and inside money relate to the potential CBDC introduction. CBDC could affect the bank funding costs, as it may crowd out private bank deposits, and it could have implications for private banks' profitability and lending. These studies are important for our purpose, since the effect on commercial banks liability side is similar to the effect central banks' note monopolies had on private note-issuing banks. Considering a monopolistic banking sector, Andolfatto (2021) studies how CBDC affects profitability and lending of private banks, concluding that while profits go down, lending can remain unaffected or even increase if the depositors base extends. Whited et al. (2022) and Chiu et al. (2023a) confirm these results for banks having market power. If banks operate in a competitive market instead, competition from the CBDC can result in bank disintermediation, as Keister and Sanches (2022) and Williamson (2021) note.

Our paper relates to the literature on the franchise value of the banks (Demsetz et al.,

1996; Hellmann et al., 2000; Monnet and Sanches, 2015). According to this theory, high present value of banks' profits diminishes the moral hazard and risk-taking by banks, as their shareholders may have more to lose. Franchise values are usually higher in monopolistic settings and where no or little branching was allowed. A ban on note issuance lowered the franchise value of affected banks. However, Swedish banks operated in a competitive market and with an extensive branching structure, and the regulatory change in Sweden affected unlimited liability banks, which are all factors mitigating the potential increase in risk taking after Riksbank's banknote monopoly.

Last, but not least, our paper relates also to the literature on central bank liquidity support and collateralized lending. Bekkum et al. (2018) and Hüttl and Kaldorf (2024) document that changes in collateralized framework lead to portfolio rebalancing of affected banks and may increase their risk-taking. Since the majority of offered liquidity support by the Riksbank was in our case uncollateralized, we expect the portfolio reshuffling to be limited in the Swedish case. Although most literature argue that lender-of-last-resort programs, including central bank liquidity support, would encourage banks to engage in risk-taking behavior, Repullo (2005) argues that the existence of a lender of last resort does not necessarily increase the incentives to take risk. Brunnermeier and Niepelt (2019) discuss how central banks' liquidity support can affect market outcomes when inside money is substituted with outside money. As such, we expect the lending of the Riksbank to be important at least for some of our outcome variables.

Before formulating our hypotheses, we analyze the effects that the 1897 law had on ULBs' balance sheets and business model. Table 2 presents a stylized balance sheet of an ULB before 1897 and Table 3 after 1906.

Table 2: Stylized ULB balance sheet before 1897

Assets	Liabilities
Gold G_t	Banknotes N_t
Private loans L_t	Deposits D_t
	Equity E_t

Table 3: Stylized ULB balance sheet after 1906

Assets	Liabilities
Riksbank notes Rb_t	Deposits D_t
Private loans $L_{n,t}$	Equity E_t
	Loans from the Riksbank $Rb_{loans,t}$

Let us assume that gold is booked at the book value, so that it does not generate any return. The cost of printing banknotes is considered negligible. Bank shareholders aim at maximizing the profit defined as following:

$$\Pi_t = i_{p,t}L_t - i_{d,t} * D_t, \tag{1}$$

Note that before 1906 $A_t = G_t + L_t = N_t + D_t + E_t$. As such $D_t = A_t - N_t - E_t$, and the profit function becomes:

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$$\Pi_{t,o} = i_{p,t}L_t - i_{d,t} * (G_t + L_t - N_t - E_t). \tag{2}$$

We see that higher lending rates, lower deposit rates, lower gold holdings and higher equity and banknote shares increase the profitability of the ULB. Under the assumption of an unchanged size of the balance sheet, after 1906, our stylized profit function becomes:

$$\Pi_{t,n} = i_{p,t}L_t - i_{d,t} * (L_{n,t} + Rb_t - E_t - Rb_{loans,t}) - i_{rb_t}Rb_{loans,t}. \tag{3}$$

Gold is no longer part of the balance sheet of ULBs, since upon the abandonment of note issuance, they get rid of the gold reserve. Banks exchange it for Riksbank notes. Let us assume that the Riksbank loans extend to the half of previously issued notes. Then we have:

$$\Pi_{t,n} = i_{p,t}L_t - i_{d,t} * (L_t + Rb_t - E_t - 0.5N_t) - i_{rb_t}0.5N_t. \tag{4}$$

If the ULB banks aims at maintaining the same size of the balance sheet, without any additional changes, $\Pi_{t,n} < \Pi_{t,o}$, provided that loans from the Riksbank have a positive impact on profitability, i.e. as long as the deposit interest rate exceeds the preferential borrowing rate. If the ULB bank would like to maintain the profit levels, it could engage in more risky lending, increasing $i_{p,t}$ or decrease the deposit interest rate $i_{d,t}$. An alternative would be to diminish the size of the balance sheet, and reduce lending.

Decreasing deposit rates in a competitive environment could lead to customer outflows. Hence, it is more likely to occur in semi-monopolistic settings, i.e. if a bank enjoys a natural geographical monopoly due to its location. On the other hand, increasing the riskiness of loans could in long term harm the profitability of the bank as it may lead to a higher share of non-performing loans. Reducing the size of the balance sheet would mean giving up part of the market share, which banks were unlikely to willingly give up in a competitive environment. Given that, we would expect to observe largest effects either on loan intermediation, or deposit interest rates, particularly for banks located in remote areas.

Being equipped with theoretical background, we formulate testable hypotheses:

Hypothesis 1

Affected banks experience a decrease in profitability and/or they reduce lending to diminish the size of the balance sheet. In competitive areas, we expect the banks to suffer a loss in order not to loose the market share. Bank disintermediation is more likely for banks operating in remote areas.

Hypothesis 2

Loans from the Riksbank should have a mitigating effect on the fall in profitability and/or bank disintermediation.

Hypothesis 3

Affected banks increase their risk-taking, but the extent thereof is limited due to their unlimited liability status. Treated ULBs that change their status to LLB exert more risky behavior. Lending interest rates and interest margins increase to safeguard declining returns.

4 Data and empirical results

4.1 Data

We digitized monthly balance sheet data for all Swedish commercial banks in the period 1894M1-1911M12. The main data source is the "Summary of the Banks' Activities," *Sammandrag af Bankernas Uppgifter*, regularly published and readily available to the public. The December summary, apart from the balance sheet items, includes the profit and loss statements of the banks and it is a source of our yearly profit data. Apart from balance sheet items and return data, we collect information about bank-specific lending and deposit rates for different types of loans and deposits.

We start our sample at 1894 because in this year the royal charters of the Swedish banks were arranged for concurrent termination at the end of 1903 and a final tax increase on the note issue was put into effect. 1911 is the final year of our sample, because on 1st January 1912, a new banking law came into effect in Sweden, which introduced capital requirements for banks and substantially changed the banking sector, see Grodecka-Messi et al. (2021).

Working with historical data of such a great detail may raise concerns about the quality of reporting. In this respect, Swedish commercial bank data is of exceptional quality. Wendschlag (2012) provides an overview of increased bank regulation in the 19th century. First bank charters were granted for ten years by the Ministry of Finance. Before 1846, banks' were subject to onsite examinations from Stockholm authorities mostly in connection with charter renewals. Over time, the bank supervision became more independent on local officials and centralized. In the period of our study, a Bank Bureau at the Ministry of Finance was already operating.[5] In January 1907, an independent state agency, the Bank Inspection, responsible for supervision of commercial banks, was opened. At the end of the 19th century, monthly Swedish commercial banks' reports were not only scrutinized by centralized authorities but also jointly published as *Summary of the Banks' Activities* and republished by the journal *Ekonomisk Tidskrift*, readily available to the public (Grodecka-Messi et al., 2021).

Table 4 presents summary statistics for the universe of commercial banks in the period 1894M1-1911M12. We have around 14 000 observations for variables on monthly frequency and more than 1 000 for return ratios. Table 5 provides summary statistics for the subperiods of our data, differencing between two types of banks. Control banks are banks that were LLBs at the passage of law in May 1897, Treated banks are all the banks that were ULBs in May 1897. We see that before the passage of law, Treated and Control banks achieved similar

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[5]Since 1846, banks' boards were to provide quarterly financial statements to the Ministry of Finance under the physical supervision of a local civil servant representing the Crown. King could also order unsupervised inspections if any doubt persisted about the quality of the provided data. 1876, the position of a Bank Inspector was established, that, with help of an assistant, worked on-site to collect and compile monthly bank reports that were then sent to the government. 1889, a Bank Bureau at the Ministry of Finance was created, and commercial bank supervision became centralized.

Table 4: Summary statistics for the whole sample

	mean	sd	Min	Median	Max	N
			Yearly Sample			
Return on Equity (ROE)	0.07	0.03	0.00	0.07	0.70	1169
Return on Assets (ROA)	0.01	0.01	0.00	0.01	0.12	1169
Return on Capital (ROC)	0.10	0.05	0.00	0.10	1.03	1169
Dividend Ratio	0.07	0.44	0.00	0.06	15.04	1168
			Monthly Sample			
log(Assets)	16.01	1.51	11.51	16.13	19.72	14440
Cash Ratio	0.00	0.01	0.00	0.00	0.05	14440
Notes to Liabilities	0.02	0.05	0.00	0.00	0.21	14440
Lending to Assets	0.38	0.15	0.00	0.37	4.57	14440
Property Lending Ratio	0.19	0.12	0.00	0.16	0.85	14440
Share Lending Ratio	0.09	0.07	0.00	0.08	0.53	14440
Deposit Ratio	0.61	0.15	0.00	0.62	8.67	14440
Equity Ratio	0.22	0.09	0.04	0.20	2.79	14440
Non-performing Loans to Assets	0.00	0.01	0.00	0.00	0.55	14440
Riksbank Loan Ratio	0.01	0.02	0.00	0.00	0.12	14440
Property Loan Int. Margin	1.34	0.42	0.00	1.25	2.75	13840
Long-term Discounted Bills Int. Margin	1.55	0.40	0.25	1.50	3.50	13840
Short-term Discounted Bills Int. Margin	1.69	0.50	0.50	1.75	4.00	13894
Current Account Int. Rate	2.30	0.42	1.25	2.00	4.25	14430
3 Month Deposit Int. Rate	3.76	0.61	2.00	3.50	6.00	13898
6 Month Deposit Int. Rate	4.36	0.60	3.00	4.50	6.00	13843

Source: The "Summary of the Banks' Activities, 1894M1-1911M12" (*Sammandrag af Bankernas Uppgifter*). The Dividend Ratio is the sum of dividends over Capital from the 1st of January. Non-performing Loans to Assets are Assets Contingent on Legal Proceedings and Foreclosures to Total Assets. The Property Loan Int. Margin is calculated as the difference between lending rate with property collateral and 6-month deposit rate. Long-term Discounted Bills Int. Margin is a difference between the lending rate on discounted long bills and 6-month deposit rate. Short-term Discounted Bills Int. Margin is the difference between the lending rate on 3 month discounted bills and the 3-month deposit rate.

levels of return ratios, but Treated banks were slightly bigger, and offered lower deposit and lending rates, resulting in lower spreads. On the liability side, they were partially financed by notes (the average note to liability ratio stood at 13%), so their equity and deposit ratios were slightly lower than for the Control counterparts. Since note issuance was linked to certain reserve requirements, on the asset side, Treated banks held more gold than the Control banks, and lending constituted a lower share of their asset portfolio. In the second period (1897-1905), when some of the ULB banks stopped issuing notes, and got access to the preferential Riksbank support, we see an increase in return ratios for Treated banks, and a decrease for Control banks. Treated banks decreased their gold shares and increased lending, particularly against property collateral. After the withdrawal of last notes in circulation, in the last period of our study (1906-1911), we see that ROE for Treated banks goes relatively down. They increase their lending and deposit ratios, and the long-run interest margin based on the property lending

Table 5: Summary statistics for treated and control banks in separate periods

	Control		Treated		Differences	
	mean	sd	mean	sd	diff	t
			1894–1896			
Return on Equity (ROE)	0.08	0.04	0.08	0.02	-0.00	(-0.01)
Return on Assets (ROA)	0.01	0.01	0.01	0.00	0.00	(1.32)
Return on Capital (ROC)	0.10	0.05	0.11	0.04	-0.01	(-1.31)
Dividend Ratio	0.06	0.02	0.06	0.01	-0.00	(-0.90)
log(Assets)	15.27	1.41	16.52	0.71	-1.26***	(-23.71)
Cash Ratio	0.00	0.00	0.02	0.00	-0.01***	(-116.02)
Notes to Liabilities	0.00	0.00	0.13	0.03	-0.13***	(-160.20)
Lending to Assets	0.39	0.18	0.27	0.09	0.12***	(18.51)
Property Lending Ratio	0.20	0.12	0.11	0.06	0.09***	(18.94)
Share Lending Ratio	0.06	0.06	0.06	0.05	-0.00	(-0.61)
Deposit Ratio	0.63	0.18	0.56	0.10	0.07***	(9.95)
Equity Ratio	0.22	0.10	0.18	0.04	0.04***	(12.28)
Non-performing Loans to Assets	0.00	0.01	0.00	0.01	-0.00**	(-2.91)
Riksbank Loan Ratio	0.00	0.00	0.00	0.00	0.00	(.)
Property Loan Int. Margin	1.29	0.37	1.36	0.30	-0.07***	(-4.32)
Long-term Discounted Bills Int. Margin	1.50	0.52	1.46	0.35	0.04	(1.83)
Short-term Discounted Bills Int. Margin	1.71	0.56	1.56	0.40	0.15***	(6.44)
Propety Loan Int. Rate	4.84	0.45	4.77	0.32	0.08***	(4.18)
3 M Discounted Bill Int. Rate	4.71	0.69	4.38	0.40	0.33***	(12.30)
Current Account Int. Rate	2.04	0.27	1.88	0.21	0.16***	(13.98)
3 Month Deposit Int. Rate	2.99	0.26	2.82	0.27	0.17***	(13.73)
6 Month Deposit Int. Rate	3.58	0.31	3.40	0.21	0.18***	(14.25)
			1897–1905			
Return on Equity (ROE)	0.07	0.04	0.08	0.02	-0.00	(-1.88)
Return on Assets (ROA)	0.02	0.01	0.01	0.00	0.00***	(5.06)
Return on Capital (ROC)	0.09	0.06	0.12	0.04	-0.03***	(-7.15)
Dividend Ratio	0.06	0.11	0.06	0.01	-0.00	(-0.30)
log(Assets)	15.35	1.41	17.07	0.74	-1.72***	(-66.39)
Cash Ratio	0.00	0.00	0.01	0.01	-0.01***	(-57.97)
Notes to Liabilities	0.00	0.00	0.07	0.06	-0.07***	(-63.29)
Lending to Assets	0.40	0.15	0.32	0.08	0.08***	(29.05)
Property Lending Ratio	0.20	0.12	0.15	0.06	0.05***	(21.85)
Share Lending Ratio	0.09	0.08	0.09	0.05	0.01***	(3.56)
Deposit Ratio	0.62	0.15	0.60	0.10	0.01***	(4.47)
Equity Ratio	0.23	0.09	0.18	0.05	0.06***	(33.91)
Non-performing Loans to Assets	0.00	0.01	0.00	0.00	0.00***	(8.99)
Riksbank Loan Ratio	0.00	0.00	0.02	0.03	-0.02***	(-38.21)
Property Loan Int. Margin	1.17	0.30	1.14	0.30	0.04***	(5.31)
Long-term Discounted Bills Int. Margin	1.47	0.37	1.38	0.27	0.09***	(11.62)
Short-term Discounted Bills Int. Margin	1.69	0.55	1.49	0.36	0.20***	(18.50)
Propety Loan Int. Rate	5.57	0.41	5.45	0.42	0.12***	(12.23)
3 M Discounted Bill Int. Rate	5.47	0.66	5.23	0.59	0.23***	(15.57)
Current Account Int. Rate	2.33	0.41	2.23	0.41	0.09***	(9.18)
3 Month Deposit Int. Rate	3.74	0.48	3.74	0.47	0.00	(0.05)
6 Month Deposit Int. Rate	4.40	0.46	4.31	0.48	0.09***	(8.06)
			1906–1911			
Return on Equity (ROE)	0.07	0.03	0.07	0.02	0.00	(1.91)
Return on Assets (ROA)	0.02	0.01	0.01	0.01	0.00***	(3.65)
Return on Capital (ROC)	0.09	0.04	0.12	0.05	-0.02***	(-4.86)
Dividend Ratio	0.10	0.82	0.06	0.02	0.04	(0.87)
log(Assets)	15.33	1.44	17.75	0.65	-2.42***	(-85.72)
Cash Ratio	0.00	0.00	0.00	0.00	0.00	(1.08)
Lending to Assets	0.44	0.17	0.38	0.09	0.06***	(16.76)
Property Lending Ratio	0.23	0.14	0.18	0.06	0.04***	(16.19)
Share Lending Ratio	0.10	0.08	0.12	0.05	-0.02***	(-8.52)
Deposit Ratio	0.62	0.20	0.64	0.08	-0.02***	(-5.51)
Equity Ratio	0.26	0.12	0.22	0.05	0.04***	(16.01)
Non-performing Loans to Assets	0.01	0.01	0.00	0.01	0.00***	(4.35)
Riksbank Loan Ratio	0.00	0.00	0.01	0.01	-0.01***	(-45.26)
Property Loan Int. Margin	1.54	0.47	1.63	0.45	-0.09***	(-6.51)
Long-term Discounted Bills Int. Margin	1.76	0.43	1.60	0.28	0.16***	(16.11)
Short-term Discounted Bills Int. Margin	1.88	0.53	1.64	0.34	0.24***	(19.70)
Propety Loan Int. Rate	6.24	0.49	6.22	0.45	0.01	(1.04)
3 M Discounted Bill Int. Rate	6.01	0.75	5.71	0.67	0.30***	(14.43)
Current Account Int. Rate	2.48	0.41	2.33	0.33	0.16***	(14.84)
3 Month Deposit Int. Rate	4.11	0.54	4.07	0.50	0.04**	(2.66)
6 Month Deposit Int. Rate	4.70	0.53	4.58	0.51	0.12***	(7.53)

Source: The "Summary of the Banks' Activities, 1894M1-1911M12" (*Sammandrag af Bankernas Uppgifter*).

rate. Over time, the preferential Riksbank support is withdrawn, so the share of Riksbank loans to liabilities diminishes in the third subperiod. In the following sections, we study the effects of changes in law, running DiD regressions.

4.2 Identification and endogeneity concerns

The Swedish law changes and central bank policies in the historical episode we study provide an interesting and rich environment to test the hypotheses outlined in Section 3. We treat the main policy change, the Riksbank note monopoly, as a quasi-experiment that affected the banks through a number of channels.

The note-issuing banks, identified as the treatment group, exhibit intrinsic differences compared to the banks that were not authorized to issue notes. As a result, these banks could respond differently to shocks and policy changes. Thus, a potential concern is that non-note-issuing banks are not an adequate control group for former note-issuing banks, However, the key identifying assumption underlying our empirical model based on Difference in Differences (DiD) is that treated banks would have developed in a similar way as the control group banks in the post-treatment period had they not in fact affected by the law changes. This assumption is not directly testable, but we can test a weaker form of the identification assumption, namely the parallel trend assumption.

The parallel trend assumption implies that the treated banks should develop in parallel trajectories to the counterparts in the unaffected banks. The legal change, its announcement and implementation, should affect the trend after the intervention, thus allowing the DiD technique to identify the causal impact from the quasi-experiment.

We test the parallel trend assumption for the key variables of interests, including return on equity (ROE), return on capital (ROC), the bank lending to assets ratio, the property loan ratio, the property lending interest rate margins, and the short-term deposit rates. Figure 3 shows the coefficient δ_j from the regression

$$y_{i,t} = \alpha + \sum_{\tau=1894}^{1911} \delta_\tau \text{Treat}_i \times \text{After}_{\tau,t} + \gamma X_{i,t} + \eta \text{RB Loan}_{i,t-j} + \delta_i + \eta_t + \epsilon_{i,t}, \qquad (5)$$

on the annual sample. It can be considered as a DiD regression with many placebo policy change dates. The 95% confidence bands of the coefficient estimates δ_τ are also shown in the figure. The 1903 and 1906 treatment dates are considered as the true policy change dates, corresponding to the end of the notes issuance rights for private banks, and the withdrawal of circulating notes issued by private banks. These two dates are marked with dashed and long dashed vertical lines in each plot.

Figure 3 shows that we cannot reject the null hypotheses of parallel trends between the treatment group banks and the control group banks for the variables considered. The plots imply that there are no significant pre-trends before the 1903 and 1906 compliance dates, which suggests banks operating in the same year as the treated banks are a reasonable control group. Our DiD regressions will uncover the effects of policy changes by computing the average

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deviation of the trends after the respective structural change in compliance with the new law.
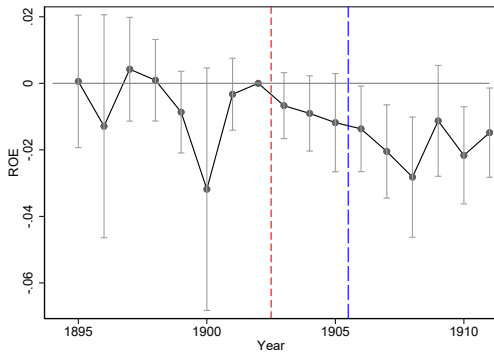
(a) Return on Equity
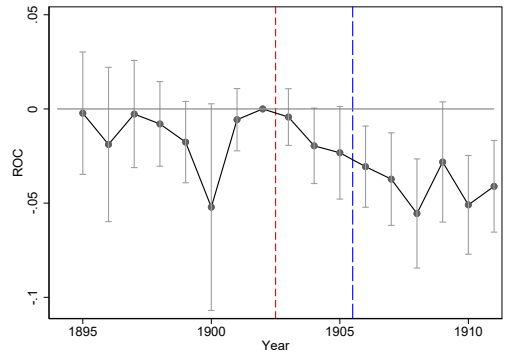
(b) Return on Capital
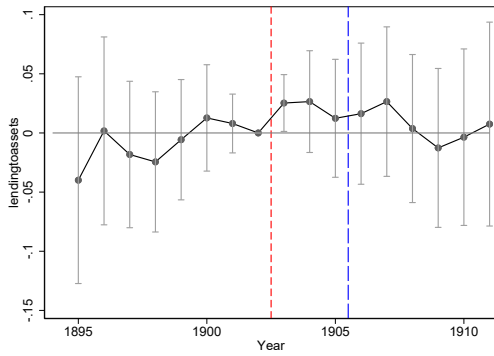
(c) Total Bank Lending to Assets
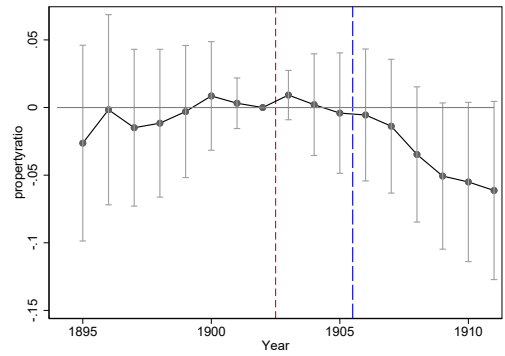
(d) Property Loan Ratio
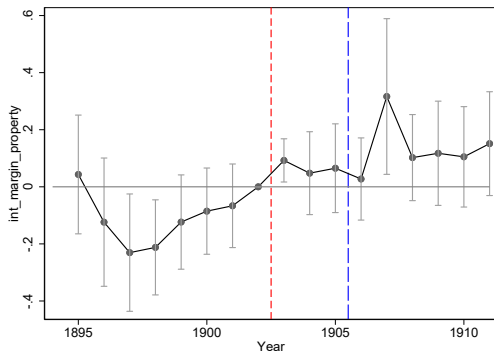
(e) Property Lending Interest Rate Margin
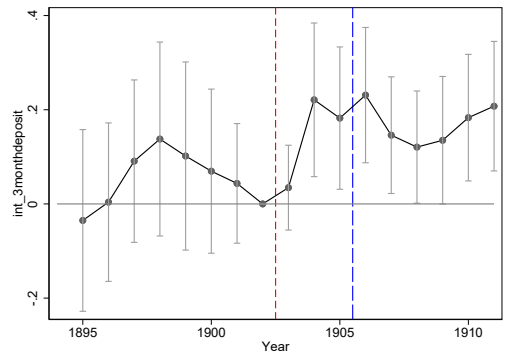
(f) Short-term (3-month) Deposit Rate

Figure 3: Returns and lending activities of banks over the period 1894-1911

In addition, the legal system change that terminated the note issuance rights and ended the circulation of private bank notes can be viewed as exogenous to individual banks' profitability and business decisions. Even though the banks are not directly comparable in the levels of key variables, for instance the average ROE or the average property loan ratio, these characteristics of the banks are essentially irrelevant for determining whether the bank is treated. Moreover, the probability of the banks being treated cannot be directly related to the expected outcome or the pre-treatment characteristics of the treated bank. We demonstrate it further in the next few sections.

By demonstrating that pre-treatment trends are parallel for banks in the treatment and

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control group respectively, we can narrow down the potential sources of endogeneity. That is, any alternative explanation for our results not only has to be plausible in and of itself, but must also be consistent with parallel pre-treatment trends. However, our analysis suggests that we can consider the two quasi-experiments as multiple different policies introduced to affect the treatment group. We shall analyze these two policy changes separately.

4.3 Effects on profits, lending and interest rates

In the first step of our analysis, we run a standard DiD regression

$$y_{i,t} = \alpha + \beta \text{Treat}_i \times \text{After}_t + \gamma X_{i,t} + \eta \text{RB Loan}_{i,t-j} + \delta_i + \eta_t + \epsilon_{i,t}. \tag{6}$$

where δ_i are the bank fixed effects, η_t are the time (year-month) fixed effects. Thus, the treatment dummy and the event dummy variables are absorbed by the fixed effects. We include bank-level control variables $X_{i,t}$ including the logarithm of total asset, the dummy variable of unlimited liability banks, the cash ratio, the lending ratio, equity ratio, non-performing loans ratio.[6] RB Loan is the ratio of the Riksbank loans to total bank liabilities.[7] Profit data is available at yearly frequency, while all other variables are monthly. The standard errors are clustered at the bank-level. Our findings are robust to other ways of computing standard errors.

The dependent variable $y_{i,t}$ is either a profit ratio (return on equity (ROE), return on capital (ROC), return on assets (ROA), and dividend ratio (div. ratio)), a lending ratio (lending to assets, total and by loan type), or different types of interest rates and interest margins. The treatment dummy takes the value of 1 for all the banks that were ULBs in May 1897, at the time of the passing of the banking law, and 0 otherwise. For the treatment time ($After$), we can consider four different threshold. The first would be *May 1897*, when the banking law was passed and the changes announced, The second is *January 1899*, when the banks first can get access to preferential Riksbank loans if they voluntarily give up the note issuance and maintain their bank branches from 1896. The third is *August 1903*, when the last ULBs gave up their note issuance privilege, and the fourth *April 1906*, the first month in which commercial banks not only had 0 note issuing rights, but also retrieved all their outstanding notes from the circulation. Interestingly, the data show that after the passage of 1897 law, commercial banks actually increased their issuance of notes at the turn of the century, so we rather expect an effect on profitability (if any) to occur after the abandonment of note issuing rights (August 1903) or when the circulating notes go down to zero (April 1906). On the other hand, changes in the bank portfolio could occur right after the passage of the 1897 law. For completeness, we present results with all four different definitions of policy changes, with tables related to 1897 and 1899 treatment times being moved to the appendix.

The results for annual profit ratios are presented in Table 6. The Panel A and B show

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[6] For regressions using the lending ratio as the outcome variable, we use the logarithm of total asset, the dummy for unlimited liability banks, the cash ratio, equity ratio, and the ratio of Riksbank loans to total liabilities.

[7] In order to alleviate concerns about the reverse causality, we take a lag (j) of 12 (in the case of annual profit data) or 1 (in the case of monthly lending data) months.

Table 6: Effects on banks' profitability

	(1) ROE	(2) ROA	(3) ROC	(4) Div%
	Panel A: 1903 treatment date			
Treat x After	-0.011**	-0.001	-0.025***	-0.018
	(0.004)	(0.001)	(0.008)	(0.019)
Lagged RB Loan	0.111**	0.019*	0.216**	0.756
	(0.051)	(0.011)	(0.084)	(0.726)
adj. R^2	0.243	0.382	0.429	0.074
	Panel B: 1906 treatment date			
Treat x After	-0.011***	-0.001	-0.027***	0.003
	(0.004)	(0.001)	(0.007)	(0.009)
Lagged RB Loan	0.008	0.008	-0.028	0.706
	(0.042)	(0.009)	(0.079)	(0.693)
adj. R^2	0.245	0.382	0.432	0.074
Add. Controls	YES	YES	YES	YES
N	1099	1099	1099	1098
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

that for the two treatment dates, from and after August 1903 and from and after April 1906, [8] treated banks experienced relatively lower profitability, indicating that the loss of seigniorage was costly for them, despite the liquidity support by the Riksbank. In particular, ROE and ROC of treated banks go down significantly. It shows that the treated banks are suffering from a reduction of 1.1 percentage points in ROE and 2.5 percentage points in ROC after the end of their notes issuance rights in 1903, compared with the control group banks. In economic terms, the treated banks have a drop in profitability between 14% and 23% after the policy changes. In some of our considered regressions, the (lagged) Riksbank loans are significantly and positively associated with profits, indicating that Riksbank loans cushioned part of the seigniorage losses, but not all of them. We will investigate the impact of Riksbank loans further in the following regressions. When it comes to other control variables, we find that higher equity ratios (i.e. less leverage) and higher share of non-performing assets are associated with lower profitability (ROE and ROC).[9]

The monthly results for bank lending, deposit ratio and interest rates are presented in Table 7. When it comes to lending, we focus on the two most important loan categories, loans against property collateral and share collateral, that accounted for ca. 49% and 25% of all loans, correspondingly. We see that both when it comes to total lending, in column (1), and bank lending differentiated by the type of collateral, there is no differential effect of the change in law on treated banks versus non-treated banks. The same applies for the deposit

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[8]For the two first treatment dates, in 1897 and 1899, we find insignificant effects on banks' profits. It suggests that the banks' old business model is not really affected in the earlier period of our sample. The results are reported in Appendix B.

[9]We leave the results for other controls out for readability, but they are available upon request.

ratio. No evidence of bank disintermediation is found, consistent with the results for Canada in Grodecka-Messi and Zhang (2023).

However, we find that loans from the Riksbank increased lending against property collateral. In the regression results table, the Riksbank loan (with 1 month lag) leads to an increase of collateralized lending with property as a security. Every 1 percentage point increase in the Riksbank loan ratio will increase the property loan ratio by 0.6 percentage points for the treated banks. On average, the Riksbank loan increases the property lending ratio by 3%. Even though the majority of Riksbank lending to banks was uncollateralized, parts were reliant on collateral that had to be approved by Riksbank directors. So the liquidity support may have induced banks to reshuffle their asset portfolio towards safer collateralized investments.

Columns (5) to (8) of Table 7 show results for interest rates. We see a significant increase in property lending rates and the long-run interest rate margin based on property loans. The 1903 treatment date panel suggests that the treated banks increased the property loan interest rate margin and the property loan interest rates by 8 percent and 3 percent, with respect to the pre-treatment average interest margins and rates before 1897.[10] Higher Riksbank loans mitigate those increases with the 1903 treatment date. No evidence for a substantial change in deposit or short-term interest margins is found. An increase in the lending rates and interest rate margins was one of the possible solutions that banks could take in order to safeguard their returns, as discussed in section 3. Higher lending rates are usually associated with higher risk-taking, but in the case of Swedish banks, this higher risk taking demonstrated itself in a still fairly safe market of loans with property collateral.

4.4 Bank-specific treatment intensities and treatment dates

In the second step of our analysis, we look into the banks' heterogeneity of treatments. We focus on two different dimensions of the treatment heterogeneity, the different treatment intensities and the different treatment dates.

Banks relied on note issuance to a different degree. They are affected by the policy change differently. In the regression analysis, we can replace the treatment dummy variable definition with a continuous variable of treatment intensity. We run the regression

$$y_{i,t} = \alpha + \beta \text{Treatment Intensity}_i \times \text{After}_t + \gamma X_{i,t} + \eta \text{RB Loan}_{i,t-j} + \delta_i + \eta_t + \epsilon_{i,t}. \quad (7)$$

$TreatmentIntensity_i$ is defined as the ratio of bank notes to the maximum right to issue notes as of last of December 1895 (given that the first law treated January 1st, 1896 as the benchmark for liquidity support). Our treatment intensity measure is thus taken before the new regulation was announced and before the banks could react to it. We include the bank fixed effects and time fixed effects in the regression, so the separate term of the $TreatmentIntensity_i$ and $After_t$ are not reported in the tables.

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[10]The same calculation for the 1906 treatment panel suggests a 7 percent and 3 percent increase for the margin and the interest rates.

Table 7: Effects on banks' business activities

	(1) Lending/Assets	(2) Prop. L. Ratio	(3) Share L. Ratio	(4) Deposit Ratio
	Panel A: 1903 treatment date			
Treat x After	-0.011	-0.017	0.012	0.010
	(0.031)	(0.025)	(0.013)	(0.022)
Lagged RB Loan	0.456*	0.601***	-0.016	0.057
	(0.268)	(0.145)	(0.156)	(0.256)
adj. R^2	0.705	0.734	0.683	0.760
	Panel B: 1906 treatment date			
Treat x After	-0.019	-0.024	0.013	0.014
	(0.027)	(0.020)	(0.013)	(0.020)
Lagged RB Loan	0.276	0.382**	0.106	0.185
	(0.244)	(0.167)	(0.151)	(0.234)
adj. R^2	0.705	0.735	0.683	0.760
Add. Controls	YES	YES	YES	YES
N	14328	14328	14328	14328
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK
	(5) Prop. Loan Int. Margin	(6) ST Discount Int. Margin	(7) Prop. Loan Int. Rate	(8) 3-Month Dep. Int. Rate
	Panel A: 1903 treatment date			
Treat x After	0.110**	0.015	0.152***	0.063
	(0.050)	(0.067)	(0.049)	(0.051)
Lagged RB Loan	-1.529**	-1.292	-1.854***	-0.728
	(0.752)	(0.853)	(0.690)	(0.550)
adj. R^2	0.688	0.698	0.879	0.895
	Panel B: 1906 treatment date			
Treat x After	0.093*	0.096	0.138***	0.029
	(0.050)	(0.064)	(0.048)	(0.040)
Lagged RB Loan	-0.700	-0.396	-0.607	-0.479
	(0.727)	(0.809)	(0.729)	(0.658)
adj. R^2	0.688	0.699	0.879	0.895
Add. Controls	YES	YES	YES	YES
N	13733	13794	14316	13798
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

The regression results for banks' profitability and operational activities are reported in Tables 8 and 9. The results largely confirm the results presented in the standard DiD setting in the previous sections. Interestingly, we find that the effects on banks' profitability are captured only in the later period when the banks have stopped issuing new notes and the private banks' notes are finally withdrawn from circulation. In particular, we find that the banks with higher treatment intensity are affected more, as shown in the lower panel of Table 8. The effects on the loans and deposits as the fraction of the banks' assets or liabilities are still insignificant after controlling for additional variables, see Table 9. When it comes to interest rates, also for the continuous treatment measure we find that property lending rate and long-run interest margin based on the property lending rate increases. As in the dummy treatment case, the effect on interest rates is stronger for the 1903 treatment date.

As evidenced in Figure 2 a), different banks gave up their note issuing privileges at different dates. Results from the previous section suggest that banks were hit by lower profitability not after the passage of the law and stop in new note issuance, but once their outstanding notes stopped circulating. In order to formally test whether it was the stop in note issuance or the final withdrawal of circulating notes, we define two alternative individual treatments: $Treatment_i^{issue}$ - that takes the value of 1 from the month in which a formerly note-issuing bank gave up its issuance of new notes and 0 otherwise, and $Treatment_i^{circ}$ that takes the value of 1 from the month in which a former note-issuing bank completely withdrew its notes from circulation, and 0 otherwise.

$$y_{i,t} = \alpha + \beta \text{Treatment}_i^{issue/circ} \times \text{After}_t + \gamma X_{i,t} + \eta \text{RB Loan}_{i,t-j} + \delta_i + \eta_t + \epsilon_{i,t}. \qquad (8)$$

Table 8: Treatment intensity and banks' profitability

	(1) ROE	(2) ROA	(3) ROC	(4) Div%
	Panel A: 1903 treatment date			
Treat Intensity x After	-0.016***	-0.001	-0.038***	-0.025
	(0.006)	(0.001)	(0.011)	(0.026)
Lagged RB Loan	0.115**	0.019*	0.230***	0.761
	(0.051)	(0.011)	(0.081)	(0.728)
adj. R^2	0.244	0.382	0.430	0.074
	Panel B: 1906 treatment date			
Treat Intensity x After	-0.014***	-0.002	-0.036***	0.003
	(0.005)	(0.001)	(0.010)	(0.011)
Lagged RB Loan	0.009	0.009	-0.029	0.702
	(0.042)	(0.009)	(0.081)	(0.692)
adj. R^2	0.245	0.382	0.432	0.074
Add. Controls	YES	YES	YES	YES
N	1099	1099	1099	1098
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

Table 9: Treatment Intensity and banks' business activities

	(1) Lending/Assets	(2) Prop. Loan	(3) Share Loan	(4) Deposit Ratio
	Panel A: 1903 treatment date			
Treat Intensity x After	-0.015	-0.016	0.016	-0.001
	(0.042)	(0.033)	(0.019)	(0.045)
Lagged RB Loan	0.458*	0.605***	-0.019	0.231
	(0.271)	(0.148)	(0.155)	(0.350)
adj. R^2	0.705	0.734	0.683	0.652
	Panel B: 1906 treatment date			
Treat Intensity x After	-0.027	-0.028	0.016	0.007
	(0.036)	(0.027)	(0.019)	(0.040)
Lagged RB Loan	0.275	0.418**	0.089	0.276
	(0.245)	(0.163)	(0.150)	(0.190)
adj. R^2	0.705	0.735	0.683	0.652
Add. Controls	YES	YES	YES	YES
N	14328	14328	14328	14328
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK
	(5) Prop. Loan Int. Margin	(6) ST Discount Int. Margin	(7) Prop. Loan Int. Rate	(8) 3-Month Dep. Int. Rate
	Panel A: 1903 treatment date			
Treat Intensity x After	0.158**	-0.028	0.214***	0.083
	(0.069)	(0.088)	(0.068)	(0.069)
Lagged RB Loan	-1.554**	-1.300	-1.881***	-0.740
	(0.762)	(0.852)	(0.701)	(0.555)
adj. R^2	0.689	0.698	0.879	0.895
	Panel B: 1906 treatment date			
Treat Intensity x After	0.127*	0.082	0.187***	0.040
	(0.072)	(0.088)	(0.069)	(0.054)
Lagged RB Loan	-0.722	-0.744	-0.632	-0.482
	(0.716)	(0.834)	(0.727)	(0.655)
adj. R^2	0.688	0.698	0.879	0.895
Add. Controls	YES	YES	YES	YES
N	13733	13794	14316	13798
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

Table 10: Effects on banks' profitability: individual treatment dates

	(1) ROE	(2) ROA	(3) ROC	(4) Div%
	Treatment (stop of note issuing rights)			
Treatment^{issue} x After	-0.001	0.001	-0.011	-0.019
	(0.007)	(0.001)	(0.012)	(0.028)
RB Loan	0.070	0.013	0.138*	0.721
	(0.046)	(0.010)	(0.078)	(0.701)
adj. R^2	0.241	0.382	0.424	0.074
	Treatment (withdrawal of circulating notes)			
Treatment^{circ} x After	-0.010**	-0.001	-0.026***	0.006
	(0.004)	(0.001)	(0.008)	(0.010)
Lagged RB Loan	0.023	0.011	0.009	0.713
	(0.045)	(0.009)	(0.082)	(0.690)
adj. R^2	0.244	0.382	0.431	0.074
Add. Controls	YES	YES	YES	YES
N	1099	1099	1099	1098
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

The additional controls are the same as in the above regression Equation 6. We also include the bank fixed effects and the time fixed effects.

Table 10 presents the results for profit ratios and Table 11 for bank lending of different loan types and interest rates. We see that what was decisive for banks' loss in profitability was the withdrawal of remaining circulating notes. On the other hand, Riksbank loans transpire as significant in the regression related to the stop in note issuing rights, because this was also the date, when banks got access to preferential liquidity support of the central bank. When it comes to aggregate lending and different subcategories of lending, once we take into account individual treatment dates, we find no significant results, supporting the findings for Canada in Grodecka-Messi and Zhang (2023). There is some evidence that Riksbank loans could have encouraged banks to increase lending against property collateral, which supports the findings that the banks reshuffled the lending activities to take less risk after receiving the liquidity support. Interest rate results are less robust to considering bank-specific treatment dates, but the regressions confirm that share of Riksbank loans was negatively correlated with the level of interest rates related to property lending.

4.5 Which banks gave up their notes issuance first?

Previous sections present empirical evidence that the note issuance, in particular the complete withdrawal of bank notes issuance by private banks, is the important event that affected individual banks' profitability and the loan portfolio. But which banks are affected earlier and stopped issuing their note issuance business early? In this section, we zoom in to the banks who adjusted accordingly to the new law, compilers, and examine their behaviour.

Table 11: Effects on banks' business: individual treatment dates

	(1) Lending/Assets	(2) Prop. Loan	(3) Share Loan	(4) Deposit Ratio
Treatment (stop of note issuing rights)				
Treatment^{issue} x After	-0.026	-0.030	0.023	0.011
	(0.046)	(0.033)	(0.019)	(0.033)
Lagged RB Loan	0.550	0.712***	-0.102	0.016
	(0.381)	(0.232)	(0.186)	(0.330)
adj. R^2	0.705	0.735	0.683	0.760
Treatment (withdrawal of circulating notes)				
Treatment^{circ} x After	-0.011	-0.017	0.015	0.000
	(0.028)	(0.020)	(0.013)	(0.021)
Lagged RB Loan	0.368	0.470***	0.103	0.055
	(0.243)	(0.151)	(0.147)	(0.244)
adj. R^2	0.705	0.734	0.683	0.760
Add. Controls	YES	YES	YES	YES
N	14328	14328	14328	14328
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

	(5) Prop. Loan Int. Margin	(6) ST Discount Int. Margin	(7) Prop. Loan Int. Rate	(8) 3-Month Dep. Int. Rate
Treatment (stop of note issuing rights)				
Treatment^{issue} x After	0.122	-0.010	0.113	-0.019
	(0.086)	(0.105)	(0.088)	(0.085)
Lagged RB Loan	-1.974**	-1.263	-2.304***	-0.682
	(0.884)	(1.032)	(0.835)	(0.604)
adj. R^2	0.688	0.698	0.878	0.895
Treatment (withdrawal of circulating notes)				
Treatment^{circ} x After	0.075	0.076	0.103**	0.028
	(0.051)	(0.064)	(0.050)	(0.039)
Lagged RB Loan	-0.939	-0.690	-1.080	-0.525
	(0.696)	(0.788)	(0.655)	(0.627)
adj. R^2	0.688	0.698	0.878	0.895
Add. Controls	YES	YES	YES	YES
N	13733	13794	14316	13798
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

(a) Year of new issuance stop

(b) Year of note withdrawal

Source: The "Summary of the Banks' Activities, 1894M1-1911M12" (*Sammandrag af Bankernas Uppgifter*).

Figure 4: Compliance year by note issuance stop and note withdrawal

Timing of compliance with law Swedish note-issuing banks complied with law at different times. Figure 4 documents how many ULB banks stopped issuing notes (panel a)) and withdrew their notes completely from circulation (panel b)) in a given year. It is evident that even though the majority of banks stopped issuing new notes in 1902 (and hence got access to the Riksbank liquidity support thereafter), almost all the banks waited with withdrawing their notes until 1906, the legally imposed limit. It is important to note that between May 1897 and May 1901, only one bank complied (in 1899). This was the bank for which note issuance from January 1st, 1896, was a valid referral point. All the remaining banks stopped issuing new notes after May 1901, and thus, for them, note issuance from January 1st, 1901, was the referral number. The update in law complicates the interpretation of the data, since banks could react to the new regulation between May 1897 and May 1901, but we can nonetheless try to see whether summary statistics for banks by different compliance years delivers some information.

Table 12 provides the average value of selected variables for different vintages of compilers in May 1897, at the passage of the banking law, and in May 1901, at the update of the law. When it comes to the compliance with the end of note issuance, we see that the early complier (1899) had the lowest note to liability ratio (NtoLiab) in May 1897, even though it executed its note issuance rights to the highest extent. It was a relatively big bank with not too extensive lending and comparatively low share of non-performing assets. It had a ROA higher than the remaining banks. The banks that decided last to stop the issuance of new notes stand out as using most rights to issue notes in 1901 (even though their notes to liabilities were the lowest), having lowest equity ratio (ER), highest lending ratio (LtoA) and highest non-performing (NPA) loan share as of May 1897. At the same time, they were achieving relatively high ROE in 1897. When we look at different vintages of banks that completely withdrew their notes from circulation, the picture becomes less clear and only the relatively highest share of non-performing assets in 1897 stands out for late compliers as of May 1897. When looking at comparable numbers for

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Table 12: Summary statistics of compliant banks by compliance year in May 1897 and May 1901

	TI_{1896}	TI_{1901}	NtoLiab	ER	Log(TA)	LtoA	NPA	ROE	ROA
			Bank data for May 1897: the passage of the law						
			End of Note Issuance						
1899	78,92%	0,00%	11,28%	18,70%	17,26	29,09%	0,09%	8,25%	1,79%
1901	74,99%	73,04%	14,03%	19,18%	16,69	31,00%	0,12%	9,11%	1,46%
1902	63,18%	73,58%	12,61%	17,88%	16,40	26,83%	0,25%	8,12%	1,51%
1903	72,82%	84,64%	12,52%	16,66%	16,95	34,56%	0,37%	9,19%	1,53%
			Withdrawal of Outstanding Loans						
1899	78,92%	0,00%	11,28%	18,70%	17,26	29,09%	0,09%	8,25%	1,79%
1901	80,93%	42,38%	16,23%	20,76%	17,21	23,61%	0,20%	12,46%	1,53%
1903	73,80%	81,49%	12,48%	22,16%	16,80	31,47%	0,09%	9,82%	1,72%
1905	76,41%	73,30%	14,64%	18,18%	15,81	29,17%	0,24%	6,50%	1,21%
1906	66,40%	77,11%	12,72%	17,15%	16,62	29,84%	0,27%	8,48%	1,49%
			Bank data for May 1901: the update of the law						
			End of Note Issuance						
1899	78,92%	0,00%	0,00%	32,47%	17,83072	25,00%	0,18%	5,31%	1,76%
1901	74,99%	73,04%	10,48%	15,56%	17,21408	29,82%	0,27%	7,80%	1,33%
1902	63,18%	73,58%	10,29%	16,05%	16,81052	28,09%	0,31%	7,80%	1,31%
1903	72,82%	84,64%	10,73%	15,94%	17,33567	31,52%	0,33%	6,01%	0,93%
			Withdrawal of Outstanding Loans						
1899				32,47%	17,83072	25,00%	0,18%	5,31%	1,76%
1901	80,93%	42,38%	7,53%	21,35%	17,96242	27,23%	0,19%	8,01%	1,78%
1903	73,80%	81,49%	10,02%	15,06%	17,35723	32,27%	0,38%	7,25%	1,22%
1905	76,41%	73,30%	13,15%	17,88%	16,24553	29,19%	0,51%	8,00%	1,34%
1906	66,40%	77,11%	10,38%	15,55%	17,02621	29,03%	0,28%	7,32%	1,19%
1906	66,40%	77,11%	12,72%	17,15%	16,62	29,84%	0,27%	8,48%	1,49%

Source: The "Summary of the Banks' Activities, 1894M1-1911M12" (*Sammandrag af Bankernas Uppgifter*).

May 1901, we focus on compliers from 1901 on. We see that the banks that were last to resign from their right to issue notes were most dependent on note issuance, they had the highest lending ratio and most non-performing assets as of May 1901. At the same time, their ROE and ROA in 1901 were relatively low. Once we look at the banks who withdraw their notes from circulation last, we see that their ROE and ROA were actually among the highest, while their non-performing loans were not high. Thus, the link between different observables and the time of compliance is not clear and we test it's robustness running a simple regression analysis.

We run a predictive regression on the year of compliance:

$$y_{i,t} = \alpha + \beta \text{Treatment Intensity}_{i,t-1} + \gamma X_{i,t-1} + \epsilon_{i,t}, \tag{9}$$

where $y_{i,t}$ refers either to the difference of bank i's compliance year for the end of issuance right

Table 13: Determinants of earlier compliance of banks

	(1)	(2)	(3)	(4)	(5)	(6)
	compliance^{issue}			compliance^{circ}		
Treatment Intensity$_{1896}$	-17.248			-51.417*		
	(13.154)			(26.317)		
Treatment Intensity$_{1901}$		15.768			31.056	
		(12.751)			(36.896)	
Notes to Liability			15.727			91.666
			(74.543)			(140.575)
N	2349	2349	2349	2349	2349	2349
adj. R^2	0.047	0.043	0.022	0.148	0.110	0.098
Add. Controls	YES	YES	YES	YES	YES	YES
Bank FE	NO	NO	NO	NO	NO	NO
Time FE	YES	YES	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK	BANK	BANK

or withdrawal of outstanding notes, in comparison with the earliest compliance year. Controls include the extent of usage of note issuance right in 1896 and 1901, notes to liabilities ratio. The other control variables $X_{i,t-1}$ include lagged equity ratio, log of total assets, and lending to assets. In the regression, we take into account all our data until May 1901 We cannot include bank fixed effects because they would be co-linear with the treatment date. We cluster our results at the bank level. The regression results are presented in Table 13.

The first three columns present results for the banks' stop of issuing private bank notes, and the columns (4) – (6) for the compliance by withdrawal of circulating the bank notes. Columns (1) and (4) present the results linked to bank i's reliance on issuing notes, measured as the fraction of notes issuance to the legal maximum rights in 1896, and columns (2) and (5) to a similar definition but computed with the statistics in 1901. Columns (3) and (6) show results for the notes to total liability ratio, which can be viewed as another key measure of how much a bank relied on the notes issuance. First of all, lower usage of note issuing rights as of 1896 was associated with later compliance. However, when we look at the usage of note issuing rights as of 1901, the opposite is true but with statistically insignificant results. Other considered variables do not seem to be consistently significant, so on the basis of the data, it would be very hard to predict which bank would comply when. We also run an ordered probit model to predict the ordering of compliance for each banks. The results are very similar.

To sum up, the predictive regression exercise suggests that the banks' decision to comply with the law cannot be predicted with the treatment intensity of the bank or other relevant bank characteristics. [11]

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[11] The regression result suggests that the compliance dates of banks are not entirely predictable by observed variables. It is reasonable to consider the policy changes in this period in a staggered DiD setting. We leave it for future research.

Table 14: Substitution between notes and Riksbank loans

| | (1) |
	ΔRB loans
ΔNotes	-0.644***
	(0.134)
N	2655
adj. R^2	0.263
Add. Controls	YES
Bank FE	YES
Time FE	YES
Std. Err.	BANK

4.6 What filled the gap of notes in the banks' balance sheets?

In this subsection, we focus on the liability side of the note-issuing banks. Once the commercial banks stopped issuing notes, provided that they wanted to maintain the same size of the balance sheet, they had to substitute notes with some other type of funding. We want to examine what filled the gap of notes in the banks' balance sheets (if anything). To that avail, we run the following regression:

$$\Delta y_{i,t} = \alpha + \beta \Delta Notes_{i,t} + \gamma X_{i,t} + \delta_i + \eta_t + \epsilon_{i,t}, \tag{10}$$

where $\Delta y_{i,t}$ stands for the difference of chosen items on the liability side of banks' balance sheets and $\Delta Notes_{i,t}$ is the change in notes in circulation. $X_{i,t}$ is a vector of control variables including the ULB dummy, the cash ratio, logarithm of total assets, lending to assets ratio, and the equity ratio. Standard errors are clustered at the bank level, and we take into account bank and time fixed effects.

Table 14 presents the results. We find that when notes in circulation go down, they are substituted by the Riksbank loans. Other items on the liability side of the banks are not significantly linked to the change in Notes.[12] For brevity, we only report the coefficient for Riksbank loans. Note that our regression is only run for the period when banks stopped their new note issuance but still had outstanding circulating notes. The highly statistically significant coefficient of -0.644 indicates that when banks lower their notes in circulation by 1, the Riksbank loans increase by 0.64, remarkably close to the 65% limit imposed by the law. It is an indication of the binding limit and importance of 'haircuts' in lending. Banks were willingly using the Riksbank liquidity support to substitute the loss of notes issuance. On one hand, it allowed them to adapt their portfolios and cushion the losses, but on the other hand, it could have made the affected banks dependent on the preferential funding. In the next section, we test how bank outcomes were related to the Riksbank liquidity support.

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[12]The coefficient on postal notes is significant, but positive, so there is no substitution going on there.

4.7 Riksbank liquidity support and bank outcomes

In this section of the paper, we look at how Riksbank liquidity support was associated with bank outcomes. We know from previous sections that Riksbank loans cushioned profit losses related to the loss of seignorage and it could have supported lending against property collateral. We are interested in studying what effect Riksbank loans had on the risk-taking of banks and their subsequent performance. This is particularly important given that 1907 marks the begin of financial crisis, both internationally and in Sweden. Previous research shows that borrowing from the Riksbank was not a significant predictor of bank distress in that crisis, and that asset choices of banks were more associated with distress. In particular, Grodecka-Messi et al. (2021) show that high share of non-performing assets and high share of lending against shares were distress contributors. Grodecka-Messi et al. (2021) take into account all commercial banks that existed at the eve of the crisis in April 1907, including newly founded banks that would not have access to Riksbank liquidity support unless they were a restructured former ULB bank. In the following analysis, we take into account only banks that existed at the passage of the banking law in May 1897. We run regression

$$y_{i,t} = \alpha + \beta X_{i,t} + \eta \text{RB loan}_{i,t-j} + \delta_i + \eta_t + \epsilon_{i,t}, \tag{11}$$

where controls include the cash ratio, logarithm of total assets, and the ULB dummy, while RB loan is the share of Riksbank loans to total liabilities.

Table 15 shows how Riksbank loans correlate with different types of bank outcomes before and after April 1907 (the last pre-crisis month as defined in Grodecka-Messi et al., 2021). This regression takes into account all banks and the main variable of interest is the lagged ratio of Riksbank loans to assets. We do not find evidence of increased bank risk-taking and sequential worse performance in crisis times due to preferential Riksbank support. We show, however, that Riksbank liquidity in the crisis times supported banks' lending, in particular against property collateral. We find thus further supporting evidence for our *Hypothesis 2*.

4.8 The role of competition

The review of the theoretical literature indicates that banks should react differently to changes in the regulation, depending on whether they operate in monopolistic or competitive markets. In the Swedish case, all banks could establish branches and thus be considered as operating in a competitive market. Banks predominantly established branches in their county of origin, but some also had branches in other regions. We use the information about the headquarter location of each bank and the geography of Sweden to define a dummy Competition equal to 1 when a bank had its headquarter located in a highly populated region (these are present in the southern part of Sweden), and equal to 0 when the headquarter of the bank was located in one of the seven more remote or isolated regions: Jämtlands län, Norrbottens län, Västerbottens län, Västernorrlands län, Gävleborgs län, Gotlands län, Kopparbergs län. These regions, located mostly in the north of Sweden, are characterized by low population density

Table 15: Bank outcomes and the Riksbank liquidity support

	(1)	(2)	(3)	(4)	(5)	(6)	(7) Prop. Margin	(8) Prop. Int.Rate	(9) 3-m Dep. Int.Rate
	ROE	ROC	NPA	LtoA	Prop.%	Share%			
					Before May 1907				
RB Loan$_{t-1}$	0.046	0.085	-0.022	0.027	0.133	0.087	-0.330	0.266	-1.688**
	(0.068)	(0.109)	(0.019)	(0.235)	(0.178)	(0.132)	(0.770)	(0.845)	(0.726)
N	770	770	9808	9808	9808	9808	9386	9525	9527
adj. R^2	0.173	0.385	0.324	0.774	0.738	0.768	0.517	0.718	0.882
Add. Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK	BANK	BANK	BANK	BANK	BANK
					After May 1907				
RB Loan$_{t-1}$	-0.264	-0.113	0.104	2.003**	1.636***	-0.304	-0.832	1.245	2.919*
	(0.211)	(0.316)	(0.147)	(0.861)	(0.489)	(0.645)	(2.713)	(2.746)	(1.560)
N	386	386	4438	4438	4438	4438	4269	4435	4193
adj. R^2	0.532	0.648	0.436	0.849	0.935	0.817	0.714	0.790	0.926
Add. Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK	BANK	BANK	BANK	BANK	BANK

even today due to their geographical characteristics.

We then focus on chosen variables that were shown as significant in previous regressions, and test whether the coefficients of interest are different for banks operating in a more or less competitive region. Table 16 presents the results for 1903 (panels A and B) and 1906 (panels C and D) treatment dates. Panels A and C focus on banks operating in competitive regions, and panels B and D on banks operating in more monopolistic regions (due to geography). We see that the decline in the return ratios and increase in property lending rate and interest margin that we documented in previous sections, is driven by banks operating in the highly competitive environment. Banks operating in more remote regions, instead, reduce lending. These findings confirm our *Hypothesis 1*.

4.9 The role of the liability status of shareholders

Treated banks in our sample all had the ULB status at the passage of 1897 law. However, some of them converted to LLB, maintaining their right to preferential liquidity support. We test whether the liability regime under which shareholders operated mattered for banks' reaction to the ban on banknotes issuance and the resulting regulatory changes. We do not find a differential effect on bank-risk taking for ULB banks that changed their liability status. Neither the liability status itself (for which we control in all of our regressions), or its interaction with variables turn out to be important for our analysis (thus we cannot confirm parts of *Hypothesis 3*). We leave out these non-significant results from the paper.

5   Robustness checks

In the previous sections, we use different regression specifications to illustrate the effects of losing notes issuance rights on the profitability and business activities of Swedish banks. There are many policies with different effective dates in the period we considered. It is an interesting setting with multiple policies affecting the treated banks. To check the robustness of our results, we restrict our sample, we run a number of regressions with multiple interaction terms, or multiple treatment dates to tease out the potential heterogeneous effects from rounds of policy interventions.

5.1   Subsamples with bank selection, matching, and different periods

Our sample covers a long time period between 1894 and 1911, so there are new banks entering the sample over time. In order to prevent that the entries from new banks affect the estimation results, we do two separate exercises, restricting our sample to banks that existed in January 1894, and in January 1897.

The regression specification follows

$$y_{i,t} = \alpha + \beta \text{Treat}_i \times \text{After}_t + \gamma X_{i,t} + \eta \text{RB Loan}_{i,t-j} + \delta_i + \eta_t + \epsilon_{i,t},$$

as in the Section 4.3. The results are reported in the Appendix A.

The results from January 1894 and January 1897 appear to be consistent with the main findings in the regression 6. Banks that lost the notes issuance rights experienced lower returns (ROE and ROC), but the lending activities are not too much affected.

One potential concern is that not all banks in the defined control group are proper controls for former note-issuing banks. For instance, they do not satisfy the parallel-trends assumption or the findings are biased due to inadequate chosen entities in the control group. To gauge and mitigate this concern, we use propensity score matching to ensure that we compare the profitability and lendings of treated banks with the control group banks that are similar in size (logarithm of total assets) and have similar equity ratios. Our main empirical findings hold in the matched sample.[13]

The final years in our sample coincide with the 1907 financial crisis. Even though we have always included a time fixed effect in our regressions, we would like to understand whether our main findings are driven by the experience in the distressed periods only. We restricted the dataset to a panel data until April 1907, to test whether the results are mainly driven by the financial crisis at the end of our full sample. We can recover the same empirical findings in the shortened sample. The results are available upon request.

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[13]Results from this robustness check are available upon request.

5.2 Interacted control variables

We further expand the DiD regression to include the interaction terms of the control variables and the indicator of the after treatment periods After_t, so we can cleanly identify the effects of the policy changes isolated from other changes in the bank activities.

$$y_{i,t} = \alpha + \beta \text{Treat}_i \times \text{After}_t + \gamma X_{i,t} \times \text{After}_t + \eta \text{RB Loan}_{i,t-j} \times \text{After}_t + \delta_i + \eta_t + \epsilon_{i,t}. \quad (12)$$

The key dependent variable $y_{i,t}$ is similar to the previous regression, including variables on bank profitability, and lending activities (both the volume and the price information). Note that we consider multiple policy intervention dates, because there are a number of policies that happened during the historical episode. Tables 17 and 18 present the regression results. When we interact our control variables with the After treatment dummy, the negative result for ROC is still significant, and the return ratios are positively correlated with lending from the Riksbank for the 1903 treatment date. We confirm that Riksbank loans were associated with a shift towards lending against property collateral.

5.3 Multiple treatment dates

As a further robustness check, we run the regression with multiple treatment dates

$$y_{i,t} = \alpha + \beta_1 \text{Treat}_i \times \text{After}_t^{1903} + \beta_2 \text{Treat}_i \times \text{After}_t^{1906} + \gamma X_{i,t} + \eta \text{RB Loan}_{i,t-j} + \delta_i + \eta_t + \epsilon_{i,t}. \quad (13)$$

The main dependent variables include banks' profitability measures, the lending and deposit ratios of banks, and the interest rates at the bank level. The list of control variables include cash ratio, total assets (in logarithm), equity ratio, and the one-period lagged Riksbank loan. Similar to the econometric specification in previous sections, we include the bank fixed effects and time fixed effects in all regressions.

Table 19 reports the regression results from equation 13. The effects are close to the findings presented before. We can confirm that the date of withdrawal of outstanding notes was most detrimental to private banks' returns.

6 Conclusion

We use the Swedish central bank's currency monopoly that was announced in 1897 and effective in 1907 as a natural experiment that allows us to study the effects of the end of currency competition on private banks profitability and lending activities in the historical sample 1894–1911. We use monthly bank balance sheet, return and interest rate data to address questions related to bank credit, financial stability and currency competition. We find that banks' profitability is lower after the end of private money in circulation, however bank lending activities are not largely affected. Results differ depending on the degree of market competition in the region in which a given bank was operating. In competitive regions, banks experience relative

lower return ratios, despite an increase in interest rate margins. But the bank intermediation is unaffected, since banks do not want to lose their market share. For banks operating in remote areas with limited competition, this effect is not present, so we find some evidence of reduced lending. The overall results for bank returns and intermediation are similar to the findings for Canada in Grodecka-Messi and Zhang, 2023. Putting our results into current perspective, it is important to stress that nowadays, due to development of online banking, geographical location of banks plays limited role. Nonetheless, there is evidence of relationship banking that can be stronger in certain areas.

In anticipation of negative side-effects for previously note-issuing banks due to the loss of seigniorage, Riksbank note monopoly was accompanied by temporary liquidity support to affected banks. It gave them access to Riksbank credit at preferential interest rates. The majority of the support was uncollateralized. The liquidity support program by the Riksbank did not fully cover the profit loss due to the loss of seigniorage, but provided a buffer for the banks. However, we find that the Riksbank's liquidity support to note issuance banks did not lead to excessive risk taking of banks. Instead, being partly reliant on safe collateral, it led to a portfolio shift of the affected banks, increasing their lending against property collateral. These findings bring new insights into the effect of lender-of-last-resort policies, and the optimal design of such policies.

Our results highlight the effectiveness of central bank liquidity support. In the historical episode we studied, the Riksbank's liquidity support program did not lead to higher financial stability risk, instead it may have encouraged banks to grant more loans against property collateral and reduce other riskier loans. Our paper can provide the first empirical evidence on the private banks' profitability and credit granting activities during a shift from private to public money in the presence of preferential central bank transfers to the private banking sector. It can be considered as a first test of the recent literature on central bank liquidity support when central banks start to issue CBDC, see Brunnermeier and Niepelt (2019) and Chen and Filippin (2024).

The rich cross-sectional and time-series information on the Swedish banks allows us to draw important lessons for the modern banking system. The historical period under interesting policy changes and the establishment of central bank note monopoly provides a promising avenue to test effects of lender-of-last-resort policies, bank competition, and financial stability. We leave more detailed tests related to these policies for future research.

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Table 16: The role of competition for the results

	(1) ROE	(2) ROC	(3) Lending/Assets	(4) Prop. Loan	(5) Property Int.Margin	(6) Property Int.Rate
	Panel A: 1903 treatment date, high competition					
Treat X After	-0.010*	-0.021**	0.006	-0.017	0.094*	0.103**
	(0.005)	(0.009)	(0.041)	(0.036)	(0.055)	(0.048)
N	764	764	9902	9902	9330	9898
adj. R^2	0.353	0.617	0.673	0.673	0.487	0.898
	Panel B: 1903 treatment date, low competition					
Treat x After	-0.006	-0.019	-0.091**	-0.053*	0.028	0.146
	(0.016)	(0.022)	(0.034)	(0.027)	(0.167)	(0.183)
N	335	335	4419	4419	4403	4418
adj. R^2	0.179	0.249	0.866	0.889	0.630	0.841
	Panel C: 1906 treatment date, high competition					
Treat x After	-0.010**	-0.023***	0.006	-0.026	0.056	0.085*
	(0.004)	(0.008)	(0.037)	(0.031)	(0.059)	(0.049)
N	764	764	9902	9902	9330	9898
adj. R^2	0.354	0.621	0.673	0.674	0.486	0.898
	Panel D: 1906 treatment date, low competition					
Treat x After	-0.015	-0.031	-0.065***	-0.032**	0.053	0.142
	(0.012)	(0.019)	(0.023)	(0.014)	(0.109)	(0.113)
N	335	335	4419	4419	4403	4418
adj. R^2	0.182	0.254	0.866	0.888	0.630	0.842
Add. Controls	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK	BANK	BANK

Table 17: Effects on banks' profitability with expanded interactions

	(1) ROE	(2) ROA	(3) ROC	(4) Div%
	Panel A: 1903 treatment date			
Treat x After	-0.008	-0.000	-0.030***	-0.039
	(0.005)	(0.001)	(0.009)	(0.043)
Lagged RB Loan	-0.057	-0.007	-0.209	0.127
	(0.096)	(0.018)	(0.138)	(0.145)
Lagged RB Loan x After	0.199*	0.030	0.520***	0.798
	(0.103)	(0.020)	(0.173)	(0.899)
adj. R^2	0.246	0.386	0.432	0.069
	Panel B: 1906 treatment date			
Treat x After	-0.002	0.000	-0.022**	-0.094
	(0.005)	(0.001)	(0.008)	(0.098)
Lagged RB Loan	0.031	0.012	-0.024	0.057
	(0.044)	(0.009)	(0.083)	(0.072)
Lagged RB Loan x After	-0.083	-0.015	0.044	4.298
	(0.135)	(0.032)	(0.226)	(4.451)
adj. R^2	0.245	0.382	0.432	0.071
Add. Controls	YES	YES	YES	YES
N	1099	1099	1099	1098
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

Table 18: Effects on banks' business activities: with expanded interactions

	(1) Lending/Assets	(2) Prop. Loan	(3) Share Loan	(4) Deposit Ratio
	Panel A: 1903 treatment date			
Treat x After	-0.032	-0.082	0.045**	0.035
	(0.082)	(0.073)	(0.021)	(0.026)
Lagged RB Loan	0.161	-0.004	0.346*	0.257
	(0.289)	(0.190)	(0.176)	(0.180)
Lagged RB Loan x After	0.607	0.997**	-0.531*	0.062
	(0.536)	(0.385)	(0.284)	(0.570)
adj. R^2	0.705	0.746	0.690	0.669
	Panel B: 1906 treatment date			
Treat x After	-0.023	-0.073	0.048**	0.036
	(0.067)	(0.056)	(0.021)	(0.028)
Lagged RB Loan	0.179	0.134	0.254	0.321
	(0.288)	(0.214)	(0.162)	(0.198)
Lagged RB Loan x After	1.116	1.447***	-0.726	0.513
	(0.710)	(0.474)	(0.496)	(0.959)
adj. R^2	0.707	0.743	0.691	0.688
Add. Controls	YES	YES	YES	YES
N	14328	14328	14328	14328
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK
	(5) Prop. Loan Int. Margin	(6) ST Discount Int. Margin	(7) Prop. Loan Int. Rate	(8) 3-Month Dep. Int. Rate
	Panel A: 1903 treatment date			
Treat x After	0.073	0.093	0.108	0.021
	(0.083)	(0.090)	(0.072)	(0.063)
Lagged RB Loan	-0.596	-0.271	-1.215	-1.353*
	(1.073)	(0.865)	(1.066)	(0.742)
Lagged RB Loan x After	-1.553	-1.826	-0.914	1.406
	(1.304)	(1.400)	(1.269)	(0.965)
adj. R^2	0.690	0.700	0.879	0.895
	Panel B: 1906 treatment date			
Treat x After	0.074	0.141*	0.069	-0.004
	(0.089)	(0.085)	(0.073)	(0.053)
Lagged RB Loan	-0.422	-0.045	-0.641	-0.762
	(0.802)	(0.793)	(0.852)	(0.707)
Lagged RB Loan x After	-2.052	-2.154	0.491	2.954**
	(1.735)	(2.250)	(1.903)	(1.445)
adj. R^2	0.689	0.702	0.879	0.895
Add. Controls	YES	YES	YES	YES
N	13734	13795	14317	13799
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

Table 19: Effects on banks' profitability and business activities

	(1) ROE	(2) ROA	(3) ROC	(4) Div%
Treat x After[1903]	-0.005	-0.000	-0.008	-0.031
	(0.004)	(0.001)	(0.008)	(0.035)
Treat x After[1906]	-0.008*	-0.001	-0.023***	0.017
	(0.004)	(0.001)	(0.007)	(0.023)
Lagged RB Loan	0.040	0.009	0.026	0.900
	(0.053)	(0.010)	(0.093)	(0.912)
N	1099	1099	1099	1098
adj. R^2	0.244	0.382	0.432	0.073
Add. Controls	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK
	(5) Lending/Assets	(6) Prop. Loan	(7) Share Loan	(8) Deposit Ratio
Treat x After[1903]	0.001	-0.004	0.006	-0.007
	(0.024)	(0.020)	(0.009)	(0.022)
Treat x After[1906]	-0.020	-0.022*	0.010	0.006
	(0.018)	(0.013)	(0.011)	(0.021)
Lagged RB Loan	0.270	0.401***	0.077	0.284
	(0.221)	(0.129)	(0.140)	(0.218)
N	14328	14328	14328	14328
adj. R^2	0.705	0.735	0.683	0.652
Add. Controls	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK
	(9) Prop. Loan Int. Margin	(10) ST Discount Int. Margin	(11) Prop. Loan Int. Rate	(12) 3-Month Dep. Int. Rate
Treat x After[1903]	0.079*	-0.062	0.101**	0.066
	(0.042)	(0.054)	(0.043)	(0.048)
Treat x After[1906]	0.052	0.129**	0.085*	-0.006
	(0.045)	(0.053)	(0.043)	(0.032)
Lagged RB Loan	-1.055	-0.115	-1.071	-0.779
	(0.763)	(0.763)	(0.757)	(0.598)
N	13733	13794	14316	13798
adj. R^2	0.688	0.699	0.879	0.895
Add. Controls	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

A   Appendix: robustness checks with different sub-samples

Table A1: Effects on banks' profitability: the 1894 sample

	(1) ROE	(2) ROA	(3) ROC	(4) Div%
	Panel A: 1903 treatment date			
Treat x After	-0.008	-0.001	-0.022**	-0.001
	(0.006)	(0.001)	(0.010)	(0.004)
Lagged RB Loan	0.087	0.011	0.149	0.047
	(0.064)	(0.011)	(0.101)	(0.056)
adj. R^2	0.147	0.259	0.315	0.356
	Panel B: 1906 treatment date			
Treat x After	-0.009	-0.001	-0.026***	-0.003
	(0.007)	(0.001)	(0.009)	(0.003)
Lagged RB Loan	0.028	0.004	-0.010	0.033
	(0.048)	(0.009)	(0.089)	(0.047)
adj. R^2	0.148	0.260	0.318	0.357
Add. Controls	YES	YES	YES	YES
N	655	655	655	654
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

Table A2: Effects on banks' business activities: the 1894 sample

	(1) Lending/Assets	(2) Prop. L. Ratio	(3) Share L. Ratio	(4) Deposit Ratio
	Panel A: 1903 treatment date			
Treat x After	-0.041	-0.034	0.009	0.005
	(0.058)	(0.052)	(0.019)	(0.048)
Lagged RB Loan	0.121	0.329**	0.120	-0.366
	(0.262)	(0.150)	(0.165)	(0.337)
adj. R^2	0.630	0.658	0.695	0.664
	Panel B: 1906 treatment date			
Treat x After	-0.041	-0.032	0.010	0.009
	(0.049)	(0.041)	(0.021)	(0.047)
Lagged RB Loan	-0.140	0.127	0.187	-0.309
	(0.326)	(0.258)	(0.163)	(0.438)
adj. R^2	0.630	0.657	0.695	0.664
Add. Controls	YES	YES	YES	YES
N	8453	8453	8453	8453
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

	(5) Prop. Loan Int. Margin	(6) ST Discount Int. Margin	(7) Prop. Loan Int. Rate	(8) 3-Month Dep. Int. Rate
	Panel A: 1903 treatment date			
Treat x After	0.126**	-0.040	0.138**	0.056
	(0.054)	(0.077)	(0.057)	(0.051)
Lagged RB Loan	-1.176	-1.143	-1.607**	-1.250**
	(0.866)	(0.808)	(0.777)	(0.555)
adj. R^2	0.679	0.630	0.878	0.913
	Panel B: 1906 treatment date			
Treat x After	0.098	0.045	0.127**	0.045
	(0.067)	(0.070)	(0.061)	(0.041)
Lagged RB Loan	-0.598	-0.823	-0.796	-0.967
	(0.845)	(0.810)	(0.827)	(0.628)
adj. R^2	0.679	0.630	0.878	0.913
Add. Controls	YES	YES	YES	YES
N	7929	8392	8442	8394
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

Table A3: Effects on banks' profitability: the 1897 sample

	(1) ROE	(2) ROA	(3) ROC	(4) Div%
	Panel A: 1903 treatment date			
Treat x After	-0.010**	-0.001	-0.022**	0.003
	(0.005)	(0.001)	(0.008)	(0.004)
Lagged RB Loan	0.083	0.013	0.154*	0.034
	(0.055)	(0.010)	(0.089)	(0.054)
adj. R^2	0.169	0.280	0.360	0.345
	Panel B: 1906 treatment date			
Treat x After	-0.008*	-0.001	-0.023***	0.001
	(0.005)	(0.001)	(0.007)	(0.003)
Lagged RB Loan	0.012	0.007	-0.031	0.047
	(0.043)	(0.008)	(0.081)	(0.045)
adj. R^2	0.169	0.280	0.362	0.344
Add. Controls	YES	YES	YES	YES
N	791	791	791	790
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

Table A4: Effects on banks' business activities: the 1897 sample

	(1) Lending/Assets	(2) Prop. L. Ratio	(3) Share L. Ratio	(4) Deposit Ratio
	Panel A: 1903 treatment date			
Treat x After	-0.018	-0.025	0.019	-0.003
	(0.041)	(0.035)	(0.017)	(0.039)
Lagged RB Loan	0.115	0.392***	-0.019	0.013
	(0.224)	(0.128)	(0.153)	(0.318)
adj. R^2	0.641	0.679	0.637	0.631
	Panel B: 1906 treatment date			
Treat x After	-0.016	-0.028	0.023	0.003
	(0.037)	(0.029)	(0.017)	(0.038)
Lagged RB Loan	-0.006	0.176	0.163	0.038
	(0.264)	(0.208)	(0.152)	(0.296)
adj. R^2	0.641	0.679	0.638	0.631
Add. Controls	YES	YES	YES	YES
N	10158	10158	10158	10158
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK
	(5) Prop. Loan Int. Margin	(6) ST Discount Int. Margin	(7) Prop. Loan Int. Rate	(8) 3-Month Dep. Int. Rate
	Panel A: 1903 treatment date			
Treat x After	0.152***	-0.010	0.144***	0.024
	(0.048)	(0.068)	(0.051)	(0.051)
Lagged RB Loan	-2.007**	-0.946	-2.057***	-1.161**
	(0.787)	(0.856)	(0.763)	(0.530)
adj. R^2	0.662	0.637	0.877	0.905
	Panel B: 1906 treatment date			
Treat x After	0.154***	0.049	0.147**	0.023
	(0.056)	(0.065)	(0.056)	(0.040)
Lagged RB Loan	-0.847	-0.554	-0.909	-0.987
	(0.768)	(0.833)	(0.773)	(0.621)
adj. R^2	0.663	0.637	0.877	0.905
Add. Controls	YES	YES	YES	YES
N	9590	9905	10147	9908
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

B   Appendix: other potential treatment dates

Table A5: Effects on banks' profitability: other dates

	(1) ROE	(2) ROA	(3) ROC	(4) Div%
	Panel A: 1897 treatment date			
Treat x After	-0.000	-0.001	-0.005	0.002
	(0.011)	(0.002)	(0.013)	(0.007)
Lagged RB Loan	0.068	0.015	0.118*	0.689
	(0.043)	(0.009)	(0.071)	(0.658)
adj. R^2	0.241	0.381	0.424	0.074
	Panel B: 1899 treatment date			
Treat x After	-0.015	-0.003**	-0.019	-0.005
	(0.009)	(0.002)	(0.013)	(0.005)
Lagged RB Loan	0.064	0.014	0.115	0.687
	(0.043)	(0.009)	(0.070)	(0.657)
adj. R^2	0.245	0.387	0.426	0.074
Add. Controls	YES	YES	YES	YES
N	1099	1099	1099	1098
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK

Table A6: Effects on banks' business activities: other dates

	(1) Lending/Assets	(2) Prop. L. Ratio	(3) Share L. Ratio	(4) Deposit Ratio
	Panel A: 1897 treatment date			
Treat x After	0.010	0.012	-0.013	0.025
	(0.022)	(0.018)	(0.013)	(0.018)
Lagged RB Loan	0.467*	0.617***	-0.030	0.250
	(0.272)	(0.146)	(0.158)	(0.353)
adj. R^2	0.705	0.734	0.683	0.653
	Panel B: 1899 treatment date			
Treat x After	0.014	0.013	0.002	0.014
	(0.022)	(0.018)	(0.010)	(0.017)
Lagged RB Loan	0.468*	0.615***	-0.019	0.239
	(0.272)	(0.147)	(0.155)	(0.351)
adj. R^2	0.705	0.734	0.682	0.652
Add. Controls	YES	YES	YES	YES
N	14328	14328	14328	14328
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK
	(5) Prop. Loan Int. Margin	(6) ST Discount Int. Margin	(7) Prop. Loan Int. Rate	(8) 3-Month Dep. Int. Rate
	Panel A: 1897 treatment date			
Treat x After	-0.100	0.032	-0.005	0.122*
	(0.073)	(0.103)	(0.077)	(0.072)
Lagged RB Loan	-1.628**	-1.273	-1.912***	-0.658
	(0.765)	(0.859)	(0.718)	(0.558)
adj. R^2	0.688	0.698	0.878	0.896
	Panel B: 1899 treatment date			
Treat x After	-0.032	-0.009	0.014	0.099
	(0.077)	(0.089)	(0.076)	(0.065)
Lagged RB Loan	-1.574**	-1.302	-1.900***	-0.694
	(0.762)	(0.855)	(0.712)	(0.556)
adj. R^2	0.687	0.698	0.878	0.896
Add. Controls	YES	YES	YES	YES
N	13733	13794	14316	13798
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES
Std. Err.	BANK	BANK	BANK	BANK