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**Supervision without Regulation:  
Discount Limits at the Austro-Hungarian  
Bank, 1909-1913**

Kilian Rieder and Clemens Jobst

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# Supervision without Regulation: Discount Limits at the Austro-Hungarian Bank, 1909-1913

*Kilian Rieder and Clemens Jobst*

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33 Great Sutton Street, London EC1V 0DX, UK  
Tel: +44 (0)20 7183 8801  
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## Abstract

We show that European central banks used credit limits for discount loans as a means to enforce supervisory standards long before they had any formal regulatory powers. Drawing on novel micro data from the Austro-Hungarian Bank's archives, we document that credit limits were continuously monitored and that their size was contingent on counterparties' liquidity and capital position. Counterparties had an incentive-compatible economic motive to abide by informal prudential "rules of the game": higher credit limits enabled counterparties to streamline their day-to-day liquidity management. We exploit the heterogeneous exposure of counterparties to an exogenous liquidity shock to evidence that the Bank relaxed credit limits during crises to fulfill its role as a lender of last resort.

JEL Classification: E58, G28, N13, N23

Keywords: lender of last resort, banking regulation, central bank lending, Liquidity Crisis, credit limits

Kilian Rieder - [kilian.rieder@oenb.at](mailto:kilian.rieder@oenb.at)  
*Oesterreichische Nationalbank (Eurosystem) and CEPR*

Clemens Jobst - [clemens.jobst@univie.ac.at](mailto:clemens.jobst@univie.ac.at)  
*University of Vienna, Oesterreichische Nationalbank and CEPR*

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# Supervision without Regulation: Discount Limits at the Austro-Hungarian Bank, 1909-1913

Clemens Jobst\*

Kilian Rieder†

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*We show that European central banks used credit limits for discount loans as a means to enforce supervisory standards long before they had any formal regulatory powers. Drawing on novel micro data from the Austro-Hungarian Bank's archives, we document that credit limits were continuously monitored and that their size was contingent on counterparties' liquidity and capital position. Counterparties had an incentive-compatible economic motive to abide by informal prudential "rules of the game": higher credit limits enabled counterparties to streamline their day-to-day liquidity management. We exploit the heterogeneous exposure of counterparties to an exogenous liquidity shock to evidence that the Bank relaxed credit limits during crises to fulfill its role as a lender of last resort.*

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\*Department of Economic and Social History, University of Vienna & Centre for Economic Policy Research (CEPR). Universitätsring 1, 1010 Vienna, Austria. Email to [clemens.jobst@univie.ac.at](mailto:clemens.jobst@univie.ac.at).

†Economic Analysis and Research Department, Oesterreichische Nationalbank (Eurosystem) & Centre for Economic Policy Research (CEPR). Otto Wagner Platz 3, 1090 Vienna, Austria. Email to [kilian.rieder@oenb.at](mailto:kilian.rieder@oenb.at).

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Reminiscent of developments in 2007-08, the market turmoil at the onset of the COVID-19 pandemic in March 2020 has revived calls arguing that financial intermediaries' repeated access to the central bank balance sheet during crises should go hand in hand with tighter prudential supervision (Aramonte et al., 2021; Capotă et al., 2021; Carstens, 2021; ESMA, 2021; FSB, 2021; Grill et al., 2022). The economic rationale for this argument is well-known. While lenders of last resort can mitigate the negative financial and real effects of liquidity shocks (Richardson and Troost, 2009; Bernstein et al., 2010; Duygan-Bump et al., 2013; Gorton and Metrick, 2013; Drechsler et al., 2016; Garcia-de Andoain et al., 2016), public liquidity provision may also invite moral hazard (Anderson et al., 2018; Calomiris et al., 2021). Anticipating central bank support, financial institutions have an incentive to downsize their holdings of non-interest bearing liquid assets (Carlson and Wheelock, 2018) and may even gamble for survival at the discount window (Freixas et al., 2004). By reducing aggregate financial sector liquidity, individually optimizing behavior can foster fragile short-term borrowing and diminish the financial system's resilience to systemic shocks and contagion (Anderson et al., 2020). Hence, an important goal of state-of-the-art financial regulation is to alleviate these externalities by imposing minimum liquidity standards (Carlson et al., 2015).<sup>1</sup>

Against this modern background, the extensive history of lending of last resort in Europe raises an important question: how did European central banks, which had been orchestrating liquidity support at least since the mid-18th century (Bignon et al., 2012; Ugolini, 2017; Bindseil, 2019), deal with moral hazard (long) before they first received formal regulatory powers in the interwar period (Turner, 2014; Hotori et al., 2022)? In this paper, we provide a novel answer to this question. We focus on the period before World War I, when a majority of central bank counterparties in Europe, including large joint-stock universal banks, still operated "in the shadows" by modern standards. We show that 19th and early 20th century European central banks used credit limits for discount loans as a means to control the liquidity and capital adequacy of their borrowers.

Credit limits were in force at all major banks of issue, including the Bank of England, Banque de France and Banca d'Italia (Calomiris et al., 2016).<sup>2</sup> The limits determined the maximum exposure to an individual counterparty the central bank was willing to hold on its balance sheet. Compliance with the limits was continuously monitored by central bank staff and the limits had to be respected in non-crisis times. The central bank made the size of individual limits contingent on its counterparties' liquidity and capital position. Good behavior and sound balance sheets were rewarded with a higher credit limit. Imprudent counterparties saw their allowance reduced or cancelled. Central banks had no legal mandate to define specific minimum regulatory standards and firms were under no legal obligation to obtain a credit limit. Yet, borrowers had an incentive-compatible economic

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<sup>1</sup>In response to the financial crisis of 2007–2008, the Basel III framework introduced new global liquidity standards with the explicit aim of minimizing reliance on central bank funding during future crises (Basel Committee on Banking Supervision, 2013).

<sup>2</sup>In the 1920s, the U.S. Federal Reserve System also used credit limits. Known to contemporaries as basic lines, these limits were calculated individually for each member bank on the basis of its reserves and capital position (Wallace, 1956; Rieder, 2021). Unlike in most European countries, however, U.S. banks were subject to federal or state regulation including capital and reserve requirements long before the foundation of the Federal Reserve System (White, 1984, 2009).

motive to abide by these “rules of the game”: higher credit limits enabled counterparties to further streamline their day-to-day liquidity management. All else equal, counterparties with sizeable allowances benefited from reduced liquidity management costs relative to a situation without regular or reliable discount window access.

To explain how this system of credit limits worked in practice, we focus on the experience of the Austro-Hungarian Bank (*Oesterreichisch-ungarische Bank*, OeUB). The Bank’s archives provide unique information on credit limits (so called *Personalkredite*) and their role in day-to-day lending operations. We hand-collected credit limits for 3,400 individual counterparties between 1909 and 1913, covering both normal times and crisis episodes. We classify counterparties according to their field of business and we match credit limits to the corresponding firm-level balance sheets. We draw on these novel data to furnish the following results. First, our descriptive analysis reveals that credit limits represented a key feature of OeUB’s counterparty risk management framework. Across all types of counterparties, the Bank paid particular attention to the absolute level of firm equity and personal wealth when assessing credit limits. Second, the OeUB regularly justified changes in credit limits by referring to the borrowers’ current financial position in terms of leverage, asset liquidity and refinancing risk. These leverage- and liquidity-related considerations played a more important role for the credit limits of financial intermediaries than for those of non-financial institutions – an intuitive finding, given the special risks associated with maturity transformation. Third, controlling for time and counterparty fixed effects, we confirm econometrically that liquidity and leverage ratios represented significant determinants of the size of credit limits. Fourth, we use survival analysis techniques to show that the OeUB enforced credit limits as a maximum ceiling for discount window loans in normal times.

Counterparty-specific credit limits seem to stand in direct contradiction to the notion of a lender of last resort *à la Bagehot* (1873). It is hard to imagine how free lending during a liquidity crisis could square with the OeUB’s enforcement of individual *Personalkredite*. We argue that this apparent contradiction was null and void in practice because the OeUB operationalized its discount credit limits as a system of “contingent rules”. To illustrate how this system worked in a crisis and why it was compatible with the Bagehotian lender of last resort function, we study the banking panic of 1912 (Jobst and Rieder, 2016). The panic was triggered by a looming war with Russia and provides a plausibly exogenous source of liquidity distress. Financial institutions that were located in the border regions with Russia or entertained significant business relations in these regions experienced large deposit withdrawals. We exploit counterparties’ geographically heterogeneous exposure to this exogenous liquidity shock as an instrumental variable for bank-level deposit withdrawals. We show that counterparties’ exposure to the shock caused the Bank to temporarily tolerate large transgressions of credit limits and to deploy emergency clauses suspending the strict enforcement of *Personalkredite* in return for additional collateral. To be sure, there was also a crucial flipside to this extraordinary accommodation in crisis times. Once the panic had abated, the OeUB used its informal regulatory powers to impose a strict resolution and deleveraging regime on counterparties whose large-scale liquidity needs and transgressions it deemed to be “homemade” rather than exogenously driven. This

“carrots and sticks” approach meant that the Bank did not implicitly endorse imprudent behavior in the run-up to the crisis by indiscriminately relaxing credit limits during the panic.

This paper contributes to several literatures. First, we provide a new explanation for how lenders of last resort counteracted moral hazard (long) before legally mandated microprudential regulation became the standard. While earlier studies emphasize the role of penalty rates to incentivize proper liquidity management in normal times (Humphrey and Keleher, 1984; Crockett, 1996), more modern accounts tend to discard this hypothesis based on a re-interpretation of Bagehot’s doctrine (Martin, 2009; Bignon et al., 2012; Castiglionesi and Wagner, 2012), arguments related to adverse selection (Stiglitz and Weiss, 1981) and negative signaling (Freixas et al., 1999). Others refer to “constructive ambiguity” regarding the central bank’s willingness to assume lender of last resort responsibilities as an effective strategy to foster proper risk management (Freixas, 2000).<sup>3</sup> This last approach in turn suffers from an inherent time-inconsistency problem due to potential political pressures and the central bank’s own exposure to the financial system in a crisis.<sup>4</sup> Moreover, residual ambiguity concerning public liquidity provision likely obviates the latter’s original rationale to nip financial panics in the bud. Building on a recent literature stressing the importance of supervision and monitoring in central bank operations (Flandreau and Ugolini, 2013, 2014; Carlson et al., 2015; Avaro and Bignon, 2019), we argue that banks of issue employed incentive-compatible systems of credit limits to reign in moral hazard temptations in normal times.

Second, we add a novel interpretation of the economic rationale underlying the early use of central bank credit limits. Calomiris et al. (2016) conjecture that credit limits served to formalize lending standards, while ensuring impartiality and inter-temporal consistency. Flandreau and Ugolini (2013, 2014) mention the Bank of England’s use of counterparty rating books including quantitative borrowing limits during the 19th century. Molteni (2020) briefly refers to the existence of credit limits (known as *castelletti*) at the Banca d’Italia in the 1920s and 1930s. Rieder (2021) shows that several U.S. Federal Reserve Banks made use of credit limits (so called basic lines) to design financial stability policies in the early 1920s.<sup>5</sup> In our paper, we document the role of credit limits in day-to-day lending operations and we describe their wider rationale as a proto-regulatory tool.<sup>6</sup>

Third, we show that European central banks’ systems of credit limits may be likened to – but also substantially differed from – proto-regulatory practices in the United States. The European approach of conducting “supervision without regulation” may be best compared to early episodes of American banking history. By regularly forcing state banks to redeem their notes in specie, the First and Second Banks of the United States found ways

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<sup>3</sup>Bagehot (1873) himself would have likely opposed these tactics because he argued that the Bank of England’s policies in crisis situations should be fully transparent and known *ex ante*.

<sup>4</sup>Self-interested motives might have been particularly prevalent in the past when central banks still operated as private institutions which answered to their shareholders. Evidence on this front is mixed, c.f. Bartels et al. (2016) and Calomiris et al. (2016).

<sup>5</sup>These practices have to be distinguished from the use of credit limits for monetary policy aimed at controlling aggregate credit growth. Monnet (2014) describes how the Banque de France employed rediscount ceilings and credit limits as monetary policy instruments in the post-World War II era.

<sup>6</sup>Okazaki (2007) notes that the Bank of Japan granted discount window access to counterparties based on financial criteria, including the liquidity of the counterparties’ balance sheet.

to influence state banks' risk-taking without formal regulatory authority (Holdsworth and Dewey, 1910; Redlich, 1951; Hammond, 1957; Knodell, 2016). In contrast to the practices of the First and Second Banks of the United States, however, European systems of credit limits entailed the maintenance and periodical updating of a sophisticated in-house apparatus of proprietary information on central bank counterparties. Credit limits represented explicit discounting ceilings which were tailored to counterparty-specific characteristics and revised at least once a year. In addition, credit limits did not only aim at containing the risk-taking of financial institutions, but applied to all eligible central bank counterparties, including non-financial companies and wealthy individuals.

Finally, we contribute to a growing literature exploiting the impact of exogenous capital and liquidity shocks on financial systems to inform the design of appropriate policy responses. Carlson et al. (2011) show how targeted liquidity provision by the Federal Reserve Bank of Atlanta helped mitigating a looming panic in Florida following a local solvency shock in 1929. Frydman et al. (2015) argue that the consequences of runs on trust companies during the panic of 1907 may have been prevented in the presence of an effective lender of last resort for this type of "shadow banks". Bignon and Jobst (2017) provide results suggesting that broader central bank eligibility criteria dampened the economic effects of a geographically heterogeneous solvency shock in 19th century France. In this paper, we focus on the rationale for central bank liquidity provision. We connect bank-specific exposures to an exogenous liquidity shock directly to micro-level data on the central bank's policy response. We marshal evidence that the Austro-Hungarian Bank channeled liquidity to financial institutions affected by the exogenous shock but imposed *ex post* sanctions on counterparties with weak fundamentals.

This paper is organized as follows. In Section 1, we briefly summarize the historical and institutional background. Section 2 explains our main argument in the form of research hypotheses. Section 3 describes our primary sources and presents the new data sets compiled for this paper. Section 4 provides descriptive and econometric evidence on the implementation of the OeUB's system of credit limits in normal times. Section 5 investigates how the OeUB handled credit limits during the panic of 1912. Section 6 concludes. A detailed online appendix complements the paper.<sup>7</sup>

# 1 Historical background

## 1.1 Institutional setting

The Austrian National Bank (*Oesterreichische Nationalbank*) was established in 1816 as a privately owned stock company. The Bank enjoyed the note-issuing monopoly in the Austro-Hungarian monarchy.<sup>8</sup> To reflect the bi-national structure of the Empire, the Bank was renamed Austro-Hungarian Bank (*Oesterreichisch-ungarische*

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<sup>7</sup>The online appendix can be downloaded here: <https://tinyurl.com/yckzywx3>.

<sup>8</sup>For a detailed account of the OeNB's institutional history, see Jobst and Kernbauer (2016).



*Bank, Osztrák-magyar bank*) in 1878 and received two head offices (*Hauptanstalten*) in Vienna and Budapest, headed by two directorates (*Direktionen*). The key decision powers resided with the Governing Council placed at the central level, above the two directorates.<sup>9</sup> The responsibilities of the General Council notably comprised the setting of interest rates, the definition of the general terms and conditions for all central bank lending operations, the management of the Bank's reserve assets and the establishment of branch offices.<sup>10</sup> The two directorates in turn monitored the Bank's discount lending in each half of the Empire. The directorates also appointed the head of branch offices and the so-called discount censors (*Zensoren*) for each branch. Censors formed the local discount committees responsible for taking decentralized lending decisions.<sup>11</sup> Censors were usually chosen among highly reputable individuals from the local business community. The Bank did not pay censors for their services but the latter could continue to exercise a remunerated position in a local firm.<sup>12</sup>

In principle, all firms and wealthy individuals domiciled in Austria-Hungary had the possibility to obtain central bank funding from the OeUB's discount window. Discount window access was not limited to financial institutions. The discount window was organized as a standing facility: the central bank defined the general lending conditions, but the actual transactions had to be initiated by the central bank's counterparties. In discount operations, the Bank bought bills of exchange with a short initial or remaining maturity at a discount to their nominal value (the so-called discount rate). Thus, strictly speaking, standard discounts by the OeUB and other contemporary European central banks did not represent loans. Unlike in the case of the U.S. Federal Reserve System, central bank discounts constituted unsecured outright purchases which did not require the posting of additional collateral. Although Bagehot's famous guiding principles for the effective provision of last resort liquidity include a warning to "only lend against good collateral" (Bagehot, 1873), the original reference likely referred to the Bank of England's secured lending arm, and not to its discount window purchases.<sup>13</sup> Alternatively, Bagehot's reference to "good collateral" may also be interpreted as a plea to discount only top-notch bills of exchange (Bignon et al., 2012). Yet, due to its unsecured character, the quality of a discount depended solely on the ability of the selling counterparty and/or the endorser (often called "acceptor") to honor the bill at maturity (Accominotti et al., 2021). Hence, even though the safety of bill purchases was augmented by specific legal provisions such as joint liability (Santarosa, 2015), discounting required central banks to operate sophisticated risk control and monitoring frameworks. The OeUB's system of credit limits partly served this purpose.

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<sup>9</sup>The General Council was composed of the governor, the two chairmen of the Vienna and Budapest directorates acting as vice governors, and additional members from each of the two directorates. The General Council also contained members elected by the shareholder assembly.

<sup>10</sup>By 1900, the Bank entertained an extensive network of branches throughout the monarchy (Jobst, 2010).

<sup>11</sup>For more details regarding lending decisions, see Appendix A.1.

<sup>12</sup>A managing position in a local commercial bank was no exclusion criterion for becoming a censor. Censors could not vote on bills submitted by their own firm.

<sup>13</sup>Besides discounts, the Bank also granted advances (secured loans, also known as *Lombards*). Since the Bank's system of credit limits only applied to discount window lending, we do not discuss advances in this paper. For more details on the Bank's lending facilities, see Appendix A.1.

## 1.2 The system of credit limits

The system of discount credit limits was introduced in 1878 when the OeNB was re-chartered as the Austro-Hungarian Bank (Leonhardt, 1886).<sup>14</sup> This institutional change in the credit risk management framework of the OeNB's discount business had three main reasons. First, centralized control over lending activities at the Bank's branches had proven problematic over the preceding decades. Credit decisions at the branch-level had been difficult to oversee and the quality of discounted bills had not always been uniform across locations (Lucam, 1876). At the same time, the renewal contract of its note-issuing privilege in 1878 required the Bank to open yet another series of new branches across the Empire. Thus, the renegotiation of the Bank's charter with the Austrian and the Hungarian governments provided a fitting occasion to revamp lending operations. Second, after 1878, the branch directors presided over the colleges of censors and received a veto right on lending decisions (Leonhardt, 1886).<sup>15</sup> To guarantee that branch directors did not engage in discriminatory practices but instead followed harmonized rules in their considerations, it became necessary to introduce a uniform lending framework for the entire Empire. Finally, the Austro-Hungarian Bank also had to fulfill the delicate mission of providing fair and equal access to central bank services for all firms and nationalities in the monarchy. In the years preceding 1878, the Bank had often been accused of discriminating against particular nationalities or ethnic minorities (Jobst and Kernbauer, 2016). Officially re-chartered as the Austro-Hungarian Bank, the Bank faced even more explicit pressure to act on these allegations. The management seized the occasion of the institutional re-organization to create a framework that would allow forestalling complaints about discriminatory treatment in the future.

Individual credit limits governed all discount window transactions of the Bank.<sup>16</sup> Credit limits, known to contemporaries as *Personalkredite*, put a ceiling on the Bank's discounting exposure vis-à-vis its counterparties. Bank officials monitored counterparties' compliance with this ceiling. The term "exposure" was defined to include both, the total amount the counterparty had directly discounted "with" the Bank (as a discounter) and the total amount of bills others had discounted "upon" the counterparty by submitting bills featuring the counterparty's signature (i.e. implicating the counterparty as an acceptor). Hence, at the end of any given day  $t$ , the Bank's exposure to counterparty  $c$  included all bills implicating  $c$  previously discounted with the Bank that had not yet matured, plus bills featuring  $c$  discounted on day  $t$ , minus previously discounted bills involving  $c$  maturing during day  $t$ . Counterparty  $c$  could therefore transgress its credit limit due to one of two reasons: either  $c$  had heavy active recourse to the discount window as a discounter and/or a third party discounted large amounts of paper implicating  $c$ .<sup>17</sup>

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<sup>14</sup>Our description draws on the so called *Dienstunterricht für die Beamten der Oesterreichisch-ungarischen Bank* ("On-the-job education for officers of the Austro-Hungarian Bank"), a manual which contains detailed information on the day-to-day operation of the Bank's business areas.

<sup>15</sup>Before 1878, the local censors had the sole power to decide upon the acceptance or rejection of a bill at the discount window.

<sup>16</sup>Credit limits did not regulate *ad hoc* discount window credit, so called *Zensurkredite*. *Zensurkredite* were granted on a case-by-case basis to firms which had not (yet) received an individual credit limit. Firms could be considered for *Zensurkredite* if they possessed sufficient collateral and as long as the counterparties' total amount of *ad hoc* loans did not transgress an internally set maximum sum.

<sup>17</sup>The discount of paper accepted by  $c$  did not necessarily have to take place in the same bank district. To keep track of

At each branch office, the local discount college (*Zensorenkollegium*) regularly revised credit limits of local firms and individuals based on public and private information. Revisions took place at least once a year. Changes to the local list of credit limits could occur due to any one of the following reasons: (1) the introduction of a new counterparty<sup>18</sup>; (2) the increase of an existing limit; (3) the decrease of an existing limit; (4) the elimination of a counterparty from the list of *Personalkredite*<sup>19</sup>; (5) the amalgamation or separation of counterparties due to mergers or the dissolution of an existing firm or partnership; (6) the renaming of a counterparty; and (7) changes in the form of incorporation of a counterparty. The summaries of the review process did usually not bear explanations as to why a certain counterparty should be newly introduced to the credit list or receive a higher credit limit. Reductions in the limits and eliminations from the list, however, always included a justification or comment explaining the proposed change.

The reviews of individual credit limits followed clearly stipulated internal OeUB guidelines. These rules instructed local discount colleges to not revise credit limits on the basis of current Bank exposures to specific counterparties and, in any case, independently of a counterparty's current as well as previous recourse to the discount window. Instead, the colleges' main focus of attention needed to be placed on the solvency, liquidity, general business situation and management quality of the examined counterparty. The assigned credit limit was generally not to exceed the liquid assets of the counterparty under review. In fact, the limit could be considerably smaller than the liquid reserves maintained by the counterparty, in particular if it was known that the person/firm in question also heavily discounted with other financial institutions. Moreover, the Bank established a whole set of additional procedural rules for its dealings with proper legal entities, which included, *inter alia*, most of the financial sector (e.g. joint-stock banks, credit cooperatives and savings banks).<sup>20</sup> Finally, counterparties could not receive multiple limits from several branch offices. The standard was a single *Personalkredit* per counterparty, granted by the branch office responsible for the Bank district in which the person/firm under review was domiciled.

Once the proposals for the altered limits had been agreed upon by the discount college, the list was passed on to the head of the branch who could add further counterparties or suggest a different credit limit than the one proposed by the *Zensorenkollegium*.<sup>21</sup> The revised lists of credit limits were subsequently sent to the responsible directorate in Budapest or Vienna for their final approval. When sending the revised credit lists to the respective directorates, the branch offices were also under the obligation to attach the balance sheets, and where applicable the statutes, of all incorporated companies, such as joint-stock firms or credit cooperatives. Since the directorates in Budapest and Vienna could only review a limited amount of branch lists per meeting, branches distributed their

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developments elsewhere, branch offices were in close contact with each other.

<sup>18</sup>A new introduction meant the counterparty in question was assigned a *Personalkredit* for the first time.

<sup>19</sup>An elimination meant a downgrading of a *Personalkredit* counterparty to *Zensurkredit* status, unless the elimination from the list resulted from a permanent closure of business.

<sup>20</sup>We describe these guidelines in more detail in appendix A.2.

<sup>21</sup>If the college of censors remained internally divided with regard to the size of (the change in) a credit limit, or if a limit proposed by the college was considered as too high by the head of the branch office, the latter could suggest separate "dissenting" limit proposals (including an explanation for the disagreement).

submissions to the directorates throughout the year.<sup>22</sup> This arrangement did not preclude branches from sending in additional *ad hoc* lists to correct or complement the annual submission, although the directorate meeting minutes for the period between 1908 and 1913 suggest that these additional subannual postings were rare. Upon approval by the directorates, the branch offices received a list containing the universe of counterparties located in the various Bank districts and the corresponding individual *Personalkredite* (including the annual updates and additions).<sup>23</sup>

## 2 Hypotheses

The credit limit system served as a key component of the OeUB's credit risk management framework.<sup>24</sup> The Bank employed credit limits to minimize counterparty risk in its discount lending activities. By constantly overseeing and controlling its exposures to individual counterparties, the OeUB effectively monitored the probability that one, several or all of the signatures on the discounted bills of exchange would default at maturity. The net worth of a given counterparty influenced the probability of default and the subsequent recovery rates for outstanding discount loans. Hence, our first hypothesis is that the OeUB considered equity or wealth (in the case of private individuals or owner-proprietorships) as an important factor when setting the level of individual credit limits (*HI*).

Our main argument in this paper is that the Bank also employed credit limits to achieve a second aim. This second goal was distinct from pure counterparty risk management and derived from the Bank's role as a lender of last resort. The presence of a lender of last resort for system-wide shocks induces central bank counterparties to downsize costly buffer holdings of unremunerated liquid reserves. As it is notoriously hard for the lender of last resort to separate illiquid from insolvent institutions, counterparties may also leverage up and gamble for survival by banking on emergency lending in a crisis. Without additional regulatory measures, the liquidity insurance provided by a lender of last resort can thus endogeneously increase the probability of systemic crises. We argue that the OeUB drew on its system of credit limits in non-crisis periods to counter this form of collective moral hazard. Whenever the OeUB had become concerned with the liquidity or leverage position of a particular counterparty, it threatened to reduce – and often effectively reduced – the firm's or person's credit limits. In extreme cases, the Bank even proceeded to withdraw the *Personalkredit* altogether. By making the size of credit limits contingent on counterparties' liquidity and capital cushions, the OeUB enforced minimum standards for liquidity and capital adequacy. Credit limits increased system-wide liquidity buffers relative to a scenario characterized by the presence of an explicit lender of last resort and the absence of formal liquidity regulation. The Bank's counterparties had an incentive to abide by the Bank's minimum expectations because higher credit limits allowed them to further streamline their day-to-day liquidity management in normal times. All else equal, firms and persons with higher

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<sup>22</sup>The meeting minutes from the directorates in the years between 1908 to 1913 suggest that the directorates usually discussed up to six lists sent in by branches at each meeting. Directorate meetings took place once per month except for the summer period (business break of two months in July and August).

<sup>23</sup>As we explain in more detail in Appendix A.2, the structure and the design of the credit list were meticulously regulated.

<sup>24</sup>For more details about the OeUB's credit risk management framework, see Appendix A.1.

discount limits benefited from efficiency gains when dealing with unexpected idiosyncratic liquidity needs. The receipt of a sizeable limit reduced liquidity management costs relative to a situation without regular or reliable discount window access in normal times. Thus, if our argument is correct, liquidity and leverage ratios should be significant predictors of the size of credit limits (*H2*).

Of all the counterparties the OeUB assessed to assign credit limits, financial institutions should have been most prone to engage in moral hazard following the creation of a credible lender of last resort. Financial intermediaries generate profit by engaging in maturity transformation: they collect short-term liabilities and invest in longer term assets. Therefore, the availability of a lender of last resort provides a strong incentive for credit institutions to downsize liquidity holdings in exchange for interest-yielding assets. At the same time, financial institutions also constitute the class of counterparties which seems *ex ante* most vulnerable to system-wide liquidity shocks. During panics, financial firms frequently experience mass withdrawals of callable liabilities. Non-financial institutions are unlikely to face the same intensity of liquidity pressures at short-notice. As a corollary, our third hypothesis is that liquidity-related considerations played a much bigger role in the OeUB's credit limit assessments of banks than in the assessments of non-financial institutions (*H3*).

Evidence in favor of *H2* and *H3* could still be consistent with an interpretation of credit limits as a pure counterparty risk management tool. One could easily come up with good reasons why more liquid counterparties entail lower credit risk for the central bank. For example, a higher amount of liquid assets makes timely payment of matured bills more likely. Moreover, higher liquidity buffers reduce the probability of illiquidity-induced insolvency in case the counterparty suffers from large funding withdrawals. To distinguish between counterparty risk management motives and our novel interpretation of credit limits, we rely on additional information regarding how the OeUB handled its discount ceilings in times of crises. If the system of credit limits had been targeted at controlling counterparty risk alone, one would expect the OeUB to have enforced the limits regardless of the state of the world, i.e. even during crises. Although the enforcement of credit limits during systemic panics would have thwarted the OeUB's role as a lender of last resort, such behavior would have been in line with basic counterparty risk management principles. In contrast, if the Bank had regularly increased or even temporarily suspended credit limits during system-wide liquidity shocks, its reaction would have been consistent with "free lending" à la [Bagehot \(1873\)](#), but inconsistent with strict counterparty risk management motives. Ramping up credit limits during a crisis would have increased the overall exposure of the Bank, without any concomitant increase in the quality of counterparties – a counterproductive response from a pure risk management perspective. This reasoning leads to our fourth hypothesis. Had the OeUB operated credit limits exclusively as a counterparty risk management tool, we should expect the OeUB to have refrained from increasing or suspending *Personalkredite* during systemic crises (*H4*).

Our interpretation of credit limits as a tool to rein in collective moral hazard requires a rejection of the fourth hypothesis. Yet, a simple rejection of *H4* is not enough. If the OeUB had indiscriminately increased or suspended

all limits in the face of a systemic shock, it could have implicitly endorsed imprudent behavior by some counterparties in the run-up to the crisis. Hence, indiscriminate increases or suspensions of all credit limits during liquidity crises would have also been inconsistent with our novel interpretation of *Personalkredite*. Any such behavior by the central bank would have fueled moral hazard rather than addressing it. If the Bank was truly concerned about moral hazard, it should have only softened the limits for those counterparties which it perceived to experience liquidity distress due to an exogenous shock. Counterparties that suffered from liquidity problems as a consequence of bad fundamentals or mismanagement in the run-up to a crisis should have received a rather different treatment. The latter should have been penalized for imprudent behavior in normal times by seeing their *ad hoc* demands for credit limit suspensions, transgressions or increases rejected. Hence, our fifth hypothesis is that the OeUB operated its system of credit limits as a set of “contingent rules”. In line with the concept of “free lending” during crises, the OeUB relaxed credit ceilings for counterparties it perceived to be suffering from liquidity distress unrelated to idiosyncratic fundamentals (*H5.A*). We also expect the Bank to have penalized imprudent behavior in normal times by refusing to loosen credit limits for counterparties suffering from liquidity distress due to unsound fundamentals (*H5.B*). Arguably, the refusal to extend liquidity to weak firms should have been enforced only once acute panic conditions had abated to avoid losses for the creditors of distressed counterparties (e.g. due to the necessity of starting “fire sales” of remaining assets to honor liabilities).

## 3 Data

### 3.1 Decisions on credit limits

The administration and monitoring of credit limits produced several types of Bank-internal documents, some of which survived in the historical archives of the *Oesterreichische Nationalbank*.<sup>25</sup> Most importantly, the lists documenting the annual (re-)assessments of credit limits and the routine monitoring by the directors in Vienna and Budapest were classified with the meeting minutes of the two directorates which can be consulted in the Bank’s archives. As explained in Section 1, the regional branch offices submitted a hand-written form with proposals for credit limit changes to the Bank’s directorates at least once per year. For this paper, we collected all credit assessments that were submitted by OeUB branches located in the Austrian crownlands to the Viennese directorate between 1909 and 1913.<sup>26</sup>

Altogether, the forms submitted to the Viennese directorate include a total of 4,273 assessments of individual credit limits between 1909 and 1913. The data contain information for approximately 3,400 unique counterparties

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<sup>25</sup>The *Oesterreichische Nationalbank* is the successor institution of the Austro-Hungarian Bank and Austria’s current central bank.

<sup>26</sup>The Austrian crownlands covered the entire territory of Cisleithania: Bohemia, Bukovina, Carniola, Corinthia, Dalmatia, Galicia, Gorizia and Gradisca, Istria, Moravia, Lower Austria, Salzburg, Silesia, Styria, Trieste, Tyrol, Upper Austria, and Vorarlberg.

as some persons and firms were assessed several times during this five year interval. In terms of structure, our data set represents an annual cross-sectional sample of credit limits. It contains all those limits which happened to be re-assessed by the branches during our observation period. For a subsample of this cross-sectional data set (all banks and savings banks), we also exploit two particularly useful features of the assessment forms to construct a panel data set.<sup>27</sup> First, each time a credit limit (re-)assessment was submitted to the directorates, the old limit was also reported on the form. Second, the mere fact that a counterparty was not assessed in a given year also provides relevant information: it tells us that the previous limit remained in vigor. Hence, as long as a counterparty appeared at least once in the re-assessment forms submitted by the branches, we are able to infer its credit limit for all five years from 1909 until 1913.

The forms submitted to the directors contain the following information on counterparties and credit limits. First, besides the name of the firm or person, the forms always feature a description of the counterparty's business or occupation. The second piece of information concerns the counterparty's domicile. To be listed in the credit limit reports of a given OeUB branch, the firm or person had to be domiciled in the bank district attributed to the assessing branch. For some counterparties several locations are listed, reflecting the sites of their branches and affiliates. Third, the forms show the current credit limit.<sup>28</sup> Fourth, every time a counterparty was (re-)assessed, the branch communicated its proposal for the new credit limit. This proposal could be put forward by the local discount college at the OeUB branch, the director of the branch, or the responsible clerk (*Referent*) at the Viennese head office. Thus, in case the different parties disagreed, the forms list up to three distinct credit limit proposals. Fifth, the reports provide information on the credit limit eventually agreed upon by the directorate, i.e. the new credit henceforth in force. Finally, the decisions by the directorate usually come with a handwritten justification. Most of these remarks are negative in the sense that they represent a justification for why no limit was granted, why a given limit would not be raised despite a recommendation of the local college of censors to do so, or why a limit was lowered/cancelled.

We collected the raw data from the forms and then proceeded to clean this information. We also classified counterparties' business activities into 25 categories based on the official Austrian statistics at the time. We describe the corresponding details in Appendix B.1. Moreover, we harmonized the handwritten remarks explaining the final decisions by the directorates. Albeit not standardized in the forms, the comments refer to a relatively small number of recurring arguments. We classified and coded the individual comments to allow for their statistical analysis. We distinguished between 20 different arguments motivating changes in individual credit limits. Comments often drew on several arguments at once to explain a single decision. We discuss these justifications and their relative frequency in the period 1909–1913 in detail in Section 4 below. Appendix B.1 provides several examples for each of the different justification classes.

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<sup>27</sup>We focus on banks and savings banks because we can systematically match their credit limits to annual balance sheet data from other sources (see below).

<sup>28</sup>The forms report credit limits in thousand *Crowns*. If the counterparty was assessed for the first time or had her *Personalkredit* revoked at a previous round, the preceding limit was reported as zero.



Appendix C.1 shows descriptive evidence summarizing the cross-section of our collected credit limits for 1911. In terms of absolute numbers, non-financial firms accounted for more than 85% of all counterparties assessed in 1911 (1,897 out of 2,221). Data on lending volumes, however, reveal that financial institutions with reporting requirements (joint-stock banks, savings banks and credit cooperatives) dominated at the discount window as they regularly submitted between 90–95% of all bills between 1904 and 1910 (c.f. Appendix C.1). Private banks (without reporting requirements) likely accounted for a significant share of the remaining 5–10%. Thus, direct credit to non-financial firms was *de facto* irrelevant by 1904 (and probably already earlier). By the end of the 19th century, the OeUB had clearly become the Bank of banks. Non-financial firms mostly served as ultimate payers of bills submitted by financial institutions.

### 3.2 Reports on transgressions of credit limits

Ideally, one would like to compare the levels of a counterparty's individual limit to the actual amount of central bank credit received to evaluate whether credit limits were effective maximum ceilings for central bank borrowing in normal times. Unfortunately, we cannot reconstruct the running exposure of the Bank vis-à-vis particular borrowers because the discount ledgers of the OeUB and its branches did not survive in the archives of the central bank. To yield insights regarding the possibility, consequences and length of credit limit transgressions, we thus focus on another primary source. Large counterparties with limits above 2 million *Crowns* were directly monitored by the responsible directorate. The precise amount of these large limits was a well-guarded secret known only by the heads of branches and the directorate. Yet, the branch offices had to report the Bank's exposure vis-à-vis high limit firms to the corresponding directorate on a weekly basis (on the 7<sup>th</sup>, 15<sup>th</sup>, 23<sup>th</sup> and the last of each month). We draw on these additional reports to collect counterparty-level data on credit limit transgressions between March 1906 and November 1911 (i.e. in normal times). The protocols of the monthly directorate meetings in Vienna list the amount (in *Crowns*) of transgressions for the four preceding weeks. Counterparties were only mentioned in the protocols if they had effectively violated their assigned limit. As a corollary, if the corresponding branch reported a limit transgression by firm  $f$  in week  $w$  but not in  $w + 1$ , the firm's borrowing had again decreased below the limit by  $w + 1$ . We use the information on transgressions to construct a weekly panel data set. We discuss and analyze these data in more detail in the last part of Section 4 below.

To obtain complementary information on how the OeUB dealt with limit transgressions during periods of financial distress, we also examined the Viennese directorate meeting minutes during the crisis episode of 1912. In the months from October 1912 until January 1913, the Austrian directorate discussed transgressions of limits and/or increases in the limits for individual counterparties at almost every meeting. These discussions convey systematic qualitative information which we exploit in Section 5.



### 3.3 Other qualitative sources

This paper builds on several additional primary sources. First, we draw on a Bank-internal manual used by the OeUB to communicate minimum expectations to its employees on how to conduct business in the different lending and depositing arms of the central bank. This manual was entitled *Dienstunterricht für die Beamten der Oesterreichisch-ungarischen Bank* (“On-the-job education for officers of the Austro-Hungarian Bank”).<sup>29</sup> Second, we employ qualitative evidence from the directorate meeting minutes to inform our discussion of the OeUB’s policy reaction to the crisis of 1912. The debates and decisions by the Viennese directorate allow for a first-hand reconstruction of how the Bank perceived the crisis, including what it judged to be its cause, and how it reacted to distress in the panic-stricken regions. While we are also able to marshal quantitative evidence on this aspect, the meeting minutes constitute an invaluable source to understand how the OeUB interpreted its role as a lender of last resort in autumn 1912. Third, we exploit digitized versions of contemporary newspapers available on the so-called “ANNO - AustriaN Newspapers Online” platform provided by the Austrian National Library in Vienna.<sup>30</sup> We primarily draw on ANNO to identify the location and timing of runs on banks in the autumn of 1912.<sup>31</sup>

### 3.4 Balance sheet data and other quantitative evidence

To conduct econometric analyses, we match annual balance sheet information to our credit limit data for Austrian credit institutions. Appendix B.2 provides a brief overview of the Austrian banking system. Balance sheet data is available for financial institutions which were subject to official annual reporting requirements, i.e. joint-stock banks, savings banks and credit cooperatives. We collected balance sheets for all joint-stock banks and savings banks from the official Austrian statistics (*Oesterreichische Statistik*) published by the Imperial statistical commission (*k.k. statistische Zentralkommission*) to construct a panel data set covering the years 1908–1913. To compile balance sheet data for credit cooperatives, we had to resort to an annually published financial yearbook, the *Compass - Finanzielles Jahrbuch*. Due to the large number of cooperatives (more than 12,000), we hand-collected annual balance sheet data only for those credit cooperatives which appear in our credit limit data set in a given year. Hence, we obtained an annual cross-section of cooperative balance sheets for the years 1908–1913.

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<sup>29</sup>For the present paper, we have drawn extensively on the 1907 edition of the manual to describe the OeUB’s credit limit system.

<sup>30</sup>The platform is freely accessible via the following link: <http://anno.onb.ac.at/>. Besides its easy and free accessibility and the possibility to conduct complex full-text searches, the platform covers newspapers from the entire area of the Empire, ranging from Bukovina in the East to Vorarlberg in the West.

<sup>31</sup>In principle, we follow a methodology similar to Jalil (2015) who used newspapers to construct a new series for banking panics in the United States between 1825 and 1929. Since our purpose is not to distinguish between individual bank runs and more general panics and because we do not rely on the reports to construct a disciplined time series, we do not follow a strict rule for identifying a “panic” versus a “run”. We rather searched for obvious references (*Panik*; *Runs*; *Einlegeransturm*, i.e. “mass withdrawals”; *Spareinlagen*, i.e. “deposits”, and *Krise*) in order to get a sense of the geographic dispersion of runs and the drivers of mass withdrawals of deposits. The most relevant newspapers for this study were *Neue Freie Presse*, *Pester Lloyd*, *Reichspost*, *Salzburger Volksblatt*, *Linzer Tagblatt*, *Czernowitzer Allgemeine Zeitung*, *Bukowinaer Post* and *Prager Tagblatt*.

We always looked for balance sheet information published as close as possible (but prior) to the date of our credit limit record. Only if we were not able to find a matching record in the *Compass*, we matched the credit limit data with balance sheet information from the last available official survey of credit cooperatives, which was published by the Imperial statistical commission in 1902.

In addition to our balance sheet data, we use a weekly magazine, the *Tresor*, and a daily newspaper, the *Wiener Zeitung*, to collect weekly data on OeUB lending operations, note issuance and interest rates. Both are available on the ANNO platform mentioned above. Moreover, we also transcribe daily official stock market reports of the Viennese Stock Exchange (VSE), the *Coursblatt des Gremiums der k.k. Börse-Sensale* to compile a data series on market interest rates for prime bills. Finally, we draw on a geocoded GIS shape file of the Austro-Hungarian Empire originally created by [Rumpler and Seger \(2010\)](#) to calculate distances between the locations of individual credit institutions and the Russian border. This information is relevant for our econometric analysis of credit limit transgressions in times of distress (Section 5).

## 4 The system of credit limits in normal times

### 4.1 Changes in credit limits: descriptive evidence

We now turn to a descriptive analysis of the reasons for changes in credit limits. Written comments on the directors' reasoning are available for 2,106 of the 4,278 assessments in our sample. Table 1 shows the observed frequency of arguments for all decisions taken between 1909 and 1913. Table 1 also highlights how often a specific reason was used in a decision that led to the cancellation, the reduction, the maintenance or the increase of an existing limit, and whether the decision captured the first time a limit was granted. As evidenced by the bottom row of Table 1, written arguments were typically provided when it came to justifying the cancellation, the downsizing or the maintenance of a credit limit at its current level. The reasons for these types of decisions were documented in more than 95% of the cases. This observation holds much less true for increases in limits and for occasions when a counterparty was attributed a limit for the first time. In these instances, arguments were only noted down in 12% of all cases, and usually only if the directors wanted to justify why their final decision differed from the initial proposal made by the local college of censors.

The arguments put forward by the directorate can be grouped under five headings: disappearance/closure of a firm (rows 1–5 in Table 1), equity or wealth (rows 5–8), other balance sheet indicators (rows 9–13), quality of management (rows 14–17), and references to rules governing the OeUB's discount window lending (rows 18–20). Appendix C.2 provides more background on the individual reasons for limit changes displayed in Table 1. While the Viennese directorate's assessment of credit limits relied on a wide variety of arguments, Table 1

shows that almost half of all decisions – notably the canceling of limits – were due to the voluntary dissolution of firms, the death of their owners/partner or the moving of the firm to a different OeUB Bank districts. Hence, strictly speaking, this entire range of changes in the *Personalkredite* did not directly relate to the current economic situation of the counterparty. Among the economic reasons more narrowly speaking, equity or wealth ranks first. If changes induced by the availability and identity of personally liable owners (e.g. alterations in ownership and corporate form) are included in this category, the relative prominence of capital-related arguments increases even more. The directors’ emphasis on wealth and net worth is well in line with the interpretation of credit limits as an essential counterparty risk management tool. Table 1 therefore provides suggestive empirical support for our first hypothesis as put forward in Section 2.

(Table 1 here)

In Section 2, we also hypothesize that the Bank used its system of credit limits to enforce minimum standards for liquidity and capital adequacy. Table 1 shows that the directorate’s concerns about refinancing risk, asset liquidity and leverage make up the second most important class of arguments. Individually, each of these arguments was voiced about as often as all arguments related to management quality taken together. The relative importance of changes in credit limits attributed to reasons related to counterparties’ liquidity<sup>32</sup> and leverage position constitutes initial evidence backing our second hypothesis.

(Table 2 here)

In a next step, we investigate whether our third hypothesis is borne out in the descriptive data: did the Bank focus on different characteristics when assessing credit limits of financial intermediaries? In Section 2, we argue that the likelihood to succumb to moral hazard incentives should have been particularly high for financial institutions. Thus, we expect the OeUB to have monitored financial institutions’ liquidity and leverage positions with high diligence when assessing credit limits. In Table 2, we distinguish between the arguments voiced by the OeUB directorate according to whether they concerned financial institutions with reporting requirements (joint-stock banks, savings banks and credit cooperatives) or non-financial firms (NFIs). To facilitate comparison, we simplify the categorization of arguments. We aggregate changes in credit limits due to voluntary dissolution, the death of the owner and the relocation of the firm into one group named “dissolved, relocated, death”. We also combine the two arguments related to ownership structure (change in ownership or legal form, withdrawal of partner) and we merge the four reasons related to management characteristics (including management quality, experience, risk taking and payment moral). The arguments central to our story (equity or net worth, liquidity and leverage) remain separate.<sup>33</sup>

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<sup>32</sup>When mentioning counterparties’ liquidity position without further qualification, we always refer to both, the asset side and the liability side of the balance sheet.

<sup>33</sup>The remaining categories (which only appear in a handful of cases) are not included in Table 2.

Table 2 highlights clear differences between the assessments of non-financial counterparties and financial firms.<sup>34</sup> We implement a mean comparison test for each category of arguments to analyse whether their relative prevalence is statistically different across the two groups of counterparties. The main take-aways from Table 2 are as follows. First, arguments concerning ownership appear significantly more often for non-financial firms. This observation is intuitive given that most financial firms operated under limited liability regimes.<sup>35</sup> Limited liability turned the identity of individual owners into less relevant determinants of credit limits. Our second finding is also in line with this reasoning. Absolute net worth featured more prominently in decisions concerning non-financial firms. Third, when assessing the *Personalkredite* of financial institutions, the OeUB directorate paid special attention to leverage and liquidity adequacy. Refinancing risk stands out in this category, appearing in almost twice as many assessments as leverage and asset liquidity. Taken together, leverage and liquidity were referred to in about 60% of all decisions affecting financial institutions. In contrast, only 9% of decisions on NFIs' credit limits belong to this group of reasons. These results support our third hypothesis. Fourth, we find that management quality particularly mattered for financial firms, while presence at the discount window played a bigger role in credit limit assessments of NFIs. Finally, the prevalence of decisions based on firms' turnover was not statistically different for the two counterparty types.

## 4.2 The determinants of credit limits: econometric evidence

In this subsection, we proceed to examine the determinants of the size of individual credit limits using regression analysis. For this purpose, we match our data on credit limits for financial institutions with the corresponding balance sheet data. We focus our econometric analysis on financial institutions for the following reasons. First, in contrast to most non-financial firms and private banking houses, financial institutions regularly published their balance sheet information in annual yearbooks (c.f. Section 3). Second, as discussed in Appendix C.1, financial institutions took the lion share of discount window loans. Should the OeUB have had the intention to check collective moral hazard, commercial and savings banks' liquidity management efforts must have constituted the Bank's biggest concern. Third, our hypotheses and the descriptive analysis in the previous subsection accord a special role to financial institutions when it comes to counterparties' propensity to succumb to moral hazard. Due to their focus on deriving profit from maturity transformation, financial intermediaries have an incentive to keep asset liquidity at a minimum. At the same time, financial institutions are particularly vulnerable to system-wide liquidity shocks.

We estimate several regression models to analyze whether the OeUB showed regulatory "teeth" when assessing

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<sup>34</sup>Table 2 only draws on 4,090 assessments because we dropped financial institutions without reporting requirements (private bankers, discount brokers etc.) from the sample. Since we merely obtained about 200 observations for this class of counterparties, we could not create a meaningful third category for the mean equality tests. At the same time, financial institutions without reporting requirements constituted a clearly distinct category which cannot simply be merged with any of the other two classes.

<sup>35</sup>The next subsection investigates the consequences of limited liability in more detail.

the credit limits of financial institutions. In Model 1, we draw on our pooled cross-section of credit limits for cooperatives, joint-stock banks and savings banks. We regress the size of individual limits ( $C$ ) on counterparty-level financial variables capturing size, age, leverage, liquidity, management quality and institutional type (all included in vector  $\mathbf{X}$ ). Our financial explanatory variables are lagged by one year, i.e. we use information from year  $t - 1$  to explain the level of credit limits in year  $t$ .<sup>36</sup> We rely on lagged independent variables to minimize reverse causality concerns and to proxy the contemporary information available to the OeUB as accurately as possible.<sup>37</sup> Moreover, besides a standard constant ( $\alpha$ ), Model 1 also features a full set of regional dummies ( $\phi_r$ )<sup>38</sup> and year fixed effects ( $\gamma_t$ ):

$$C_{i,t} = \alpha + \mathbf{\Lambda}'\mathbf{X}_{i,t-1} + \phi_r + \gamma_t + u_{i,t} \quad (1)$$

In Appendix D.1, we draw on a standard principal-agent framework to provide a theoretical underpinning for Model 1. We show that the coefficients in Model 1 have an intuitive economic interpretation. Our coefficients deliver estimates for the remuneration elasticities ( $\mathbf{\Lambda}$ ) and the lump sum payments ( $\alpha$ , plus region- and year-specific add-ons,  $\phi_r$  and  $\gamma_t$ ) consistent with meeting the participation and compatibility constraints in a setting where the OeUB uses credit limits as a regulatory tool to check collective moral hazard. Summary statistics and exact definitions for all covariates in Model 1 are shown in Table 3.<sup>39</sup>

(Table 3 here)

Table 4 reports the main results. We follow a step-by-step approach to clarify how the coefficient estimates change after the inclusion of each additional variable and the two sets of fixed effects. The main take-aways from Table 4 are as follows. First, counterparty size and age exhibit a statistically significant correlation with the size of credit limits. In the fully fledged specification (column 11), a 1% in increase in total assets is associated with a 0.75% increase in the corresponding *Personalkredit*. The coefficient on counterparty age is also statistically significant in most specifications. The estimated elasticity of a 1% increase in age amounts to about 0.3%. Hence, the coefficients on these two structural variables confirm that credit limits were tailored to the economic weight and standing of counterparties. Second, our coefficient estimates for the four balance sheet ratios suggest that there was more to obtaining a high credit limit than simply size and firm maturity. Since the coefficients for balance sheet ratios are standardized, we can directly compare their relative economic size. We find that the two

<sup>36</sup>Balance sheet data for credit cooperatives is not available for all institutions in every relevant year. Consequently, we always employed the closest balance sheet publication available in the sources. To preempt post-treatment bias, we never used balance sheet data published in the years after the credit limit decision was taken.

<sup>37</sup>We assume that the OeUB always used the latest available balance sheet data when taking decisions on credit limits. Moreover, the OeUB is likely to have benefited from additional private information on its counterparties. Since this information is not available to us, we need to resort to publicly available data.

<sup>38</sup>The regional fixed effects control for unobserved heterogeneity at the level of Austrian crownlands.

<sup>39</sup>Following up on the results of specification tests and to facilitate the interpretation of the econometric results, we run our regressions using log-transformations of some covariates. More specifically, we transform our dependent variable, and the control variables capturing counterparty size and age.

liquidity-related ratios constitute the *only* financial indicators which are consistently statistically significant. The marginal effect of a one standard deviation increase in the liquidity ratio averages around 16%.<sup>40</sup> The negative coefficient on refinancing risk is in a similar ballpark: a standard deviation increase in this covariate is associated with a 20% reduction in the credit limit. Third, even after controlling for  $\mathbf{X}$ , we find that joint-stock banks tended to receive a significantly higher credit limit than savings banks and credit cooperatives. On average, all else equal, joint-stock banks benefited from credit limits that were 3.3 times larger than those of other financial institutions. Finally, we find that the estimated constant term is not statistically different from zero. Cast in terms of our theoretical framework (c.f. Appendix D.1), this finding suggests that the OeUB did not need to make any general lump sum “side payments” to financial institutions to induce them to submit to the rules of the Bank’s credit limits framework.<sup>41</sup>

(Table 4 here)

The results in Table 4 corroborate our hypothesis regarding the importance of liquidity ratios in the assessment process of credit limits for financial institutions ( $H3$ ). From the perspective of  $H2$ , however, the economic and statistical insignificance of the leverage ratio seems puzzling. In Appendix D.2, we show that this finding is due to the pooling of firms with different liability regimes. The full sample underlying the results in Table 4 contains both limited and unlimited liability firms. Whereas joint-stock banks and most credit cooperatives enjoyed limited liability, savings banks and some credit cooperatives faced unlimited liability. In line with the literature connecting risk-shifting incentives and limited liability (Dell’Ariccia et al., 2014; ?), we find that the OeUB monitored the leverage ratio of limited liability firms very closely, while paying less attention to leverage in the presence of unlimited liability. A standard deviation increase in the leverage ratio of firms with limited liability is associated with a hefty, statistically significant reduction in the credit limit of 75% (c.f. Table 5 in Appendix D.2). In contrast, the leverage ratio was virtually irrelevant for the *Personalkredit* of financial institutions with unlimited liability (c.f. Table 6 in Appendix D.2). Hence, in the terms of our theoretical framework, the estimated remuneration coefficients exhibit non-negligible heterogeneity with regard to the applicable legal framework.

We implement several robustness checks. First, the inclusion of our proxy for refinancing risk leads to a significant drop in the number of observations in our pooled cross-sectional sample (compare column 5 to column 6 in Table 4). The smaller sample size is due to missing data for rediscounts for many small credit cooperatives. Hence, in Appendix D.3 we re-estimate Model 1 without the variable capturing refinancing risk. The resulting larger sample allows for a more precise differentiation between the three types of financial institutions (credit cooperatives, savings banks, and joint-stock banks) and the associated jumps in the size of credit limits. In addition, the coefficient on the dummy for financial institutions operating as OeUB affiliates indicates that this

<sup>40</sup>Since the dependent variable is logarithmized, we compute the marginal effects of a standard deviation increase in the financial ratios by exponentiating the coefficient, subtracting 1 and multiplying by 100%.

<sup>41</sup>Bank-specific and region-specific lump sum payments are soaked up by the two vectors of fixed effects.

function tended to be associated with higher credit limits. Since OeUB affiliates took care of the central bank’s business in regions without OeUB branches in close proximity, more generous limits likely reflected affiliates’ higher turnover and refinancing needs. Most importantly, however, Appendix D.3 confirms the crucial role of liquidity in the determination of credit limits.<sup>42</sup>

Second, in Appendix D.4 we re-estimate Model 1 drawing on an alternative specification of our dependent variable. Instead of the log-transformation, we normalize the credit limit by a counterparty’s total assets. We also re-run Model 1 using three alternative specifications of the liquidity ratio. The liquidity position remains a highly statistically and economically significant predictor of credit limits in all these alternative specifications.<sup>43</sup> Table 10 in Appendix D.4 summarizes an additional set of regressions controlling for the number of branches of the financial institutions in our sample. In principle, financial counterparties with a wider geographic exposure and the ability to fund inter-regional trade might have received higher limits. The results in Appendix D.4 suggest that the number of branches is indeed positively correlated with the size of financial intermediaries’ credit limit, even after controlling for firm size and balance sheet ratios. The inclusion of the joint-stock bank dummy, however, strips the coefficient on the branch variable of its statistical and economic significance (see columns 9–12 in Table 10, Appendix D.4). The indicator variable soaks up most of the variation in branch networks because Austrian savings banks and credit cooperatives rarely maintained branches (network). The inclusion of the number of branches in Model 1 does not alter any of our conclusions discussed before.

Third, we exploit the balanced panel structure of our credit limit sample for joint-stock banks and savings banks. We re-estimate Model 1 for the subsample of banks and savings banks by drawing on a fixed effects estimator, effectively replacing  $\phi_r$  with a bank-level fixed effect  $\phi_i$ . This additional specification allows us to control for any remaining unobserved bank-specific heterogeneity in our cross-sectional regressions. The corresponding summary statistics and estimation results are shown in Appendix D.5.  $\mathbf{X}$  is defined and lagged by one year as in Model 1 above.<sup>44</sup> The fixed effects panel estimates yield slightly smaller marginal effects than the cross-sectional specification (11% and –6% for a standard deviation increase in the liquidity ratio and refinancing risk respectively) but the results remain highly statistically significant. The panel regressions in Appendix D.5 may entail some artificial deflation of standard errors as the limits of several banks are changed only once between 1909 and 1913. It is important to note, however, that this potential concern should not apply to the pooled cross-sectional specification in Table 4. The estimation sample for Table 4 only includes firms whose credit limit was effectively assessed for changes in a given year.

Fourth, another worry may be that the OeUB selected certain types of financial institutions for credit limit re-

<sup>42</sup>We also re-ran the split sample regressions for limited and unlimited liability firms without our refinancing risk proxy. The economic and statistical significance of the coefficients for the leverage and liquidity ratios mirrors the results reported in Appendix D.2.

<sup>43</sup>Liquidity ratio 4 receives a negative sign because it proxies for asset illiquidity (c.f. variable definitions in Table 3). Hence, higher ratio values reflect a more illiquid asset portfolio.

<sup>44</sup>Since our panel regressions include bank and year effects, we drop age and the bank-type dummies from  $\mathbf{X}$ .



assessments more often than others. In this case, the estimated coefficients in Table 4 and our conclusions may only adequately describe the functioning of the credit limits system for a specific sub-sample of financial institutions. For example, if the Bank predominantly assessed very large credit intermediaries, our estimated parameters might not be representative of firms situated at the lower end of the size distribution. To check for systematic selection bias in the OeUB's re-assessment decisions, we resort to a data set covering the full population of Austrian joint-stock banks and savings banks for the period between 1909 and 1913. We pool the bank-level information for assessed and not assessed financial intermediaries in each year to test whether the balance sheet indicators used in Model 1 systematically predict the OeUB's decision to conduct a credit limit re-assessment. As above, all right-hand side variables are lagged by one year. Appendix D.6 reports the summary statistics and the results of a limited probability model with a binary variable indicating selection into re-assessment as the outcome of interest. We run five independent cross-sectional regressions for each year (1909–1913, columns 1–5 of Table 14 in Appendix D.6). In addition, we also pool all five years in a panel regression with bank-level and year fixed effects (column 6 of Table 14 in Appendix D.6). Although some explanatory variables emerge as significant predictors of re-assessment decisions in particular years, our results do not provide any evidence for a systematic selection effort by the OeUB. While these findings cannot rule out selection due to unobservables, Appendix D.6 does not suggest that our narrative on the determinants of credit limits is inherently biased.

Overall, the econometric evidence marshaled in this subsection shows that liquidity and leverage considerations played an important role in the OeUB's assessment of counterparty credit limits. These results support our interpretation of credit limits as a tool to enforce minimum regulatory standards for central bank counterparties.

### 4.3 Transgressions of credit limits in normal times

Were counterparty credit limits always strictly enforced in normal times? How did the OeUB directorate handle transgressions of credit limits in non-crisis periods? The *Dienstunterricht für die Beamten der Oesterreichisch-ungarischen Bank*, a regularly updated Bank-internal manual, provided clear guidelines on the OeUB's day-to-day lending business at the discount window. In principle, the manual did not permit transgressions of credit limits. Yet, in practice, the Bank's clerks required some flexibility in handling credit limit transgressions for the following reasons. First, counterparties did not have full control over the actual utilization of their own credit limit. The degree of utilization was also affected by the discounting activities of third parties who brought in bills carrying the counterparty's name as an acceptor. Second, bills carrying the counterparty's name could be discounted at any OeUB branch office in the monarchy. Information on the discount loans granted in another Bank district, however, only reached the home branch office after some delay. Due to this delay, it was *de facto* impossible for branch clerks to enforce credit limits on a real time basis.

As a corollary, the *Dienstunterricht* emphasized that Bank clerks needed to comply with the broader spirit



of the credit limits framework, rather than focusing on the written provisions alone. Bank officers were warned not to “believe that a merely mechanistic, literal implementation of the written provisions and the neglect of non-written implicit rules are sufficient to live up to [their] tasks”. The manual also listed some concrete examples for situations in which strict abidance by the written rules would be undesirable. First, clerks were instructed to not refuse the purchase of bills merely because their discount would lead to a small transgression of the limit. Second, the manual advised against the refusal of small submissions by a counterparty whose line of credit was exhausted if previously discounted bills were close to maturity and a reduction of the Bank’s exposure to amounts within the limit could be expected in due course.<sup>45</sup>

The degree of flexibility and discretion in handling limit transgressions is particularly well documented for the counterparties with the highest limits, i.e. *Personalkredite* above 2 million *Crowns*. These counterparties were directly monitored by the directors in Vienna and Budapest. Between 1906 and 1911, every single directorate meeting featured an agenda item entitled *Kreditbelastung der mit Krediten über K 2000/m bemessenen Firmen* (“Borrowing by firms with credit limits above 2 million *Crowns*”). The minutes for this meeting item always contained a brief general report on the current level of outstanding loans and then listed the current transgressions by counterparties with high limits. In total, 24 counterparties with *Personalkredite* above 2 million *Crowns* exceeded their credit limit at least once during our observation period.

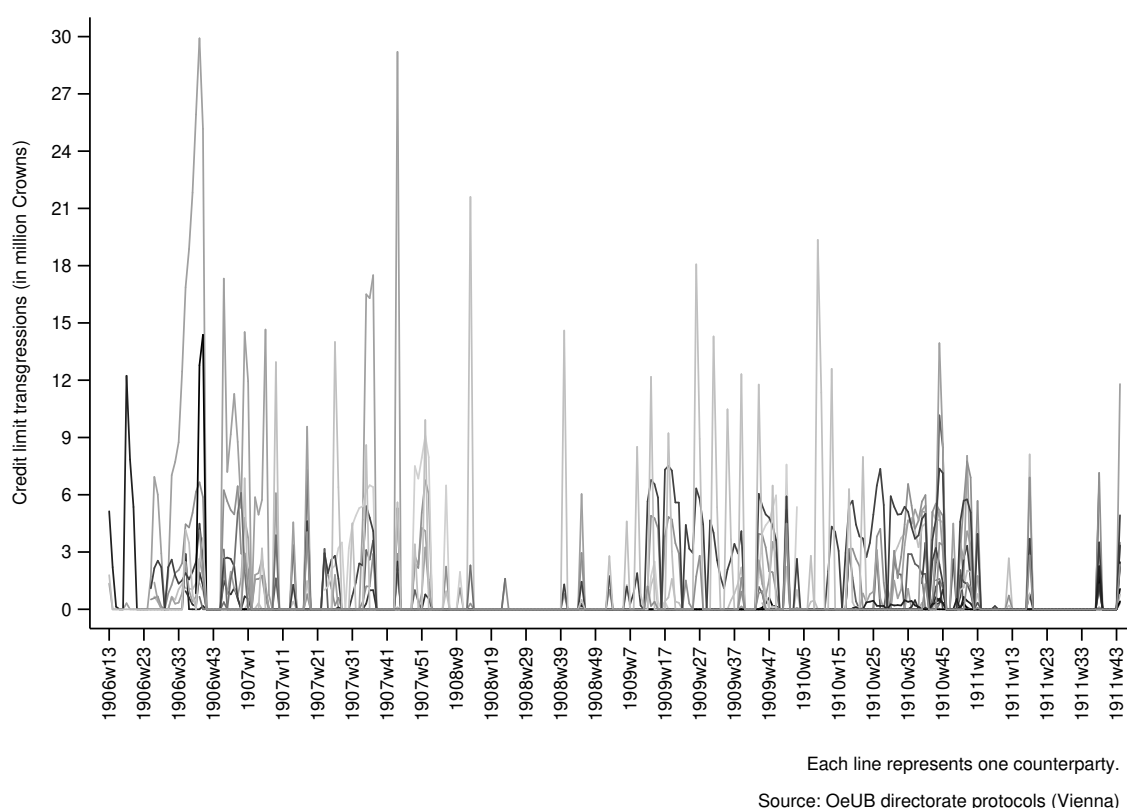
Although we can use these data to shed more light on the duration and size of credit limit breaches in normal times, the transgressions by large counterparties – which all happened to be financial institutions – are unlikely to be representative of the more general dynamics in the overall population of borrowers. The duration and the extent of transgressions in our sample of counterparties with high limits are probably characterized by a significant upward bias: important banks and financial firms likely received more lenient treatments because they played a pivotal role in their local economy and the financial market as a whole. Forcing these counterparties to deleverage quickly in response to credit limit breaches could have important negative consequences, also for third parties. Thus, we consider these data to reflect upper bound estimates for the length and severity of credit limit transgressions in the overall population.

In Appendix D.7, we tabulate the correlation matrix for the credit limit transgressions of the 24 banks in our sample. The correlation coefficients reveal that the period between 1906 and 1911 did not cover any systematic aggregate shocks that triggered universal, simultaneous credit limit transgressions. Figure 1 confirms this impression. Apart from two gaps in 1908 and 1911 which did not see any transgressions on record, credit limit breaches did not follow clear patterns. Yet, transgressions occurred frequently and could be sizable. The great Viennese banks at the time (*Wiener Bank-Verein*, *Wiener Giro- und Cassen-Verein* and *Anglo-Oesterreichische Bank*) dominated absolute transgression numbers. The *Anglo-Oesterreichische Bank* committed the five highest breaches

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<sup>45</sup>Other examples of actions not to be followed by the clerks included the expansion of credit merely on the grounds of increasing the Bank’s earning assets without due consideration of the quality of bills and the application of laxer screening standards because the submitting counterparty showed an impeccable credit history with the Bank.

Figure 1: Transgressions of credit limits by counterparties with limits above 2 million *Crowns*



in our sample, with a maximum transgression of approximately 30 million *Crowns*. Relative to the bank’s total assets (660 million *Crowns*), its total discount portfolio (140 million *Crowns*) and its paid-up capital (100 million *Crowns*), the transgressions were large but remained in a reasonable ballpark.<sup>46</sup>

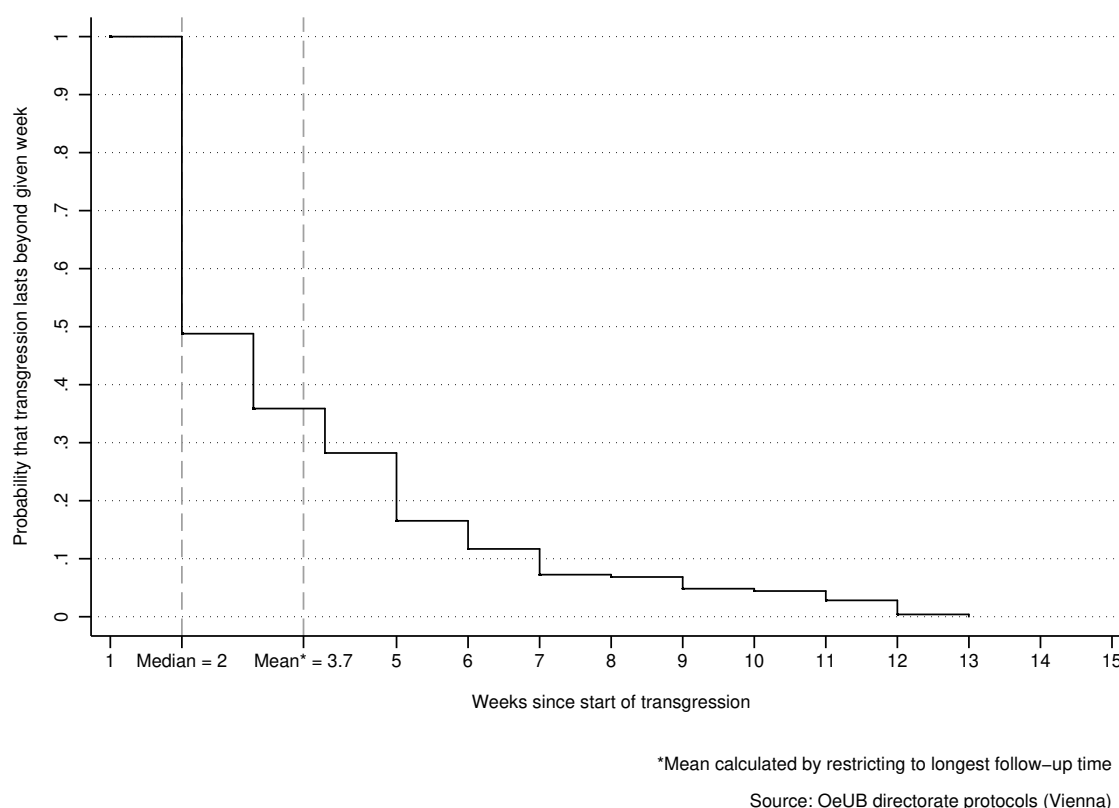
The spikes in Figure 1 suggest that credit limit transgressions were typically short-lived in normal times. To formalize our analysis of the duration of credit limit violations, we compute a non-parametric survival function based on the Kaplan-Meier estimator.<sup>47</sup> Figure 2 summarizes the results. We obtain a median survival estimate of 2 weeks, i.e. more than half of the transgressions ended in the week following the initial breach. The average duration of transgressions in our sample amounted to 3.7 weeks.<sup>48</sup> The short duration of transgressions may reflect the effectiveness of regular policy interventions by the OeUB directorate. If counterparties continued to exceed their limits for several weeks and whenever several counterparties simultaneously accumulated large excess positions, the OeUB directorate issued warnings cautioning the firms to respect their credit limits. In these cases, the minutes of the directorate meetings often contained a comment that “the necessary steps had been taken”.

<sup>46</sup>As explained in Section 3 above, we do not know the precise size of the credit limits for counterparties who received *Personalkredite* above the 2 million *Crowns* threshold.

<sup>47</sup>Our event indicator flags when a given bank’s transgression reverted to zero after a breach had occurred. Hence, in our setting each bank can experience multiple events.

<sup>48</sup>This estimate is driven by a few very long-lasting transgressions committed by a single institution. The long-lasting transgressions can be attributed to a large joint-stock bank located in Prague, the *Ústřední banka českých spořitelén*. This bank became subject to close scrutiny by the OeUB during the crisis of 1912. We provide a more detailed discussion of this case in Section 5.

Figure 2: Duration of credit limit transgressions – non-parametric Kaplan-Meier estimator



(Table 5 here)

Unfortunately, these comments in the directorate protocols are not systematic enough to permit a fully-fledged event study. Hence, we exploit another, more indirect avenue to test the effectiveness of OeUB warnings. Since credit limit transgressions exhibit no clear correlation (c.f. Appendix D.7), there is no *a priori* reason why the duration of breaches in our sample should have been similar in different Austrian bank districts. Without effective and centralized interventions by the OeUB directorate in Vienna, the duration of transgressions may have just as well followed heterogeneous patterns across regions. In Table 5, we report the results of tests for the equality of survival functions across the seven locations in our sample of large counterparties. None of the five standard test statistics rejects the null of equality at conventional confidence levels. Counterparties domiciled in cities as different as the monarchy’s capital and the small Czech town of Hradec Králové experienced statistically identical transgression durations. We interpret the similarity of transgression dynamics in different locations as suggestive evidence for a common disciplining force behind the scenes.

## 5 The system of credit limits during the banking panic of 1912

### 5.1 The OeUB's lending policy during the crisis

Between October and December 1912, the Austro-Hungarian financial system experienced a series of bank runs concentrated in the northeastern provinces of Galicia and Bukowina. The backdrop of this crisis was the unresolved political situation in the Balkans, along the southeastern border of the Austro-Hungarian Empire. The possibility of war with Serbia, Russia or both raised fears among the Austrian public in the autumn of 1912. In case of a war with Russia, the region most likely to become immediately affected was Galicia, a province to the northeast of the Austrian part of the monarchy. Galicia shared a long and open border with Russia. Rumors had it that, in the case of a Russian attack, Austrian forces planned to retreat towards the fortified cities of Lviv (ger. *Lemberg*, pol. *Lwów*) and Przemyśl to concentrate on a move towards Warsaw, the capital of the Russian-dominated part of today's Poland. This strategy would have left significant parts of Galicia exposed to Russian occupation. Fearing an imminent war with Russia, local depositors panicked and converted their deposits into banknotes and hard cash. In Appendix E.1, we provide more details on the historical background and the intensity of bank runs. Appendix E.1 also features a map illustrating the geographical concentration of bank runs at the northeastern border with Russia.

In 1912, the Austro-Hungarian Bank fully assumed its role as a lender of last resort. The OeUB's secretary general compared the developments to "a contagious disease", affecting even the most stable banking institutions in the region.<sup>49</sup> Under these circumstances, so the Bank's management opined, commercial "banks had no other choice but to obtain funds for further repayments from the bank of issue, as a last resort".<sup>50</sup> The Bank interpreted the panic as a crisis caused by an exogenous liquidity shock to the banking system. While market rates peaked during the panic window in 1912, they never exceeded the OeUB's discount rate. Figure 3 shows no instances of a positive spread between the central bank's main refinancing rate and the prevailing market rates for the same type of collateral. This observation testifies to the absence of central bank credit rationing during the crisis of 1912.

The scale of the runs had a direct impact on the balance sheet of the Austro-Hungarian Bank. From early October, when the first runs had occurred, until the end of December 1912, banknotes in circulation rose from 2.4 billion *Crowns* to 2.8 billion *Crowns*, i.e. by roughly 15%. Over the same period, discounts and advances increased from 1.2 to 1.7 billion *Crowns* (an increase of over 40%). On 23 December 1912, the currency in circulation was still 300 million *Crowns* above the level reached on the same day during the previous year. The Bank also saw heavy demand for coins, both gold and divisional silver money. Occasionally, even nickel coins were found to be preferred to banknotes.<sup>51</sup> Eventually, the pressure on bank deposits subsided in late December 1912 following the

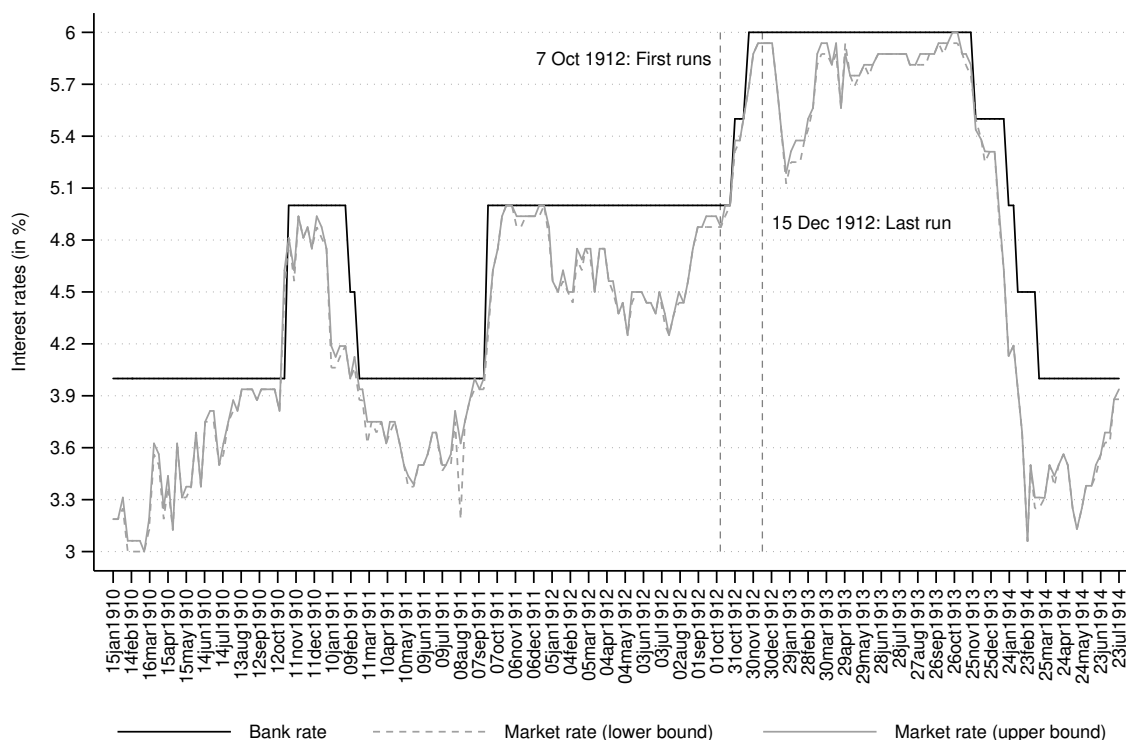
<sup>49</sup>Bank General Council meeting, 19 December 1912, OeNB archives 1912/I-4b.

<sup>50</sup>In German, this iconic line reads "in letzter Linie bei der Notenbank", c.f. *ibid.*

<sup>51</sup>OeUB General Council meeting, 19 December 1912, OeNB archives 1912/I-4.

convocation of an international peace conference in London on 16 December 1912. While newspapers reported runs on an almost daily basis in early December, none were featured after 15 December 1912.<sup>52</sup> By January 1913, some financial institutions began to see a slow return of deposits. Appendix E.2 summarizes these balance sheet dynamics and the Bank's interpretation of the crisis in more detail.

Figure 3: The OeUB's discount rate and prime market rates (1910-1914)



Source: Coursblatt, Der Tresor, Wiener Zeitung

Behind the scenes, the OeUB took two main steps to live up to its role as a lender of last resort. First, the Viennese directorate approved substantial transgressions and increases in counterparty credit limits. Banks targeted by runs rapidly exhausted their ordinary *Personalkredite* and asked for additional funds.<sup>53</sup> While loans until the limit threshold were at the discretion of the local branch officers, the receipt of credit beyond the *Personalkredit* required approval by the head office. As speed was crucial, the Bank's day-to-day management did not always wait for the next scheduled meeting of the directorate to approve its decisions. The secretary general tolerated transgressions, granted higher *Personalkredite ex praesidio* and asked for the directors' endorsement *ex post*. Appendix E.3 reveals that increases in credit limits could be substantial. In many cases, the boost amounted to 50% or 100% of the initial level. Some *Personalkredite* were even tripled in the course of the panic.

Second, the Viennese directorate ordered a general, but rules-based loosening of credit limits on 3 Decem-

<sup>52</sup>The last reported run occurred in Csanád, today *Cenad*, in western Romania, c.f. *Czernowitzer Allgemeine Zeitung*, 15 December 1912, p.8.

<sup>53</sup>Bank directorate meeting in Vienna, 29 October 1912, OeNB archives 1912/I-4b.

ber 1912.<sup>54</sup> This measure allowed the heads of OeUB branches to lend beyond the credit limits as long as the submitted bills carried the signature of at least one safe endorser. Moreover, discount loans transgressing the *Personalkredit* had to be collateralized by additional securities.<sup>55</sup> For example, the *First Croatian Savings Bank* in Zagreb obtained an increase in its credit allowance of 3 million *Crowns* after agreeing to pledge additional *Lombard*-eligible securities worth the same amount.<sup>56</sup> Thus, while relaxing the strict constraint imposed by credit limits in normal times, the OeUB’s measures did not soften credit standards. The case-by-case increases and the general loosening of *Personalkredite* provide suggestive evidence that the system of credit limits did not stand in the way of effective liquidity provision during the crisis of 1912. In Appendix E.4, we compare the amount of withdrawals and liquid reserves for those 20 Austrian savings banks which experienced the highest year-on-year loss of deposits from 1911 to 1912. Without the OeUB’s liquidity assistance, these financial institutions would have most probably defaulted.

## 5.2 Liquidity shocks and credit limits: econometric evidence

The OeUB’s policy response to the panic of 1912 contradicts our fourth hypothesis. To accommodate liquidity distress, the Bank increased credit limits and permitted transgressions during the crisis. Hence, the observed flexibility corroborates our argument that the system of credit limits did not simply serve the purpose of a rigid counterparty risk management framework. We also argue that the increased flexibility in times of crisis should have been primarily geared towards counterparties suffering from an exogenous liquidity shock, rather than “home-made” funding needs (see hypotheses *H5.A* and *H5.B*). We now turn to econometrics to substantiate these claims. We start by estimating the following reduced form model to investigate the link between counterparties’ *ex ante* exposure to the exogenous liquidity shock in 1912 ( $E$ ) and bank-level increases in credit limits and/or tolerated transgressions ( $IT$ ):

$$IT_i = \alpha + \beta E_i + \mathbf{\Lambda}' \mathbf{X}_i + u_i \quad (2)$$

Employing a probit model, we fit equation 2 for three different definitions of  $IT$ . First, we draw on an indicator variable flagging bank-level tolerations of credit limit transgressions. Second, we use a binary variable to highlight credit institutions which received a permanent *Personalkredit* boost. Third, we construct a dummy variable indicating whether a bank received permission to transgress its credit limit or obtained an increase. To construct a plausibly exogenous treatment variable that reflects banks’ direct exposure to the shock, we geocoded

<sup>54</sup>Bank directorate meeting in Vienna, 3 December 1912, OeNB archives 1912/I-4b. The circular 67 dated 20 March 1909 summarizes this extraordinary measure already taken once in 1909 and again deployed in 1912.

<sup>55</sup>The market value of securities had to amount to at least 90% of the discounted bills. Compared to conventional advances, these “augmented” discount loans remained attractive during the panic because the OeUB’s discount rate was always 50 to 100 basis points below the *Lombard* rate. If a counterparty did not dispose of enough eligible securities or bills, it could still apply for standard advances subject to the haircuts and interest rates in place.

<sup>56</sup>Bank directorate meeting in Budapest, 27 November 1912, OeNB archives 1912/I-4b.

the location of each credit institution in our combined banks and savings banks data set for 1912. We then calculated the simple linear distance (in kilometers) between each bank location and the nearest border with Russia as our proxy for  $E$ . We also generate various alternative specifications of our exposure variable. On the one hand, we construct an indicator variable flagging both financial institutions domiciled in Galicia or Bukovina and banks which operated branches in at least one of these two regions. This variant of  $E$  captures counterparties which suffered intermediated liquidity strains due to the exposure of their branches. On the other hand, we compute the natural logarithm of the distance to the border and the inverse of the distance to the border as alternative measures of  $E$ . Finally, to purge the effect of  $E$  from potential confounding forces, we include all variables in  $\mathbf{X}$  (defined as in Model 1 above).<sup>57</sup> Appendix E.5 reports the summary statistics for our estimation sample.

Table 6 summarizes the reduced form results. Controlling for  $\mathbf{X}$ , we find that a one standard deviation increase in the distance to the Russian border (about 200 kilometers) decreases the likelihood to obtain a transgression waiver or a limit increase by two percentage points (see column 9). The unconditional probability of receiving a waiver or limit increase in the sample is 3.2%. Hence, the estimated impact of the shock is economically large. The marginal effect is also statistically significant at the 1% level. This summary extends to all specifications of  $E$ . Columns 5 to 8 in Table 6 show that the coefficient estimate is driven by tolerated transgressions, rather than permanent increases in *Personalkredite*. This finding suggests that the OeUB’s decision-making process for increases in credit limits remained relatively unaffected by the liquidity shock. Yet, we caution against over-interpreting this last result because our dummy variable approach discounts the actual size of limit increases. An analysis of percentage changes in credit limits may reveal a relevant connection between a stronger exposure to the shock and size extensions. Unfortunately, a non-negligible share of limit increases concerned financial intermediaries with limits above 2 million *Crowns* and credit institutions whose initial limit was not referenced in the protocols documenting the OeUB’s *ad-hoc* decisions during the panic. Thus, we cannot estimate a convincing model linking percentage changes in credit limits to the bank-level shock exposure.

(Table 6 here)

For robustness purposes, we re-estimate Model 2 by drawing on a penalized maximum likelihood (PML) estimator. The use of standard maximum likelihood estimators can lead to a substantial underestimation of event probabilities and biased standard errors in binary models with rare events (King and Zeng, 2001). As we only observe a small number of positive outcomes in our sample, we employ Firth logistic regressions (Firth, 1993) to check whether our coefficient estimates are robust to the use of PML techniques. The results in Appendix E.6 show that our findings in Table 6 hold up.

In a final step, we connect financial intermediaries’ heterogeneous exposure to the liquidity shock, bank-level

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<sup>57</sup>To estimate Model 2, we only draw on our bank-level cross-section for 1912. Hence, the year fixed effects  $\gamma$  drop out of the regression model. Moreover, since  $E$  is based on the geographic location of the credit institutions in our sample, we drop the regional fixed effects  $\phi$ .

deposit withdrawals and the OeUB’s decision to tolerate a limit transgression or grant a credit limit increase. The reduced form regressions in Table 6 show a direct link between the exogenous liquidity shock and the OeUB’s policy response during the crisis of 1912. Yet, the reduced form model does not shed any light on the channel through which the shock affected Austrian financial intermediaries. The previous subsection suggests that deposit withdrawals mediated the balance sheet impact of the bank-level exposure to war risk. To substantiate this particular causal chain of events, we use the following two-stage instrumental variable approach:

$$D_i = \alpha + \beta E_i + \mathbf{\Lambda}'\mathbf{X}_i + u_i \quad (3)$$

$$IT_i = \delta + \kappa \hat{D}_i + \mathbf{\Gamma}'\mathbf{X}_i + e_i \quad (4)$$

Model 3 represents our first stage. We regress the bank-level change in deposits ( $D$ ) between 31 December 1911 and 31 December 1912 on our exposure variable  $E$  and all covariates in  $\mathbf{X}$ . Our second stage (Model 4) links the OeUB’s decisions on tolerations and increases of credit limits to the fitted values from the first stage ( $\hat{D}$ ). Our main identification assumption is the conditional independence of the instrumental variable: after controlling for the covariates in  $\mathbf{X}$ , the exogenous exposure to the threat of war only influenced  $IT$  via its impact on deposit withdrawals. Judging from the extensive narrative evidence presented in the previous subsection and in Appendices E.1–E.4, this assumption seems plausible.

We report the results for our instrumental variable regressions in Table 7. For the first stage OLS regressions, we draw on our various exposure proxies to instrument the bank-level change in deposits. The first stage coefficients and the statistic for the F-test of excluded instruments are displayed in columns 1, 3, 5 and 7 of Table 7. According to the F-statistics, IV relevance is highest when we build the two-stage procedure on the logarithmized distance or the inverse distance to the Russian border (F-statistics of 12.4 and 15.5). The even numbered columns in Table 7 summarize the corresponding second stage results (all estimated using a probit model). Based on the two most convincing first stages, a 10% reduction in instrumented deposits is associated with a substantial increase in the likelihood of tolerations of transgressions or increases in credit limits by between 5.3% and 9.6% (columns 6 and 8 in Table 7). The marginal effects of interest are statistically significant at the 5% or 10% level. Thus, the econometric evidence in Tables 6 and 7 supports hypothesis  $H5.A$ . The OeUB relaxed its credit limits framework for counterparties hit by the exogenous liquidity shock in 1912.

(Table 7 here)



### 5.3 Carrots or sticks: fine-tuning liquidity provision during and after the crisis

The OeUB made clear that its extraordinary measures had to be considered as temporary. On the one hand, the Bank stood ready to prolong additional credit lines if need be and it extended several transgression allowances in January 1913 when they came up for renewal. On the other hand, counterparties felt continuous pressure to scale down central bank borrowing as quickly as possible. As a general rule, the Viennese directorate granted crisis-induced increases in discount limits initially for a maximum duration of three months. Yet, the meetings minutes of the Viennese directorate also suggest that the OeUB very much fine-tuned its grip on counterparties. This tailored approach is consistent with the hypothesis that the Bank paid close attention to counterparties' fundamentals by rewarding a sound financial position and penalizing imprudent behavior during normal times (*H5.A* and *H5.B*).

A first important factor was whether the Bank perceived its borrowers to engage in sufficient efforts to reestablish market funding. The prolongation of extraordinary credit extensions to the *Galizische Aktien-Genossenschafts-Bank* in Lviv was a case in point. When the Lviv branch of the OeUB commented on the extension request in February 1913, it observed that (1) the condition of the bank was improving slowly due to consolidation efforts, and that (2) external conditions still remained challenging: due to the confidence crisis, deposits had not yet returned to provincial credit cooperatives. In the eyes of OeUB directorate in Vienna, the combination of the credit cooperative's own efforts and the persistent difficulties outside the control of the counterparty justified the renewal of the temporary credit extension.<sup>58</sup>

Counterparty solvency and the quality of names on submitted bills also played a role in shaping the OeUB's response to additional liquidity requests during the panic of 1912. In cases where the solvency of a counterparty was in doubt, the Bank only granted discount loans beyond the credit limit if the reputation of the remaining endorsers on the bills was exceptionally good. For example, although the *Záložni úverní ústav*, a bank located in northeastern Bohemia, had breached its credit limits during the crisis, the directors considered further submissions as "perfectly legitimate". Their reasoning was that the bank's submissions consisted almost exclusively of trade bills endorsed by clients of industrial companies which had themselves been assessed in the Bank's credit lists. As a corollary, most of these bills could have been discounted without the endorsement of the *Záložni úverní ústav*. Hence, the discounted paper constituted a safe investment even if the *Záložni úverní ústav* had faced difficulties in honoring its debts.<sup>59</sup>

In this regard, the OeUB was also open to creative solutions. To justify a persisting transgression of the credit limit despite a portfolio of insufficient quality, counterparties could interpose additional good endorsements on the

<sup>58</sup>Bank directorate meeting in Vienna, 25 February 1913, OeNB archives 1913/I-4b.

<sup>59</sup>In contrast, when the temporary increase in the credit limit of the *Kasa zaliczkowa* in Nowy Sacz came up for renewal, the responsible branch inspector argued for a gradual reduction citing the "[limited] quality of the cooperative's discount portfolio". See Bank directorate meeting in Vienna, 4 February 1913, OeNB archives 1913/I-4b.

bills. When several Galician savings banks had exhausted their direct credit lines in December 1912, the OeUB encouraged them to discount their remaining bills at the *Galizische Landesbank*, which then could proceed to rediscount the same bills at the central bank. Thanks to this workaround, the OeUB received the complementary guarantee of the *Landesbank*, which was considered a very good risk. In anticipation of this workaround, the Austro-Hungarian Bank offered to raise the *Landesbank's* credit limit from 20 million before the crisis to 70 million to allow for increased rediscounting on behalf of smaller financial institutions in the hinterland.<sup>60</sup>

Finally, the OeUB directorate did not shy away from more confrontational tactics whenever counterparties undermined the spirit of its credit limit system. The Bank's treatment of the *Ústřední banka českých spořitelén* illustrates this point. The *Ústřední banka* was one of the largest joint-stock banks of the monarchy, located in its industrial heart, Prague. The *Ústřední banka* served as the central institution of Bohemian savings banks: it helped with the refinancing of smaller institutions, but it also recycled regional deposits to invest in riskier projects from which ordinary savings banks were banned. In 1912, the *Ústřední banka* got caught in the central bank's cross fire. On 23 September 1912, well before the start of the runs, the OeUB issued a first warning to the *Ústřední banka*. According to the OeUB's regular *ex ante* monitoring, the bank had overstretched itself by its large business expansion into Galicia and Bukovina. Consequently, the OeUB's directorate turned down *Ústřední banka's* request for an increase in its credit limit on 24 September 1912.<sup>61</sup> The start of the crisis in late October fully revealed the weak position of the bank. The OeUB directors quickly agreed that the *Personalkredit* of the *Ústřední banka* should be lowered as soon as possible. Given the ongoing run, however, an immediate adjustment was out of the question. Due to the bank's important position in Bohemia and elsewhere, the OeUB directors argued that a refusal to grant additional refinancing lines would have "led to a catastrophe" and would have put the bank's customers at risk.<sup>62</sup>

The OeUB's hope to resolve the situation with leniency and accommodation was disappointed during the following weeks. It became clear that the *Ústřední banka's* management was not ready to take any serious measures to address the increasing gap between its *Personalkredit* and its ballooning central bank borrowing. Thus, OeUB officials increased pressure on the bank to get its house in order. The central bank became more restrictive. The OeUB started to refuse a certain percentage of the bills submitted by the *Ústřední banka* (*quotenmäßige Aufteilung*), while providing just sufficient credit to enable the bank to continue operations and to protect its customers (*ohne Gefährdung ihrer Kunden*).<sup>63</sup> In a drastic move, the OeUB also made the *Ústřední banka's* future access to central bank refinancing conditional on changes in its business model.<sup>64</sup> The directors' strategy began to bear fruit in December 1912, when the OeUB was in a position to lower *Ústřední banka's* credit limit without causing disruptions to the bank's daily business.<sup>65</sup> In February 1913, the directorate meeting minutes reported

<sup>60</sup>Bank directorate meeting in Vienna, 3 December 1912, OeNB archives 1912/I-4b.

<sup>61</sup>Bank directorate meeting in Vienna, 24 September 1912, OeNB archives 1912/I-4b.

<sup>62</sup>Bank directorate meeting in Vienna, 19 November 1912, OeNB archives 1912/I-4b.

<sup>63</sup>Bank directorate meeting in Vienna, 3 December 1912, OeNB archives 1912/I-4b.

<sup>64</sup>Ibid.

<sup>65</sup>Ibid.

that the management of *Ústřední banka* had been changed and that a program to restructure the bank was already on its way.<sup>66</sup>

Although the case of the *Ústřední banka* constituted a particularly prominent example, similar policies were imposed on several other counterparties. As late as 23 September 1913, three banks in Bohemia (the *Böhmische Industrial-Bank*, the *Prager Credit Bank* and the *Záložni úverní ústav* in Hradec Králové, ger. *Königgrätz*) continued to overborrow at the discount window. The central bank was determined to follow up on the credit institutions' lax lending and liquidity standards.<sup>67</sup> The OeUB ultimately restricted their credit limits once it had become possible to do so without triggering negative externalities for third parties.<sup>68</sup> The OeUB directorate in Vienna also arranged for the temporary application of tighter censoring standards for bills submitted by these banks.

## 6 Conclusion

This paper argues that central banks used credit limits for discount window loans as a means to enforce supervisory standards at a time when they possessed no formal regulatory powers. Drawing on unique micro data from the Austro-Hungarian Bank's archives, we show that credit limits defined ceilings for central bank borrowing in normal times. The size of individual limits was contingent on counterparties' liquidity and capital position. We exploit heterogeneous exposures to an exogenous liquidity shock to illustrate that the requirement to abide by credit limits was suspended during crises to allow central banks to function as lenders of last resort. The evidence we marshal in this paper reveals that the historical roots of prudential regulation by central banks may run much deeper than previously thought.

The difference in the frequency of large-scale banking panics between Europe and the United States during the long 19th century is striking. It appears that the emergence of lenders of last resort on the Old Continent did not go hand in hand with an increase in collective moral hazard. While this observation and our narrative could mean that credit limits played a crucial role in this regard, we do not assess the actual effectiveness of financial regulation at the time. To do so would require a counterfactual scenario of financial intermediaries' liquidity management in the absence of a lender of last resort and a precise quantification of the optimal precautionary amount of liquidity banks should have held. Both aspects would certainly be worthwhile, though challenging topics for future research.

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<sup>66</sup>Bank directorate meeting in Vienna, 4 February 1913, OeNB archives 1913/I-4b.

<sup>67</sup>Bank directorate meeting in Vienna, 23 September 1913, OeNB archives 1913/I-4b.

<sup>68</sup>*Ústřední banka*'s credit limit was eventually reduced from 15 million to 8 million *Crowns*. For the three banks mentioned above, a direct comparison is not possible as the old credit limits are not listed in the directorate meeting minutes.

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Table 1: Assessments of credit limits (reasons and decisions taken, 1909-1913)

	Reason	Canceled	Lowered	Unchanged	Increased	New	Total
1	Bankrupt	54	0	0	0	0	54
2	Dissolved	211	0	11	0	0	222
3	Illness, death	202	0	1	0	0	203
4	Change location/name	104	0	4	1	18	127
5	Absolute level of equity or wealth	213	145	63	10	22	453
6	Change in owner	63	7	2	0	0	72
7	Withdrawal of partner	20	51	1	0	0	72
8	Change legal form	68	0	1	0	0	69
9	Leverage	24	9	26	3	10	72
10	Asset liquidity	10	17	41	8	17	93
11	Refinancing risk	48	42	83	2	11	186
12	Volume of business	18	18	6	2	4	48
13	Limit adequate	1	2	13	6	6	28
14	Management quality	14	7	11	3	0	35
15	Experience	0	2	5	0	12	19
16	Payment history	10	3	1	1	0	15
17	Risky loan portfolio	3	3	3	1	0	10
18	Absent from discount window	289	0	11	0	0	300
19	OeUB rules	4	0	10	0	2	16
20	Quality of bills submitted	1	1	4	1	2	9
	<b>Total decisions</b>	1,290	253	346	1,039	1,350	4,278
	<b>Decisions with written comment</b>	1,269	234	307	126	170	2,106

Note: Several reasons can be given for decisions on credit limits (sum of columns can be larger than total number of changes).

Source: OeUB directorate protocols (Vienna; 1909-1913)



Table 2: Changes in credit limits of financial and non-financial counterparties (1909-1913)

<b>Reason</b>	<b>NFIs</b>	<b>Financial inst.</b>
Dissolved, relocated, death	505 28.8% (1.081)	25 4.4% (1.389)
		t-statistic: 7.91***
Bankrupt	52 3.0% (0.405)	1 0.4% (0.448)
		t-statistic: 2.19**
Owners, partners, legal form	202 11.5% (0.762)	4 1.8% (0.891)
		t-statistic: 4.50***
Equity and wealth	413 23.5% (1.013)	22 9.9% (2.001)
		t-statistic: 4.67***
Leverage	37 2.1% (0.343)	33 14.8% (2.383)
		t-statistic: -9.89***
Asset liquidity	55 3.1% (0.416)	37 16.6% (2.497)
		t-statistic: -9.17***
Refinancing risk	67 3.8% (0.458)	62 27.8% (3.007)
		t-statistic: -14.35***
Management	38 2.2% (0.348)	30 13.5% (2.290)
		t-statistic: -8.88***
Volume of business	46 2.6% (0.381)	2 0.9% (0.633)
		t-statistic: 1.57
<b>Decisions with written comments</b>	1,754	223
<b>Total decisions</b>	3,520	570

Note: Percentage shares based on number of decisions with comments per type.

T-statistics for mean comparison tests (relative prevalence of reasons).

Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 3: Summary statistics and variable definitions – all financial institutions with reporting requirements

Variable	Obs	Mean	Std. Dev.	Min	Max	P50
Credit limit (here: in 1,000 Crowns)	489	204.7035	319.8078	0.0000	2,000.0000	100.0000
						<i>Definition: credit limits as recorded by OeUB</i>
Total assets (here: in 1,000 Crowns)	489	4,962.8080	6,159.7600	65.4820	45,663.3000	2,553.0620
						<i>Definition: total assets as reported by source</i>
Age (in years)	471	26.1380	13.5177	1.0000	57.0000	28.0000
						<i>Definition: years since foundation as reported by source</i>
Leverage ratio	451	16.8912	31.3373	1.3291	563.0192	11.6824
						<i>Definition: total assets divided by sum of equity and reserves</i>
Liquidity ratio	433	0.8620	1.6203	0.0000	13.0714	0.3257
						<i>Definition: discountable bills plus cash divided by total deposits</i>
Liquidity ratio 2	410	0.3698	0.2995	0.0000	0.9803	0.2734
						<i>Definition: discountable bills divided by total assets</i>
Liquidity ratio 3	402	0.8931	1.6156	0.0000	12.7726	0.3587
						<i>Definition: discountable bills divided by total deposits</i>
Liquidity ratio 4	484	0.3297	0.3018	0.0000	0.9550	0.3252
						<i>Definition: mortgages, real estate &amp; advances divided by total assets</i>
Return on equity	420	0.0618	0.4698	-1.0000	3.9667	0.0887
						<i>Definition: total annual profits divided by equity<sup>a</sup></i>
Refinancing risk	296	0.0964	0.1548	0.0000	0.9173	0.0239
						<i>Definition: total rediscounts divided by total assets<sup>b</sup></i>
OeUB affiliate	489	0.1084	0.3112	0.0000	1.0000	0.0000
						<i>Definition: dummy for institutions operating as OeUB affiliate</i>
Joint-stock bank	489	0.0736	0.2614	0.0000	1.0000	0.0000
						<i>Definition: dummy for joint-stock banks</i>
Savings bank	489	0.2822	0.4505	0.0000	1.0000	0.0000
						<i>Definition: dummy for savings banks</i>
Number of branches	489	0.2290	0.9838	0.0000	9.0000	0.0000
						<i>Definition: number of branches (count variable)</i>

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Note: Sample for baseline regression displayed in column (1) of Table 4 in the main paper.

<sup>a</sup>To compute the return on equity for savings banks, we use reserve funds instead of equity. Savings banks in Austria did not have any paid up equity capital but relied on reserve funds instead.

<sup>b</sup>Rediscounts represent a liabilities-side position on the balance sheet. Rediscounts are equivalent to the sum of bills rediscounted with other institutions. For savings banks, no precise data on rediscounts are available. Hence, we draw on a residual balance sheet position instead (other liabilities).

Table 4: Determinants of credit limits – all financial institutions with reporting requirements

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Total assets (ln)	0.74*** (0.03)	0.74*** (0.03)	0.77*** (0.03)	0.80*** (0.03)	0.82*** (0.03)	0.81*** (0.03)	0.81*** (0.04)	0.71*** (0.04)	0.70*** (0.04)	0.75*** (0.05)	0.75*** (0.05)
Age (ln)		-0.04 (0.05)	-0.06 (0.05)	0.05 (0.06)	0.08 (0.06)	0.12** (0.05)	0.12** (0.06)	0.29*** (0.05)	0.30*** (0.05)	0.30*** (0.05)	0.29*** (0.06)
Leverage ratio			-0.15 (0.10)	-0.11 (0.09)	-0.10 (0.09)	-0.11 (0.08)	-0.11 (0.08)	-0.03 (0.05)	-0.03 (0.06)	-0.01 (0.05)	-0.01 (0.05)
Liquidity ratio				0.16*** (0.04)	0.17*** (0.04)	0.25*** (0.04)	0.25*** (0.04)	0.17*** (0.04)	0.17*** (0.04)	0.15*** (0.04)	0.15*** (0.04)
Return on equity					-0.03 (0.03)	0.28 (0.18)	0.28 (0.18)	0.05 (0.18)	0.08 (0.20)	0.07 (0.19)	0.14 (0.29)
Refinancing risk						-0.28*** (0.05)	-0.28*** (0.05)	-0.16*** (0.05)	-0.15*** (0.06)	-0.19*** (0.05)	-0.18*** (0.05)
OeUB affiliate							-0.07 (0.10)	0.03 (0.11)	0.02 (0.11)	0.03 (0.11)	0.02 (0.11)
Joint-stock bank								1.13*** (0.17)	1.16*** (0.21)	1.44*** (0.23)	1.46*** (0.22)
Savings bank									0.04 (0.15)	0.06 (0.15)	0.09 (0.16)
Constant	0.63 (0.43)	0.70 (0.46)	0.38 (0.46)	-0.37 (0.47)	-0.81* (0.44)	-0.61 (0.52)	-0.68 (0.55)	0.15 (0.55)	0.21 (0.60)	-1.19* (0.69)	-1.13 (0.71)
Observations	489	471	440	423	403	283	283	283	283	283	283
R-squared	0.57	0.57	0.59	0.60	0.62	0.71	0.71	0.76	0.76	0.78	0.78
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	No	No	No	No	No	No	No	No	No	Yes	Yes
Year FE	No	No	No	No	No	No	No	No	No	No	Yes

Note: Coefficients on continuous variables (except total assets and age) represent effect of 1 std. dev. increase.

Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Table 5: Tests for equality of survivor functions

City	Events observed	Events expected
Bielsko-Biala	5	5.49
Brno	11	11.01
Graz	16	21.38
Hradec Králové	9	9.8
Lviv	13	13.36
Prague	115	124.08
Vienna	79	62.87
Total	248	248

1) Log-rank test:  $Chi2(6) = 11.37$ ,  $Pr > Chi2 = 0.08$   
2) Cox test:  $LR Chi2(6) = 6.38$ ,  $Pr > Chi2 = 0.38$   
3) Wilcoxon-Breslow-Gehan test:  $Chi2(6) = 7.91$ ,  $Pr > Chi2 = 0.24$   
4) Tarone-Ware test:  $Chi2(6) = 10.12$ ,  $Pr > Chi2 = 0.12$   
5) Peto-Peto-Prentice test:  $Chi2(6) = 10.12$ ,  $Pr > Chi2 = 0.12$

Note: Null hypothesis for tests 1 to 5: survival functions are equal.

Table 6: Probit reduced form regressions – tolerations of credit limit transgressions and increases during the panic of 1912

VARIABLES	(1) Transgression	(2) Transgression	(3) Transgression	(4) Transgression	(5) Increase	(6) Increase	(7) Increase	(8) Increase	(9) Trans. + incr.	(10) Trans. + incr.	(11) Trans. + incr.	(12) Trans. + incr.
Distance to Russian border	-0.02*** (0.01)				-0.00 (0.00)				-0.02*** (0.01)			
Regional exposure		0.03*** (0.01)				0.00 (0.02)				0.05*** (0.02)		
Distance to Russian border (ln)			-0.01*** (0.00)				0.00 (0.00)				-0.02*** (0.01)	
Distance to Russian border (inverse)				0.00*** (0.00)				-0.01 (0.01)				0.01** (0.00)
Total assets (ln)	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Age (ln)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.02** (0.01)	-0.02** (0.01)	-0.02** (0.01)	-0.02** (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Leverage ratio	-0.45 (0.29)	-0.47* (0.25)	-0.55** (0.27)	-0.71** (0.31)	-0.23* (0.14)	-0.23* (0.14)	-0.24* (0.14)	-0.26* (0.15)	-0.26 (0.19)	-0.23 (0.17)	-0.25 (0.17)	-0.29 (0.19)
Liquidity ratio	-0.00* (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	-0.02 (0.01)	-0.02 (0.01)	-0.02 (0.01)	-0.02 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.00 (0.01)
Return on equity	-0.02 (0.03)	-0.02 (0.02)	-0.03 (0.02)	-0.02 (0.02)	0.01 (0.03)	0.01 (0.03)	0.01 (0.03)	0.01 (0.03)	0.00 (0.04)	0.00 (0.04)	0.00 (0.04)	0.00 (0.04)
Refinancing risk	-0.01* (0.00)	-0.01 (0.01)	-0.01 (0.00)	-0.01 (0.00)	-0.02* (0.01)	-0.02** (0.01)	-0.02 (0.01)	-0.01 (0.01)	-0.02** (0.01)	-0.03** (0.01)	-0.02* (0.01)	-0.02 (0.01)
OeUB affiliate	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.02 (0.01)	0.05*** (0.02)	0.05*** (0.02)	0.05*** (0.02)	0.05*** (0.02)	0.07*** (0.02)	0.07*** (0.02)	0.07*** (0.02)	0.07*** (0.02)
Joint-stock bank	0.03 (0.02)	0.02* (0.01)	0.02* (0.01)	0.02 (0.01)	-0.01 (0.03)	-0.01 (0.03)	-0.01 (0.03)	-0.01 (0.03)	0.05* (0.03)	0.04* (0.02)	0.05** (0.02)	0.05* (0.03)
Observations <sup>a</sup>	710	710	710	710	710	710	710	710	710	710	710	710
AUC statistic	0.97	0.96	0.97	0.94	0.81	0.81	0.80	0.81	0.84	0.84	0.83	0.77
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Coefficients on continuous variables (except total assets and age) represent the average marginal effect of 1 std. dev. increase.  
Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

<sup>a</sup>Explanatory note: The number of observations in Table 6 differs from the number of observations in Table 4 because the estimation samples are different. The regressions in Table 4 draw on a pooled cross-section of financial institutions between 1909 and 1913. Financial institutions only enter the estimation sample for Table 4 if their limit was re-assessed between 1909 and 1913. In contrast, the estimation sample for Table 6 contains a complete cross-section of Austrian financial institutions in 1912. All Austrian financial institutions enter this sample, no matter whether their credit limit was re-assessed in 1912 or not.

Table 7: Probit instrumental variable regressions – tolerations of transgressions and/or increases during the panic of 1912

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	First stage	Second stage	First stage	Second stage	First stage	Second stage	First stage	Second stage
Change in deposits (instrumented)		-2.63*		-0.93**		-0.96**		-0.53*
IV = Distance to Russian border	0.01** (0.00)	(1.50)		(0.47)		(0.46)		(0.32)
IV = Regional exposure			-0.05*** (0.02)					
IV = Distance to Russian border (ln)					0.02*** (0.00)			
IV = Distance to Russian border (inverse)							-0.01*** (0.00)	
Total assets (ln)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)
Age (ln)	-0.04*** (0.01)	-0.00 (0.01)	-0.04*** (0.01)	-0.00 (0.01)	-0.04*** (0.01)	-0.00 (0.01)	-0.04*** (0.01)	-0.01 (0.01)
Leverage ratio	0.03** (0.01)	-0.22 (0.16)	0.03** (0.01)	-0.17 (0.13)	0.03** (0.01)	-0.20 (0.14)	0.03** (0.01)	-0.24 (0.16)
Liquidity ratio	-0.00 (0.03)	-0.01 (0.01)	0.00 (0.03)	-0.01 (0.01)	-0.00 (0.03)	-0.01 (0.01)	-0.00 (0.03)	-0.00 (0.01)
Return on equity	-0.00 (0.02)	-0.01 (0.06)	-0.01 (0.02)	-0.01 (0.04)	-0.01 (0.02)	-0.01 (0.04)	-0.01 (0.02)	-0.00 (0.03)
Refinancing risk	-0.00 (0.01)	-0.02** (0.01)	0.00 (0.01)	-0.03** (0.01)	0.00 (0.01)	-0.02* (0.01)	-0.00 (0.01)	-0.02 (0.01)
OeUB affiliate	-0.03* (0.02)	0.07*** (0.02)	-0.03* (0.02)	0.07*** (0.02)	-0.03* (0.02)	0.07*** (0.02)	-0.03* (0.02)	0.07*** (0.02)
Joint-stock bank	0.01 (0.04)	0.09 (0.11)	0.02 (0.04)	0.07 (0.05)	0.01 (0.04)	0.07 (0.05)	0.01 (0.04)	0.06 (0.04)
Observations	710	710	710	710	710	710	710	710
R-squared (first stage)	0.16	-	0.18	-	0.18	-	0.18	-
F-statistic (test of excluded instruments)	4.67	-	9.50	-	12.43	-	15.47	-
AUC statistic (second stage)	-	0.84	-	0.83	-	0.81	-	0.75
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Coefficients on continuous variables (except total assets, age and change in deposits) represent the (average) marginal effect of 1 std. dev. increase.

Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1