

# Macroscoping the Historical Lender of Last Resort: A Transatlantic Perspective

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## Abstract

*Drawing on new research, this paper dissects the experiences of central banks as lenders of last resort (LOLR) during the nineteenth and early twentieth century. Focusing on Europe and North America, the paper clarifies the mechanics of historical LOLR operations and discusses why the LOLR limited support to illiquid, but solvent counterparties. It sheds light on the nature and the origin of the frequent supply as well as demand constraints on liquidity provision in the past, and it explores their impact on financial markets. The paper also examines the moral hazard implications of successful lending of last resort and explains how central banks attempted to address these risks. The conclusion highlights several topics for future work.*

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Keywords: lender of last resort, Bagehot, LOLR, financial crisis, central bank, credit rationing, stigma, moral hazard, banking regulation

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# 1 Introduction

Published in 1873, Walter Bagehot's book *Lombard Street* has become the epitome of the so-called lender of last resort (LOLR) – a concept that continues to shape policy responses to financial crises. Building on earlier work by Francis Baring and Henry Thornton, Bagehot's book popularized the LOLR as an *ad-hoc* or permanent institution that offers an elastic source of liquidity to all eligible counterparties during a financial crisis, when regular funding markets cease to function. While many different private and public institutions – including public-private partnerships – have assumed this role in the past, modern central banks are in a natural position to act as LOLR in today's financial markets. As the monopoly issuer of currency, the modern central bank is the only institution that cannot become illiquid itself.

Why is the LOLR important? The LOLR's main role is to mitigate the negative economic externalities of financial crises (Gorton and Metrick, 2013).<sup>1</sup> Financial crises entail flights to safety. Observing a negative economic or financial signal, creditors begin to doubt the quality of debts they hold and rush to convert relatively risky or illiquid portfolios into safer and highly liquid assets (Gorton and Ordoñez, 2014). In such circumstances, debtors are often forced to liquidate their assets to meet the increased demand for liquidity. Negative asset price spirals develop as many market participants sell their holdings simultaneously (Brunnermeier, 2009). These asset price declines in turn affect third parties in financial markets and other sectors of the economy. Pure contagion effects, e.g. due to rumors about the financial health of specific intermediaries, may also spread distress to initially unaffected market participants (Friedman and Schwartz, 1963). Pecuniary losses, heightened uncertainty and rising costs of credit intermediation weaken aggregate demand, and can cause or amplify recessions (Bernanke, 1983; Calomiris and Mason, 2003). For all these reasons, financial crises are usually associated with large costs for creditors, tax payers and the real economy at large (Frydman and Xu, 2023).

The LOLR addresses the negative externalities of financial crises by offering an unlimited supply of highly liquid, risk-free assets, such as cash, central bank reserves or top-notch sovereign bonds. The LOLR can furnish these prime assets in two ways: either by extending loans against eligible collateral or by purchasing illiquid but safe assets from counterparties in exchange. This elastic supply of liquidity allows all debtors to honor their liabilities as long as they possess eligible collateral or assets of sufficient quality. Thus, the LOLR can stop an incipient run and avert large scale asset fire sales with potentially severe macroeconomic consequences.

Central banks' ability and willingness to act as LOLR required many years of apprenticeship. It took several centuries of non-linear progress and setbacks until central banks slowly evolved into effective LOLRs during the nineteenth century. The present paper does *not* attempt to re-sketch this general history of the LOLR function's evolution across time and space, nor does it engage in a detailed institutional account of individual LOLRs: the existing literature already offers many exhaustive and informative contributions along these lines.<sup>2</sup> For similar reasons, this paper will *not* add to the uncountable interpretations and modern rationalizations

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<sup>1</sup>While there is no universally accepted definition of a financial crisis, these episodes of turmoil tend to share dynamics that allow for their characterization as systemic events affecting the stability of many or most intermediaries in a given financial market (Gorton, 2018).

<sup>2</sup>For a non-exhaustive list, c.f. Humphrey and Keleher (1984); Bordo (1990); Goodhart (1999); Bordo (2014); Ugolini (2017); Bindseil (2019).

of Walter Bagehot's infamous principles for lending of last resort.<sup>3</sup> While controversies over the history of ideas are intellectually stimulating, they can also distract from the 'events on the ground'. At times, differing operational details and jargon can even impede a mutual transatlantic understanding of the historical LOLR and its defining features. In an attempt to partly resolve these incongruences, the present paper puts the historical LOLR, as practiced during the nineteenth and early twentieth century, 'under the microscope'. Drawing on new research, its goal is to create more common ground by shining a spotlight on four specific questions that students of European and North American economic history – but also modern policy-makers – may have encountered when reflecting on the LOLR, past and present.

The first question asks what exactly a standard LOLR operation involved at the micro – i.e. transaction – level, and how the concomitant balance sheet mechanics played out in practice. Many scholars stress that it always was, and still remains, key for the LOLR to limit its support to illiquid, but strictly solvent counterparties. Given that liquidity was exclusively lent in exchange for high quality collateral or issued in return for safe assets, informed observers may have wondered why counterparty risk should have mattered for LOLR operations in the first place. Shedding light on the first question, Section 2 also sets out to clarify this point in the historical context of the long nineteenth century.

The second question asks why central banks frequently rationed credit during financial crises instead of providing unlimited liquidity as the LOLR role would demand. Delving deeper, some readers may have puzzled over how exactly central banks implemented credit rationing and why they often resorted to price *and* quantity rationing strategies when confronted with a demand for liquidity they could not or were not willing to accommodate. Section 3 discusses credit rationing resulting from institutional and ideational supply side constraints on the LOLR. It explores the mechanics and consequences of credit rationing, and it explains how policy-makers attempted to tackle the underlying supply side constraints.

The third set of questions tackles demand side constraints on liquidity provision by the LOLR. Why were counterparties sometimes unwilling to claim LOLR liquidity in a panic? How did the LOLR react to liquidity requests from counterparties that were not eligible or that did not hold enough eligible assets or collateral? Given that the LOLR usually entered a crisis with a fixed list of eligible counterparties, and pre-determined requirements for collateral and purchasable assets, which preconditions had to be met for the LOLR to deviate from its pre-panic framework? Section 4 introduces the concept of stigma to explain why some historical LOLRs came to build a toxic reputation that deterred counterparties. The section also analyzes how and when historical LOLRs managed to extend liquidity to counterparties and against securities that lay beyond the scope of their traditional confines. Finally, it draws a line between the LOLR and emergency liquidity assistance (ELA) – two distinct concepts that are often inadvertently mixed up.

Section 5 is dedicated to the fourth topic: moral hazard. Many accounts casually refer to moral hazard as a consequence of lending of last resort, but most remain vague regarding the exact definition of hazardous behavior and what precise dangers it implies for the financial system. Section 5 picks up this point and explains

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<sup>3</sup>According to many accounts, Bagehot noted that the LOLR should lend freely, at high interest rates, and in return for good collateral. Although Bagehot never formulated these rules as a coherent set of principles, they are generally ascribed to him and derived from various passages in his main work, *Lombard Street*. For a detailed discussion, c.f. Goodhart (1999).

why prudential regulation represents the standard first line of defense against moral hazard deriving from LOLR in modern financial systems. Today’s formalized banking supervision, however, represents a quite recent phenomenon in comparison to the long history of LOLR. Thus, financial history *aficionados* may have asked themselves how LOLRs dealt with moral hazard before they first received formal regulatory powers. Section 5 also provides an answer to this question. Section 6 concludes and highlights several topics for future research.

This introduction closes with a double note of caution. First, the present paper concentrates on central banks’ experience as LOLRs. While many aspects of the four topics discussed below should be sufficiently broad to remain relevant for the study of LOLRs in a variety of historical contexts, the paper’s focus also means that its institutional backdrop does not always perfectly apply to LOLRs that pre-dated the foundation of modern central banks, such as e.g. U.S. clearinghouses in the pre-1913 era (Gorton and Tallman, 2016). Second, while the roots of lending of last resort go back several centuries (Ugolini, 2017; Bindseil, 2019), this paper deliberately covers the nineteenth and early twentieth century only. By the mid-nineteenth century, many European countries had already founded central banks that had come to or were expected to assume LOLR responsibilities in one form or another (Bignon et al., 2012). The reports of the U.S. National Monetary Commission that led to the establishment of the Federal Reserve were heavily coined by its surveys of nineteenth and early twentieth century European central banking (Meltzer, 2003). Studying the emerging archetypes on the Old Continent and their application (and modifications) in the New World during the period between c. 1840–1930 allows for the construction of a conceptual bridge connecting the two sides of the Atlantic.

## 2 An anatomy of lender of last resort operations

### 2.1 The fundamentals

A basic, yet important point is that lending of last resort as practiced by central banks during the long nineteenth century did not entail any special instruments that were only activated during financial crises. The liquidity facilities that central banks employed when assuming their role as LOLR were identical to the ones they operated day in, day out in tranquil times. These facilities were called standing facilities – where the term ‘standing’ alludes to the fact that they could be used by all eligible counterparties at any time. The central bank defined the general conditions under which it was willing to provide liquidity through these facilities, including information on who was eligible to apply for liquidity in the first place. Yet, the facilities stayed in stand-by mode until a request for liquidity came in: contrary to modern open market operations, all standing facility transactions were initiated by the central bank’s counterparties, not the central bank itself.

Typically, central banks ran two different standing facilities. The first one was commonly known as the discount window. Through this facility, central banks purchased certain types of assets outright, but at a discount. Central banks announced the list of acceptable safe assets and the discount rate, i.e. the discount at which it bought assets relative to their nominal or current market value. For example, a discount rate of 6% meant that assets would be purchased at a price that amounted to 94% of their nominal or current

market value.<sup>4</sup> Central banks often maintained a range of discount rates at the same time, rather than a single uniform rate. For instance, while the Bank of England published a single official Bank rate, it merely considered this rate as the minimum discount at which it was willing to purchase assets.<sup>5</sup> Actual transactions frequently deviated from this minimum rate and deviations could be hefty (up to 200 basis points) (Anson et al., 2017). Similarly, in its early years, the U.S. Federal Reserve System had an entire schedule of discount rates for different classes of assets (Carlson, 2023). Although research has yet to shed a comprehensive light on the motivation for charging different discounts, working with a range of rates likely allowed central banks to better account for the idiosyncratic risk parameters of each transaction, such as asset quality, price volatility and remaining maturity. These parameters varied, even within the pool of safe assets considered eligible for purchase through the discount window.

The second standing facility was the Lombard facility, also known as advances or – in the American context – as bills payable. In contrast to discount window purchases, Lombard facility transactions constituted collateralized loans. Advances allowed counterparties to obtain highly liquid central bank money for a limited time period (usually not longer than three months) in exchange for posting less liquid collateral. In these transactions, central banks applied haircuts, i.e. the loan amount was fixed at a pre-determined fraction of the market value of the pledged collateral. Many central banks published the list of eligible collateral and the minimum haircuts for each individual asset. Haircuts differed depending on the perceived quality of the collateral asset and could be considerable. For example, in the case of the Austro-Hungarian Bank, haircuts ranged between 10% (for short-term treasury bills) and 40% (for shares of industrial companies) in 1914 (Hanel, 1915). Central banks could also place margin calls and require the posting of additional collateral if the market value of pledged securities had significantly fallen at any point during the loan duration. At maturity, the borrowing counterparty repaid the principal plus interest and the central bank returned the securities deposited as collateral. The interest rate for advances, the Lombard rate, tended to be set at a fixed positive spread relative to the discount rate.<sup>6</sup> While Lombard rates could vary across loans, e.g. to assure preferential treatment of loans collateralized by government securities, they tended to be more uniform than discount rates, likely because haircuts already provided a tool to fine-tune lending conditions to heterogeneous risk characteristics.

Conditional on fulfilling the standard criteria for asset and collateral eligibility, counterparties were free to choose between the discount window and advances when requesting central bank liquidity. Yet, is worthwhile noting that standing facilities transactions could have substantially different implications for counterparties' balance sheets, depending on the prevailing accounting practices. For example, discount window transactions initiated by U.S. member banks<sup>7</sup> in the early 1920s left the length of banks' balance sheets practically unchanged. Detailed balance sheets from national bank examiner reports show that discounts with the Federal Reserve

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<sup>4</sup>This specific example holds for assets with a one-year maturity. Most discount operations involved assets with shorter maturities, c.f. next subsection.

<sup>5</sup>In some isolated cases, the Bank also purchased assets at a discount rate below Bank rate.

<sup>6</sup>Note that Lombard haircuts and Lombard interest rates serve two different goals. Whereas haircuts mitigate the risk of asset price depreciation, interest rates remunerate the lender.

<sup>7</sup>Member banks are commercial banks that decided to join the U.S. Federal Reserve System. These banks have access to Federal Reserve liquidity but also have to abide by additional regulatory requirements. When the Federal Reserve System was founded, all U.S. national banks automatically became member banks. State-chartered banks could decide to join the Federal Reserve System on a voluntary basis.

System were deducted from the asset position “Loans and Discounts” and added to the asset-side item reflecting the reserve account with the local Federal Reserve Bank (“Due from Federal Reserve Bank”). Hence, discount window operations essentially represented a swap between different types of assets (minus the amount of the discount rate). In contrast, advances increased both liabilities (by adding to the item “Bills Payable with Federal Reserve Bank”) and assets (via the reserve account to which the proceeds were credited, i.e. “Due from Federal Reserve Bank”). Thus, in the early 1920s, a national bank that refinanced a large part of its investments using the discount window would have exhibited a significantly lower leverage ratio (i.e. balance sheet size relative to equity) than the very same bank had it decided to refinance investments via advances. Interestingly, accounting practices for U.S. national banks’ discount window transactions seem to have changed over time, as examiner reports from earlier *and* later periods (e.g. in 1893 and 1929) show no evidence of discounts being deducted from the asset side.

How does lending of last resort relate to these institutional intricacies of central banks’ standing facilities? Stripped to its bare bones, the LOLR role simply required central banks to keep their standing facilities operating during a financial crisis. The key to successful lending of last resort was to exhibit inertia. As long as support was available according to the same purchasing and lending criteria that prevailed in normal times, the financial and economic reverberations of sudden scrambles for liquidity could be contained. Moreover, the mere presence of a reliable and elastic safety net dampened the extent of runs compared to time periods during which the supply of highly liquid safe assets had remained fixed *ex ante*.

Thus, the balance sheets of central banks acting as LOLR expanded and contracted with the ebb and flow of financial distress, as is still the case today. Discount window transactions and advances would augment the securities or loan portfolio on the asset side of the central bank balance sheet. If the counterparty received the proceeds from the sale or the loan in cash, the liability side pendant of discounts and Lombards was an increase in the currency in circulation. Alternatively, the counterparty could have an amount of reserves equivalent to the proceeds credited to the current account it held with the central bank. This second option was not always available as the right to open a current account was subject to certain criteria that varied across central banks. For example, prospective account holders with the Bank of England needed to be introduced to the management by personal recommendation of the directors. In other countries, central bank counterparties were even required by law to hold a reserve account – as was the case with all member banks of the U.S. Federal Reserve System. Whether and under which circumstances counterparties that had access to central bank current accounts chose cash over reserves or vice versa remains a question to be answered by future research. As Section 3 suggests, this choice was not always innocuous because it could impact a central bank’s ability to act as LOLR.

## 2.2 Illiquid vs. insolvent counterparties

The institutional and historical background above furnishes the fundamentals for a discussion on why the literature stresses the importance of differentiating between illiquid and insolvent counterparties. It is a widely accepted view that the LOLR should extend liquidity support only to the former, but not to the latter. The

available empirical evidence strongly suggests that central banks acting as LOLR *did* care about counterparty risk during the long nineteenth century. For example, the Bank of England closely tracked its exposure vis-à-vis each individual counterparty in a complex and painstakingly detailed ledger system (Flandreau and Ugolini, 2013, 2014)– and the *Old Lady of Threadneedle Street* was far from a historical outlier in this regard. Other central banks also routinely monitored their counterparties on a daily basis: the Banque de France operated a multi-layer system of information and controls to harness counterparty credit risk (Avaro and Bignon, 2019); the Federal Reserve Banks paid close attention to the leverage and liquidity positions of member banks when dealing with their individual requests for discounts and advances (Carlson, 2023); and the Austro-Hungarian Bank maintained a system of counterparty-level credit limits that involved recording exposures almost in real time (Jobst and Rieder, 2023).

While historical practice appears to confirm the important role of counterparty risk, the exact economic rationale for why the LOLR should only furnish liquidity to solvent counterparties requires a more in-depth analysis. Some scholars trace the origin of this dictum back to Walter Bagehot himself. In *Lombard Street*, Bagehot (1873, p.97) argues that the LOLR should only provide liquidity against “good collateral” which he defines as an asset that, “in ordinary times, is reckoned a good security” and that is “commonly pledged and easily convertible”. Drawing on these snippets, Castiglionesi and Wagner (2012, p.202) argue that “institutions without sufficient collateral were assumed to be insolvent and should, in Bagehot’s view, be allowed to fail”.

This attempt to instrumentalize Bagehot’s words has three downsides. First, *stricto sensu*, the reference to good collateral only seems to apply to advances. Discount window transactions constituted outright purchases that did usually not involve the pledging of collateral. Yet, the point that the LOLR should distinguish between illiquid and insolvent counterparties arguably extends beyond Lombard loans, to all channels of central bank liquidity provision. The reference to collateral in Castiglionesi and Wagner (2012) appears to derive from an anachronistic view of liquidity provision by the LOLR. Historically, the LOLR purchased assets *and* lent against collateral, while today’s central banks acting as LOLR generally provide liquidity via secured lending facilities only.<sup>8</sup>

Second, this interpretation of Bagehot’s dictum does not clarify why counterparty risk should matter for the LOLR in the first place. Without further explanation, it remains unclear why the default of a given counterparty would have any direct consequences for assets purchased outright from that very counterparty. Likewise, in case a counterparty defaulted on the advance it had received, the combination of collateral, haircuts and margin calls should have provided powerful tools whose ability to protect the LOLR from losses were in principle unrelated to counterparty solvency.

Third, the rationalization by Castiglionesi and Wagner (2012) does not answer the following question. If the distinction between illiquid and insolvent counterparties was so crucial for Bagehot and his contemporaries, why do prominent historians describe the Bank of England’s discount window as “made of frosted glass and raised just a few inches” (Capie, 2002, p.310)? After all, a standard interpretation of this description is that

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<sup>8</sup>In fact, it is likely that Bagehot had a broader interpretation in mind and meant to include discounted bills when referencing “good collateral” (Ugolini, 2017, p.109–115).

the Bank's Discount Office clerks did not need to know who was on the other side of the discount window, but only cared about the quality of assets submitted for purchase.

To reconcile empirics, economic rationale and historical narrative, one first needs to take a closer look at the assets LOLRs purchased via the discount window during the long nineteenth century. Central banks mainly bought so-called bills of exchange. Bills of exchange constituted negotiable debt instruments used by a debtor (the drawer) to obtain short-term credit from a lender (the discounter) in exchange for a written promise (i.e. the bill) to repay the loan at a pre-defined date in the future. Usually, the bill was co-signed by a guarantor who accepted liability for payment in case the drawer defaulted on her obligation to repay the loan at maturity. Guarantors, who were also known as acceptors, provided their signature in return for a fee charged to the drawer. If the transaction played out as planned, the drawer repaid the principal to the acceptor shortly before the maturity date.<sup>9</sup> At maturity, the discounter presented the bill to the acceptor, who subsequently issued the funds to the discounter to complete the transaction. To remunerate the discounter for her lending services, the drawer only obtained an amount slightly below the nominal sum written on the bill. In other words, the discounter applied a 'discount' when paying out the proceeds of the loan but eventually received the full nominal amount at maturity.<sup>10</sup>

A special feature of bills of exchange was that the initial discounter could sell them to any other agent in the economy – an act often known as rediscounting. Each bill could be rediscounted an unlimited number of times. Yet, every owner (including the initial discounter) had to endorse the bill before re-selling it. Endorsement meant signing the bill and becoming co-liaible for its repayment at maturity (Santarosa, 2015). In practice, this joint liability framework worked as follows. Whoever owned the bill at maturity would first present it to the initial acceptor to obtain payment. If the acceptor failed to honor her commitment, the owner would instead present the bill to the last agent who had endorsed the bill to demand payment. The repayment chain would then cascade all the way down to the very first discounter who would attempt to make good on her loss by taking legal action against the acceptor or by registering a claim against the acceptor's insolvency estate.

Understanding the detailed mechanics underlying bills of exchange allows to clarify the remaining questions raised above. It explains why counterparty risk mattered in discount window operations, despite the fact that these transactions constituted outright purchases of assets. The quality of the asset, i.e. the bill, bought by the central bank in these transactions depended *inter alia* on the quality of endorsements written on the bill. Since the last endorser was always the very counterparty that sold the bill to obtain liquidity, the central bank had an interest in purchasing assets only from those agents who could reasonably be expected to maintain their solvency at least until the bill became due. After all, the last endorser was the first person the central bank could turn to for payment in case the acceptor – whose name was another crucial determinant of asset quality – were to default on her obligation. Importantly, central banks' interest in the solvency of their direct discount window counterparties was compounded when they acted as LOLR. In a financial crisis, otherwise solid counterparties can quickly run into solvency issues as market prices spiral downwards and large redemption demands require

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<sup>9</sup>Technically, whenever an acceptor was part of the transaction, the drawer was liable only to the acceptor, not to the discounter.

<sup>10</sup>Additional agents could be involved in bills of exchange transactions. For more details, please refer to [Accominotti et al. \(2021\)](#).



the sale of assets at considerable discounts.<sup>11</sup> Hence, while purchasing bills of exchange always required the central bank to keep an eye on whom it was buying from, distinguishing illiquid from insolvent discount window counterparties (in expectation) became even more crucial in times of distress.

On a side note, it is worthwhile mentioning that the historical LOLR's focus on purchasing bills of exchange meant that a rapid expansion of the central bank's balance sheet during crises was generally followed by a quick and automatic contraction of the balance sheet once the panics had abated. Bills of exchange were self-liquidating and rarely ran for periods longer than 90 days. At maturity, the asset-side claim on the central bank balance sheet disappeared. On the liability side, repayment either diminished the amount of currency in circulation as the cash repayment flowed in or reduced counterparties' current accounts by an equivalent amount. The interest rate proceeds deriving from the discount rate were booked into the profits and loss statement.

Does the importance of distinguishing between illiquid and insolvent counterparties in outright purchases extend to contexts where bills of exchange play(ed) a less important role? In the 1910s and 1920s, discount window operations of the U.S. Federal Reserve System mainly involved the purchase of certain types of loans that member banks had made to their own customers. *A priori*, the quality of these loans should have not directly depended on the soundness of the member bank requesting liquidity at the discount window. To gather additional protection, however, Federal Reserve Banks required member banks to guarantee the loans that they were selling at the discounting window. Consequently, member banks retained all the credit risk associated with their discount window transactions (Carlson, 2023). At maturity, the Federal Reserve Banks presented the purchased loan contract to the member bank and they demanded payment from their direct counterparty, i.e. the member bank. Hence, from a European perspective, U.S. member banks assumed a dual role of acceptor *and* discounter. This dual role may also explain why national examiner reports listed member banks' discount window sales as an off-balance sheet item under the heading of "Contingent Liabilities" – at least during the early 1920s. Overall, the Federal Reserve System thus had an incentive to discriminate between illiquid and insolvent counterparties at the discount window, despite the fact that it purchased member bank loans rather than bills of exchange. More generally, the distinction between illiquid and insolvent counterparties makes sense whenever central banks acting as LOLRs purchase assets whose quality is a function – or was *by design* turned into a function – of counterparty solvency.

The mechanics underlying bills of exchange also allow a qualified verdict regarding Forrest Capie's "frosted glass" metaphor. Superficially, there is some truth buried in the statement that the Bank of England's Discount Office clerks did not need to see exactly who was on the other side of the discount window. Yet, the reason why the discount window's glass could be frosted was not that the central bank did not care about counterparty risk. In fact, the clerks did not even have to peer through the metaphorical glass to know who was standing on the other side. The name of the very counterparty presenting the bill was written on the document passed beneath the window: as described above, the last owner had to endorse the bill before rediscounting it with the central bank. As a corollary, the Discount Office always knew instantly with whom it was entering into a transaction.

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<sup>11</sup>Vice versa, a solvency shock can also induce wide-spread liquidity stress. Carlson et al. (2011) show that a fruit-fly infestation that caused large losses for Floridian farmers in 1929 ultimately developed into a liquidity crisis and culminated in runs on local banks.

Finally, why did the distinction between illiquid and insolvent counterparties matter for advances too? In a world without legal and financial frictions, repossessed collateral can always be sold without having to incur write-offs on the defaulted loan. While collateral, haircuts and margin calls represented several layers of protection against losses from counterparty default, real world central banks acting as LOLRs had incentives to minimize the expected transaction costs of seizing and liquidating pledged assets. If markets remained illiquid and thin for a prolonged period of time following a financial crisis, the liquidation of collateral could result in losses despite the initial haircut and pre-panic margin calls. Countering this point, one may argue that central banks should always be able to benefit from the option to sit out the recovery period before selling repossessed assets. While this strategy might work well in modern contexts where central banks exclusively pursue general interest goals and can rely on public backstops, it may have had its limits in the past. For example, many central banks still had private shareholders in the nineteenth century. Holding repossessed assets for a long time could mean foregoing the realization of profits and may have weighed on profitability, thus affecting dividend payments. Moreover, as discussed below, many central banks were bound by convertibility rules and could not take the risk to immobilize their assets for too long.

Ultimately, even today's central banks have a clear interest in maintaining the distinction between illiquid and insolvent counterparties as an important aspect of last resort lending. Liquidity provision to fundamentally insolvent counterparties – no matter its form – may prove economically harmful, even if it does not result in any losses for the central bank. For instance, by prolonging the life of unviable companies, the LOLR may contribute to the creation of 'zombie firms' that bind productive capital, distort competition and reduce overall productivity (Peek and Rosengren, 2005; Caballero et al., 2008). These developments can affect modern central banks' ability to achieve their targets and provide a clear rationale for keeping an eye on counterparty solvency.

### 3 Supply constraints on lending of last resort

The previous section argued that successful lending of last resort rested on central banks' ability to keep their standing facilities operating as usual during a financial crisis. On the surface, remaining inertial does not seem too much to ask. In practice, however, central banks did not always find it easy to keep their standing facilities functioning as intended during panics. Supply and demand constraints frequently obviated an elastic liquidity provision by the LOLR and rendered the goal to display inertia *de facto* impossible. The present and next sections discuss whence these constraints originated, which impacts they had on financial markets and how central banks responded to them.

#### 3.1 Origins of supply constraints and credit rationing

Historically, central banks acting as LOLRs faced two main types of supply constraints. The first of these constraints was purely ideational in nature. It derived its power from locally dominant but misguided economic thought regarding the correct policy response to a financial crisis. The reaction of the Federal Reserve Bank of St. Louis to the banking panics throughout the 1920s and early 1930s constitutes an infamous example for

an ideational supply constraint on the LOLR. At the time, the Federal Reserve Bank's management feverishly subscribed to a variant of the so-called Real Bills doctrine (Richardson and Troost, 2009). Based on the fallacy that a lower level of economic activity necessitated less credit to sustain it, this doctrine held that the supply of credit should contract during recessions. Consequently, the Federal Reserve Bank of St. Louis considered it its duty to proceed as if an invisible force curtailed its capacity to act as a LOLR whenever the economy turned sour. When providing funds through the discount window, the Federal Reserve Bank of St. Louis only did so in return for double collateral: member banks had to pledge \$2 of their best securities to obtain \$1 of central bank liquidity (Richardson and Troost, 2009). Instead of displaying inertial behavior, the Bank's standing facilities were operated in a pro-cyclical manner until well into the Great Depression. It refused to satisfy the high demand for central bank liquidity in panics while lending and purchasing more freely during expansions.

Understanding the genesis of the second, institutional supply constraint on the LOLR requires some knowledge of the wider economic and historical context. During the long nineteenth century, central banks typically operated within the framework of a common international monetary regime: the gold standard. This monetary regime was not the result of a formal international agreement. Instead, the gold standard resulted from the individual decisions of countries to define a gold parity for their currency, i.e. a fixed rate at which banknotes could be converted into gold on demand. Since many countries defined gold parities for their legal tender, this ensemble of decisions gave rise to a *de facto* fixed exchange rate regime. In theory, anyone in possession of a country's official banknotes could present these notes to the country's central bank and demand the gold equivalent in return. Hence, to ensure convertibility at all times, central banks were legally required to hold a certain amount of gold reserves as cover for the currency they had released into circulation.

The precise way in which this gold reserve requirement was stipulated differed from central bank to central bank. The Bank of England's rules in this regard represent one particularly well-known example that can serve to illustrate the concrete functioning of cover requirements. The Charter Act of 1844 ordered the Bank of England to back newly issued banknotes one-for-one with gold, with the exception of an initial £14 million fiduciary issue (Anson et al., 2017). To make this rule operable, the 1844 Act divided the Bank into two departments: the issue department and the banking department. The issue department monitored the overall stock of issued banknotes relative to the Bank's gold reserves. The banking department was home to the actual lending and the purchasing arms of the central bank. It received a fixed amount of the issue department's total stock of banknotes as its own reserve. Given the overall cover requirement, the banking department's note reserve could only be augmented if the Bank's total bullion reserve had increased accordingly. Within the confines of its note reserve, the banking department was free to provide liquidity to its counterparties by lending against eligible collateral and by purchasing bills of exchange. Moreover, interestingly, the growth of the banking department's deposit liabilities was not tied to any cover requirement. Thus, in theory, customers who sold assets to the discount window or took advances and then stored the corresponding proceeds on their current accounts did not put a strain on the banking department's note reserve. In practice, current accounts likely represented a free lunch for the Bank only on paper: the banking department had to bookmark an adequate amount of notes to be able to redeem deposits on demand (Rieder et al., 2023).

While the intellectual fathers of the 1844 Act believed the new stipulations would guarantee monetary and price stability, the gold cover requirement introduced a *de facto* supply constraint on the Bank of England's ability to function as an elastic source of liquidity in a crisis. Surging demand for central bank liquidity in a panic could only be satisfied as long as the banking department had enough banknotes in reserve. This constraint was complicated by the fact that scrambles for cash and scrambles for gold tended to coincide in times of distress. On the one hand, market participants tested the willingness of the Bank to keep its promise to maintain parity, i.e. that Sterling banknotes were 'as good as gold'. On the other hand, panics often occurred when – or precisely because – the bullion reserve was low. For example, bad harvests could trigger large gold outflows as merchants paid for grain imports from abroad. Hence, ironically, the institutional supply constraint on central bank liquidity was more likely to become binding when the economy was already in a weak position.

The institutional supply constraint constituted a predicament that all central banks promising gold convertibility had to face in one form or another.<sup>12</sup> Even central banks that had permanently suspended the convertibility of banknotes into gold usually complied with gold reserve ratios because their declared goal was to prepare for a return to convertibility in the future. The Austrian National Bank (Austro-Hungarian Bank after 1878) is a case in point. Convertibility was suspended during most of the second half of the nineteenth century until the introduction of a 'shadow' gold standard in the late 1890s. Yet, the central bank struggled to act as a fully-fledged LOLR because it felt supply-constrained by its cover ratio throughout this period (Jobst and Rieder, 2016).

What prevented central banks from temporarily ignoring their reserve requirement in times of distress? One motivation for playing strictly by the rules was that violating the cover stipulations could be considered a legitimate reason for governments to revoke the central bank's charter, including the privilege to issue legal tender. Another reason for respecting reserve rules was that central banks dreaded the threat of the so-called confidence constraint (Jobst and Rieder, 2016). In general, the public's trust in banknotes and its willingness to hold them are contingent on the notes' observed and expected capacity to store value over time. Modern central banks maintain public confidence by committing to and achieving their inflation targets. In the nineteenth century, public confidence in banknotes was built on central banks' commitment to guarantee convertibility into gold. It was feared that a discretionary violation of reserve requirements by the central bank could diminish the credibility of this commitment, precipitate a run on gold and eventually end convertibility, with potentially severe consequences for the central bank's and the currency's reputation. Currencies whose convertibility was suspended traded at a marked discount below the official gold parity on foreign exchange markets.

How did LOLRs react when supply constraints became binding during a financial crisis? The answer is straightforward. Central banks abiding by reserve requirements had no choice but to start rationing credit. Central banks abiding by misguided ideational constraints would have had a choice but thought they did not. Hence, they also rationed credit. An intellectually more stimulating question is how exactly central banks implemented credit rationing. In principle, a limited capacity or willingness to satisfy applications for liquidity

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<sup>12</sup>Similar frictions still apply today as central banks operating under fixed exchange rate regimes face recurrent reserve constraints (Jorge-Sotelo, 2019).

left LOLRs with two options to respond to the scramble for safe central bank assets in a panic. First, in theory, central banks could have attempted to discourage recourse to the standing facilities and dissipate demand by hiking the cost of liquidity. Cranking up the discount or Lombard rate, so the argument goes, would have reduced the number of counterparties fleeing into the central bank balance sheet. High rates should have helped the LOLR to siphon off those who really needed liquidity and were thus prepared to pay high prices, while crowding out counterparties which hoarded cash for mere precautionary motives. Price rationing, it is argued, would have addressed the supply constraint by inducing an upward movement on the liquidity demand curve.

Second, LOLRs could have also responded to supply constraints by engaging in quantity rationing. A central bank using quantity rationing would have declined new loan applications and requests for discounts coming in via the standing facilities whenever gold reserves started to run thin. As a fraction of previously granted loans and purchased bills matured each day, quantity rationing should have allowed the central bank to gradually replenish its reserve position. While the rationale itself sounds intuitive and simple to understand, central banks engaged in quantity rationing would have likely had to answer a set of difficult questions. Quantity rationing boils down to the centralized allocation of a scarce resource: central bank liquidity. Hence, the LOLR would have needed to decide which specific counterparties should be turned down and according to which rules, if any. Central banks could have picked some counterparties, assets or collateral to consistently discriminate against or in favor of selected characteristics. Alternatively, the LOLR could have satisfied liquidity demand on a first come, first served basis until a certain threshold (e.g. the amount of reserves freed due to maturing transactions each day) before virtually shutting the discount window.

*Prima facie*, price rationing seems to constitute the more elegant solution to address supply constraints: it delegates the delicate matter of credit allocation to market actors. Historically, however, LOLRs appear to have dealt with supply constraints by drawing on a combination of price and quantity rationing. Supply-constrained LOLRs during the long nineteenth century often tended to hike rates early in a panic *and* then proceeded to decline substantial amounts of requests for liquidity. The most plausible explanation for the adoption of this joint approach is that LOLRs felt strong political and public pressure to not hike interest rates to levels that would have allowed them to virtually clear the market for central bank liquidity. Central bank rates already served as reference rates for the wider financial system and influenced lending conditions for the real economy at the time. For example, [Frame \(2020\)](#) describes the political economy considerations underlying the Bank of England's actions during the crisis of 1847 and shows that mounting public pressure from the mercantile community brought the Bank and its discounting policy under political scrutiny. In a similar vein, [Schneider \(2022\)](#) shows that the Bank came under renewed pressure during the British crisis of 1866 as it was accused of keeping its discount rate unnecessarily high for too long.

An interesting question is whether central banks could have successfully addressed the supply constraint by raising the interest rate alone had they not been subject to outside pressure. Economic theory suggests that this might have not been the case. The intuition for this conjecture is as follows. Due to adverse selection dynamics, interest rates affect both the counterparties' demand for liquidity and the LOLR's willingness to supply liquidity ([Stiglitz and Weiss, 1981](#)). All else equal, higher interest rates only deter relatively safe counterparties but cannot

put off risky ones who are willing to pay any price to gamble for survival. Consequently, the LOLR's expected return to liquidity provision may be hump-shaped: it decreases once the interest rate exceeds a certain level because the negative impact on earnings deriving from a higher probability of default associated with riskier counterparties more than outweighs the positive earnings effect of higher interest rates. Once the LOLR has reached the high point of the hump, it can only lose by increasing interest rates further. Of course, in practice it is not only difficult to estimate where exactly this theoretical high point lies; there is also no guarantee that the interest rate prevailing at the maximum of the LOLR's return curve suffices to reduce liquidity demand to a level consistent with the prevailing supply constraint. For these reasons, and because profit considerations should have played a more prominent role for LOLRs during the long nineteenth century than today, it is unlikely that an approach based solely on price rationing would have represented a satisfying solution for the LOLR's supply constraint at the time. On the contrary: from the point of view of the LOLR, combining both rationing strategies may have even constituted an optimal solution to address supply constraints.

### 3.2 Consequences of credit rationing

Taking the rationale for LOLRs described in Section 1 as a starting point, the consequences of supply constraints would seem clear-cut. Supply constraints obviate an elastic supply of liquidity during financial crises. Forced to ration credit, the LOLR cannot fulfill its core role. As a corollary, one would expect panics to trigger particularly dire financial and macroeconomic consequences in the presence of supply constraints on the LOLR. As funding markets seize up and the LOLR cannot furnish the liquidity required to allow its counterparties to redeem their short-term debt, mass failures ensue: fundamentally sound but illiquid counterparties need to fire-sell assets into an already thin market to pay out panicking creditors, incur heavy losses and are pushed into illiquidity-induced insolvency. The concomitant contraction of credit would subsequently transmit the financial shock to the real economy.

In addition, quantity rationing might also have consequences that extend well beyond the specific financial crisis during which it is used to address the LOLR's supply constraint. Picking 'winners' in terms of particular counterparties, collateral or asset characteristics may induce behavioral consequences that reshape financial markets. To what extent these behavioral changes prove detrimental is likely to depend on the criteria the LOLR devised to allocate liquidity. *A priori*, limiting liquidity provisions to insiders, e.g. to firms sharing management board interlocks with the central bank, would seem more harmful for the LOLR's longer-term reputation than rationing rules that rely on cut-offs for widely accepted financial indicators instead. Nonetheless, it should be clear that neither form of allocation would be entirely innocuous. Both would represent deviations from the conditions under which counterparties expected to be able to obtain central bank liquidity in a panic and, as such, they would set precedents that serve as updated focal points for the future. Learning from their experience, counterparties may adapt to emulate strategies or characteristics that were key in obtaining liquidity from a supply-constrained LOLR. Emulation in turn may distort competition, asset values and even entire business strategies.

Attentive readers may have noted the extensive use of conditional verbs in the first two paragraphs of this subsection. This cautious tone reflects the fact that it is difficult to marshal convincing empirical evidence for many of the claims above. Perhaps the biggest challenge is to find a credible control group that allows the researcher to disentangle supply side constraints from demand side factors. After all, a stark increase in rejection rates at the discount window or for Lombard applications during crises may simply reflect the lower quality of counterparties, collateral or assets pouring into the LOLR's standing facilities in times of distress. As an outside observer it is hard to distinguish between a supply-constrained LOLR that breaks the rule of inertia and a freely lending or purchasing LOLR that gets swamped by illegitimate requests for liquidity. Applications from *de facto* insolvent counterparties, vast numbers of ineligible bills of exchange or unsuitable collateral can convey the misleading impression that the LOLR experiences a supply constraint. Even if the underprovision of liquidity in a crisis coincides with binding institutional constraints or clear ideational misconceptions about the role of the LOLR, a more or less large fraction of rejections may still derive from the comparatively lower quality of demand. Hence, endogeneity concerns loom large whenever researchers attempt to gauge the impact of credit rationing by relying on aggregate data alone. While this point remains true for more recent episodes, the conventional lack of data compounds the difficulty of identifying the causal effects of credit rationing in the historical context of the long nineteenth century.

To devise a convincing research design that addresses these identification concerns, researchers may want to build on the following elements. First, an ideal study would provide both narrative and quantitative evidence on the presence of supply-side induced credit rationing. [Bignon et al. \(2012\)](#) propose a simple, yet powerful test for the presence of credit rationing at the discount window during financial panics in the long nineteenth century. Under the null hypothesis of free lending, the central bank's interest rate for any given quality of bills must always be above, or equal to, the market rate for the same type of bills. The market rate can only be higher than the Bank's discount rate in the presence of credit rationing.<sup>13</sup> Under free lending, an initially higher market rate would decrease due to funding liquidity arbitrage. Counterparties would sell bills to the central bank and use the proceeds to purchase bills from financial market participants to benefit from the interest rate spread. The high demand and increasing competition for bills in the open market would gradually bid down the market rate to the level of the central bank's discount rate. Unfortunately, this test does not come without caveats. For one, it mainly works for discounts, as historical high-frequency data on Lombard rates in the open market are harder to find. Moreover, the market rates for Lombard loans cannot be easily compared to the prevailing central bank rate if data on market haircuts are not available. In fact, even for discounts it may even prove difficult to ascertain that the market rate adequately reflects the interest rate for exactly those types of bills that are commonly purchased by the central bank. Also, as discussed in Section 2 above, central banks often charged a range of different discount rates. It remains an open question which of these should be compared with market rates and whether aggregation, e.g. computing the weighted mean rate, represents an informative solution. Hence, overall, complementing the quantitative test with qualitative 'smoking guns' appears the most

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<sup>13</sup>An underlying assumption in [Bignon et al. \(2012\)](#) is that the central bank's lending facilities are not affected by program stigma (c.f. the discussion in Section 4 below).

promising way forward.

Second, an ideal empirical set-up would exploit a crisis situation in which a group of counterparties experiences supply-side induced credit rationing, while another group benefits from unlimited liquidity provision by the LOLR. Crucially, the two groups must exhibit statistically identical characteristics as regards all traits relevant for the LOLR's lending and purchasing decisions under unconstrained circumstances. Moreover, the two groups must be submitting assets of statistically identical quality for purchase or asking for Lombard loans based on collateral of statistically identical quality. Here, the relevant quality indicators for assets and collateral are those which the central bank routinely takes into account when it is not supply-constrained. In essence, this first design component requires that treatment, i.e. credit rationing, is quasi-randomly assigned to the LOLR's counterparties. Naturally, this requirement can complicate identification whenever the LOLR engages in quantity rationing by discriminating against pre-selected counterparties.

Third, the study's setting would need to comply with the so-called stable unit treatment value assumption (SUTVA). SUTVA requires that a given counterparty's outcome only depends on the treatment status it was assigned, and not on the treatment status of other counterparties. To illustrate the concept, consider a hypothetical study interested in estimating the causal impact of credit rationing on counterparties' probability of failure. SUTVA may not hold in this context as rationed counterparties may become more likely to default on loans they received from their peers. Hence, their treatment status can trigger a spill-over effect on their peers' probability of survival. Violations of SUTVA can bias the effect of rationing upwards or downwards. Continuing the previous example, a SUTVA violation would bias the effect on failure downwards if rationed counterparties had mainly received loans from firms that were not treated. Vice versa, the estimated impact may be upward biased if firms that experienced rationing were heavily financially connected to each other. Since SUTVA violations are often difficult to rule out completely, discussing their likely impact on estimated treatment effects is crucial. Finally, the fourth design component is merely a logical corollary of the second and third. Micro data on the LOLR's lending and purchasing decisions, including detailed information on counterparties, assets and collateral constitute a key pre-requisite to identify the causal impacts of credit rationing.

The remainder of this section summarizes a handful of contributions that focus on the causal analysis of central bank credit rationing in the historical context of interest for this paper. These papers have identified episodes characterized by quasi-experimental conditions that plausibly comply with the research design components discussed above. While the available research can confirm many of the theoretical predictions listed at the beginning of this subsection, more work would be necessary to gain a broader picture of the mechanics and consequences of central bank credit rationing during the long nineteenth century, in particular outside the core countries.

As mentioned above, U.S. Federal Reserve Banks partly succumbed to misguided economic theories that induced them to shut their standing facilities in times of distress in the late 1920s and early 1930s. [Richardson and Troost \(2009\)](#) and [Jalil \(2014\)](#) exploit the ideational supply constraints that prevented Federal Reserve Banks from assuming their LOLR role during the Great Depression in a border discontinuity framework. These two studies compare the fate of commercial banks and the local economy located within short distances around



the borders of Federal Reserve districts with different conceptions of the LOLR’s role. Within these small bands, bank-level characteristics and local economic conditions exhibited statistically identical levels and trends before credit rationing started. In [Richardson and Troost \(2009\)](#) and [Jalil \(2014\)](#), the specific architecture of the U.S. interbank network reduces the threat of SUTVA violations due to interbank lending. Most commercial banks entertained interbank ties, but the bulk of these were with banks in financial centers. The latter were located far away from the border regions considered in the analyses and do not enter the respective estimation samples. Using extensive micro data on individual bank balance sheets, the studies find that the ideational supply constraint on the LOLR had disastrous consequences: credit rationing caused high bank failure rates, reduced credit availability in the real sector and depressed business activity.

[Rieder et al. \(2023\)](#) investigate the consequences of credit rationing deriving from the Bank of England’s institutional supply constraint. Drawing on transaction-level data from the central bank’s ledgers on discount window purchases, their paper exploits a regression discontinuity design in time. The sudden kicking-in of the reserve constraint in the spring of 1847 caused the Bank to raise rejections rates from one day to the next. Micro data on counterparty quality and bill features show that observable characteristics were not statistically different in relevant event windows spanning several days before and after the reserve rule became binding. The study provides evidence suggesting that counterparties experiencing credit rationing had significantly higher probabilities to fail.<sup>14</sup> Moreover, [Rieder et al. \(2023\)](#) investigate how the Bank of England implemented quantity rationing. The maturity of bills and the size of requests played a key role. When supply-constrained, the Bank started to discriminate in favor of short maturity bills and small requests. This implementation of credit rationing is consistent with the notion that the Bank tried to safeguard ‘reserve space’ for particularly urgent requests and attempted to avoid tying its hands for too long during the acute phase of the crisis. The Bank’s rationing strategy also had behavioral consequences that surfaced during a subsequent financial panic in the fall of 1847. Conditional on survival and compared to counterparties that had emerged from the spring phase of the crisis unscathed, previously-rationed counterparties came to the discount window more often in the fall, but submitted significantly smaller loan requests and relied less on central bank liquidity overall. These results support the conjecture that the allocation of central bank credit implied by quantity rationing can distort competition in the financial sector, e.g. by generating differential liquidity management costs.

[Mitchener and Monnet \(2023\)](#) provide evidence that quantity rationing practices could also take much more personal forms. During the banking crisis of 1930–31, the Banque de France did not fulfill its role as an LOLR because of a self-imposed ideational supply constraint. The central bank’s management considered that wide liquidity provision would hurt its shareholder value. To understand why, note that time is of the essence during financial panics. The difference between illiquidity and illiquidity-induced insolvency can be a matter of hours. Hence, although the number of counterparties applying for liquidity expands relative to normal times, central banks usually have less time to screen requests. Time pressure can weigh on the quality of the LOLR’s purchasing and lending decisions. In 1930-31, the Banque de France appears to have believed that assuming its

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<sup>14</sup>Due to the absence of systematic data on financial exposures between counterparties, it proves difficult to evaluate the plausibility of SUTVA in this context. The paper’s implicit assumption is that biases ran in both directions and canceled out.

full role as LOLR would have led to the accumulation of a large portfolio of non-performing assets and loans. Such investments, it was presumed, would have curtailed the Bank's ability to achieve its most specific goal at the time, i.e. to pay dividends to its shareholders. As [Mitchener and Monnet \(2023, p.10-11\)](#) explain, "the statutes of the central bank were quite specific about the distribution of shares and the voting power of the shareholders, but they did not stipulate a precise objective in terms of monetary or financial stability". When the financial crisis erupted, the Banque de France thus carefully selected to whom it was furnishing liquidity. Banks or bank board members that were corporate shareholders of the central bank received significantly more liquidity than unconnected counterparties. This form of preferential treatment was absent in tranquil times preceding the crisis. Interestingly, [Mitchener and Monnet \(2023\)](#) exploit a violation of SUTVA to showcase the complex consequences of credit rationing in general equilibrium. The authors argue that the Banque de France's rationing policies amplified the banking crisis to such an extent that it eventually affected connected counterparties too. As the central bank's large exposures to its connected counterparties gradually turned sour, the very rationing practices intended to preserve profitability ultimately proved devastating for shareholder value *and* the economy at large.

### 3.3 Remedies for credit rationing

The ideational origins of credit rationing can be hard to address in the short-run. Misguided ideas can capture policy-makers' minds for decades and even centuries. The Banque de France and the Federal Reserve System had to live through the dramatic experience of the Great Depression to overcome these misconceptions. In both cases, this experience paved the way for substantial institutional reforms. In France, the government overhauled central bank governance by changing the shareholder voting structure and the selection procedure for the board of directors, including other Bank committees, to better align the Bank's interests with those of the general public ([Mitchener and Monnet, 2023](#)). In the United States, the catastrophic waves of bank failures in their districts helped to convert Federal Reserve Banks that had previously subscribed to counterproductive interpretations of the LOLR's role ([Richardson and Troost, 2009](#)). Moreover, unilateralist policy changes and idiosyncratic lending practices in the different Federal Reserve districts became less frequent after the Banking Act of 1935 centralized much more authority with the Federal Reserve Board based in Washington, D.C. ([Carlson, 2023](#)).

The experience of institutional supply constraints on the LOLR also solicited active policy action resulting in both *ad-hoc* and permanent fixes. The English crisis year of 1847 produced a blueprint in this regard that shaped the LOLR's response to financial crises for years and decades to come. With the consequences of the Bank's rampant credit rationing in the spring 1847 still fresh on market participants' mind, public pressure escalated quickly when financial markets entered a second panic phase in October 1847. Leading firms in the City of London petitioned the government to suspend the Bank Act of 1844. The Prime Minister and the Chancellor reacted by writing a letter to the Bank's governor on 25 October 1847. The letter allowed the Bank to further expand its balance sheet by temporarily indemnifying the Bank from any legal breach of the

1844 Act. When the document was published, the panic abated. The Bank was never forced to breach its reserve requirement in the fall of 1847. The dual panic of 1847 offered useful lessons for later crises. Arguably, *ad-hoc* suspension became an *ex ante* expectation in subsequent British financial crises during the nineteenth century. During later episodes of turmoil, the government announced the temporary suspension of the reserve requirement almost immediately after the scramble for cash had begun – an act that rapidly calmed financial markets in 1857 and 1866 (Hughes, 1956; Flandreau and Ugolini, 2013).

While the English *ad-hoc* solution proved repeatedly successful, this allegedly simply-to-copy blueprint did not necessarily work as intended in other countries. During the long nineteenth century, the Bank of England benefited from a strong reputation in terms of defending Sterling's gold parity. Financial market participants always believed in the temporary nature of the suspension. Thus, they never feared an end to gold convertibility and trusted in a rapid return to the 'rules of the game' once panic conditions had faded. Elsewhere, public confidence was not always on the LOLR's side. For example, the Austrian National Bank continued to shadow its cover requirement even after the government had officially suspended it during the crash of 1873 (Jobst and Rieder, 2016). The Bank management struggled to believe in the unconditional power of temporary suspension and feared its medium-term consequences. Despite the legal possibility to furnish liquidity freely, the LOLR's policy response to the crisis was hesitant at best. The Bank's cautiousness was rooted in its preoccupation with maintaining the value of the currency. Since the convertibility of the Austrian Florin into metal had been officially suspended after 1866, adherence to the statutory cover requirements remained the only formal safeguard in place. Lifting the cover requirements thus represented a potentially far-reaching intervention that put the public's confidence to a litmus test. In fact, when granting suspension, the government explicitly advised the Bank not to abuse its newly gained freedom. Despite its benevolent intention, this cautious approach had its costs. The formal test à la Bignon et al. (2012) suggests that the Bank continued to ration credit in 1873.

The Austrian solution to this dilemma was to institutionalize a certain degree of automatic flexibility during financial crises. When the Bank's statutes came up for renewal in 1888, the cover requirement was amended to allow for temporary transgressions of the Bank's absolute reserve rule that had been modeled on the English Charter Act of 1844. The new statutes unleashed the liquidity supply during panics by shifting the focus on a much less constraining proportional cover ratio and by introducing a compensatory tax on the temporary excess issue of banknotes payable to the government (Jobst and Kernbauer, 2016). This alteration integrated a form of rule-based flexibility into the Bank's policy framework that was publicly known and that fundamentally alleviated the trade-offs the Bank faced when acting as LOLR. The institutionalization stripped the newly gained flexibility from any bitter aftertastes that might have accompanied *ad-hoc* suspensions. The penalty tax in turn regularly reminded the Bank that transgressions should last only for as long as necessary. The additional room for maneuver conceded by the statutes of 1888 took credit rationing off the agenda during the following episodes of distress until World War I (Jobst and Rieder, 2016).

The institutional framework of the Federal Reserve System contained an interesting alternative mechanism destined to accommodate particularly heavy but regionally heterogeneous demand for central bank liquidity. The Federal Reserve Act of 1913 obliged the System as a whole, as well as the individual Federal Reserve

Banks, to abide by specific gold reserve requirements. The System and the Reserve Banks had to maintain reserves of 35% in gold or lawful money against member bank deposit liabilities, and a 40% reserve in gold against Federal Reserve notes.<sup>15</sup> On their own, these rules could have resulted in regionally binding supply constraints: individual Federal Reserve Banks would have had to ration credit once their respective lending or purchasing activities triggered a transgression of the 35% or 40% threshold. Yet, the Federal Reserve System had an inbuilt mechanism that afforded regional flexibility and preempted these situations. Any one Federal Reserve Bank could borrow from another Federal Reserve Bank via the so-called Gold Settlement Fund to address a deficiency in its own reserves (Wallace, 1956). For example, Federal Reserve Banks located in agricultural districts significantly expanded liquidity provision to their member banks during the recession of 1920-21. Several regional banking systems faced heavy deposit withdrawals due to a generalized agricultural commodity price collapse (Jaremski and Wheelock, 2020). In reaction to this income shock, farmers had to withdraw funds to pay interest and principal on outstanding loans, and to prepare the next round of sowing. Interdistrict accommodation allowed particularly strained Federal Reserve Banks to seek support from non-agricultural districts that had a comfortable reserve position. As long as the entire System was not violating its cover requirements, individual districts were free to compensate undershootings by borrowing via the Gold Settlement Fund (Eichengreen et al., 2015). This alternative form of institutionalized flexibility successfully prevented supply-side induced credit rationing during the recession of 1920-21 (Tallman and White, 2020).

## 4 Demand constraints on lending of last resort

Preempting or addressing supply constraints does not always guarantee that the central bank can fulfill its role as LOLR. History has known situations in which perfectly unconstrained LOLRs failed to calm financial panics because counterparties were either unwilling or unable to claim central bank liquidity through the discount or Lombard facility. This section explores the origins of two of the historically most prominent demand constraints, dissects their consequences and sheds light on how central banks reacted to them. More precisely, the present section will analyze the challenges presented by stigmatized lending facilities and limited eligibility.

### 4.1 Stigmatized standing facilities

In the context of lending of last resort, the term stigma can have several meanings. Most frequently, stigma is intended to capture the idea that counterparties are reluctant to borrow from the central bank's standing facilities during a crisis because "they are concerned that this borrowing might be discovered, interpreted as a sign of trouble, and lead to deposit withdrawals or other creditor exit" (Carlson, 2023, p.47). This conventional use of the term technically corresponds to "potential stigma" (Vossmeier, 2019): counterparties fear a certain outcome and hence behave accordingly. In contrast, "realized stigma" occurs when the identity of borrowing counterparties is effectively revealed to the public: it describes the actual consequences of this disclosure,

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<sup>15</sup>In practice, the Board and the Federal Reserve Banks tended to monitor the combined reserve position computed as the ratio of total cash reserves (including gold) to the sum of net deposits and Federal Reserve notes.

whatever they may be. Researchers also distinguish between “bank stigma” and “program stigma” (Vossmeier, 2019). The former concept refers to the potential or realized consequences of identity disclosure for borrowing counterparties. The latter term captures the negative effects of bank stigma on the liquidity providing facility itself: if counterparties associate reputational loss and harmful financial consequences with the recourse to a specific central bank lending or purchasing arm, this very association – be it justified or not – can result in the stigmatization of the facility in question.

From the perspective of the LOLR, program stigma can constitute a highly problematic demand constraint. Stigmatized standing facilities will not be used by central bank counterparties in normal times and much less so during panics – even if the requirements for access remain perfectly inertial and unaffected by supply constraints. When a financial crisis hits, the presence of stigmatized standing facilities can be linked to financial and economic consequences akin to those observed in the absence of an LOLR or in the presence of supply constraints: illiquidity-induced insolvency, negative asset price spirals and, further down the road, real economic fallout. In fact, from the point of view of the LOLR, running a stigmatized facility might even lead to outcomes that turn out to be worse than those caused by the complete closure or absence of standing facilities. Stigma can trigger an adverse selection of borrowers at the the central bank’s Lombard or discount window facility (Anbil and Vossmeier, 2019): as counterparties explore every alternative before tapping into stigmatized facilities, the LOLR ends up transacting only with desperate firms that have nothing left to lose. Adverse selection of this form can have severe consequences for central bank profitability if the LOLR is not able to perfectly discriminate between *ex ante* illiquid and insolvent counterparties.

Yet, how does a standing facility become stigmatized in the first place? The history of the Federal Reserve System’s discount window during the latter part of the 1920s provides a prominent illustration of how program stigma can emerge. In the aftermath of the land price and credit boom that coined the immediate post-World War I years and contributed to the deep recession in 1920-21, Federal Reserve Bank officials grew suspicious of member banks holding continuous and heavy recourse to the discount window. While it is true that commercial banks in some areas refinanced large portions of their loan portfolio at the discount window in the run-up to the crisis of 1920-21 (Rieder, 2021), the elastic provision of currency during the sharp downturn also appears to have nipped potential financial panics in the bud (Tallman and White, 2020). Nonetheless, in the course of the 1920s, a narrative began to develop around the notion that member banks took advantage of the discount window to engage in stock market speculation and fuel real estate bubbles (Gorton and Metrick, 2013). Rather than welcoming the intended functioning of the discount window in times of (seasonal) liquidity squeezes, Federal Reserve Bank officials engaged in moral suasion to create a ‘reluctance to borrow’ on the part of member banks. Officials repeatedly emphasized that recourse to the discount window should be temporary at best and thus conjured a (misguided) conceptual connection between regular, heavy or longer-term access to the discount window and unsound banking. Counterparties started to worry about bank stigma. As a corollary, the discount window itself became contaminated and turned into a stigmatized standing facility. Interestingly, the literature on program stigma in the United States does not explicitly distinguish between the discount window in the

narrow ‘European’ sense and the Federal Reserve’s second standing facility, i.e. bills payable.<sup>16</sup> It remains an open question whether both lending arms were equally affected at the time and whether program stigma can be contagious, i.e. whether and when it spills over to other lending facilities or even spreads to other central banks.

Discount window stigma is said to have hampered the Federal Reserve System’s ability to function as a fully-fledged LOLR during the Great Depression (Gorton and Metrick, 2013). Empirically, however, this statement is tricky to test against the data. Researchers lack a credible control group because program stigma reduced the incentive of all eligible counterparties to take recourse to the discount window. Hence, it is difficult to construct a counterfactual scenario that uncovers how member banks would have had reacted in the absence of program stigma. In principle, one could dissect individual Federal Reserve Banks’ moral suasion efforts in the 1920s to investigate whether more deterrence by regional officials resulted in stronger reluctance to access the local discount window. Yet, without a more specific and detailed research design, this approach is prone to a list of endogeneity concerns stemming from various other parameters that could influence regionally heterogeneous demand for discount window liquidity. Not least due to these challenges, economic historians have only identified suitable quasi-experimental conditions to shed light on the causal effects of realized bank stigma. Anbil (2018) and Vossmeier (2019) exploit the *ex ante* unexpected disclosure of a list of U.S. commercial banks that had borrowed from the so-called Reconstruction Finance Corporation (RFC), a public institution that took over an auxiliary LOLR role in 1932. Anbil (2018) confirms that counterparties whose identity was revealed experienced significantly more deposit outflows than other borrowing counterparties whose names stayed undisclosed. Realized bank stigma also dampened affected banks’ lending and coincided with a major drop in liquidity requests from the RFC (Vossmeier, 2019). The latter finding provides evidence indicating that the RFC suffered from program stigma as a consequence of realized bank stigma.

Program stigma has plagued the Federal Reserve System’s discount window ever since the 1920s and remained an issue during the 2007-08 financial crisis (Armantier et al., 2015). For this reason, the absence of successful historical fixes for program stigma may come at no surprise. Recent contributions indicate, however, that policy-makers are not necessarily powerless once stigma has taken hold of the LOLR’s standing facilities. According to Anbil (2018), the introduction of coordination mechanisms can function as a remedy: if many counterparties were to access the discount window simultaneously, *ex post* disclosures would be less likely to result in a targeted investor or depositor attack on an individual bank. Armantier and Holt (2020) propose to turn individual discount window requests into unremarkable and uninformative events by ensuring that counterparties regularly tap into the stigmatized facility, even in normal times. As discussed above, historically, the discount window was a standing facility that was intended to be drawn upon regularly and continuously in normal times *and* during panics. Armantier and Holt (2020) conduct a randomized controlled trial to test this proposal and show that it can be effective – in contrast to alternative strategies that lower the cost of discount window liquidity or reduce the probability of disclosure.

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<sup>16</sup>In the United States, the term ‘discount window’ is typically thought to encompass both, the facility that discounted paper properly speaking and the secured lending facility.

Based on a comparison between the European Central Bank’s unstigmatized marginal lending facility and the U.S. discount window, [Lee and Sarkar \(2018\)](#) argue that specific design choices can help to prevent the emergence of program stigma going forward. First, careful aggregate disclosure policies that do not allow inferences about individual counterparties seem crucial. Second, the conditions under which a facility can be used and how the central bank characterizes the facility may also matter. For example, wider collateral/asset or counterparty eligibility at the discount window compared to other standing facilities can prove counterproductive. Less stringent conditions may tarnish a facility’s reputation by linking it to troubled counterparties. Third, to minimize the probability of program stigma, the discount window should not be designated as a last resort or back-up source of liquidity.

## 4.2 Limited eligibility

Inertia was a crucial factor for a successful LOLR in the long nineteenth century. Inertial behavior implied that the central bank did not tighten the requirements for liquidity provision in a financial panic. Yet, does the principle of inertia also rule out the softening of lending or purchasing conditions and the widening of the pool of eligible counterparties in distressed times? The answer is ‘it depends’. Imagine a panic in which counterparties are desperate to obtain central bank liquidity but cannot access the standing facilities because they are either not eligible or do not hold enough eligible assets and collateral. In this situation, the LOLR faces a demand constraint grounded in technical eligibility criteria that may curtail its ability to calm financial markets. In deciding how to respond to this predicament, the LOLR needs to weigh several considerations.

First, the LOLR requires a clear understanding of the reasons underlying the onset of financial distress. In theory, it would need to distinguish between panics that resulted from an exogenous liquidity shock and endogenously engineered depositor or creditor flights due to counterparties’ unhealthy fundamentals. Endorsing an *ad-hoc* softening of eligibility criteria to accommodate demand constraints can foster toxic behavior if badly behaving counterparties come to expect unconditional flexibility by the LOLR in future crises.<sup>17</sup> In contrast, an unexpected shock unrelated to the financial position of counterparties could justify leniency, particularly if it causes an unusually large scramble for central bank assets that exceeds safety buffers of salable or pledgeable assets normally considered as sufficient.

A second consideration concerns the dimension of the panic at hand and its potential for future escalation due to financial contagion and rumors. A localized shock that only impacts a small, financially and economically well-isolated part of the monetary area may provide a less strong rationale for widening the central bank’s general eligibility requirements. Local panics of this nature do not trigger a broad dis-functioning of money markets. Hence, interbank lending that can be obtained against less stringent criteria than central bank liquidity should be able to address the temporary funding gap in the affected regions. Moreover, should market providers of interbank credit require refinancing to stem a temporary lending spike, the LOLR stands ready to provide the necessary resources under the usual conditions. Broad shocks that hit large parts of the financial system or local

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<sup>17</sup>This specific form of moral hazard is different from the more general implications of a successful LOLR discussed in the next section.

shocks that have the power to spread rapidly, on the contrary, may warrant a more active and direct handling by the LOLR.

Third, it should be clear from the discussion above that the LOLR cannot adjust eligibility requirements idiosyncratically to alleviate the demand constraints experienced by individual counterparties. Historically, idiosyncratic eligibility rules would have contradicted the notion that central bank standing facilities were accessible by *ex ante* comparable counterparties on equal terms.<sup>18</sup> Moreover, on a more timeless note, idiosyncratic modifications of access criteria to support specific (groups of) counterparties would always run the risk of endorsing unsound financial practices *ex post* and can fuel risky behavior on the basis of expectations of similar adjustments in the future. Thus, the classical LOLR as understood in this paper can only broaden eligibility in two complementary ways. On the one hand, it may add clearly specified asset and collateral classes to the list of eligible securities that apply to all eligible counterparties.<sup>19</sup> On the other hand, based on a well-defined loosening of *hitherto* prevailing criteria, the LOLR may decide to add a group of new agents to the pool of eligible counterparties. Importantly, these features conceptually distinguish support by the LOLR – both, historically and today – from so-called emergency liquidity assistance (ELA), a different tool that is often incorrectly mixed up with lending of last resort. In contrast to the LOLR, ELA functions on a case-by-case, discretionary basis. ELA is precisely the instrument that modern central banks would use to extend liquidity to an individual financial institution that is no longer able to refinance itself via standard liquidity facilities. Taking the current modalities in the euro area as an example<sup>20</sup>, ELA can be drawn upon if a counterparty is not eligible for standard liquidity support, e.g. because it does not or no longer fulfill the minimum access criteria, or if it does not hold sufficient eligible collateral to apply for liquidity via the standard procedures. Thus, ELA allows the Eurosystem to allocate central bank money to counterparties that would otherwise have no claim on receiving liquidity support.

Finally, the widening of eligibility criteria should go hand in hand with adequate protection mechanisms for the institution acting as LOLR. As discussed in Section 2 above, counterparty risk was and remains a crucial concern for the LOLR. The admission of additional members to the pool of eligible counterparties thus requires the LOLR to extend the safeguards and detailed monitoring practices it already applies to existing customers to newly minted ones too. Section 5 below explains why this logic should not only be limited to solvency checks, but also concerns prudential standards for liquidity management.<sup>21</sup>

Did limited eligibility hamper central banks' ability to address liquidity shocks in the past, and if yes, how did LOLRs attempt to mitigate demand constraints? Does the empirical evidence on mitigation efforts echo the four considerations discussed above? Eligibility constraints played a particularly important role in the early years of

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<sup>18</sup>This statement is conditional on all else (e.g. counterparty and asset/collateral quality) being equal. As discussed in Section 2, some central banks charged different discount rates to account for differences in asset quality, price volatility and remaining maturity.

<sup>19</sup>Historically, broadening the list of eligible assets could also be achieved by accepting longer-term maturity assets, e.g. by extending the maximum remaining maturity of bills accepted at the discount window.

<sup>20</sup>The corresponding information is available on the website of the European Central Bank (last accessed 5 April 2023): <https://www.ecb.europa.eu/mopo/ela/html/index.en.html>.

<sup>21</sup>Taking a comparative perspective, the pre-crisis length of the list of eligible assets may represent an additional important parameter. For example, before 2008, the list of central bank-eligible assets in the United States was short relative to the one prevailing in the euro area. This difference might partly explain why the Federal Reserve quickly extended eligibility in the wake of panic, while the ECB did not (Jobst and Ugolini, 2016).



the LOLR. The discount window facilities of European central banks were fraught with geographical frictions that led to the systematic exclusion of counterparties and specific types of bills of exchange. For example, French law required the last owner of a bill of exchange to collect payment virtually at the acceptor's door (Bignon and Jobst, 2017). As a corollary, the Banque de France did not discount any bills payable in locations where it did not operate a branch. By default, this rule meant that counterparties residing in locations without central bank branches had substantially lower chances to access the discount window because they were more likely to work with bills accepted by guarantors from ineligible towns and cities. Hence, for a long time, the dimensions of the central bank's branch network pre-determined eligibility at the discount window and could generate significant demand constraints whenever liquidity shocks reached unbanked areas. Identical rules applied elsewhere too. The Austrian National Bank also limited discounting to bills payable in branch or subsidiary locations (Jobst and Rieder, 2016). Similarly, Anson et al. (2019) show that the discount office at the headquarters of the Bank of England in Threadneedle Street systematically rejected all bills endorsed by acceptors outside of London in 1847.

While the evidence on the French and the Austro-Hungarian cases suggests that the location requirement gradually lost significance with the extension of central bank branch networks in the second half of the nineteenth century, earlier episodes characterized by demand constraints had dire consequences. Bignon and Jobst (2017) study the impact of an exogenous economic shock in historical France by comparing areas with wide eligibility to regions with low access to the LOLR's discount window. In 1863, a phylloxera plague hit wide areas of the French territory involved in wine production and decimated output for years to come. The corresponding agricultural productivity downturn morphed into a liquidity shock affecting local banking systems. Bignon and Jobst (2017) exploit this shock to provide plausibly causal estimates connecting wider eligibility due to the local presence of central bank branches to significantly lower illiquidity-induced default rates. Thus, limited eligibility for the LOLR's discount facility translated into a heavy economic burden for marginalized areas at the time.

The quasi-experimental setting in Bignon and Jobst (2017) did not feature any attempts by the LOLR to actively mitigate the reigning demand constraints. Yet, the Austrian record suggests that historical LOLRs did sometimes take quite creative steps to alleviate the economic effects of limited eligibility. In the spring of 1848, financial repercussions of the revolutionary uprisings hit the Austrian Empire: banks and merchants situated in areas affected by escalating tensions between the imperial army and revolutionary guards experienced increasing funding difficulties. Lacking branches in many provinces, the Austrian National Bank found itself initially unable to ease local liquidity conditions during the crisis of 1848. A positive spread between the market rate on prime bills in local financial centers such as Trieste and the corresponding costs in Vienna testified to the pronounced decoupling of money market conditions across the Empire (Jobst and Rieder, 2016). At this point, the central bank faced a tricky dilemma. On the one hand, bending its rules to accept bills payable outside branch cities would have widened eligibility and mitigated regional liquidity distress. On the other hand, this decision would have come with considerable additional risks. In fact, the Bank had little to no information in store on the agents that would have joined the pool of eligible counterparties, nor did it possess any knowledge on the quality of the signatures on the bills these new counterparties would have likely submitted to the discount

window.

To address predicaments of this nature, the Austrian LOLR usually pushed for the creation of so-called support committees (*Aushilfs-Comités*) – a solution that it had already tested in 1820 and would again draw upon during the crisis of 1873 (Jobst and Rieder, 2016; Rieder, 2018). These temporary committees were formed by representatives of several leading banks in Vienna, but also included firms outside the banking system. Members of the support committees were eligible counterparties that joined forces to buy bills not admissible at the central bank’s discount window and that agreed to lend against collateral not acceptable at the Lombard facility. The LOLR refinanced the operations of these committees in two ways: either directly, by discounting otherwise ineligible bills after the committee members had jointly guaranteed them with their signature; or indirectly, by agreeing to discount eligible bills from the committee members’ own portfolios. The committee members exploited the initial spread between regional market rates and the central bank facilities to obtain a compensation for their additional risk-taking. By construction, *Aushilfs-Comités* enabled the central bank to widen the reach of its standing facilities in the face of demand constraints without incurring any substantial extra counterparty risk. Moreover, since the Bank outsourced the screening of ineligible bills and collateral to the members of the committees, the LOLR found a way to access private information while shifting associated risk management costs back to the market. Overall, *Aushilfs-Comités* seem to have constituted a practical solution to technical demand constraints that allowed the LOLR to incorporate all four considerations discussed above. In response to arguably exogenous localized liquidity shocks that would have had the power to spread through the lands, these committees temporarily widened *de facto* access to the discount window. At the same time, the LOLR did not commit to any idiosyncratic relaxation of standards and the inbuilt protection mechanisms indemnified the central bank for slightly stretching its usual mandate.

To close this subsection on limited eligibility, a cautionary note is warranted. Historically, the boundaries between the concepts of lending of last resort and ELA sometimes blurred in real world contexts. When it came to counterparty solvency, LOLRs in the past did not necessarily have a precise rule book to discriminate between their customers. Rather than fixed capital ratios, qualitative information and reputation sometimes determined whether central bank counterparties could count on liquidity support in a crisis. Instead of issuing outright bans, the LOLR may have continued to accept applications by counterparties it did not fully trust anymore as long as the latter pledged additional guarantees or collateral. Technically, these ‘enhanced’ transactions occupied middle ground between standard liquidity provision and ELA. Carlson (2023) discusses a fascinating series of discount window interventions by U.S. Federal Reserve Banks during the 1920s that all lie on a spectrum between conventional standard facility operations and emergency liquidity assistance.

## 5 Moral hazard and the lender of last resort

A fully-fledged, unconstrained LOLR can become the victim of its own success. Today, effective lending of last resort is frequently associated with the notion of moral hazard (Freixas et al., 1999). Yet, the precise meaning of this term and the behavioral changes it implies often remain vaguely defined. This paper argues that moral

hazard in the context of lending of last resort relates mainly to liquidity risk. Counterparties that experienced a functional LOLR during past episodes of liquidity distress may become tempted to ‘bank’ on the safety net provided by the central bank. As observing and learning agents, they form expectations based on their experience and project them forward. Anticipating central bank support, counterparties thus have an incentive to downsize their holdings of non-interest bearing liquid assets. Functioning LOLR facilities may therefore significantly increase the financial sector’s reliance on central bank funding to buffer future dislocations. By reducing aggregate private financial sector liquidity, individually optimal behavior can diminish the financial system’s resilience to future systemic shocks or contagion, and endogenously increase the probability of future crises.

A second interpretation of moral hazard in the context of the LOLR emphasizes solvency risk. Counterparties may exploit the unconstrained liquidity facilities of the LOLR to ‘gamble for survival’ (Freixas et al., 2004). This argument only holds, however, if the LOLR is systematically unable to distinguish between illiquid and insolvent counterparties or eligible and ineligible assets/collateral. Betting on the LOLR’s inability to separate the ‘wheat from the chaff’, central bank counterparties could pile up risky assets or balance sheet mismatches in normal times that increase their *ex ante* probability of requiring support by the LOLR in crises. If these risky counterparties manage to pass off their requests as legitimate demands for central bank liquidity, the LOLR effectively provides them with a solvency back-stop. Although a perfect real-time picture of counterparty solvency remains difficult to establish even in modern contexts, in the light of the monitoring machinery discussed in Section 2 it seems unlikely that historical LOLRs systematically misjudged counterparty solvency in a way that caused agents to fully rely on central banks’ liquidity facilities to gamble for survival. This point is the reason why moral hazard deriving from the creation of a successful LOLR is more convincingly related to heightened liquidity risk (as per the preceding paragraph) than to actual bail-out expectations. By its very definition, the LOLR constitutes a liquidity net for solvent but illiquid institutions, whereas outright rescue operations for insolvent counterparties (e.g. in the context of too-big-to-fail considerations) belong to the realm of the treasury.<sup>22</sup> Based on this insight, the remainder of this section discusses moral hazard in historical lending of last resort by concentrating on its implications for liquidity risk-taking.

Empirical evidence for the presence of moral hazard is hard to establish. Despite its potentially serious consequences for financial stability, we continue to know little about the causal effect of the LOLR on moral hazard in historical and modern environments. As so often, convincing empirical evidence on this link remains elusive because researchers usually lack a credible control group. In a world where LOLR support has become near universal (Goodhart, 1999), all eligible, solvent counterparties should benefit from equal and unlimited access to the central bank balance sheet – provided they possess enough high quality collateral. An unconstrained LOLR’s decision to grant or to refuse liquidity is not determined by supply or demand frictions, but rather depends on the quality of credit demand. As a corollary, endogeneity concerns loom large whenever different

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<sup>22</sup>In borderline cases, ELA could also remain an option. Historically, central banks sometimes participated in so called “lifeboat” operations, but, as a general rule, they attempted not to assume any solvency risk in these contexts (Hautcoeur et al., 2014). In practice, lifeboats sometimes resulted in losses for the central banks involved (c.f. the lifeboat floated by the Banque de France to the Comptoir d’Escompte in 1889 and the support provided by the Bank of England to Barings in 1890).

groups of counterparties exhibit varying degrees of access to the discount window or the Lombard facility.

Hence, the available evidence on the historical link between the LOLR and moral hazard is scant. [Bernstein et al. \(2010\)](#) use the founding of the Federal Reserve System in 1913-14 as a shock to identify the broader effects of a LOLR on financial markets. They find that the creation of the System ‘pacified’ financial markets as stock and interest volatility fell significantly. [Calomiris et al. \(2021\)](#) and [Carlson and Wheelock \(2018\)](#) also draw on the founding of the U.S. central bank as the identifying source of variation. Their studies show that commercial banks sharply downsized holdings of liquid assets in reaction to the establishment of an LOLR and “illustrate how the introduction of a lender of last resort can alter private behavior in ways that increase the likelihood that the lender will be needed” ([Carlson and Wheelock, 2018](#), p.1714). [Anderson et al. \(2020\)](#) argue that the new safety net provided by the Federal Reserve System after 1913 even fueled moral hazard by nonmember banks. The latter started to count on indirect liquidity support via member banks’ access to the System’s facilities and decreased their liquid asset portfolios accordingly. Finally, [Rieder et al. \(2023\)](#) investigate the link between the LOLR and moral hazard by exploiting the Bank of England’s response to the dual crisis of 1847. [Rieder et al. \(2023\)](#) evidence that counterparties who had experienced credit rationing in the spring of 1847 counted less on central bank support in the near future. Moreover, rationed counterparties adopted strategies to minimise their expected rejection probability in the following episode of financial distress that erupted in October 1847.

Today, minimum liquidity standards represent the standard solution to counter the negative incentives in terms of liquidity risk management that follow from the establishment of a functional LOLR ([Carlson et al., 2015](#)). As this paper made repeatedly clear, however, the lender of last resort is not an invention of the twenty-first century. At the same time, many countries did not introduce a special banking law, let alone a comprehensive banking code, until the interwar period. In fact, not a single European central bank received an official role in banking supervision before the 1920s ([Grossman, 2010](#); [Turner, 2014](#); [Hotori et al., 2022](#)).<sup>23</sup> The long history of the LOLR thus raises an interesting question: how did central banks deal with moral hazard before they first received formal regulatory powers?

Several studies emphasize the role of ‘penalty rates’ in crises to incentivize proper liquidity management in normal times ([Humphrey and Keleher, 1984](#); [Crockett, 1996](#)). According to this line of argument, LOLRs charged very high interest rates during financial crises in order to deter reliance on the standing facilities. Anticipating these high costs, so it is argued, counterparties would have had a strong motive to keep sufficient liquid reserves to avoid the LOLR as long as possible. The verdict on this strategy is mixed at best. The expectation of interest rate hikes may have helped to contain moral hazard if, and only if, the LOLR could effectively commit to higher interest rates in financial panics. Yet, usury ceilings and political economy considerations curtailed central banks’ credibility in this regard ([Jobst and Rieder, 2016](#); [Anson et al., 2017](#)). Moreover, as discussed in [Section 3](#), hiking interest rates would have not incentivized *ex ante* risk-prone counterparties to divert course, while potentially aggravating adverse selection at the standing facilities.

Other accounts refer to ‘constructive ambiguity’ regarding the central bank’s willingness to assume lender

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<sup>23</sup>Unlike in most European countries, 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](#)).

of last resort responsibilities as an effective strategy to foster proper risk management (Freixas, 2000). This concept describes the idea that central banks always maintained a certain ambiguity about whether they would act as LOLRs during financial crises. As a corollary, so the argument goes, counterparties could not count on the support by the LOLR and thus continued to hold prudent liquidity buffers. In practice, this approach would have likely suffered 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. Although the empirical evidence on this front is not clear-cut (Bartels et al., 2016; Calomiris et al., 2016), self-interested motives might have been particularly prevalent in the past when central banks still operated as private institutions that mainly answered to their shareholders. Readers should also note that contemporaries like Walter Bagehot strictly opposed these tactics because they considered it crucial that the LOLR’s role be fully transparent and known *ex ante* (Ugolini, 2021). He argued that subscribing to ‘constructive ambiguity’ would significantly reduce the powers of the LOLR to nip panics in the bud: an unreliable safety net does not preempt scrambles for liquidity. Interestingly, while Bagehot fiercely criticized ambiguity when it came to central banks’ general willingness to provide LOLR support, he also advocated keeping the “exchange rate” between collateral and cash unfavorable and unpredictable (Ugolini, 2021). According to Bagehot, the uncertainty surrounding the interest rate (for discounts) and the applicable haircuts (for Lombard loans) during future crises could help to mitigate moral hazard. The persistent popularity of ‘constructive ambiguity’ as a tool to address moral hazard (Enoch et al., 1990; Bank for International Settlements, 2014) may be due to these fine nuances in Bagehot’s argument.

Building on the literature stressing the importance of supervision and monitoring in historical central bank operations (c.f. Section 2), Jobst and Rieder (2023) argue that central banks without formal regulatory powers resorted to informal supervision via the discount window to mitigate moral hazard concerns. Their study highlights that the Austro-Hungarian Bank used credit limits for discount window transactions in an attempt to control the liquidity and capital adequacy of its counterparties. These credit limits defined the maximum exposure to each 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. Most importantly, the Austro-Hungarian Bank made the size of individual limits contingent on counterparties’ liquidity and capital position. Prudent behavior and sound balance sheets were rewarded with a higher credit limit. Counterparties that behaved in unacceptably risky ways saw their allowance reduced or canceled. Although the central bank did not possess any formal legal mandate to define specific minimum regulatory standards, its counterparties had an incentive to abide by these ‘rules of the game’. More elevated credit limits enabled counterparties to streamline their day-to-day liquidity management because they could build their business operations around a more extensive and regular recourse to central bank liquidity facilities. All else equal, counterparties with large and stable allowances thus benefited from reduced liquidity management costs relative to a situation without regular or reliable discount window access.

In theory, credit limits represented an enticing add-on to the conventional set-up of standing facilities that could have allowed the LOLR to engage in ‘supervision without regulation’. Jobst and Rieder (2023) also make clear that credits limits were not incompatible with the central bank’s LOLR function. In crises, the

Austro-Hungarian Bank tolerated large but temporary transgressions of credit limits as long as counterparties' liquidity needs were deemed to be exogenously driven rather than 'homemade'. Overall, the basic principles of the Austro-Hungarian system of credit limits appear to have been surprisingly close to the modern solution to LOLR-induced moral hazard: they formed an early and informal type of the prudential standards known today.

Although [Jobst and Rieder \(2023\)](#) propose a plausible explanation for how central banks harnessed moral hazard before they first received formal regulatory powers, two caveats seem warranted. First, the effectiveness of informal regulation via credit limits remains an open question. For want of an appropriate quasi-experimental setting, [Jobst and Rieder \(2023\)](#) cannot make any normative statement on the success of the Austro-Hungarian Bank's approach to contain moral hazard in the long nineteenth century. Second, while several other major central banks, including the Bank of England, the German Reichsbank, the Banca d'Italia and the U.S. Federal Reserve System maintained some form of credit limits at various points in time, more research is needed to ascertain whether the Austro-Hungarian use of counterparty-specific discount window allowances was representative of similar mechanisms in other countries.

## 6 Conclusion

Central banks acted as the typical lenders of last resort (LOLR) during the nineteenth and early twentieth century. By keeping their standing facilities operating as usual in a financial crisis, central banks furnished an elastic source of liquidity. Although subscribing to inertia may sound like an easy task, the historical LOLR frequently encountered both supply and demand constraints that obviated a free provision of central bank liquidity in periods of distress. Over time, LOLRs learned how to address most of these constraints but their evolution into reliable and institutionalized remedies against financial panics was far from a linear process. In addition, the more successful LOLRs became, the more they solicited undesirable behavior in the form of liquidity risk-related moral hazard. Ironically, their success as LOLRs turned on central banks by causing them even more work: supervising counterparties' liquidity position crystallized as the logical counterpart of effective lending of last resort.

By macroscoping the historical LOLR, this paper identified a list of open questions for future research. In the order of their appearance in the text above, these questions are as follows. Why did central banks often work with a range of different discount rates simultaneously? How did counterparties react and adapt their behavior to the experience of central bank credit rationing in crises outside the English context of the nineteenth century? How can researchers marshal convincing empirical evidence on the causal effects of program stigma on liquidity demand at the discount window? Did stigma in the U.S. context of the 1920s and 1930s only affect the discount window *stricto sensu* or did it also extend to central bank advances? Is program stigma contagious? Can researchers uncover additional historical settings to put the causal link between fully-fledged LOLRs and moral hazard on a broader empirical footing? Was informal supervision without regulation an effective remedy for moral hazard deriving from the creation of LOLRs? This paper will have achieved its mission if it motivated students and scholars of economic history to pursue one or several of these avenues in the future.

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