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Abstract

We use the German Crisis of 1931, a key event of the Great Depression, to study how depositors behave during a bank run in the absence of deposit insurance. We find that deposits decline by around 20 percent during the run and that there is an equal outflow of retail and nonfinancial wholesale deposits from both ex-post failing and surviving banks. This implies that regular depositors are unable to identify failing banks. In contrast, the interbank market precisely identifies which banks will fail: the interbank market collapses for failing banks entirely but continues to function for surviving banks, which can borrow from other banks in response to deposit outflows. Since regular depositors appear uninformed, it is unlikely that deposit insurance would exacerbate moral hazard. Instead, interbank depositors are best positioned for providing "discipline" via short-term funding.

Key words: bank run, deposit insurance, financial crises

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1 Introduction

Understanding depositor behavior in banking crises is key to evaluating the policy measures to prevent them. For instance, a predominant feature of modern banking systems is the presence of deposit insurance schemes.[1] In theory, deposit insurance is socially desirable if it prevents bank runs that stem from coordination failures (Diamond and Dybvig, 1983; Goldstein and Pauzner, 2005; Egan et al., 2017). However, deposit insurance can also exacerbate moral hazard if it undermines depositors' incentives to discipline bankers (Calomiris and Kahn, 1991; Diamond and Rajan, 2000, 2001). Studying bank runs empirically is typically constrained as deposit insurance schemes distort depositors withdrawal decisions and make runs infrequent in modern banking crises (Baron et al., 2020). Thus, while empirical studies of bank runs have made great progress in understanding depositor behavior (Iyer and Puri, 2012; Iyer et al., 2016; Martin et al., 2018; Iyer et al., 2019), the literature lacks evidence on how different types of depositors would react to a major financial shock when there is no deposit insurance.

In this paper, we ask—in absence of deposit insurance—how do depositors behave in a bank run? To answer this question, we study the run on the German banking system from May through July of 1931, one of the largest bank runs in economic history and a key event of the Great Depression (Kindleberger, 1973; James, 1984). There are two key advantages in studying this historical episode. First, the German system was lightly regulated with no capital and liquidity requirements and no deposit insurance. Thus, all types of depositors could plausibly expect to realize losses in the case of a bank failure.[2] Second, the system-wide nature of the bank run provides an empirical laboratory with a large number of failing banks—15 out of 123 banks in our sample failed during the crisis—exposed to the same macroeconomic environment. Taken together, this allows us to establish whether depositors anticipate which banks will fail.

Our findings are simple but striking. Deposits decline by around 20% over the two months from the start of the run to the end, when the government declared a bank holiday. There is no difference in total deposit outflows between failing and surviving banks. This implies that, *on average*, depositors seem unable to successfully identify which banks will fail.

However, the average obscures the distinct behaviors of different types of depositors. We find that

[1] For instance, Demirgüç-Kunt et al. (2008) report that the number of countries with deposit insurance rose from twenty in 1980 to eighty-seven by the end of 2003, covering all developed economies. In the United States, around 2/3 of all deposits (1/3 of all bank liabilities) are insured as of 2019.

[2] Indeed, we provide evidence on bank failures preceding the system-wide bank run in which depositors realized substantial losses.

regular depositors—retail and non-financial wholesale deposits—do not discriminate between failing and surviving banks. In contrast, interbank depositors do so with a high degree of precision. Failing banks start to lose access to the interbank market early on in the run. By the time the banking system collapses, they are essentially shut out of the interbank market. Furthermore, banks that experience deposit inflows do not hoard liquid funds. In contrast, they continue to lend to surviving banks that are subject to deposit outflows. Thus, the interbank market remains functioning for surviving banks during times of high financial distress—echoing findings from Afonso et al. (2011)—but collapses for failing banks.

We argue that banks are very well informed about which banks will fail but regular depositors are essentially uninformed. This interpretation is subject to the concern that banks' withdrawals from failing banks—rather than being a result of banks being well informed about which banks are weak—represents the original cause of the failures. This reverse causality concern, however, is alleviated by the fact that deposit funding contracts by about the same percent for failing and surviving banks. This equal outflow of total funding is possible despite the striking differences in interbank deposits flows because interbank deposits represent on average only a small share of overall deposit funding. Given that the decline in total deposits is the same for failing and surviving banks, it is unlikely that banks fail because they lost access to funding from other banks, similar to findings by Perignon et al. (2018). Moreover, to further support the view that banks are more informed, we also show that our findings are unchanged when restricting our sample to banks that rely very little on interbank funding to begin with and for which interbank deposit outflows cannot plausibly be the immediate cause of failure.

However, it is important to highlight that our empirical approach does not allow us to determine the causes of bank failures more generally. This implies that we cannot distinguish whether withdrawals are primarily caused by the prospect of fundamental insolvency (as in a solvency run) or whether overall withdrawals are the primary cause of default (as in a panic-based run).[3] Our approach instead focuses on the information structure: which depositors understand which banks will ultimately fail? The differential response between regular and interbank deposits allows us to conclude that domestic banks are very well informed about which banks will fail due to the crisis, while regular depositors are essentially uninformed. However, we cannot identify *what* information banks are acting on. Our

[3]Following the terminology of Diamond and Dybvig (1983) and Goldstein and Pauzner (2005), we refer to a *panic-based run* as a run in which a bank had survived under the counterfactual in which the depositors don't withdraw but failed because withdrawals happened. In a solvency run, in contrast, the bank would have been insolvent irrespective of withdrawal decisions.

findings allow for different possibilities. Banks can have information about a specific bank's solvency that is independent of deposit withdrawals. Or banks can have information about which banks are more likely to be perceived as fragile by regular depositors and fail as a consequence of their withdrawals.

Analyzing deposits separately by maturity, we find that on average demand deposits—most commonly held by retail depositors—are stable throughout the run. Instead, the run is almost entirely centered on the withdrawal of time deposits, which are comparable to modern wholesale funding. Our findings suggest that retail depositors, despite being uninsured, do not withdraw until a salient bank failure—the failure of the second largest bank the time "Danatbank"—occurs at the height of the run. The fact that retail depositors do not withdraw until this large salient bank failure takes place is in line with retail depositors having higher information acquisition costs than other depositors (He and Manela, 2016) and neglecting crash risk (Gennaioli et al., 2013, 2015). However, in line with a sudden revision of expectations in light of a salient event (Gennaioli and Shleifer, 2018), retail depositors start a physical bank run once they learn about the failure of the Danatbank, which is then immediately stopped by a bank holiday.

Furthermore, we find that failing banks are subject to demand deposit *inflows* throughout the run, but these inflows are mirrored by *outflows* of time deposits. Thus, depositors are more likely to take a cautious stance in failing banks and convert deposits with longer maturity into those that can be withdrawn easily, indicative of maturity shortening (Brunnermeier and Oehmke, 2013).

We also study the extent to which the stock market identifies failing banks. We find that the stock prices of failing banks start to decline in the first month of the run and fall by around 25% more than those of surviving banks over the course of the crisis. Still, these stock returns are predicted by interbank flows in the early phase of the run. Thus, while banks are best informed about the state of the banking system, the stock market eventually learns and incorporates the informational content of interbank market movements. However, regular depositors' decisions—even though stock prices are publicly available—do not reflect this information.

Taken together, our evidence also provides an empirical reconciliation between the two standard rationales for the existence of short-term debt. On the one hand, short-term debt can be a means to provide valuable liquidity services to depositors (Gorton and Pennachi, 1990; Gorton, 2012; Dang et al., 2017). On the other hand, it can also be an instrument that allows depositors to discipline bank behavior (Calomiris and Kahn, 1991; Diamond and Rajan, 2000, 2001). The two types of rationales differ considerably in how they view depositors and may thus be in conflict (Admati and Hellwig, 2013): while the former regards them as liquidity demanders, the latter considers them to be informed providers of discipline. While we do not test either theory directly, our finding that different types of depositors vary widely in how informed they are offers a resolution: interbank depositors get rewarded for being informed and attentive by withdrawing first from failing banks—comparable to the informed depositors in the model from Calomiris and Kahn (1991)—and are thus able to discipline other banks; regular depositors, in contrast, are less informed and thus not well positioned to provide discipline but are more naturally demanders of liquidity.

Our findings have important policy implications. A logical conclusion from our evidence is that the potential for a deposit insurance scheme that targets regular depositors to undermine the disciplining effect of short-term debt is limited. Evidence from settings with deposit insurance suggests that insured depositors are less likely to run than uninsured depositors (Iyer and Puri, 2012; Iyer et al., 2016; Martin et al., 2018). We find that retail and non-financial wholesale depositors—even if uninsured—may not run at all, and to the extent that they do run, they don't discriminate between banks by their likelihood of failure. Thus, the concern that deposit insurance schemes that target retail depositors undermine discipline and exacerbate moral hazard is alleviated. In contrast, the existence of a functioning interbank market can possibly be valuable beyond standard risk-sharing rationales. Central bank actions that make interbank markets redundant—such as an abundant reserves regime—should consider the cost of losing the valuable information contained in the interbank market and the potential to provide discipline through interbank flows.

Our findings also lend support to the view that banking crises are not just sudden and unpredictable events. Existing research shows that crises typically follow credit booms (Schularick and Taylor, 2012; Baron et al., 2020) and whether a crisis will happen can thus in part be predicted (Greenwood et al., 2020). We complement these findings: given that we find that banks themselves know exactly "where to bodies are buried", it suggests that conditional on being in a banking crisis, it is in part possible to predict which banks are more likely to fail.

Our analysis proceeds as follows. First, we review the theoretical and empirical bank run literature in Section 2. We then provide a description of our data and provide background about the German banking system in 1931 in Section 3. Next, we provide a comprehensive empirical description of the dynamics of the German Crisis of 1931 and a system-wide run in Section 4. Having granular balance sheet data for a large set of banks as well as the central bank, we study what types of depositors withdraw first and how banks meet withdrawals. Our main analysis is presented in Section 5 where we study the cross-sectional variation in bank deposit flows and bank failures and investigate whether failing banks are more likely to lose deposits. We also provide more background on the dynamics in the interbank market and the stock market. Section 6 concludes.

2 Literature

Our paper contributes to a rich literature on bank runs and banking crises. Seminal work by Diamond and Dybvig (1983) shows under which conditions demand deposit contracts can insure depositors against idiosyncratic liquidity risk, but also how demand deposit contracts set the stage for coordination failures and self-fulfilling runs.[4]

A complementary rationale for the existence of short-term funding of banks and bank runs is provided by Calomiris and Kahn (1991) and Diamond and Rajan (2000, 2001), who argue that demand deposit contracts are an instrument to discipline the behavior of the bank's management. In this line of argument, bank runs are equilibrium outcomes as a response to information about non-diligent behavior of bankers as well as the aggregate state of the economy.[5]

While the theoretical literature on system-wide bank runs has made great progress,[6] the empirical

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[4]There are a large number of theoretical studies of the subject, which can broadly be categorized into three generations of models. The first generation of bank run models explains bank runs as a consequence of coordination failures as in Diamond and Dybvig (1983)

The second generation of models shows under which conditions models of self-fulfilling bank runs have a unique equilibrium. Morris and Shin (1998), Rochet and Vives (2004) and Goldstein and Pauzner (2005) suggest setups in which the common knowledge assumption is relaxed, allowing for a unique threshold equilibrium to exist in which all agents withdraw from a bank when the aggregate return of the bank's assets falls short of a cutoff. Importantly, there exists a range of states of the world in which the bank is fundamentally solvent but nonetheless experiences a run. These types of runs are then referred to as panic-based runs. In the context of interbank markets, Liu (2016) models the interplay of interbank market funding conditions and creditor runs on financial institutions, revealing that credit crunches of the interbank market can worsen the coordination problems among regular creditors.

Further, a third generation of bank run models provide theories of dynamic bank runs. He and Xiong (2012) show that dynamic coordination games, in which rollover decisions are based on anticipated future rollover decisions by other debtholders, can exhibit unique threshold equilibria without the common knowledge assumption being violated. He and Manela (2016) discuss the interaction of agents incentives to acquire information and the dynamics of a bank run. Their analysis shows that depositors' incentives to acquire information increase the longer the run continues.

[5]Eisenbach (2017) provides a model in which short-term debt is disciplining, but withdrawals also induce fire sales, implying that the disciplining effect is too weak in boom periods but too strong in downturns. Yet another alternative rationale for short-term debt is provided by Brunnermeier and Oehmke (2013) who argue that maturity of debt may have a tendency to be excessively short when intermediaries cannot commit to the overall maturity structure of their debt.

[6]Building on the work by Diamond and Dybvig (1983), a large set of papers analyze bank runs in comparable frameworks including welfare analysis of bank runs when there is aggregate uncertainty (Allen and Gale, 1998), investment choices when there are sunspot runs (Cooper and Ross, 1998), optimality of demand deposits in case of sunspots (Peck and Shell, 2003), coexistence of financial markets and banking solutions (Green and Lin, 2003), interbank trade where there are local liquidity shocks and contagion (Allen and Gale, 2000), concepts of fire sales (Allen and Gale, 1994), systemic runs (Uhlig, 2010), runs in repo markets (Martin et al., 2014), and discussions of optimal government interventions (Ennis and Keister, 2009) as well as the financial fragility arising form bailouts when governments have limited commitment (Keister, 2015). Further, Gertler and Kiyotaki (2015); Gertler et al. (2017) incorporate bank runs in general equilibrium models, studying how the probability of a bank run taking place feeds back to real economic outcomes and vice versa. Kashyap et al. (2017) utilize the concept of unique equilibrium bank run models to discuss optimal banking regulation. Egan et al. (2017) provide a structural model of the U.S.

study of the subject is typically constrained by the lack of adequate settings and data. Either governments intervene before a system-wide bank run fully plays out (Baron et al., 2020), or, when it does occur, data are only available at a low frequency. Thus, existing empirical work either focuses on bank runs in settings in which deposit insurance or related government distortions affect depositors' incentives, or the analysis is concerned with banking crises from prior to or during the Great Depression, when data are typically not available at a high frequency. The key advantage of our setting is that our granular data allow us to analyze depositors' behavior during a major financial shock in a setting in which depositors of all types had to expect to realize losses if their bank failed.

Evidence on the importance on the heterogeneity of depositor behavior during bank runs in contemporary settings is provided by Iyer and Puri (2012) and Iyer et al. (2016), Martin et al. (2018), Artavanis et al. (2019) and Iyer et al. (2019). Iyer and Puri (2012) establish that depositors that have stronger ties to the banks, either socially or financially, are less likely to withdraw. Iyer et al. (2016) provide evidence that sophisticated and uninsured depositors are more sensitive to solvency risk. Martin et al. (2018) show that, prior to bank failures, outflows of uninsured deposits are offset with inflows of insured deposits. Iyer et al. (2019) provide evidence that systemically important banks successfully retain and attract uninsured deposits in a crisis at the expense of other banks. Moreover, Artavanis et al. (2019), using deposit-level data from a run on a Greek bank in 2015, can identify to what extent depositors are withdrawing due to concerns about bank solvency and to what extent their behavior is driven by the strategic motives and worries about other depositors' actions. All of the above settings, while providing valuable information about depositor behaviour, feature deposit insurance schemes that distort depositors' behavior, leaving it unanswered how depositors would behave in absence of deposit insurance.[7]

banking sector. Estimating the elasticity of deposit supply to bank default risk, they are able to analyze counterfactuals and argue that higher capital requirements can decrease the number of adverse bank run equilibria. Finally, theories by Chari and Jagannathan (1988) and Jacklin and Bhattacharya (1988) provide models with asymmetric information in which solvency and liquidity shocks cannot be distinguished by all agents, making information-based panics an equilibrium phenomenon.

[7] See also Goldstein (2013) for an overview of empirical evidence on bank runs. Further, there are several detailed accounts of run-like phenomena in specific market segments during the 2007-09 financial crisis (see Brunnermeier, 2009, for an overview). Gorton (2012) and Copeland et al. (2014) focus on the collapse in bilateral and tri-party repo during the crisis, respectively. Covitz et al. (2013) and Krishnamurthy et al. (2014) focus on the run on ABCP in the summer of 2007 and Acharya et al. (2013) on the implications for commercial banks that had sponsored off-balance-sheet ABCP conduits. Kacperczyk and Schnabl (2013) and Schmidt et al. (2016) study the pre-crisis behavior of and the runs on money market mutual funds, in particular subsequent to the failure of Lehman Brothers. Foley-Fisher et al. (2019) study the run on U.S. life insurers during the summer of 2007. Moreover, further evidence from the 2007-2009 financial crisis is provided by Ivashina and Scharfstein (2010), who show that, next to runs by short-term debt holders, firms draw on credit lines, increasing the liquidity needs of banks during times of financial fragility. This type of phenomena is also discussed in Acharya and Mora (2015) and Ippolito et al. (2016) and for the COVID pandemic by Chodorow-Reich et al. (2021). The advantage of our setting is that we can study a run that concerns the entire banking system and not just specific market segments.

Other papers that have studied system-wide banking panics absent of deposit insurance are largely confined to historical episodes in which data are available at a much lower frequency. In a classic study, Gorton (1988) and Calomiris and Gorton (1991) show that system-wide banking panics during the National Banking Era typically occurred when economic activity peaked. Saunders and Wilson (1996) and Calomiris and Mason (2003b) study causes of bank failures during the Great Depression using biannual data and find evidence that the causes of the bank runs were related to fundamental solvency concerns.[8] Frydman et al. (2015) study the real effects of the Panic of 1907, which originated in New York's trust companies which are akin to modern day shadow banks. Kelly and Ó Gráda (2000) and Ó Gráda and White (2003) study depositor runs using depositor-level data in a New York bank during the Panics of 1854 and 1857. Ó Gráda and White (2003) find that less sophisticated depositors withdrew during the non-systemic run of 1854, but more educated depositors were withdrawing their deposits during the system-wide crisis of 1857. Monnet et al. (2021) find that the ability of depositors to transfer funds to savings banks intensified withdrawals from regular banks in France during the Great Depression. As mentioned above, most of these studies of historical banking crises lack data that is of sufficiently high frequency to investigate the dynamics of bank runs.

An important exception is the paper by Schumacher (2000), which studies the cross-sectional variation in bank stability during a banking panic that took place in Argentina in 1995 following the Mexican "Tequila shock." Importantly, Argentina at the time had no deposit insurance scheme and no wider safety net. However, the crucial advantage of our empirical approach is that we have information on the different types of deposit flows and thus the richness of our data allows us to test for heterogeneity in depositor information explicitly.

Our paper also directly relates to empirical studies of interbank market dynamics. Iyer and Peydró (2011) test financial contagion due to interbank linkages and Iyer et al. (2014) study the real effects of interbank market distress. Similarly, Craig and Ma (2020) study systemic risk in the contemporary German interbank market. Afonso et al. (2011) study the interbank market in the U.S. during the 2007-09 financial crisis. Like Afonso et al. (2011) we find evidence that the interbank market continues to function during a major financial shocks. Banks do not hoard liquidity but only stop lending to failing banks. Surviving banks continue to be able to borrow. Our findings are also in line with evidence from Perignon et al. (2018), who study wholesale funding dry-ups for European banks around the European

[8] Calomiris and Mason (2003a) study the real effects associated with the banking crisis. A classic study by Calomiris and Mason (1997) also provides an account of the bank failures in Chicago during 1932 and supports the view that weaker banks were more likely to fail.

Debt Crisis and stress the role of informed and uninformed investors.

Finally, our paper also contributes to the literature on the Great Depression in Germany. Papers studying the more general role of the economic and political crisis and the rise of political extremism and the Nazi party are provided by Galofré-Vilà et al. (2017) and Doerr et al. (2021), with the latter focusing on the impact of the failure of the "Darmstaedter and Nationalbank" or "Danatbank"—the second largest bank at the time and discussed in more detail below—on the rise of fascism. Two important accounts of the crisis episode, interpreting it primarily as a banking crisis, are provided by Born (1967) and James (1984). In contrast, Temin (1971, 2008) and Ferguson and Temin (2003) put more emphasis on the actions of the German government. Kindleberger (1973) and Eichengreen (1995) emphasize the international dimensions of both, currency and banking crisis. Schnabel (2004) emphasized the role of "too big to fail" guarantees for the large Berlin banks that may have led to excessive risk-taking. Moreover, Schnabel (2009) also studies the effect of liquidity and government guarantees on bank stability during the crisis.

3 Data and Setting

Our main data source is a set of detailed monthly bank balance sheets that were collected by the central bank—henceforth "Reichsbank"—and made publicly available via the contemporary newspaper *Deutscher Staats- und Preussischer Reichsanzeiger*. Digital versions of the newspaper are made available by the University of Mannheim (Kling, 2016) and complemented by hand-collected data from the archives of the Reichsbank held at the Federal German Archives ("Bundesarchiv") in Berlin and Koblenz.[9]

Bank balance sheets for most major banks are available monthly between 1928 and 1933, excluding balance sheets as of December and January.[10] Banks that report to the Reichsbank include the the major banks with a nation-wide branch network—so called "Berlin banks"—as well as the regional credit banks with a local or no branch network. Further, our sample also includes clearing banks and brokers for savings banks ("Girozentralen") and publicly-owned banks ("Landesbanken"). Our data do not include information on local savings banks or private investment banks and brokers. Altogether, our data cover more than 50% of the entire German banking sector's assets (Schnabel, 2004) and an average of more than 120 banks per month.

[9] All Reichsbank data are available in the federal archives in Berlin and can be seen for specific research purposes with special dispensation from the archives. For the data described above, see, for instance, Reichsbank archival data: R 2501 "Deutsche Reichsbank": 6479, 6480, 6482, 6484, 6491-2, 6559, 6634, 6709, 6746, 7712.

[10] Note that all balance sheets were reported either as of the 28th, 29th, 30th or 31st of the respective month.

The data are fairly granular with more than 70 balance-sheet items reported. Among other things, the data distinguish between domestic interbank and regular deposits, demand and time deposits, loans and covered bonds, as well as high- and low-quality liquid assets.[11] Table 1 gives an overview of the observable characteristics in our sample. The table reports the average of assets (Panel A) and liability (Panel B) items as a share of total assets and liabilities for 126 banks reporting between February and April 1931. We report the respective shares as averages for the entire banking sector as well as for the four different types of banks mentioned above. In the columns far left of Panel A, we also report the bank size and number of banks in each category.[12]

The largest banks in our sample are the 6 Berlin banks (of which 4 had nation-wide branch systems) with an average balance-sheet size of around 2 billion Reichsmarks (RM). In contrast, regional credit banks are much smaller, with an average balance-sheet size of only 50 million RM.[13] Girozentralen are considerably larger than the regional banks but also smaller than the Berlin banks, with an average asset balance of 300 and 240 million RM, respectively.

The average bank in our sample has around 68% of its funds invested in illiquid assets. Illiquid assets, in turn consist of 53% commercial and industrial loans and 15% covered bonds such as mortgages and municipal bonds. Around 26% of banks' funds are invested in liquid assets. Liquid assets can broadly be categorized into liquid assets of higher and lower quality as well as interbank claims. High-quality liquid assets consist of cash, reserves, or government bonds. Lower-quality liquid assets are bills of exchange from private non-financial firms. Around 5% of assets are in high quality liquid assets and around 12% in low quality, and 9% in interbank claims. Note that for interbank claims, we can also distinguish between those due within seven days. On average around 45% of interbank claims are short-term.[14]

On the liability side, we can distinguish between different types of deposits. The balance sheet splits deposits into three different categories: deposits from domestic banks, regular deposits (which combines retail and non-financial wholesale deposits—including those denominated in foreign currency) and other types. Further, the reporting form distinguishes between those deposits that are due within seven days (which we refer to as demand deposits) and those with a specified maturity of more than

[11] Appendix A.6 in the Appendix provides an example of a reported balance sheet. Subsets of the data have been used before, e.g. by James (1984), Ferguson and Temin (2003), Schnabel (2004, 2009), Adalet (2009) and Collet and Postel-Vinay (2021).

[12] Note that we report the distribution of some of the core characteristics in Figure A.14 in the Appendix.

[13] Table A.1 provides information on the largest 40 banks.

[14] This contrasts with the contemporary German interbank market for which, from 2005-2009, the bulk of interbank loans was longer term (see Craig and Ma, 2020).

seven days (which we refer to as time deposits). Note that the distinction by maturity is only applied for the sum of domestic interbank deposits and regular deposits. That is, we cannot distinguish by maturity within domestic interbank and regular deposits. Given that interbank claims have to be equal to interbank deposits in the aggregate, it's fair to assume that a little less than half of interbank deposits are due within seven days.

On average, banks finance 66% of their assets with deposits of which the majority are regular deposits: 51% of assets are financed by regular deposits and only 12% by domestic interbank deposits. Further, one can observe that equity finance is relatively higher at the smaller regional banks (23%), since these banks are not diversified geographically. In contrast, equity finance is lowest at the Berlin banks and Landesbanken (7% and 5%, respectively).

Note that there is considerable variation across the different types of banks, with Girozentralen and Landesbanken having a different business model than the large Berlin banks and the smaller regional banks. Berlin banks and regional banks were largely in the business of financing non-financial firms, in part by discounting their trade credit claims. In contrast, Girozentralen and Landesbanken intermediated investments from local savings banks, investing in mortgages and municipal bonds. Hence, interbank deposits are much more common at the Girozentralen and the Landesbanken.[15] The main focus of our analysis is on regional banks and Berlin banks, which resemble a textbook banking business model of financing loans with deposits. All cross-sectional and panel estimations thus include bank-type or bank-type-time fixed effects, respectively. Further, throughout our analysis we also show that all main findings are not bank-type dependent and hold when using a sample of only the smaller regional banks.

[15] Reflecting the differences between the bank business models, Berlin banks and regional banks also have a somewhat stronger reliance on deposit financing (86% and 70%, respectively), and Girozentralen and Landesbanken rely more on bond financing (44% and 38%, respectively). On average around 1/3 of regular and interbank deposits are short-term and 2/3 are time deposits.

Table 1: ***Bank Assets and Liabilities by Share of Total Assets in Spring 1931***.

Panel A: Assets

Bank Type	Illiquid Assets			Liquid Assets					Assets	No. of
							Interbank		(in mil. RM)	Banks
		Loans	Covered Bonds		High	Low	Total	Short-term		
All Banks	0.68	0.52	0.15	0.26	0.05	0.12	0.09	0.04	214	126
Berlin Banks	0.61	0.60	0.00	0.36	0.06	0.17	0.14	0.07	2,088	6
Girozentralen	0.70	0.21	0.49	0.26	0.06	0.04	0.17	0.03	300	17
Regional Banks	0.67	0.63	0.03	0.26	0.04	0.15	0.07	0.04	52	82
Landesbanken	0.72	0.32	0.39	0.25	0.07	0.07	0.11	0.03	241	21

Panel B: Liabilities

Bank Type	Deposits							Acceptances	Bonds	Equity
		Demand	Time	Regular	Domestic Bank	Other	Foreign			
All Banks	0.66	0.22	0.40	0.51	0.12	0.03	0.04	0.01	0.14	0.17
Berlin Banks	0.86	0.27	0.42	0.60	0.09	0.17	0.37	0.05	0.01	0.07
Girozentralen	0.49	0.20	0.29	0.17	0.32	0.00	0.00	0.00	0.44	0.05
Regional Banks	0.70	0.23	0.44	0.61	0.06	0.03	0.03	0.01	0.03	0.23
Landesbanken	0.56	0.19	0.36	0.36	0.19	0.01	0.01	0.00	0.38	0.05

Notes: This table reports key balance sheet figures as a share of total assets. These shares are computed at the bank-level as averages for February through April 1931. Loans comprise credit lines to non-financial firms ("*Debitoren in Laufender Rechnung*"), lombard credit ("*Lombard und Reports*"), and trade credit ("*Vorschuesse auf verfrachtete oder eingelagerte Waren*"). Covered bonds consist of mortgage- and municipal bonds ("*Langfristige Ausleihungen gegen hypothekarische Sicherungen oder gegen Kommunaldeckung*"). Shares held consist of equity investments in other companies and financial firms ("*Konsortialbeteiligungen*"). High quality liquid assets are the sum of cash ("*Kasse*"), reserves ("*Guthaben bei Notenbanken*"), and short-term government bonds ("*unverzinsliche Schatzanweisugen*"), securities that qualify for being discounted at the Reichsbank ("*bei der Reichsbank beleihbare Wertpapiere*"). Low quality liquid assets are bills of exchange net of government bonds ("*Schecks und Wechsel*").

For liabilities, we distinguish between domestic interbank deposits ("*Deutsche Banken, Bankfirmen, Sparkassen, und sonstige deutsche Kreditinstitute*") and regular deposits ("*Sonstige Kreditoren* "). Demand deposits are the sum of all regular and domestic interbank deposits with no specified maturity or a specified maturity of less than 7 days. Time deposits are all regular and domestic interbank deposits with a maturity of more than 7 days. There is no information on the maturity of other deposits ("*Seitens der Kundschaft bei Dritten benutzte Kredite*"). Foreign deposits are estimated by multiplying the share of foreign deposits as of either July 1930 or July 1929 (depending on when available) with total deposits. Further, the tables report acceptances ("*Akzepte*") which is a type of bill of exchange, bonds ("*Langfristige Anleihen bzw. Darehen*"), and equity as the sum of capital paid in and reserves ("*Aktienkapital*" and "*Reserven*").

Source: Deutscher Reichs und Preussicher Staatsanzeiger from February 1931 through April 1931. Foreign Deposit data are constructed from confidential filings with the Reichsbank as described in the main text.

Further, we also obtain data that were confidentially filed with the Reichsbank—and thus not publicly available during the run—and allow us to approximate the use of deposits denominated in foreign currencies. Information on the exposure to deposits denominated in foreign currency is crucial as many observers stress the role of deposits denominated in foreign currency in the run (see, e.g., Schnabel, 2004; Temin, 2008).[16] The information on the use of foreign-currency-denominated deposits available to us is limited to the summers of 1929 and 1930. We use it as a proxy for which banks hold foreign deposits and make foreign investments. Specifically, we approximate foreign-currency-denominated deposits by multiplying the maximum share of those deposits observed between 1929 and 1930 with the amount of overall deposits net of domestic interbank deposits. Table 1 shows that deposits denominated in foreign currency are highly concentrated in the large Berlin banks and a few of the larger regional banks. Foreign funding is essentially non-existent in the smaller regional banks and uncommon for Girozentralen and Landesbanken.

We also use the Reichsbank records as well as information from Born (1967) and Schnabel (2009) to determine which banks fail, which are merged, and which are actively bailed out by the state, see Table A.2 in the Appendix. We identify 15 banks that fail, and 6 banks that didn't fail but were distressed and received some form of government aid or were subjected to a distressed merger. We focus on contrasting deposit flows in failing versusu surviving banks but also show that our results are robust to using a more general version of distressed banks.

We also hand-collect data on daily stock prices for the banks that were traded from the *Monatskursblatt*, published by the *Berliner Börsenpapiere* for 1931. These are monthly publications that contain daily stock- and bond-price information for stocks traded on the Berlin Stock Exchange. It tracks closing trading prices for each day of the month. Not all the banks in our sample are publicly traded or listed on the Berlin exchange. We are able to match daily stock prices with balance sheet information from 24 banks covered in the *Reichsanzeiger*.

We supplement the balance sheet data of banks with additional filings from the Reichsbank. We hand-collect the weekly balance sheets of the Reichsbank for the entire year of 1931. The balance sheet includes information on the amount of notes outstanding as well as the amount of gold held by the Reichsbank in its vaults which we use in Appendix A.3 in the Appendix to provide more background on the Reichsbank's actions.

[16] Note that James (1984) emphasizes that while deposits were foreign denominated, they were mostly held by Germans who had transferred funds to the Netherlands and Switzerland.

A key advantage in studying the German Crisis of 1931 is that the bank run took place in a banking system that had very little government interventions. Specifically, there was no capital or liquidity regulation and most importantly no deposit insurance. The German banking system was following a German tradition of "self-regulation" in which the only interventions came from the Reichsbank with its only real power stemming from the ability to refuse to act as a lender of last resort (James, 1984).[17]

Given our research objective, it is important to establish that depositors—regular depositors and interbank depositors alike—had a reason to believe that they would realize losses on their deposits in case of a bank failure. Thus, in Appendix A.1, we provide evidence that bank failures were quite common before the run in 1931 and in those bank failures, depositors typically realized losses. Thus, depositors of any type had reasons to expect that they would realize losses if their respective bank would fail.

4 The German Crisis of 1931

In this section, we first provide a brief discussion of the key events of the crisis and then discuss how the run presents itself in our data. Note that we keep the description of the historical events to a minimum and provide a more detailed description of the crisis and its circumstances in Appendix A.2 and refer to existing work that provides detailed narratives of the crisis (Born, 1967; James, 1984; Schnabel, 2004).

The run on the German banking system in 1931 was preceded by a three-year period of contraction in output and employment, deflation, and a high degree of political uncertainty. The run on the German banking system can be broadly categorized into three phases from early May 1931 through July 1931. In the first phase in May 1931, the interbank market shows signs of distress and starts to collapse. The distress started when the failure of the largest Austrian bank, the "Creditanstalt", was announced on May 11, 1931 (Born, 1967; Kindleberger, 1973; James, 1984). German banks were not contractually linked to the Creditanstalt. Although bank failures were quite common in interwar Germany, as discussed in Appendix A.1, the failure of the Creditanstalt was remarkable. It was the largest Austrian bank and its failure was widely unanticipated by the public. Thus, the failure of the Creditanstalt is sometimes interpreted as a "*Minsky* moment" that triggered a banking crisis without revealing any additional information about the state of the German banking system (James, 1984).

The second phase of the run coincides with the German government's announcement on June 6

[17] More details on the behavior of the Reichsbank are provided in Appendix A.3 in the Appendix.

that it was unwilling/unable to continue reparations payments, thus raising doubts about Germany's ability to maintain the Gold Standard. During this second phase in June and early July, withdrawals continued with varying intensity. For instance, withdrawals picked up when a major creditor of Danatbank announced heavy losses, leading to speculation about the bank's imminent failure. Similarly, withdrawals started to slow down noticeably after the announcement of the "Hoover moratorium" on June 19, a suggestion by U.S. President Herbert Hoover to pause all war-related debt payments for one year. However, when French opposition to the arrangement became clear throughout the end of June, withdrawals intensified again.

The third and final phase of the crisis was reached on July 10-13 when the Reichsbank's gold reserves had fallen below the legally mandated 40% gold-to-notes coverage ratio. In anticipation, the Reichsbank had started a last attempt to obtain emergency loans from the Bank of England and the Banque de France.[18] When this attempt was unsuccessful, the Reichsbank decided to further increase the discount rate and tighten its already restricted liquidity provision to the banks. This rendered the Danatbank illiquid, as it had already discounted all of the assets that qualified for Reichsbank purchases. As an additional last-minute attempt to merge Danatbank and Deutsche Bank failed, the Danatbank had announced it would not open its branches again on Monday, July 13.

Following the failure of Danatbank, retail depositors started a full-blown panic, queuing at most banks to withdraw their funds. This triggered the illiquidity of "Dresdner Bank", at the time the third largest bank, on July 14. The then full-blown run led the government to intervene by imposing a two-day bank holiday, which was followed by an effective suspension of convertibility lasting throughout August[19] and the introduction of capital controls. Further, the government ensured that illiquid banks would have access to the liquidity provision of the Reichsbank and set up a conduit that allowed banks to make their securities eligible for Reichsbank purchases. While deposits continued to contract until the end of 1931, albeit at a slower pace, the financial crisis was over when the government restructured the largest banks in spring 1932.[20]

How does the run present itself in the data? Figure 1 depicts the aggregate flows of a selected set of bank assets and liabilities relative to the previous month. The shaded areas depict month-to-month flows in assets, while the colored lines depict flows in liabilities. Aggregate deposits contract by around

[18] In a dramatic turn the Reichsbank's president Hans Luther travelled by air—quite uncommon at the time—to both London and Paris, requesting an emergency loan (Luther, 1968). Both turned Luther's requests down.

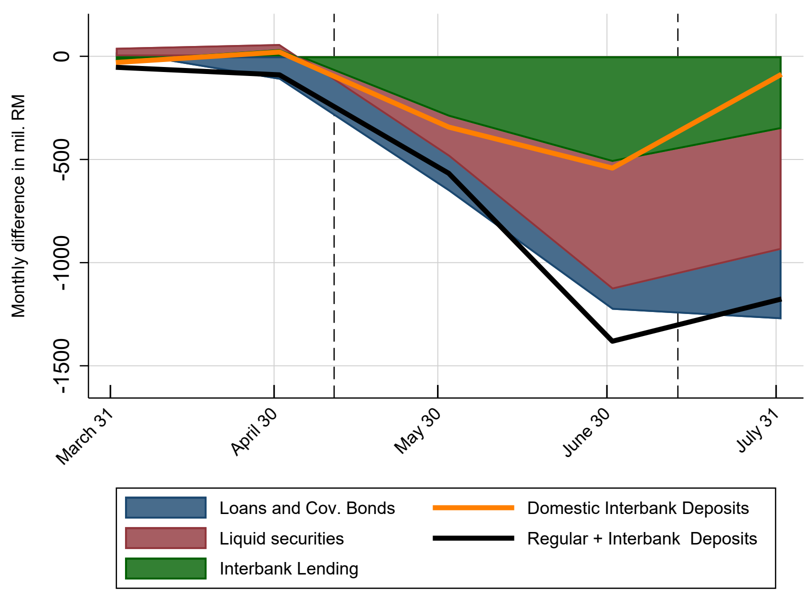
[19] A maximum of 200 RM per account per day could be withdrawn per account.

[20] The failing Danatbank and Dresdner bank were merged and recapitalized by the government.

500mil RM from April to May. From May to June as well as from June to July, the aggregate deposit outflow almost triples, to a little less than 1,500mil RM per month, representing an outflow of around 8% of the pre-crisis level of total deposits for two consecutive months. Overall, deposits fall by around 5bn RM between March and November 1931, around 25% of the pre-crisis level.[21]

Figure 1 reveals that during the first month of the bank run—in the immediate aftermath of the failure of the Creditanstalt—the deposit outflow is largely accounted for by a contraction in domestic interbank deposits, which is accompanied by an equal fall in interbank claims.[22] The first month of the run is therefore largely a run of banks on banks. Moreover, interbank lending and borrowing continue to contract steadily throughout the crisis.

Figure 1: ***Aggregate Dynamics of Assets and Liabilities.***



Notes: The figure shows the flow of key balance sheet components during the crisis in 1931. In both panels, domestic inter-bank borrowing is depicted in orange, the sum of all deposits in black, illiquid assets (primarily loans and covered bonds) are in blue while liquid assets are in red. Inter-bank lending is in dark green. sheet. The first vertical line, on May 11, 1931, marks the date of the failure of the Austrian Creditanstalt. The second vertical line, on July 13, 1931, and corresponds to the failure of Danatbank. Note that bank balance sheet data is available at a monthly frequency, excluding December and January.

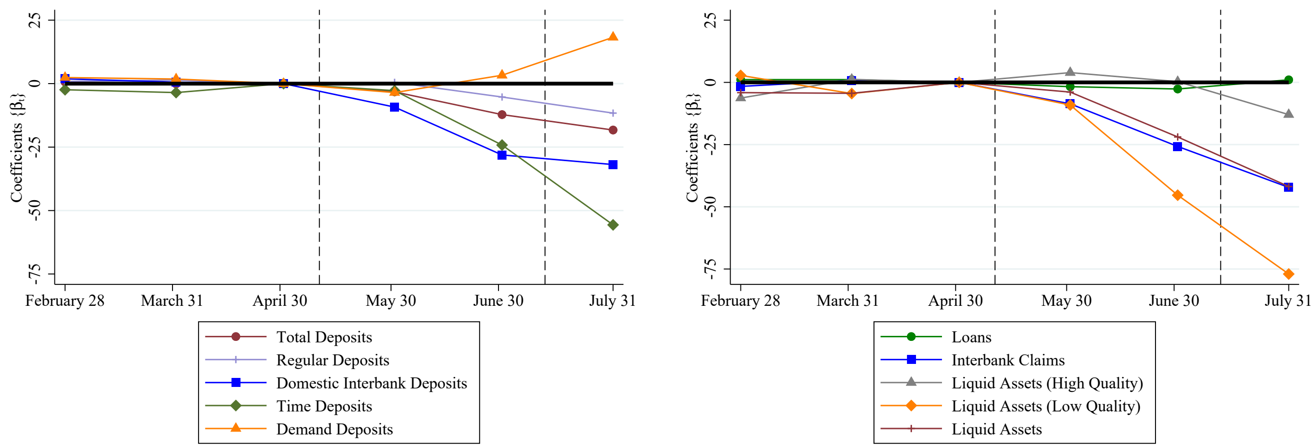
Between May and July, deposit outflows intensify. In addition to the contraction of interbank deposits in May, more than 1bn RM of regular deposits such as retail and non-financial wholesale deposits are withdrawn from the banking system in both June and July. Banks meet these withdrawals largely by reducing their holdings of liquid securities (red shaded area), discounting them at the Reichsbank as discussed in more detail in Appendix A.3. Illiquid assets such as loans and mortgages are also

[21] Figure A.3 in the Appendix also plots the aggregate levels of bank assets and liabilities in the period before, during, and after the crisis.

[22] By definition, interbank claims and interbank deposits need to add up in the aggregate. While the change in interbank deposits is almost equal to the change in interbank claims, the difference can be explained by the fact that while our data cover most important banks our coverage is not complete and misses the interbank movements stemming from savings banks.

Figure 2: ***Deposit and Asset Dynamics during Spring 1931.***

(a) *Deposits* **(b)** *Assets*



Notes: The above figures display the sequence of coefficients $\{\beta_t\}$ that results from estimating the model:

$$\ln y_{bt} = \gamma_b + \sum_{t \neq \text{April 1931}} \beta_t \times \gamma_t + \epsilon_{bt},$$

where y_{bt} is the natural logarithm of either a bank b's deposits (total, interbank, demand, and time deposits) or bank b's assets (liquid assets net of interbank claims by quality, interbank claims, and credit). We weight each observation by bank size and normalize the set of time-varying coefficients $\{\beta_t\}$ to April 1931. Figure A.6 and Figure A.7 show the estimates with confidence bands.

contracting (blue shaded area) but contract much more slowly than the securities portfolio during the bank run itself.

To obtain the dynamics for more detailed categories of assets and liabilities, we estimate the following model:

$$y_{bt} = \gamma_b + \sum_{t \neq \text{April 1931}} \beta_t \times \gamma_t + \epsilon_{bt}, \tag{1}$$

where y_{bt} is the natural logarithm of either bank b's deposits (total, interbank, demand, and time deposits) or bank b's assets (high- and low-quality liquid assets, interbank claims, and loans and mortgages). Further, γ_b is a set of bank fixed effects to ensure a within-bank-across-time comparison. Finally, we normalize the set of time-varying coefficients $\{\beta_t\}$ to April 1931.

Figure 2 shows results for the dynamics of deposits in Panel (a) and assets in Panel (b). In line with the dynamics of aggregate deposits, initially only interbank deposits contract. We estimate that interbank lending falls on average by around 10% in May. The interbank market continues to collapse throughout the run and on average, interbank deposits decline by more than 30% by July. Further, the effect is also statistically significant in every month after April 1931; see Figure A.6 and Figure A.7 in the Appendix for point estimates with confidence bands.

In contrast to interbank deposits, regular deposits are stable throughout May. However, regular deposits start to contract in June, when they fall around 10% and by July they have contracted by more than 15%, with the effect again being statistically significant. Thus, while the run starts out as a run of banks on banks in May, it turns into a broader run that includes withdrawals by other depositors in June and July. Given that interbank deposits are a relatively small share of overall deposits, there is no decline in total deposits throughout May. However, given the relative importance of regular deposits for total deposits, total deposits also start to contract together with regular deposits in June and July. We estimate that the average bank loses around 15% of its deposits by the end of June and 20% by the end of July after the breakdown of the banking system and the start of the banking holiday.

As discussed above, our data allow us to distinguish between standard demand deposits with a maturity of less than 7 days and time deposits with a maturity between 7 days and more. Note though that time deposits could also be withdrawn at any time, although this would be subject to a penalty.

In Panel (a) of Figure 2 we estimate that on average, demand deposits are stable in the first two months of the run and actually increase in the last months. Hence, the drop in overall deposits is entirely driven by an outflow in time deposits which decline by around 55% by July. The fact that demand deposits do not fall throughout the run is a striking finding as all deposits including demand deposits are uninsured. The finding is thus seemingly incongruent with standard bank run theories, which predict that uninsured debt claims with the shortest maturity are most likely to be withdrawn first in a crisis.

While demand deposits were most commonly held by retail depositors such as households, time deposits were more akin to modern-day wholesale funding as they carried considerably larger interest payments and tended to be held by corporations and wealthy investors. Hence, the stability of demand deposits can be rationalized by the fact that the latter type of depositor is arguably more sophisticated and more attentive.[23] Retail depositors started to withdraw across the board only when the "*Danatbank*" declared bankruptcy, marking the third and final phase of the run (Born, 1967).[24] However, the attempted withdrawals were immediately stopped by the bank holiday and thus not reflected in the data. The fact that retail depositors do not withdraw until the end of the Reichsbank liquidity support and the failure of the Danatbank is in line with investors neglecting crash risk (Gennaioli et al., 2013, 2015) or having

[23]A complementary explanation would be that households may have less attractive outside options for having access to payment services and are thus more likely to stay in the banking system than wholesale investors.

[24]A similar pattern of low responsiveness of demand depositors is also evidenced by Ramirez and Zandbergen (2014) for the Panic of 1893.

higher information acquisition costs and thus only paying attention in later stages of the run (He and Manela, 2016). The finding is also reminiscent of the difference in the behavior of retail and institutional investors in money market funds after the Lehman failure, when retail investor were much less likely to react to the shock (see Schmidt et al., 2016). Further, that depositors start a physical bank run once they learn that the Danatbank is no opening its branches suggests that they then revise their expectations massively in the light of this salient event (Gennaioli and Shleifer, 2018).

The pattern of increasing rather than decreasing demand deposits can also be rationalized by maturity shortening in time deposits (Brunnermeier and Oehmke, 2013) in which worried depositors—to the extent that they are not leaving the banking system—convert time deposits into demand deposits. Figure A.8 in the Appendix indeed shows that demand deposits, are in aggregate increasing slightly during the crisis, suggesting that some time deposits are being converted to shorter maturity demand deposits.

Mirroring the outflows in deposits, Panel (b) of Figure 2 provides information on the dynamics of bank assets during the run. In line with the evidence in Figure 1, interbank claims decline throughout the run. Further, we find that high-quality liquid assets are stable throughout most of the run and only start to fall slightly in July. This pattern arguably reflects that banks are anticipating a higher value of high quality liquidity in later stages of the run and prefer to deplete their low quality liquid assets first (Diamond and Rajan, 2011). As the withdrawal of regular deposits sets in in June, banks reduce their holdings of lower-quality liquid assets such as bills of exchange. They do so by discounting the claims at the Reichsbank's discount window in return for currency, which is then used to serve withdrawing depositors. As noted above, see Appendix A.3 for more details on the behavior of the Reichsbank. We estimate that by the end of July, banks have reduced their holdings of low-quality liquid assets by around 75% compared to April, mirroring the outflow of time deposits. In contrast, banks' illiquid assets contract much more slowly and by only around 10% from April through July.

5 Deposit Flows in Ex-Post Failing and Surviving Banks

We now turn to our main analysis and ask which depositors are withdrawing from failing banks. Our empirical strategy exploits that fact that we can observe the ex-post outcomes as to which banks fail throughout or in the aftermath of the crisis and which banks survive the crisis. While we have balance sheet information for around 123 unique banks during the main phases of the crisis in 1931, 15 of these banks (around 12%) fail at some point during or in the aftermath of the run; see Table A.2 in the Appendix.[25]

Explaining Bank Failures We start out by analyzing whether there are differences in observable characteristics between failing and surviving banks. This is important as it allows us to establish that there are no obvious publicly observable differences between ex-post failing and surviving banks. We ask whether the failure of banks can be predicted by using the ex-ante publicly available balance sheet data. We estimate the following model using both OLS and Probit

$$\Pr[\text{Failed}] = \gamma_\theta + \beta \times X_b + \epsilon_b, \tag{2}$$

where γ_θ is a set of bank-type fixed effects and X_b is a set of bank characteristics determined before the run starts in May 1931. To proxy for a bank's (il)liquidity, we calculate the ratio of liquid assets over total deposits. To proxy the distance to default, we calculate the ratio of the sum of illiquid assets over a bank's equity. Given the prominent role of the interbank market, we also control for the reliance on interbank funding measured by the share of interbank deposits over total assets. Further, we control for bank size by calculating the natural logarithm of a bank's total assets and a dummy that is 1 if we have evidence that a bank has relied on deposits denominated in foreign currency at any time before the run.

Results from estimating Equation (2) are reported in Table 2. There are two main insights. First, there is a statistically significant relationship between bank failure and a bank's liquidity position. Banks with more available liquid assets relative to total deposits in spring 1931 are less likely to fail during or in the aftermath of the run. The effect is intuitive as banks with more liquid assets are less likely to become illiquid during the run and have arguably an easier time in serving withdrawing depositors. However, the effect is relatively small. For instance, a 10 percentage point increase in the ratio of liquid assets to deposits decreases the chance of failure by around 2-4 percentage points. Furthermore, no other observable characteristics predict bank failures. For instance, failing banks are not systematically more exposed to foreign-currency-denominated deposits or those that rely more on interbank funding.

Second, the overall ability to explain the cross-sectional variation in bank failures by publicly available information on bank balance sheets is limited as the R^2 is very low at just 6.1%. Taken together,

[25] For our main analysis, we focus only on failed banks. I.e., these banks' equity was entirely wiped out at some point during or after the run. In robustness checks in Table A.6 in the Appendix, we show that our results are robust to using the more general definition of 'bank distress', where we also define banks as distressed when they did not fail but when they received government aid or were subject to a distressed merger, both also signs of a bank's weakness.

Table 2: ***Explaining the Cross-section of Failure.***

Dependent variable	Failed			
Estimation	OLS		Probit	
	(1)	(2)	(3)	(4)
Leverage	-0.00	-0.01	-0.02	-0.04
	(0.01)	(0.01)	(0.03)	(0.08)
Liquidity	-0.24**	-0.18*	-0.43**	-0.32*
	(0.12)	(0.10)	(0.20)	(0.19)
Size	-0.02*	-0.02	-0.02	-0.02
	(0.01)	(0.02)	(0.01)	(0.02)
Foreign Funding	0.08	-0.00	0.13	0.04
	(0.08)	(0.08)	(0.09)	(0.11)
Interbank	0.08	0.25	0.08	0.32
	(0.12)	(0.21)	(0.15)	(0.23)
Mean	0.12	0.12	0.12	0.14
Number of Banks	125	125	125	108
Bank Type FE	No	Yes	No	Yes
R^2	.06	.077		

This table reports results from estimating

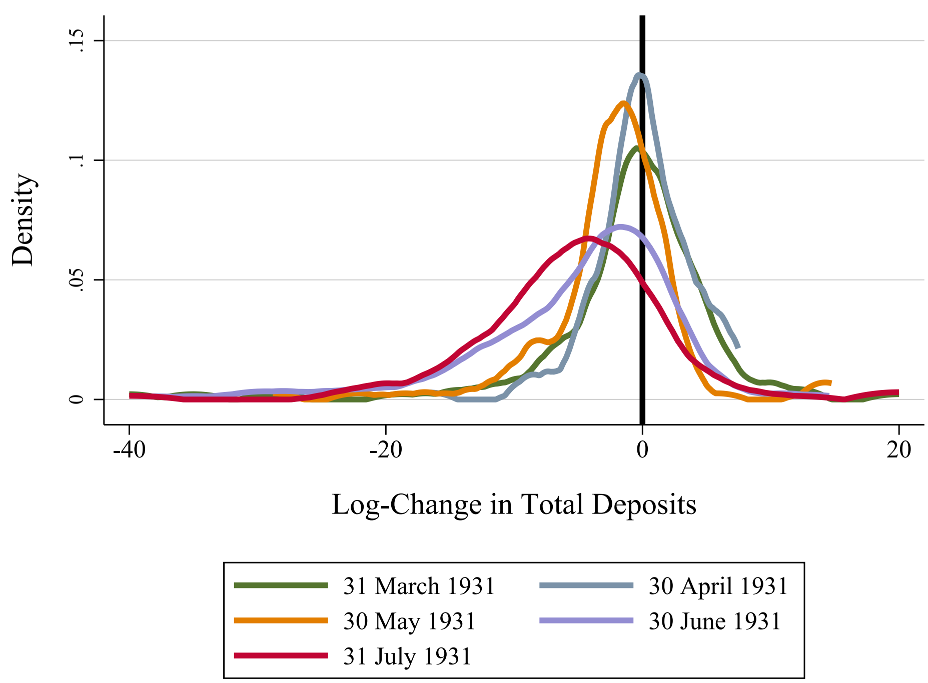
$$\begin{aligned}\text{Failed}_b = &+ \beta_1 \times \text{Equity}_b + \beta_2 \times \text{Liquidity}_b \\ &+ \beta_3 \times \text{Size}_b + \beta_4 \times \text{Foreign Deposits}_b + \gamma_\theta + \epsilon_b,\end{aligned}$$

where Failed_b is dummy variable indicating whether the respective bank becomes distressed between June 1931 and August 1932. The model is estimated using the cross-section of banks for which we have data in March 1931. Robust standard errors are clustered at the bank level in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

the findings suggest that there is no striking pattern before the run that would allow depositors to easily recognize banks that will fail from using data publicly available to depositors at the time.

The Cross-section of Deposit Flows Next to the large number of bank failures, there is also substantial cross-sectional variation in deposit flows during the run. Figure 3 plots monthly deposit growth from March through July 1931. Just before the crisis starts, the distribution of monthly bank-level deposit growth is centered around zero, with some banks receiving deposit inflows and some being subject to outflows. The interbank market then re-allocates deposits from banks with inflow to those with outflows, and the banking system as a whole does not lose deposits, indicating successful risk-sharing (Allen and Gale, 2000). However, as the crisis starts, the average deposit growth rate turns negative. Notably, between May and July, some banks lose more than 20% of their entire deposit base per month. However, other banks continue to receive sizable deposit inflows.

Figure 3: ***The Cross-section of Deposit Flows through Spring/Summer 1931***



Notes: Density of monthly bank-level log change in overall deposits from March 1931 to July 1931.

Who Withdraws From Failing Banks? Combining the cross-sectional variation in both failures and deposit flows, we next ask: do failing banks lose more deposits than surviving banks? The question is best answered by estimating a model of the following form

$$\ln y_{b\text{July }31} - \ln y_{b\text{April }31} = \gamma_\theta + \beta_1 \times \text{Failed}_b + \beta_2 \times X_b + \epsilon_b, \tag{3}$$

where $\ln y_{b\text{July }31} - \ln y_{b\text{April }31}$ captures the growth in deposits y_b between the end of April and the end of July, i.e., from just before the failure of the Creditanstalt to just after the collapse of the entire banking system and the start of the bank holiday. As indicated above, for y_b we can use interbank and regular, time and demand, as well as total deposits. Also, as above, γ_θ is a set of bank-type fixed effects that ensures a within-bank-type comparison. Failed_b is a dummy if bank b failed sometime during or after the run and our coefficient of interest is β_1, which measures the difference in deposit growth throughout the run between failed and surviving banks. We drop a bank from the sample once it has failed.[26]

We also include a set of observable bank characteristics X_b as defined above and address various concerns that way. For instance, we can control for how much liquid assets a bank has relative to its deposit funding at the start of the run. This addresses a concern that depositors are more likely to withdraw at banks that appear more likely to become illiquid throughout the run. Or, we can control for whether a bank relies on foreign-denominated deposits and thus address the concern that bank failures may primarily be a by-product of the run on the currency.[27]

An important caveat is that we do not observe the ultimate cause of bank failures. Hence, we cannot identify whether withdrawal motives are based on the *prospect* of default or whether they are the *cause* of default. Said differently, failure could be the consequence of deposit flows and the interpretation of β_1 is not causal. However, to the extent that there is variation across different types of deposits, we are nonetheless able to identify heterogeneity in depositor information. Variation in the contraction of deposit flows (or the lack thereof) across failing and surviving banks allows to understand whether depositors can tell which banks will fail or not. In particular, variation across different types of deposits can give a sense whether some depositors are better at anticipating which banks will fail or not. Thus, our research objective allows us to remain agnostic about the causes of failures. For instance, we cannot tell whether a bank would have failed even in absence of withdrawals (fundamental failure) or due to

[26] Hence, we drop all three banks that fail in either June or July 1931, see Table A.2 in the Appendix. We do so to rule out that our findings are driven by changes in a bank's balance sheets that happen after the bank's failure. However, note that our findings remain are unchanged when including the balance sheets of these banks that declare failure during the run. This is unsurprising as two of those failures, the "Danatbank" and the "Landesbank der Rheinprovinz" happened right before the bank holiday, effectively freezing the balance sheets.

[27] We discuss this concern also in more detail at the end of this section

the withdrawals (panic-based failure).[28]

Table 3 shows our results. There is no statistically significant difference in the growth of regular deposits between failing and non-failing banks throughout the run; see columns (1) and (2). The point estimates suggest that if at all, regular deposits grow at a slightly higher rate at failing banks. The confidence bands suggest that total deposit funding at most falls by 6 percentage points more at failing banks than at surviving banks. However, the confidence bands also allow for the possibility that deposits fall by 10 percentage point less for failing banks. This finding is striking in light of the fact that in Figure 2 we estimate that regular deposits fall by around 20% from April through July. While deposits are falling substantially there is no statistically significant difference between failing and surviving banks. Hence, regular depositors either don't withdraw at all, or to the extent that they do withdraw, they do not discriminate between weak and strong banks.

In contrast to regular deposits, there is a substantial difference in the growth of domestic interbank deposits between failing and surviving banks. Interbank deposits fall by around 60 percentage points more at failing banks than at surviving banks; see columns (3) and (4). The magnitude is remarkable since we estimated in Figure 2 that banks on average lose around 30% of their interbank funding. This implies that while surviving banks see essentially no changes in their domestic interbank deposits from April through July, those banks that end up failing lose approximately 60%. Thus, failing banks, while not losing more regular deposits throughout the run, effectively lose access to the interbank market.

This striking result on the difference between regular and interbank deposits can also be visualized by considering the density of the log-growth in regular and interbank deposits from April through July while splitting the sample into failing and surviving banks; see Figure 4. Panel (a) plots distribution of growth in regular deposits and reveals that—while deposits decline on average for both types of banks—there is no obvious difference in the flow of regular deposits across failing and surviving banks. As before, most banks are subject to net outflows in deposits throughout the run. However, there are both failing and surviving banks that receive deposit inflows.

Panel (b) plots the distribution of growth in interbank deposits and reveals a striking difference between failing and surviving banks. On average, there is almost no contraction in interbank deposits for surviving banks and there are many surviving banks that see their interbank liabilities grow throughout the run. In contrast, there are almost no failing banks that increase their interbank borrowing and most

[28] Our approach also allows for the possibility that some banks do not fail for some other reason such as political connectedness and anticipated government support. We are only interested in whether some depositors have more information about whether a bank will survive or not, abstracting from why it will fail or survive.

Table 3: ***Deposit Flows from April 1931 though July 1931 for Failed Banks .***

Dep. variable	Regular		Interbank		Demand		Time		Total	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Failed	3.1	2.3	-59.6**	-60.4**	5.0	13.0	-12.0	-16.6**	2.9	2.1
	(4.7)	(4.7)	(23.7)	(23.8)	(13.7)	(12.9)	(8.3)	(8.0)	(3.8)	(3.8)
Leverage		0.5		-1.2		-6.4*		1.0		-0.9
		(1.3)		(6.7)		(3.7)		(2.3)		(1.1)
Liquidity		-18.9**		-41.2		85.1***		-42.7***		-10.1
		(8.3)		(42.1)		(22.8)		(14.1)		(6.7)
Size		0.8		7.0*		4.1*		-1.8		0.6
		(0.8)		(4.1)		(2.2)		(1.4)		(0.6)
Foreign Funding		-0.6		-52.2**		-8.1		-4.5		-6.9*
		(5.1)		(26.0)		(14.1)		(8.7)		(4.1)
Number of Banks	119	119	119	119	119	119	119	119	119	119
Bank Type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.0038	.053	.053	.098	.0012	.17	.018	.15	.005	.065

This table reports results from estimating

$$\ln y_{b\text{July 31}} - \ln y_{b\text{April 31}} = \gamma_\theta + \beta_1 \times \text{Failed}_b + \beta_2 \times X_b + \epsilon_b,$$

The model is estimated using the cross-section of banks for which we have data in March 1931. Robust standard errors are clustered at the bank level and shown in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

density is to the far left, indicating that failing banks lose access to the interbank market.

Interbank deposits, however, are a relatively small part of overall deposit funding. Thus, their higher outflows at failing banks do not translate into a statistically significant difference and the above findings imply that there is no net difference in the outflow of total deposits—the sum of regular and interbank deposits—between failing and surviving banks; see column (5) of Table 3. Further, regular deposits if at all increase at failing banks, possibly because failing banks offer higher rates on regular deposits for raising funds to make up for the lost interbank funding (Egan et al., 2017).[29]

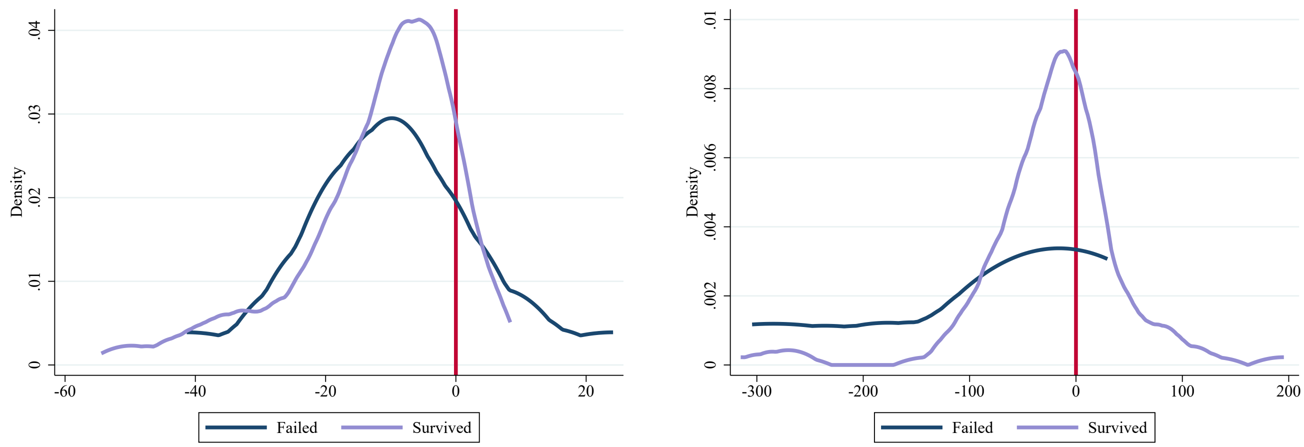
Dynamics Next we analyze the dynamics of deposit flows for failed and surviving banks in more detail. Here, we estimate a model of the following type:

$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{s \neq \text{April 31}} \beta_s \times \mathbb{I}[s=t] \times \text{Failed} + \sum_{s \neq \text{April 31}} \mu_s \times \mathbb{I}[s=t] \times X_b + \epsilon_{bt}. \tag{4}$$

[29]We cannot observe the deposit rates offered by banks. However, our findings are in line with failing banks increasing rates on regular deposits at the margin to make up for the lost interbank funding. Acharya and Mora (2015) discuss a similar mechanism in which banks with higher liquidity shortfalls during the GFC attempted to attract funding by offering higher rates.

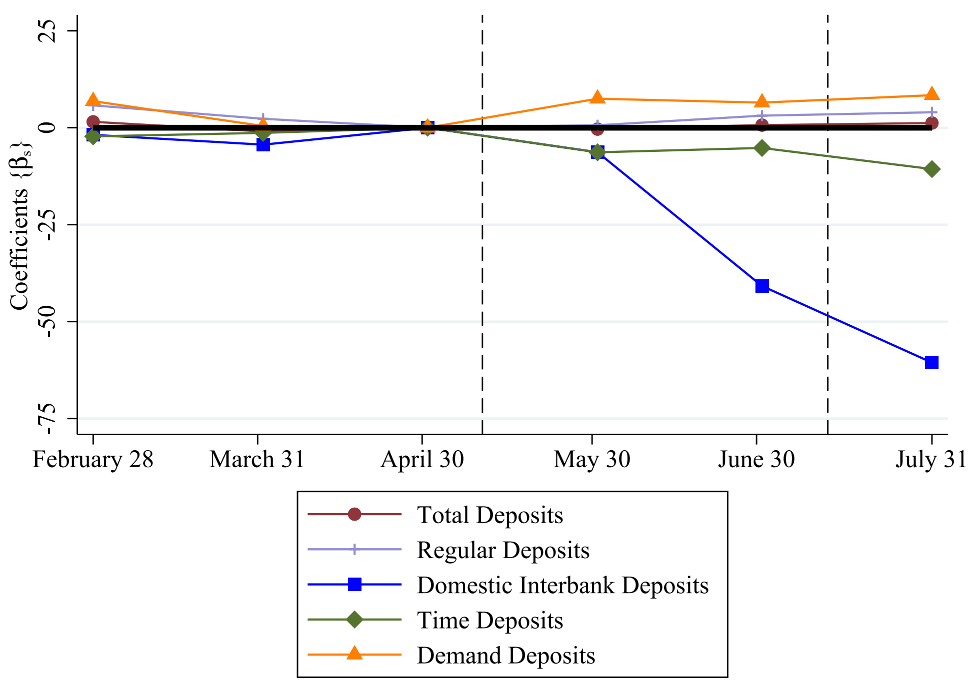
Figure 4: ***Deposit Growth from April 1931 through July 1931 for Failing and Surviving Banks.***

(a) *Regular Deposits* **(b)** *Interbank Deposits*



Notes: This figure plots the kernel density for the log-change in total deposits (Panel (a)) and interbank deposits (Panel (b)) from April 1931 through July 1931, splitting the sample into banks that failed and those that survived.

Figure 5: ***Deposit Dynamics for Failed Banks.***



Notes: The figure displays the sequence of coefficients $\{\beta_s\}$ that results from estimating the model:

$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{s \neq \text{April 31}} \beta_s \times \mathbb{I}[s = t] \times \text{Failed} + \sum_{s \neq \text{April 31}} \mu_s \times \mathbb{I}[s = t] \times X_b + \epsilon_{bt}.$$

Figure A.10 in the Appendix shows the estimates with confidence bands.

where y_{bt} is bank b's deposits in RM at month t. As in Equation (1), γ_b represents bank fixed effect. Further, $\gamma_{\theta t}$ denotes bank-type-time fixed effects to control for differences across the different types of banks. We are now interested in the sequence of coefficients $\{\beta_s\}$ that given us the relative change in deposits for failed banks over surviving banks at time $s \in \{\text{February 1931}, ..., \text{July 1931}\}$. This allows us to study to what extent deposit flows are similar before the crisis and at what time relative differences start to occur. Note that we also include our control variables X_b and allow the relationship of deposit flows and controls to change over time. As above, we drop a bank once it has failed.[30]

Figure 5 shows our findings for regular, interbank, time, demand, and total deposits. First off, there are no differences in deposit flows across failing and surviving banks before the run starts after the failure of the Creditanstalt in May. Further, in line with our results from estimating Equation (3), we find virtually no difference in the change in regular deposits across failing and surviving banks throughout the run. However, interbank deposits start to change relatively more rapidly for failing banks starting in May 1931. While the initial difference may seem relatively small, recall that in Figure 2 the difference widens as the run becomes broader in June. In June, failing banks report 40% less interbank deposits relative to surviving banks, and by July, the difference has grown to 60%. Figure A.10 in the Appendix also shows the same estimates with confidence bands and indicates that the estimates start to be precise by June.

Are Banks Better Informed or Do Interbank Deposit Outflows Cause Failure? Our preferred interpretation of the above findings is that banks are better informed than regular depositors: banks are able to discriminate between banks that end up failing and those that end up surviving and hence they withdraw from the former to protect themselves against potential losses. Regular depositors, in contrast, are uninformed and to the extent that they withdraw they hence do not distinguish between failing and surviving banks. However, this interpretation requires that interbank flows are not themselves the immediate cause of bank failure.

The concern that interbank deposit outflows are the cause of failure is in part alleviated by the fact that failing banks do not lose more total funding. Failing and surviving banks lose about the same percent of deposits despite the much higher interbank deposit outflows at failing banks since interbank funding is a relatively small share of total funding. Further, as described above, if at all, failing banks are replacing interbank funding with arguably cheaper regular deposit funding. Hence, the decline in

[30] Hence, we drop one bank in June and two banks in July from the sample, see Table A.2.

interbank funding alone is unlikely to be the immediate cause of the failures. This finding is reminiscent of the evidence by Perignon et al. (2018) who find that informed investors tend to withdraw but not cause the lower performance of weak banks when studying wholesale funding dry-ups during the European Debt Crisis.

To further address the above concern, we also provide additional evidence and show that our results are robust to excluding banks that are more reliant on interbank funding. Figure A.9 in the Appendix shows that the distribution of total and interbank deposits to total assets is relatively similar for both ex-post failing and surviving banks. While the typical bank finances between 60% and 90% of its assets with deposits, most banks finance less than 10% of their assets by using interbank funding. Further, there is no ex-ante difference between failing and surviving banks, echoing the findings presented in Table 2. If at all, failing banks are somewhat less reliant on interbank funding prior to the run. This is re-assuring, as it would be concerning if failing banks had more reliance on interbank funding to begin with.

However, Figure A.9 also shows that there are a few banks that are financing a substantial portion of their overall investments via interbank market funding. This raises the concern that those banks, which fail and are relatively more reliant on interbank funding, are also those banks that are driving our main findings. Hence, a natural additional test is to exclude these banks from our sample when estimating Equation (3). That is, we can test whether our results are robust when using only banks that have relatively little reliance on interbank funding. For such a sub-sample, it is less plausible for interbank deposit outflows to be the immediate cause of the failure as they are a small share of overall funding to begin with. We thus estimate Equation (3) to study the growth of regular, interbank, and total deposit funding throughout the run when restricting the sample to banks that either fund less than 15%, 10% or 5% of their assets with interbank deposits.

The results can be found in Table 4 and confirm our main findings: regular and total deposits fall by about the same for both failing and surviving banks. In contrast, the difference in interbank deposits remains statistically significant. For instance, we find that for the sample of banks with less than 10% of interbank funding prior to the run, interbank funding falls by around 50% on average—slightly higher than the 30% in the main sample—and the difference between failing and surviving banks is around 96 percentage points (see column (4)). In contrast, there is no difference in the decline in regular or total deposit funding (see columns (1) and (7)). Hence, we are able to confirm the differences in the decline of different types of deposits for failing and surviving banks in a sample in which the outflow of interbank

Table 4: ***Deposit Flows from April 1931 though July 1931 for Failed Banks by Reliance on Interbank Market Funding.***

Dep. variable	Regular			Interbank			Total		
Interbank share (in %)	< 10%	< 7.5%	< 5%	< 10%	< 7.5%	< 5%	< 10%	< 7.5%	< 5%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Failed	-1.8	-0.9	1.2	-96.3**	-114.6**	-138.1**	-1.2	-0.3	0.9
	(3.3)	(3.4)	(2.8)	(44.9)	(49.8)	(52.3)	(3.2)	(3.2)	(3.3)
Number of Banks	74	63	45	74	63	45	74	63	45
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.18	.15	.19	.13	.18	.24	.12	.052	.035

This table reports results from estimating

$$\ln y_{b\text{July 31}} - \ln y_{b\text{April 31}} = \gamma_\theta + \beta_1 \times \text{Failed}_b + \beta_2 \times X_b + \epsilon_b,$$

The model is estimated using the cross-section of banks for which we have data in March 1931. Robust standard errors are clustered at the bank level and shown in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

deposits is unlikely to be able to trigger a bank's illiquidty and insolvency.

An additional and related concern is that specific types of banks, those banks that are more active in the interbank market such as the Girozentralen, Landesbanken, and Berlin banks, are driving our main results. Hence, as another robustness check, we exclude these types of banks from our main sample. In Table A.4 in the Appendix we estimate Equation (3) and show that failing regional banks do not experience higher outflows in regular deposits but get excluded from the interbank market.

Information versus Opportunity Cost We can neither directly observe differences in information sets nor opportunity costs across different types of depositors. Hence, another potential concern stems from potentially unobservable differences in opportunity costs. Specifically, it may be more costly for a retail depositor to withdraw from a bank and invest funds someplace else than for bank. Hence, differences in opportunity costs may be affecting the observed outcomes and hence our interpretation of the findings. Note, however, that opportunity costs can only explain variation in the responsiveness of different types of depositors across time but not across failing and surviving banks. A depositor with relatively higher opportunity costs will plausibly withdraw later in the run (as distress becomes more severe). However, differences in opportunity cost cannot explain the fact that regular depositors do not distinguish between failing and surviving banks, as documented in Table 3. Thus, the fact that interbank deposits essentially collapse for failing banks but regular deposits do not can be explained by differences in information about prospective bank failure but not by differences in opportunity costs.

Interbank Market Next we study the interbank market in more detail and whether there is reallocation within the interbank market. We ask: do banks that reduce exposure to distressed banks re-deposit within the interbank market or do they hoard cash and other liquid assets as suggested in theories by Caballero and Krishnamurthy (2008); Allen et al. (2009)?

To measure the activity in the interbank market, we construct a measure of each bank's exposure to the interbank market as follows:

$$\text{Interbank Exposure}_{bt} = \text{Interbank Lending}_{bt} - \text{Interbank Borrowing}_{bt}$$

That is, we define the interbank exposure of a bank as the relative difference between interbank claims and interbank deposits. We can then study the correlation of change in the exposure with the change in regular deposits, both normalized by bank size.

In a normally functioning interbank market, one would expect that a bank with deposit inflows would lend out the received funds to those with deposit outflows and thus increase the interbank exposure. In contrast, a bank that is subject to deposit outflows would borrow through the interbank market and thus reduce its interbank exposure. See, e.g., Allen and Gale (2000) for a model of such interbank deposit flows in which the interbank market insures banks against bank-specific withdrawal shocks.

Figure 6 shows the relation of the month-to-month change in interbank exposure for failing and surviving banks for both the period before the run (Panel (a)) and during the run (Panel (b)). The positive correlation in Panel (a) confirms the theoretical notion of how interbank markets work and bank balance outflows by borrowing from banks with inflows. Indeed, before the run starts, both failing and surviving banks increase their interbank exposure in a month in which they receive deposit inflows and decrease their interbank exposure in a month in which they are subject to deposit outflows. Hence, the interbank market works and reallocates the funds effectively.

Panel (b), however, reveals a striking difference between failing and surviving banks during the run. The correlation between the change in interbank exposure and the change in regular deposits goes from close to 1 to zero and loses its statistical significance. Even more striking, however, is the positive correlation between interbank exposure and deposits for surviving banks, which remains close to one. Hence, while failing banks get excluded from the interbank market, surviving banks subject to deposit outflows in a given month continue to be able to borrow from those banks with deposit inflows. Said differently, banks with inflows of regular deposits during the run do not hoard the funds they receive but intermediate them to other surviving banks via the interbank market. This suggests that banks are not only very confident in there assessment which banks will fail, as discussed above, but also very confident in their assessment which banks will survive.

We also study the above relationship more formally and estimate the following model using data from 1930 through July 1931:

$$\begin{aligned}\Delta\text{Interbank Exposure}_{bt} =& \gamma_b + \gamma_{\theta t} + \beta_1 \times \Delta\text{Deposits/Assets}_{bt} \\ &+ \beta_2 \times \Delta\text{Deposits/Assets}_{bt} \times \text{Post}_t \\ &+ \beta_3 \times \Delta\text{Deposits/Assets}_{bt} \times \text{Failed}_b \times \text{Post}_t \\ &+ \beta_4 \times \Delta\text{Deposits/Assets}_{bt} \times \text{Failed}_b + \beta_5 \times \text{Failed}_b \times \text{Post}_t + \epsilon_{bt}.\end{aligned}$$

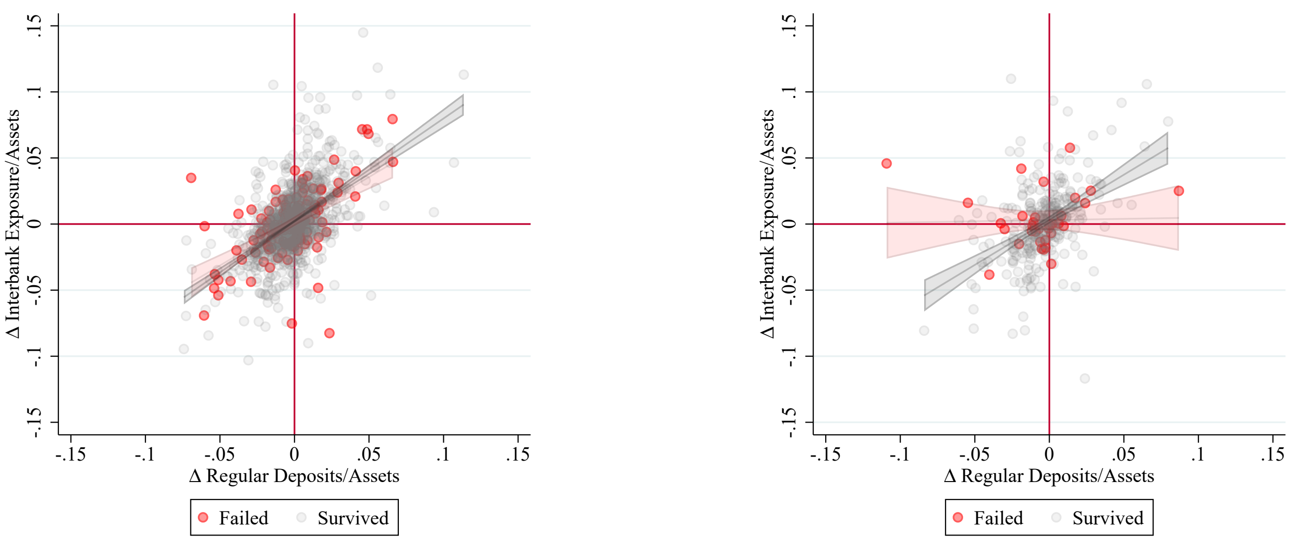
Here, there are three coefficients of interest. β_1 is the average correlation between the change in interbank exposure and deposit flows. In a functioning interbank market, this coefficient should be close to one. β_2 is the relative difference in the relationship between changes in interbank exposure and deposit flows for all banks. If the interbank collapses for all banks, it should be a negative number close to -1. Further, β_3 is the relative change in the relationship between changes in interbank exposure and deposit flows during the run for failing banks alone.

Results can be found in Table 5. First, note that β_1 is indeed close to one, confirming the notion that in normal times, banks with deposit inflows increase their interbank exposure and banks with deposit outflows decrease it. β_2 is also statistically significant and negative in some specification. Thus, the overall intermediation is less during the run than before the run. However, the slope remains positive and relatively close to one and the interbank market as a whole does not collapse but functions under distress. Finally, note that β_3 indicates that the correlation is largely reduced for failing banks during the run, echoing the findings in Figure 6. I.e., the interbank market collapses mostly for failing banks.

Our evidence here stands in contrast to theories of liquidity hoarding by banks in times of distress (Allen et al., 2009; Caballero and Krishnamurthy, 2008) and complements the findings of Afonso et al. (2011) who show that the interbank market in the U.S. became more risk-sensitive during the GFC but continued to function. We show that the latter is the case for surviving banks but not for failing banks for whom the interbank market collapses. Our findings emphasize that banks very precisely identify which banks are weak and likely to fail during the run and their actions indicate their confidence in

Figure 6: ***Deposit Growth and Interbank Exposure.***

(a) *January 1930 through April 1931.* **(b)** *May 1931 through July 1931.*



Notes: The figures correlate banks' change in regular deposit funding (excluding interbank deposits) normalized by total assets and banks' interbank exposure defined as:

$$\Delta \text{Interbank Exposure} = \Delta[\text{Interbank Lending} - \text{Interbank Borrowing}].$$

knowing which banks will survive.

Discussion Altogether, our findings thus suggest that banks have the most information about the state of the banking system and are in effect the most sophisticated type of depositor. Banks seem to have very precise information about which of their competitors will likely fail in light of an aggregate shock. The pattern that emerges from the data is very close to the mechanism suggested by Calomiris and Kahn (1991) in which the most informed depositors are rewarded for being informed since they can withdraw from failing banks before uninformed depositors do.

What information do banks have that regular depositors do not have? Unfortunately, we cannot identify *what* exact information banks are acting on. Our findings allow for different possibilities: For instance banks can have information about a specific bank's solvency, or banks have information about which banks are more likely to fail when other depositors withdraw funds. In either case, however, banks can tell failing bank from surviving banks while regular depositors cannot.

Demand and Time Deposits in Failing and Surviving Banks Aside from the regular and interbank deposits, we can also distinguish between time and demand deposits. We find that failing banks are subject to relatively higher growth of demand deposits; see columns (5) and (6). However, the effect

Table 5: ***Deposit Flows from April 1931 through July 1931 for Failed Banks.***

Dependent variable	Δ Interbank Exposure			
	(1)	(2)	(3)	(4)
ΔDeposits/Assets	0.85***	0.84***	0.80***	0.93***
	(0.04)	(0.04)	(0.05)	(0.06)
ΔDeposits/Assets×Post	-0.18**	-0.12	-0.12	-0.26**
	(0.08)	(0.08)	(0.10)	(0.13)
ΔDeposits/Assets×Post×Failed	-0.54***	-0.60***	-0.60***	-0.79
	(0.18)	(0.18)	(0.19)	(0.69)
ΔDeposits/Assets×Failed	-0.15	-0.11	-0.07	-0.56
	(0.10)	(0.10)	(0.10)	(0.48)
Post×Failed	0.00	0.00	0.00	-0.02*
	(0.00)	(0.00)	(0.00)	(0.01)
Sample	All Banks	All Banks	Only Regionals	Excl. Regionals
N	1669	1669	1079	590
Number of Banks	128	128	84	44
Time FE	Yes	No	Yes	Yes
Bank Type Time FE	No	Yes	No	No
R^2	.35	.39	.34	.4

This table reports results from estimating

$$\Delta\text{Interbank Exposure}_{bt} = \gamma_b + \gamma_{\theta t} + \beta_1 \times \Delta\text{Deposits/Assets}_{bt} + \beta_2 \times \Delta\text{Deposits/Assets}_{bt} \times \text{Post}_t + \beta_3 \times \Delta\text{Deposits/Assets}_{bt} \times \text{Failed}_b \times \text{Post}_t$$
$$+ \beta_4 \times \Delta\text{Deposits/Assets}_{bt} \times \text{Failed}_b + \beta_5 \times \text{Failed}_b \times \text{Post}_t + \epsilon_{bt}.$$

The model is estimated using the cross-section of banks for which we have data in March 1931. Robust standard errors are clustered at the bank level and shown in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

is not statistically significant. This finding, albeit not intuitive at first glance, is in line with informed depositors taking a more cautious stance in the early phase of the run and shortening maturities (Brunnermeier and Oehmke, 2013) at banks that are likely to become distressed. In particular, note that the inflow of demand deposits is mirrored by an outflow in time deposits that could be withdrawn or converted into demand deposits for a fee. A higher outflow in time deposits in turn is more likely in failing banks, see columns (7) and (8). The finding is also in line with Martin et al. (2018)'s findings that inflows in part replace outflows of failing banks. Unfortunately, as described above, our data do not allow us to distinguish whether the maturity shortening take place within the interbank market or done via regular deposits.

Figure 5 confirms this pattern of maturity shortening throughout the different phases of the run: in May, failing banks see 10% more growth in demand deposits while they also see around 10% lower levels of time deposits. Further, note that the effect is initially statistically significant, as shown in Figure A.10 in the Appendix. Thus, depositors at failing banks take a more cautious stance early in the run and convert their time deposits into demand deposits.

Asset Dynamics in Failing and Surviving Banks We also study the difference in assets between failing and surviving banks. In Table A.5 in the Appendix, we report results from estimating Equation (3) when using the banks' liquid and illiquid assets as the dependent variable. Our findings reveal that failing banks are more likely to lose liquid assets than surviving banks but do not reduce their interbank lending more. Further, failing banks are less likely to reduce their holding of illiquid assets, in line with failing banks continuing to lend to their customers, indicating possible forbearance. However, this effect is statistically insignificant.[31]

Does the Stock Market Identify Failing Banks? A natural additional test is whether the stock market identifies failing banks. If stock price dynamics reflect the chance of bank failure, the findings that regular deposits are not able to distinguish between failing and surviving banks would of course be even more striking as stock prices are publicly observable and easily available via widely circulated newspapers. Similarly, it is of interest to look at the extent to which stock prices are following or leading the dynamics in the interbank market.

[31]In Figure A.11 in the Appendix, we also consider the dynamics of assets in failing banks relative to those in surviving banks. We find that while failing banks reduce their interbank lending relatively earlier on, they do not reduce their net interbank lending by more than surviving banks.

We first study the difference in stock price between failing and surviving banks across time. Note that the sample we can use here is much smaller than our original sample as we only have data for 32 banks in the *Monatskursblatt* and only five of these banks become distressed. Further, after the breakdown of the banking system on July 13, 1931, the stock exchange was closed and only re-opened in September 1931.

Figure 7 shows the results when estimating Equation (4) for daily stock market data. It reveals that failing and surviving banks' stock were following a quite similar trajectory before the run started. Note that at the first vertical lines, right at the failure of the Creditanstalt, stock prices for failing banks drop by around 5% compared to those that survive. This is an indication that stock market participants realize the importance of the event for the stability of German banks, especially for those banks that are weaker and ultimately fail. However, the difference in the level only turns statistically significant a few days later.

Interestingly, the stock prices for failing banks are already substantially lower (by around 10%) by June 6, when the German government announced the end of reparations. Thus, similarly to the aggregate interbank flows, stock prices start to fall for failing banks early on.

By July 13 when the banking system breaks down entirely and the stock market closes, banks that end up failing have lost around 25% more of their stock market value than those that survive the run. This findings emphasizes how striking our original finding on the behavior of regular depositors is. Regular depositors are seemingly unable or unwilling to incorporate the information contained in stock prices—which are, as mentioned above, publicly available via newspapers—into their withdrawal decision.

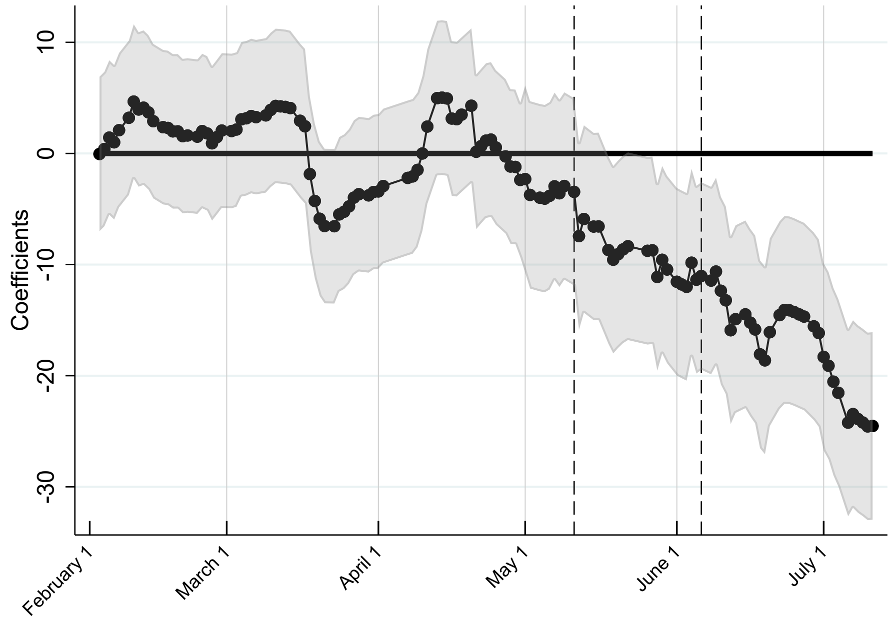
Next, we test whether interbank flows can be used to predict bank performance in the stock market. To this end, we estimate the following regression:

$$r_{b,t} = \alpha + \beta \times \Delta\text{Interbank}_{bt} + \epsilon_{b,t},$$

where $r_{b,t}$ is bank b's daily risk-adjusted stock market return and $\Delta\text{Interbank}_{bt}$ is the growth of bank b's interbank deposits over the past month. Here, we cluster our estimates at the bank level.

Table 6 reports results. We find no general relationship between past or contemporaneous interbank flows and stock prices, see column (1) in both Panel A and B. Further, studying the effect month by month, we find that outside of the run, interbank flows have no predictive power for stock market

Figure 7: *Stock Price Dynamics for Failed Banks.*



Notes: This figure plots the sequence of coefficients $\{\beta_s\}$ from estimating a regression of the form

$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{s \neq \text{April 31}} \beta_s \times \mathbb{I}[s = t] \times \text{Failed} + \sum_{s \neq \text{April 31}} \mu_s \times \mathbb{I}[s = t] \times X_b + \epsilon_{bt},$$

where y_{bt} is the stock price of bank b on day t. Robust standard errors are clustered at the bank level and 95% confidence intervals have been applied.

prices. For instance, interbank flows in March or April 1931 have no effect on stock price in April or May, respectively; see columns (2) and (3). However, we find that during the first phase of the month, May 1931, banks that lose less interbank funding have abnormally high stock market returns in June 1931, see column (4) in Panel A. However, the same is not true for contemporaneous interbank flows, see column (4) of Panel B. Thus, the interbank market seems to have more information about which banks may fail than than the stock market, especially early in the crisis. In the final month of the run, the stock market seems to have incorporated all information and there is again no relation between interbank flows and stock prices, see column (5).

The Role of Foreign-Currency-Denominated Deposits The literature on the German Crisis of 1931 has typically stressed the role of foreign-denominated deposits in the run (see, e.g., Ferguson and Temin, 2003; Schnabel, 2004). In this section, we analyze the deposit flow across banks with and without historical reliance on deposits denominated in foreign currency in more detail.

Importantly, the exposure to foreign deposits was not publicly available. Banks only reported their exposure infrequently in confidential filings with the Reichsbank. Figure A.17 in the Appendix shows

Table 6: ***Interbank Deposit Flows and Bank Stock Return***.

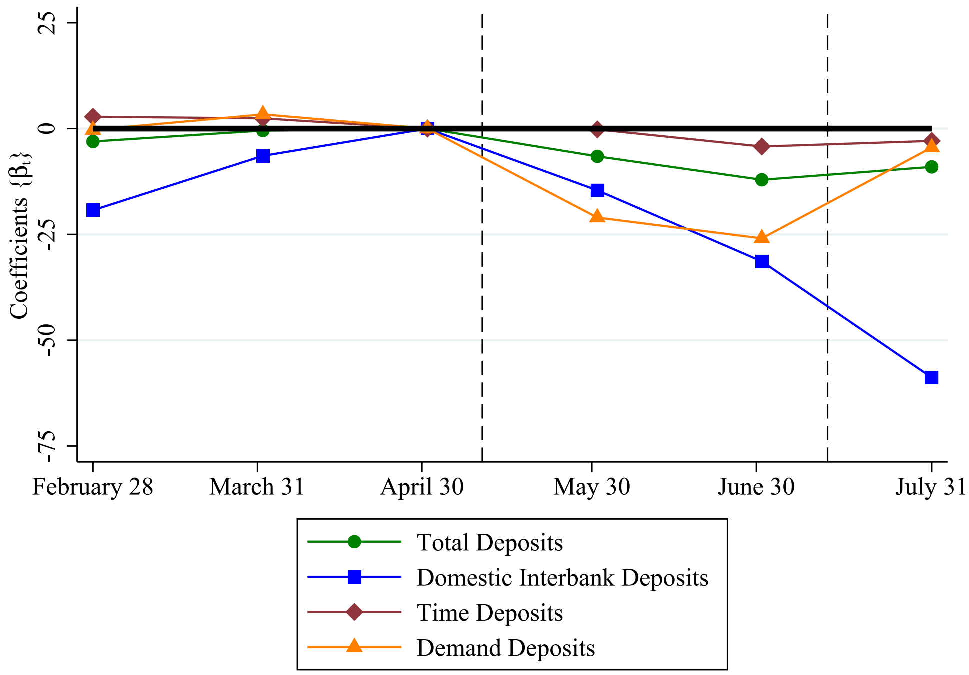
Dependent variable	Average risk-adjusted daily returns				
Sample period	April - July	April 1931	May 1931	June 1931	July 1931
	Panel A: Interbank Deposit Flows prior month				
	(1)	(2)	(3)	(4)	(5)
Prior Month Δ Interbank	-0.050	-0.133	-0.084	0.098**	-0.044
	(0.048)	(0.215)	(0.061)	(0.047)	(0.055)
N	1663	494	471	477	221
No of Banks	28	26	27	24	25
R^2	.0032	.011	.02	.005	.081
	Panel B: Interbank Deposit Flows current month				
	(1)	(2)	(3)	(4)	(5)
Prior Month Δ Interbank	-0.043	0.058	0.047	-0.031	-0.043
	(0.047)	(0.100)	(0.063)	(0.024)	(0.058)
N	1646	494	454	477	221
No of Banks	28	26	26	24	25
R^2	.0024	.011	.017	.0037	.082

Notes: This table reports results from estimating the following model:

$$r_{b,t} = \alpha + \beta \times \Delta \text{Interbank}_{b,t-1} + \epsilon_{b,t},$$

where $r_{b,t}$ is the average of bank b's daily risk-adjusted stock market return over a month. We calculate risk-adjusted return using a one-factor model. $\Delta\text{Interbank}_{t-1}$ is the growth in interbank funding of bank b in the previous or current month. We estimate the model both from April through July (column (1)) and month-by-month (columns (2) through (5)). Robust standard errors clustered at the bank level in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Figure 8: ***Deposit Dynamics for Banks with Foreign Deposits.***



Notes: The above figures display the sequence of coefficients $\{\beta_s\}$ that results from estimating the model:

$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{s \neq \text{April 31}} \beta_s \times \mathbb{I}[s = t] \times \text{Foreign} + \sum_{s \neq \text{April 31}} \mu_s \times \mathbb{I}[s = t] \times X_b + \epsilon_{bt}.$$

an example of one such filing. Of course, depositors could have had private information about which banks used foreign-currency-denominated deposits. We can thus ask: are domestic interbank deposits more likely to flow out of banks that rely on foreign deposit funding? If that were the case, to the extent that depositors with foreign currency denominated deposits had stronger incentives to withdraw, it would be another smoking gun indicating that banks are informed about which banks are more likely to be troubled during the run.

In columns (4) of Table 3, we learn that interbank deposits are indeed more likely to flow out of banks that rely on deposit funding. We find that banks with reliance on deposits denominated in a foreign currency see a 51% higher contraction in domestic interbank deposits. Column (10) suggests that these banks also lose around 7% more total deposit funding. Further note that Figure 8 confirms this pattern. Banks that rely on more foreign funding lose interbank funding over time. Note, however, that this is while controlling for whether a bank fails.

The above findings are further a reassuring robustness test as they reveal that all of our main findings hold when controlling for the exposure to foreign-currency-denominated deposits. They also support our main finding on the interbank market having private information on other banks' risks.

The exposure to foreign-denominated deposits was not publicly known, but our findings suggest that the interbank market is very well informed about which banks may be subject to withdrawals because they rely on foreign-currency-denominated deposits.

6 Concluding Remarks

In this paper, we exploit the unique historical incident of a run on the entire German banking system during the summer of 1931. Having granular balance-sheet data for commercial banks as well as the central bank, we provide a comprehensive empirical description of the dynamics of the run and establish which types of depositors are able to discriminate between failing and surviving banks in a bank run.

We find that all banks lose around 20% of their overall deposit funding before the height of the crisis and there is an equal outflow of retail and wholesale deposits from both ex-post failing and surviving banks. Regular depositors are thus unable to identify failing banks. In contrast, the interbank market precisely anticipates which banks will fail. The interbank market collapses for failing banks entirely but it continues to function for surviving banks, which can continue to borrow from other banks in response to deposit outflows (Afonso et al., 2011).

Given that both failing and surviving banks lose the same amount of deposits in the run, it is thus unlikely that the interbank market run causes bank failures (Perignon et al., 2018). However, we cannot tell what banks are informed about. Our findings allow for two possibilities: banks having information about a specific bank's solvency or banks having information about which banks are more likely to fail when other depositors withdraw from them.

Our paper contributes to the understanding of the role of short-term debt for financial intermediaries. Our findings highlight the different roles of short-term debt. We argue that some depositors are uninformed and hold short-term debt to obtain liquidity services (Gorton and Pennachi, 1990; Gorton, 2012; Dang et al., 2017), while others are informed and able to discipline banks (Calomiris and Kahn, 1991; Diamond and Rajan, 2000, 2001). Specifically, our evidence indicates that interbank depositors are most informed and they are rewarded for being informed since they are the first depositors that withdraw from failing banks, in line with the mechanism in Calomiris and Kahn (1991).

However, it is important to highlight that we are not testing the effectiveness of depositor discipline itself. This would require a different empirical setting in which deposit insurance is assigned quasi-randomly as in, e.g., Calomiris and Jaremski (2019). Our evidence is thus muted about whether or not depositors provide discipline in equilibrium. Yet, given that the provision of discipline requires information about a bank's fundamentals, our evidence implies that interbank depositors are better positioned to discipline other banks than regular depositors.

While one needs to be cautious when generalizing from historical experience,[32] we believe that the heterogeneity of depositors and their different roles have important policy implications. Concerns that deposit insurance that targets regular depositors to address coordination failures (Diamond and Dybvig, 1983) exacerbates moral hazard are somewhat alleviated: while depositors are less likely to run when their claims are covered by deposit insurance (Iyer and Puri, 2012; Iyer et al., 2016; Martin et al., 2018; Dávila and Goldstein, 2021), we find that they may not necessarily run in the absence of deposit insurance and to the extent that they do run, they seem unable to discriminate among banks by their likelihood of failure. In the case of the German Crisis of 1931, a deposit insurance scheme for retail deposit accounts would have plausibly only prevented withdrawals from those depositors that withdrew in later stages of the run and are unable to distinguish between weak and strong banks. Thus, it is unlikely that it would have undermined depositor discipline.

Further, the fact that precise information about which banks will fail exists among banks means that policy makers are in principle not only be able to anticipate the increased risk of crises (Greenwood et al., 2020). Once a crisis is underway, it is also possible to have a sense which institutions are most likely to fail by studying interbank flows. While interbank markets are typically considered to be valuable as they allow insuring banks against liquidity shocks (Allen and Gale, 2000), our evidence hence suggests that the existence of a functioning interbank market can also be valuable for its informational content. Central bank actions that make interbank markets redundant—such as an reserves regime—may thus be associated with the cost of losing valuable information.

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[32] Deposit insurance and other regulatory interventions affect the structure of the financial system in many ways and for instance lead to a coexistence of a regulated and unregulated parts of the financial system (Hanson et al., 2015) that complicate a direct comparison.

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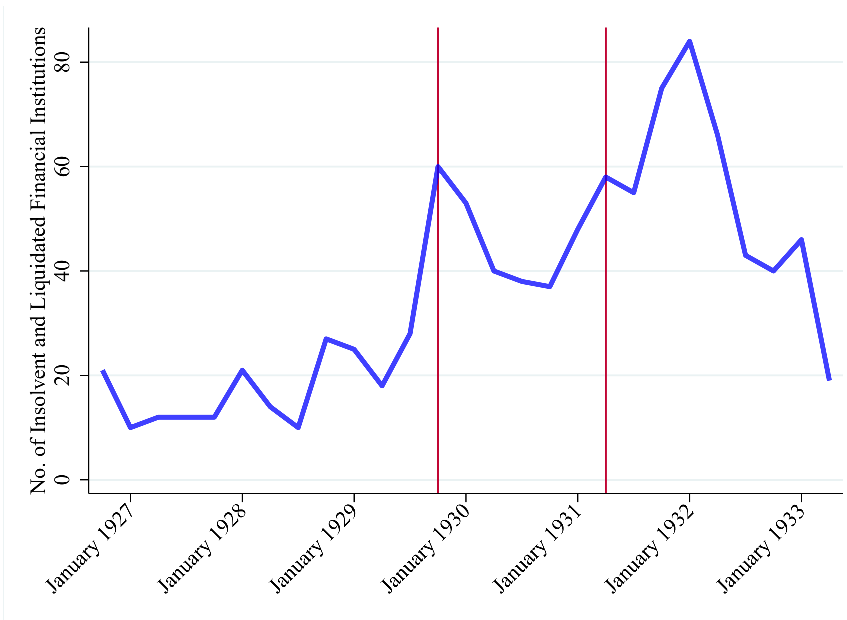
APPENDIX [FOR ONLINE PUBLICATION ONLY]

A.1 Bank Failures and Depositor Losses Prior to the Crisis of 1931

As mentioned in the main text, a key advantage in studying the German Crisis of 1931 is that the bank run took place in a banking system that had very little government interventions. Specifically, there was no capital or liquidity regulation and most importantly no deposit insurance. The German banking system was following a German tradition of "self-regulation" in which the only interventions came from the Reichsbank with its only real power stemming from the ability to refuse to act as a lender of last resort (James, 1984).

Given our research objective, it is important to establish that depositors— regular depositors and interbank depositors alike—had a reason to believe that they would realize losses on their deposits in case of a bank failure. We therefore first study the role of bank failures before the crisis in 1931. We find that failures of financial institutions were quite common in the five years before the crisis. Figure A.1 plots the quarterly number of defaults and liquidations of banks, brokers, and pawnshops. Note that our data source does not allow us to break out the different type of financial institutions. Between 1926 and 1929, on average around 20 institutions failed per quarter. Moreover, the number of distressed financial businesses increased after the stock market crash in October 1929 to more than 40 per quarter.

Figure A.1: ***Number of Insolvent and Voluntarily Liquidated Financial Institutions from 1926 through 1933.***



Notes: This figure depicts the number of institutions that fail in each quarter. It includes insolvent and voluntarily liquidated banks, pawnshops, and brokers. The data are hand-collected from various issues of the bi-monthly statistical bulletin "'Wirtschaft und Statistik'. Herausgegeben vom Statistischen Reichsamt."

Most of the institutions that failed were relatively small and no prominent or larger bank failed during this episode. It is thus difficult to find detailed systematic information on what happened to depositors' claims in default. However, we were able to identify an example of a failing bank for which detailed information is available: The "Kieler Bank" This bank was a regional bank based in Kiel in northern Germany with around 7.5 million RM in assets as of September 1929. We are also able to identify the causes of the failure as well as examine the liquidation process. According to Gold (1930), Kieler Bank's executives had used the bank's funds to speculate on the New York Stock Exchange. However, their investments were lost when the New York stock market crashed on October 24, 1929 ("Black Thursday"). As a consequence, the bank was forced into immediate insolvency.

The journal "Saling's Börsen-Jahrbuch für 1930/1931" reports that the bank's assets were liquidated and purchased by "Deutsche Bank", the largest German bank, after the default. Ultimately, all creditors with claims larger than 1,000 RM received 53 pfennig per RM invested in deposits. Further, small deposits of less than 1,000 RM received a slightly higher payout, with the exact recovery rate going unreported in the bankruptcy filings. Importantly, no depositor was able to access any funds between the bank's default on October 24 and the bank's liquidation on January 4, 1930, and subsequent takeover. Thus, even if recovery rates were higher for small deposits, depositors would face considerable uncertainty regarding if, when, and under which conditions some other bank would take over the failing bank.

There are also several other examples of bank failures in which all depositors lost their funds entirely. For instance, Gold (1930) also reports the case of the failure of the "Kieler Kredit A.G.", also based in Kiel, for which upon default all deposits were lost.

Altogether, studying bank failures from prior to the crisis of 1931 suggests that depositors would reasonably expect to realize losses in case of a bank failure. Depositors thus had strong incentives to withdraw if they expected a failure to avoid possible losses—a considerable difference compared to contemporary deposit insurance schemes (Martin et al., 2018). For instance, depositors with claims insured by the Federal Deposit Insurance Company (FDIC) immediately become depositors of the assuming bank and have access to their insured funds.

A possible concern is that depositors may only be subject to losses on their deposits in case of bank failures when the defaulting bank is small. Due to the lack of large bank failures, we cannot observe if depositors at larger banks would be bailed out, since large banks could be considered as "too big to fail." However, this concern should be somewhat alleviated by the fact that all of our main results hold when excluding large banks and when focusing only on the small regional banks. Further, it yields the testable implications whether depositors seek safety at larger banks in the bank run, which we confirm in our analysis is not the case.

A.2 The German Crisis of 1931

In this section, we provide a more detailed description of the events around the German Crisis of 1931 and historical background than in the main text. Classic references about the German Crisis of 1931 are Born (1967), James (1984) Balderston (1991, 1994), Ferguson and Temin (2003), and Schnabel (2004). Moreover, detailed accounts of the political economy around the crisis can be found in Galofré-Vilà et al. (2017) and Doerr et al. (2021).

The German Crisis of 1931 took place at the height of the Great Depression in Europe and Germany and was preceded by a phase of contraction in output and employment, deflation, and increased political uncertainty. Panel (a) of Figure A.2 shows that unemployment had been high throughout the second part of the 1920's, particularly after the stabilization in 1923/1924 following the hyperinflation and had started to increase again in 1929. Panel (b) indicates that Germany had pegged its exchange rate to the Pound Sterling which in turn was pegged to a fixed amount of gold (Gold Standard). However, at the height of the German Crisis of 1931, the Gold Standard was abandoned.

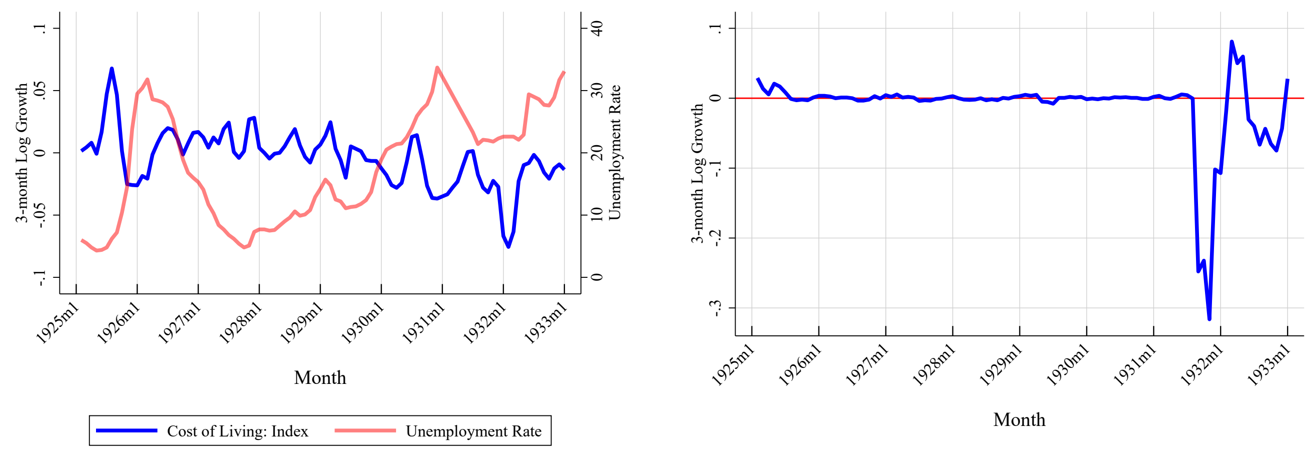
After the stabilization, the Dawes Plan of 1924 (which fixed the annuity on the reparations payments while leaving the overall reparations amount undetermined) and the Locarno Treaties of 1925 (which settled post-war territorial disputes and disallowed Germany from going to war with other countries), Germany was re-admitted to international capital markets. This led to substantial foreign capital inflows which were in part used to conduct the reparations payments. Nonetheless, the economic and political situation remained complicated in part due to the unresolved reparations question.

While the years from 1925-1929 had been times of economic prosperity—arguably fueled by inflows of cheap foreign capital—a recession started when the capital flows reversed in 1929.[1] This recession complicated the federal government's position on reparations. After the government coalition led by the social democratic and other the main democratic parties fell apart over question over unemployment

[1]Some indicators also point the economic activity already slowing in 1928. Industrial output started to fall in 1929.

Figure A.2: ***Exchange Rate and Price Level.***

(a) *Unemployment and Price Level.* **(b)** *Exchange Rate.*



Notes: The data are hand-collected from various issues of the bi-monthly journal "Wirtschaft und Statistik. Herausgegeben vom Statistischen Reichsamt".

subsidies in early 1930, democracy was de facto suspended as the government by Chancellor Bruning, coming to power on March 30, 1930, had to rule by emergency decree, tolerated by the democratic parties but without a majority in the parliament. The Bruning-led government then started to implement a series of austerity policies which arguably worsened the economic downturn.

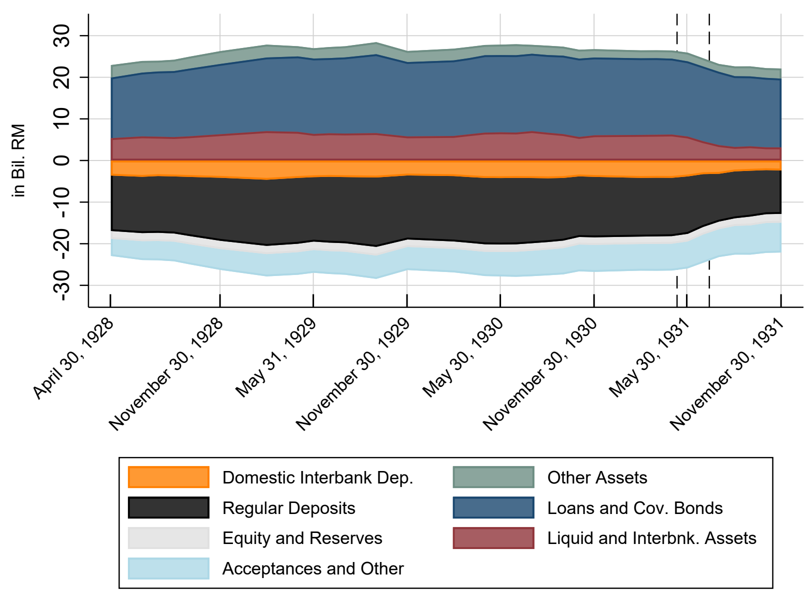
A major political shock came in September 1930 when a snap election was held and parties opposing the democratic rule outweighed the parties supporting the democratic system. Further, the announcement of an intended customs union between Germany and Austria on March 20, 1931 deepened the mistrust between the German and the French government.

Through these year preceding the run, the banking system presented itself as largely stable, from 1929 to spring 1931, the banking system had been largely stable, see Figure A.3. While there are two episodes in which deposits and assets fall, there are no larger aggregate trends. The Young plan announcement in fall 1929 led to a first wave of withdrawals from foreign creditors. Moreover, a second wave of withdrawals took place after the German snap election in September 1930.

In this environment of high political uncertainty and economic distress, the crisis started in May 1931. The German Crisis of 1931 was a run on both the banking system and the currency. For our purposes, we refer to the crisis simply as the "German crisis" rather than a "banking", "currency" or "twin" crisis. While we believe the data do not allow us to speak to the causes of the run, we argue they do allow us to study the dynamics of the run and the determinants of bank stability. Economic historians have debated the immediate cause of the crisis. Some, such as James (1984), put more emphasis on the crisis as originating in the banking system. In this narrative, emphasis is put on the failure of the largest Austrian bank, the *Creditanstalt*, which was announced on May 11, 1931 (Born, 1967; Kindleberger, 1973; James, 1984). Others, such as Temin (1971, 2008) and Ferguson and Temin (2003), put more emphasis on the actions of the German government and the fiscal and monetary problem that resulted from the German government's actions.

De facto, the crisis started after the failure of the Austrian Creditanstalt. Before failing, the Creditanstalt had been forcibly merged with the *Bodencreditanstalt* in 1929 to save the latter from bankruptcy and stabilize the Austrian economy. However, its problems were compounded when its largest client announced payment difficulties in 1930, and in 1931 it became apparent that the equity position of the Creditanstalt had become precarious. The extent of the damage became clear in May of 1931, when the Creditanstalt announced a 140-million-shilling loss. This loss ostensibly wiped out the bank's equity

Figure A.3: ***Aggregate Dynamics of Assets and Liabilities.***



Notes: The figure depicts aggregate assets and liabilities for the banking system between April of 1928 and November of 1932. Liabilities are depicted bellow the x-axis. Domestic inter-bank borrowing is depicted in orange, all other deposits in black, illiquid assets (primarily loans and covered bonds) are in blue while liquid assets are in red. Inter-bank lending is in dark green. The first vertical line, on May 11, 1931, marks the date of the failure of the Austrian Creditanstalt. The second vertical line, on July 13, 1931, and corresponds to the failure of Danatbank. Note that bank balance sheet data is available at a monthly frequency, excluding December and January.

and caused a panic in Austria and Central Europe (Kindleberger, 1973). The panic in Austria was largely contained as the Austrian central bank was able—with the help of the Bank of England—to bail out the banking system, including the Creditanstalt.

The financial distress further intensified starting June 6 when the German government announced unilaterally that it was unable to continue reparations payments under the conditions of the Young plan. In particular, the Bruning government—following its austerity policies—announced on June 5 that the salaries of government employees would be reduced by up to 8%. In order to ensure political support for such an unpopular policy, the government also made an announcement that Germany was no longer able to sustain the reparations payments on June 6. On June 7, when chancellor Bruning was visiting together with other members of his government the British prime minister MacDonald at Chequers, the German government officials explained that the governments announcement was meant to gather domestic political support. The government intended to follow the obligation of the Young Plan but argued that it could only do so until November (Born, 1967). However, international investors started to worry immediately about German's ability to maintain the Gold Standard. Hence, Ferguson and Temin (2003) argue that the announcement on June 6 triggered a run on the currency and thus emphasize the fiscal nature and the actions by the German government as the main source of the crisis.

Following the announcement on June 6 withdrawals continued with varying intensity. Withdrawals picked up when one of when the largest creditor of Danatbank, a wool-processing company called "*Nordwolle*", announced heavy losses, leading to speculation about the imminent failure of the Danatbank, the second largest German bank. The Danatbank had seen a rapid expansion of its balance sheet throughout the 1920's. Among other things, it had lent large amounts to and in part co-owned "*Nordwolle*". Danat's exposure to Nordwolle was about as large as the book value of Danat's equity. However, the owners of Nordwolle had engaged in fraudulent behavior, which became public information throughout June 1931, leading to large anticipated losses for the Danatbank. Nordwolle first announced a large loss on June 17. It later became clear that the company was not only subject to large losses but that losses largely exceeded the company's assets.

Throughout the first three weeks of June, the Reichsbank's gold reserve increasingly became under pressure, forcing it to restrict its liquidity provision. Withdrawals started to slow down noticeably after the announcement of the "Hoover Moratorium" on June 20, a suggestion by U.S. President Hoover to pause all war-related debt payments for one year. However, when French opposition of the arrangement became clear throughout the end of June, withdraws intensified again.

The crisis reached its climax on July 10 when the Reichsbank's gold reserves fell far enough that the legally mandated 40% gold-to-notes coverage ratio was breached. Beforehand, the Reichsbank had started a last attempt to obtain emergency loans from Banque de France and the Bank of England. The Bank of England turned the Reichsbank down as it had already provided emergency funding to Austria after the failure of the Creditanstalt and its gold reserves were dangerously low. The Banque de France was much better positioned to provide such a loan due to its ample gold reserves. However, given the political tension around the reparations question and the recent controversy around the customs union, such emergency funding was politically infeasible. When this attempt was unsuccessful, the Reichsbank decided to further increase the discount rate and tighten its already restricted liquidity provision to the banks. This rendered the Danatbank illiquid, as it had already discounted all of the assets that qualified for Reichsbank purchases. As an additional last-minute attempt to merge Danatbank and Deutsche Bank failed, the Danatbank had announced it would not open its branches again on Monday July 13.

Following the failure of Danatbank, retail depositors started withdraw from banks across the board, causing, among other events, the illiquidity of Dresdner Bank, at the time the third largest bank, on July 14. The then full-blown bank run then led the government to intervene by imposing a two-day bank holiday, which was followed by a partial suspension of convertibility and the introduction of capital controls. Further, the government ensured that illiquid banks would have access to the liquidity provision of the Reichsbank by founded a conduit, the "*Akzept and Garantiebank AG*", qualifiying bank securities for Reichsbank purchases. In August a *Stillhalteabkommen/standstill agreement* between Germany and its international creditors extended the maturity of all outstanding foreign lending to banks by 6 months. While deposits continued to contract until the end of 1931, albeit at a slower pace, the financial crisis was considered to be over when the government restructured the largest banks in spring 1932. The failing Danatbank and Dresdner bank were merged and recapitalized by the government. Moreover, the German government claimed one third of the equity of "*Deutsche Bank*"—Germany's largest bank.

A.3 The Reichsbank

The Reichsbank took a central role in the crisis. Especially as the crisis can be seen as a run on both currency and banks, understanding the Reichsbank's behavior is vital. On the one hand, the Reichsbank provided liquidity to banks throughout most of the run, allowing banks to serve withdrawing depositors. On the other hand, it was also constrained legally as it had to maintain a gold coverage ratio of its notes in circulation of 40%.[2] As its gold reserves started to drain and the international political tensions made a loan from a foreign central bank impossible, it became conflicted between saving the banking system and maintaining the Gold Standard (Schnabel, 2004). Thus, it started to tighten the initially generous liquidity provision and then triggered the breakdown of the entire banking system by stopping all liquidity support to the banking system when its gold reserves fell short of the gold coverage ratio.

The Reichsbank had a long history of allowing banks to discount eligible bills of exchange at the discount rate and provided funds to banks (Tilly, 1986) and it did so at the start of the run in May

[2]Following the hyperinflation during 1923, the German banking law of August 30, 1924 re-established the Reichsbank as a legal entity entirely independent of the German government, but subject to international supervision. Most importantly, the Reichsbank was required to cover 40% of its note issuance with gold reserves. Moreover, until 1930, the Reichsbank's governing council, which designated the bank's president consisted of 14 members of whom 50% had to be foreign.

(Schnabel, 2004). Panel (a) of Figure A.4 plots the amount of discounted bills and the gold reserves available at the Reichsbank. In line with the stability of total deposits in May, the Reichsbank did not discount any bills of exchange in May and its gold reserves remained stable. However, with the withdrawal of regular deposits starting in June, banks started to discount their liquid assets with the Reichsbank and obtained currency or gold in return.

Note that there were two ways in which banks could obtain funds from the Reichsbank. First, banks could discount liquid assets such as bills of exchange with the Reichsbank. This type of liquidity provision is comparable to collateralized lending in which the Reichsbank obtained a claim on a third party such as a non-financial firm in return for giving up some currency or gold. In line with banks using this way of obtaining funds, banks' liquid assets start to decline around the same time as the Reichsbank's holding of discounted claims started to increase and its gold reserves start to decrease.

However, there was a second way that banks could obtain funds. Banks could draw claims on each other, so called "acceptance liabilities". The level of outstanding acceptances is also plotted in Panel (a) of Figure A.4. In this kind of transaction, a bank would obtain a deposit at another bank in exchange for giving a deposit issued by itself. Once banks endorsed each other's claims in reciprocal agreements, the Reichsbank would discount these claims. This type of lending by the Reichsbank is more akin to a form of unsecured lending and was only possible as the Reichsbank was willing to look the other way, in violation of its own policies (Born, 1967; Schnabel, 2004).

To discount either type of claim, banks had to provide a guarantee that they would step in if the underlying claim were to lose value—referred to as endorsements. These endorsements were reported as off-balance-sheet items. We are able to observe these separately in the *Reichsanzeiger*. Thus, as banks started to discount their liquid assets or endorsements, their reported endorsement liabilities of both standard bills of exchange and acceptances started to increase, as seen in Panel (b) of Figure A.4, mirroring the banking system's increasing reliance on central bank lending.

The use of the two types of liquidity provision also allows us to better understand the Reichsbank's increasingly cautious stance throughout the run. The Reichsbank was initially willing to lend to banks against all types of claims, including acceptances. However, as its gold reserves were falling and it got closer to breaching the gold coverage ratio, it started to tighten its collateral requirements in June and July and stopped allowing banks to discount endorsed acceptance liabilities (Born, 1967). Panel (b) of Figure A.4 shows that while endorsements of bills of exchange increase and holdings of liquid assets decrease throughout June and July, the increase in acceptance liabilities and their endorsements increases only in June and then stalls in July.

The increasingly cautious stance of the Reichsbank is also reflected in the discount rates, see Panel (c) Figure A.4. Starting in May, the Reichsbank raised its discount rates steeply. It did so in an attempt to stop the outflow of deposits that were being transformed into gold. The discount rate was raised from 5% at the beginning of May to 7% on June 13, to 10% on July 13 and then to 15% on August 1.

The Reichsbank was unable to stop the run and the crisis reached it's climax on July 10 when the gold coverage ratio fell short of 40%, see panel (d) of Figure A.4. The inability of the Reichsbanks to obtain funding from other central banks then forced it to stop providing liquidity to the banks. This immediately triggered the failure of the Danatbank which in turn led to a system-wide withdraw of deposits of all banks and made forced the federal government to impose a bank-holiday. At this point the Gold Standard was effectively abandoned and capital controls were introduced.

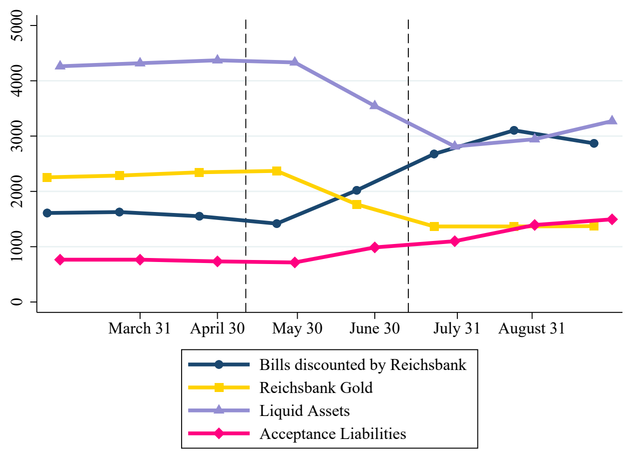
Figure A.5 also plots all assets and liabilities of the Reichsbank on a weekly basis throughout 1931. Mirroring the evidence from Figure A.4, the balance sheet expands considerably. On the assets side, we observe a fall in the Reichsbank's gold reserves from April onwards, in line with depositors exchanging currency for gold. At the same time, the quantity of discounted paper is continuously increasing. On the liability side, the increase is driven by growth in "other liabilities" as opposed to an increase in notes in circulation.

Our data allow us to further approximate what share of the withdrawn deposits is converted into gold. Figure A.5b plots the net outflow in total deposits and outflows of the Reichsbank's gold reserves.

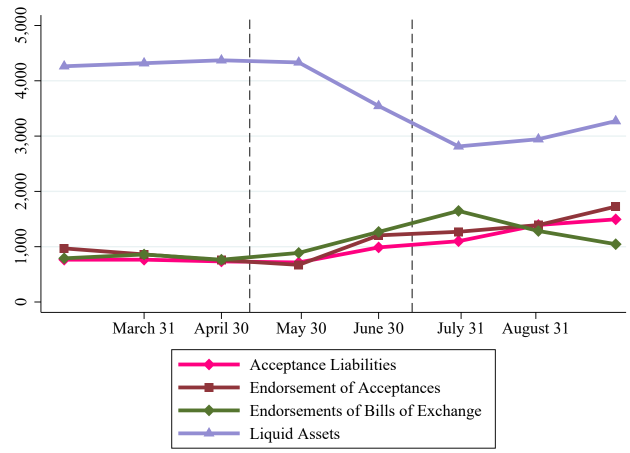
We determine that 30% of all bank deposits leaving the banking system are converted into gold. The remaining contraction in deposits is largely accounted for by a reduction in interbank lending and bank credit. We calculate that around 60% of the contraction in deposits is accounted for by a contraction in bank lending. The residual, around 10%, is arguably due to deposit withdrawals from the system that are not converted to gold, implying that depositors convert their claims into Reichsmarks to be held as notes instead of deposits. That is, the currency is stored "under the mattress".

Figure A.4: ***Dynamics of Bills Discounted at Reichsbank and Liquid Assets.***

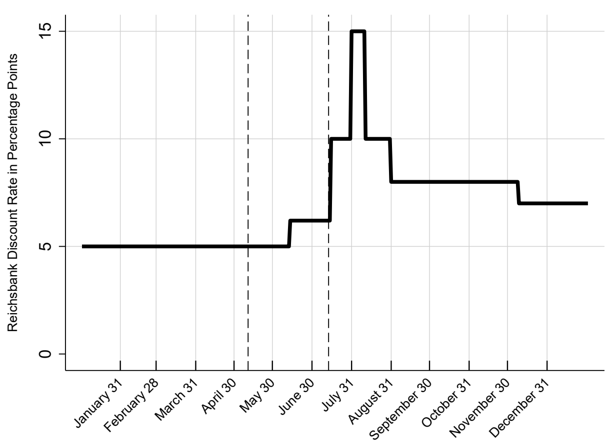
(a) *Discounted Bills, Gold, Liquid Assets, and Endorsements*



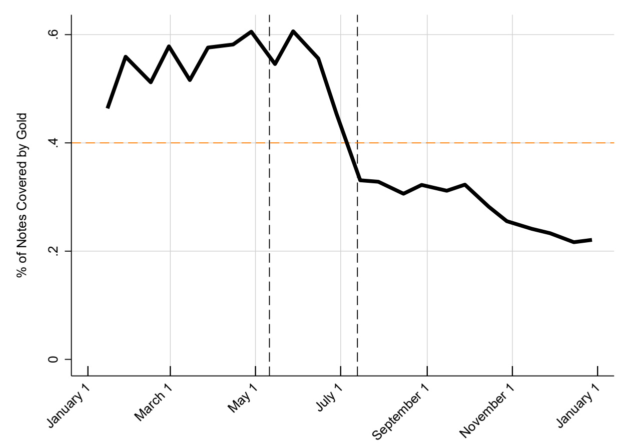
(b) *Liquid Assets, Endorsements by Type, and Acceptance Liabilities.*



(c) *Reichsbank Discount Rate in 1931.*



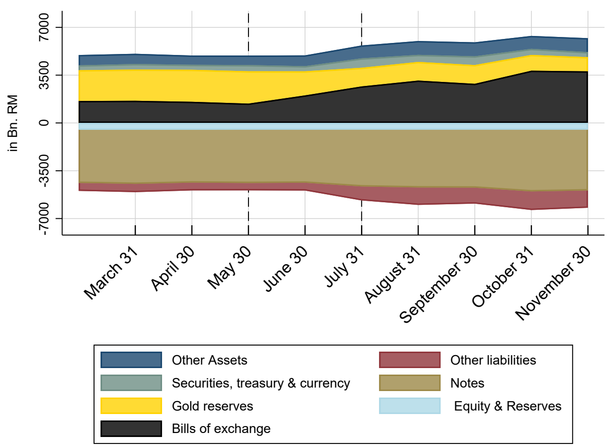
(d) *Gold Coverage Ratio.*



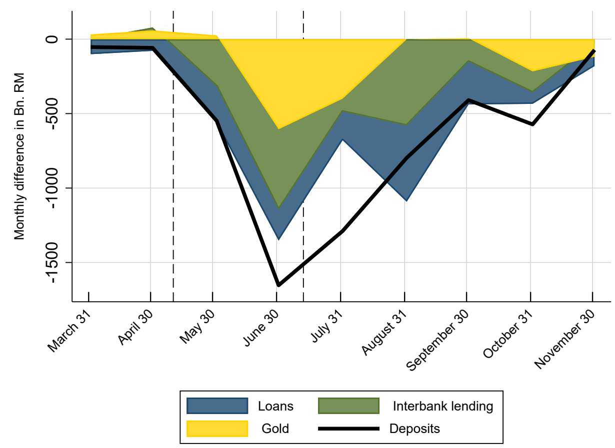
Notes: Panel (a) depicts statistics for bank balance sheet items (acceptances, discounted bills, and liquid assets) and Reichsbank balance sheet items (gold reserves). Panel (b) shows aggregate bank acceptances, endorsements and liquid assets. Both (a) and (b) are in mil. RM. Panel (c) shows the daily discount rate at the Reichsbank. Panel (d) depicts the gold coverage ratio. In panel (a)-(d), the first vertical line, on May 11, 1931, marks the date of the failure of the Austrian Creditanstalt. The second vertical line, on July 13, 1931, corresponds to the failure of the German Danatbank. Note that bank balance sheet data are available at a monthly frequency, excluding December and January, Reichsbank balance sheet data are available at a weekly frequency, and the discount rate is available at a daily frequency. Balance sheet data are obtained from the Reichsanzeiger while the discount rate is obtained from a bi-monthly statistical bulletin ("Wirtschaft und Statistik").

Figure A.5: ***Reichsbank Balance Sheet During the Crisis***

(a) *Evolution of the Reichsbank's assets and liabilities at a weekly frequency from January 1931 through December 1931.*



(b) *Month-to-month differences in aggregate deposits, gold reserves held by the Reichsbank, and inside money (interbank borrowing and credit) between March 1931 and November 1931.*

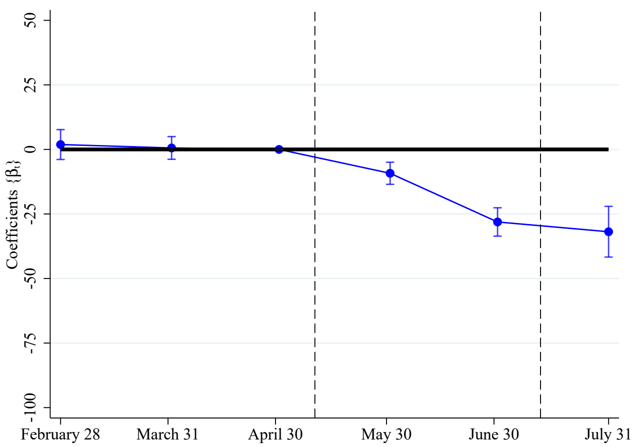


The first vertical line, on May 11, 1931, marks the date of the failure of the Austrian Creditanstalt. The second vertical line, on July 13, 1931, corresponds to the failure of the German Danatbank. Bank balance sheet data is available at a monthly frequency, excluding December and January, Reichsbank balance sheet data is available at a weekly frequency, and the discount rate is available at a daily frequency.

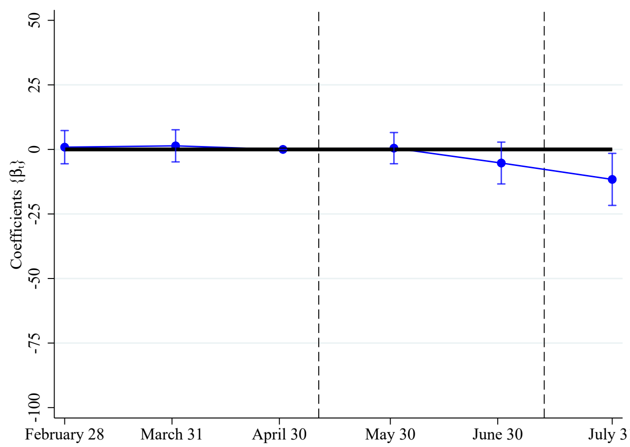
A.4 Appendix II: Figures

Figure A.6: ***Deposit Dynamics.***

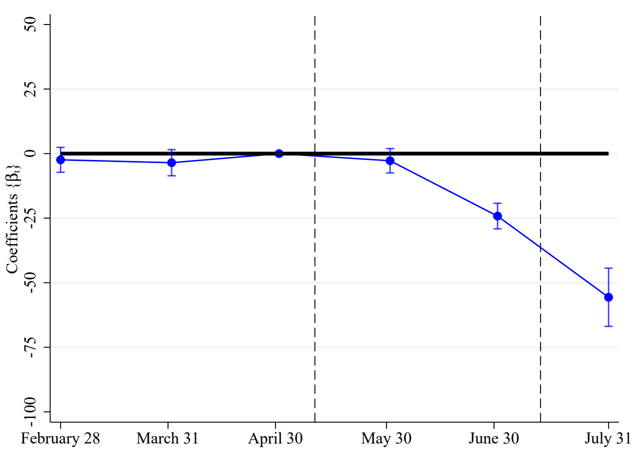
(a) *Domestic Interbank Deposits.*



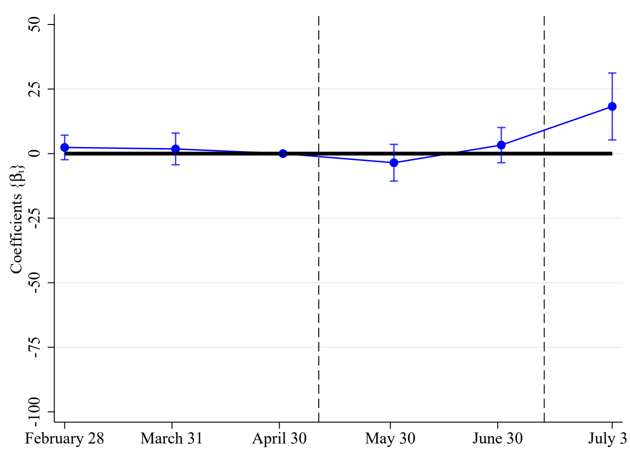
(b) *Regular deposits.*



(c) *Time deposits.*



(d) *Demand deposits.*



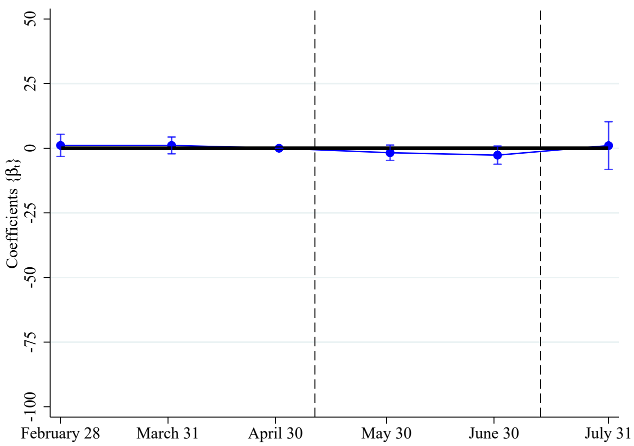
Notes: The above figures display the sequence of coefficients $\{\beta_t\}$ that results from estimating the model:

$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{t \neq \text{April 1931}} \beta_t \times \gamma_t + \epsilon_{bt},$$

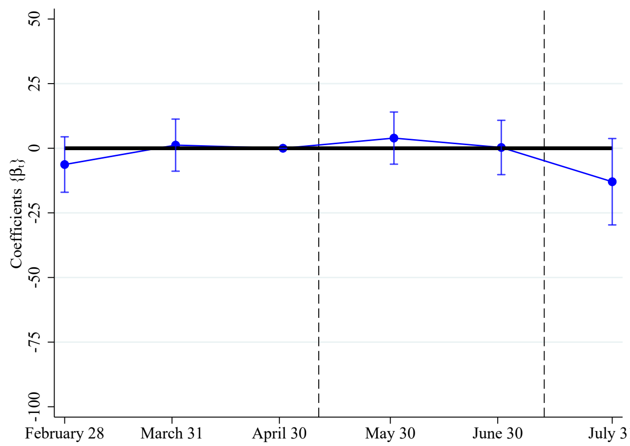
where y_{bt} is the natural logarithm of either a bank b's deposits (total, interbank, demand, and time deposits) or bank b's assets (liquid assets net of interbank claims by quality, interbank claims, and credit).
90% confidence intervals

Figure A.7: ***Asset Dynamics.***

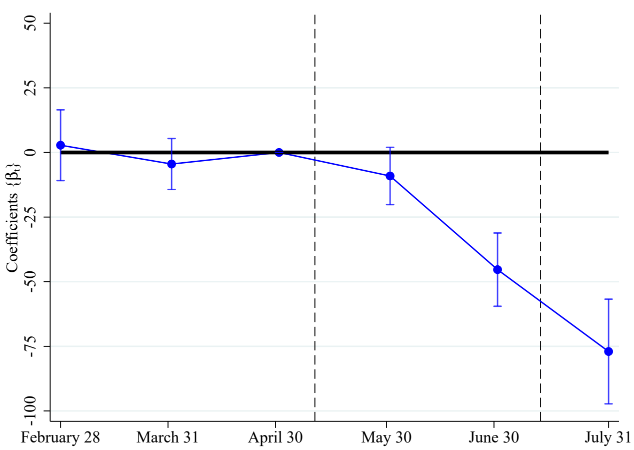
(a) *Total Credit.*



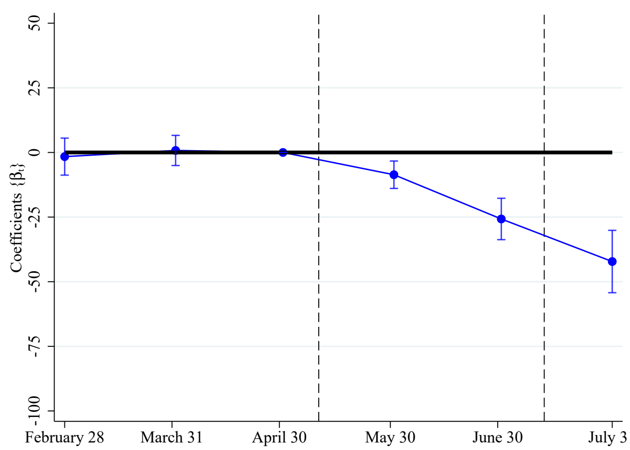
(b) *High quality liquid assets.*



(c) *Low quality liquid assets.*



(d) *Interbank Claims.*

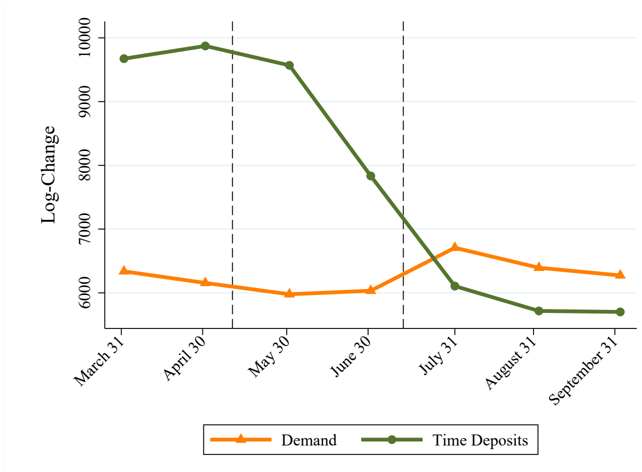


Notes: The above figures display the sequence of coefficients $\{\beta_t\}$ that results from estimating the model:

$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{t \neq \text{April 1931}} \beta_t \times \gamma_t + \epsilon_{bt},$$

where y_{bt} is the natural logarithm of either a bank b's deposits (total, interbank, demand, and time deposits) or bank b's assets (liquid assets net of interbank claims by quality, interbank claims, and credit).
90% confidence intervals

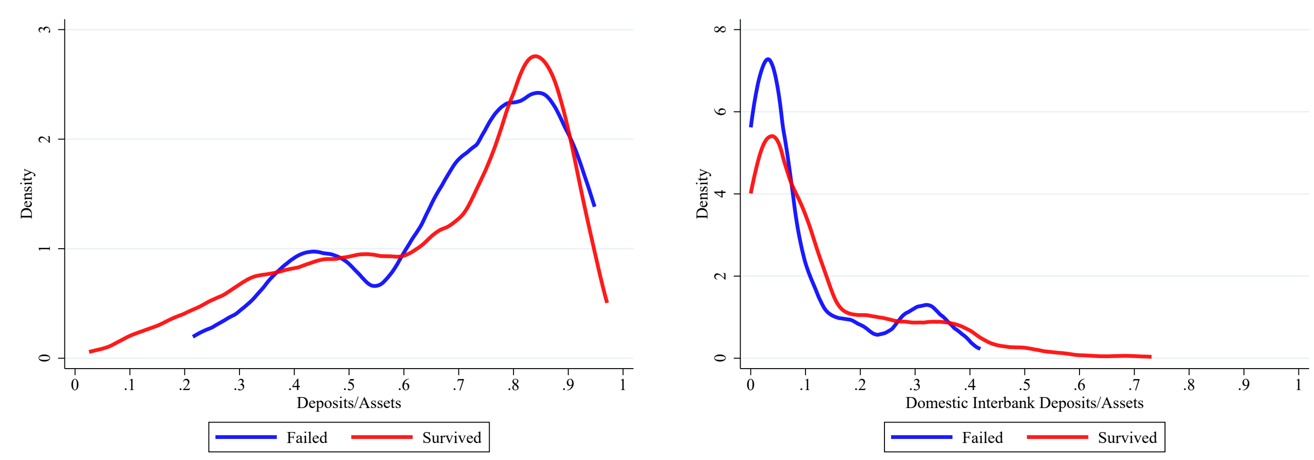
Figure A.8: ***Time and Demand Deposits.***



Notes: Aggregate levels of time and demand deposits between February 1931 and November 1931.

Figure A.9: ***Total Deposit Funding and Interbank Deposit Funding Prior to the Run.***

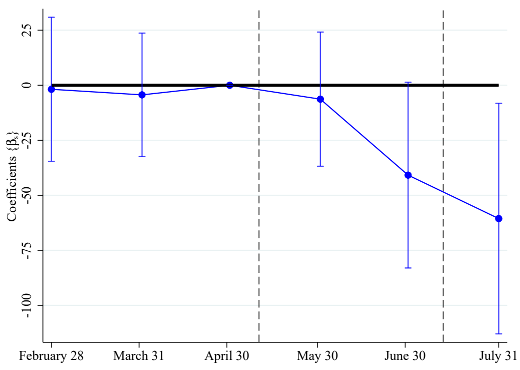
(a) *Total Deposits* **(b)** *Interbank Deposits*



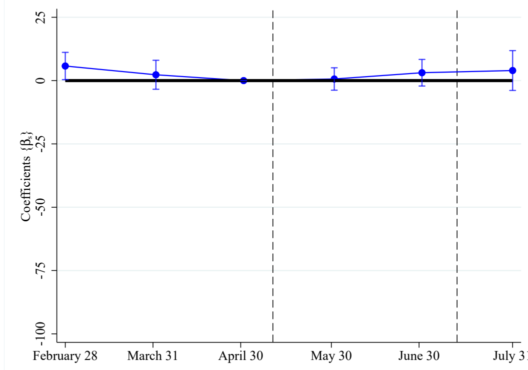
Notes: This figure plots the kernel density for the share of in total deposits (Panel (a)) and interbank deposits (Panel (b)) as of total assets between February 1931 and April 1931, splitting the sample into banks that failed and those that survived after the run from May through July 1931.

Figure A.10: ***Deposit Dynamics for Failing Banks.***

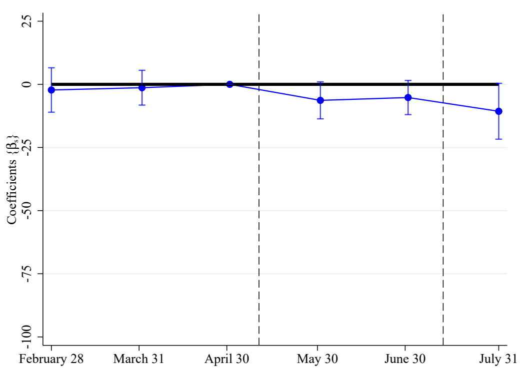
(a) *Domestic Interbank Deposits*



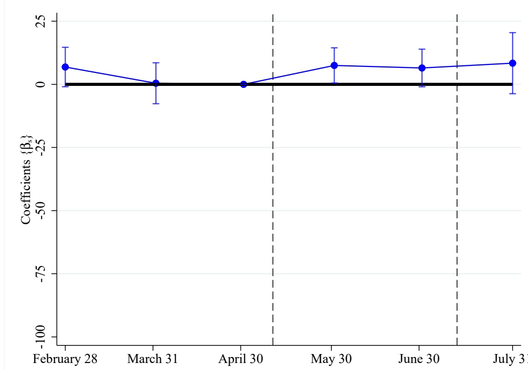
(b) *Regular Deposits*



(c) *Time Deposits*



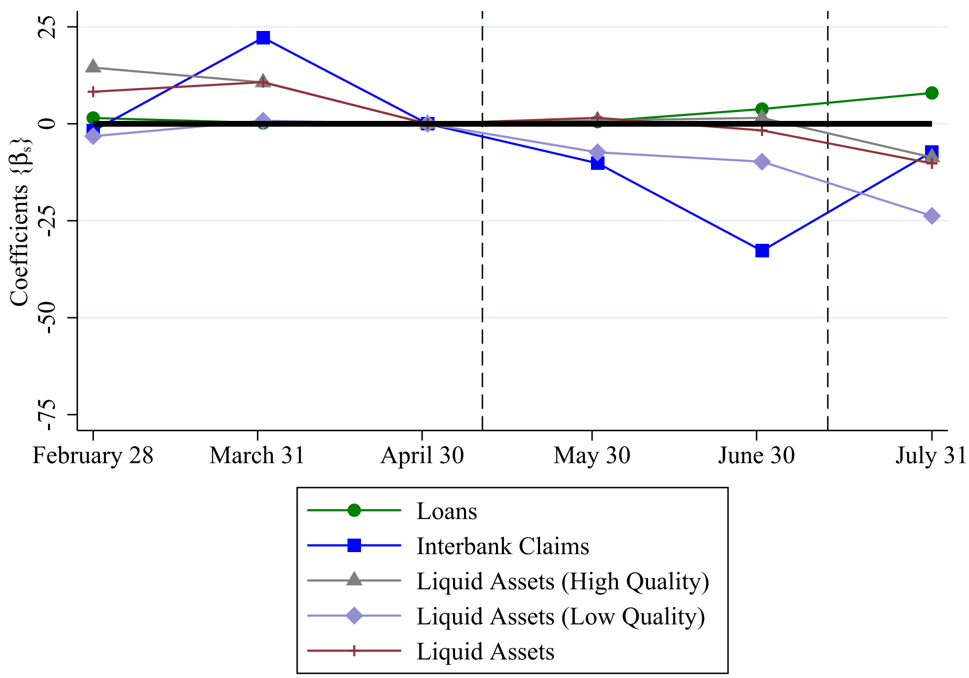
(d) *Demand Deposits*



Notes: The above figures display the sequence of coefficients $\{\beta_s\}$ that results from estimating the model:

$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{s \neq \text{April 31}} \beta_s \times \mathbb{I}[s = t] \times \text{Foreign} + \sum_{s \neq \text{April 31}} \mu_s \times \mathbb{I}[s = t] \times X_b + \epsilon_{bt}$$

Figure A.11: ***Assets Dynamics for Failed Banks.***

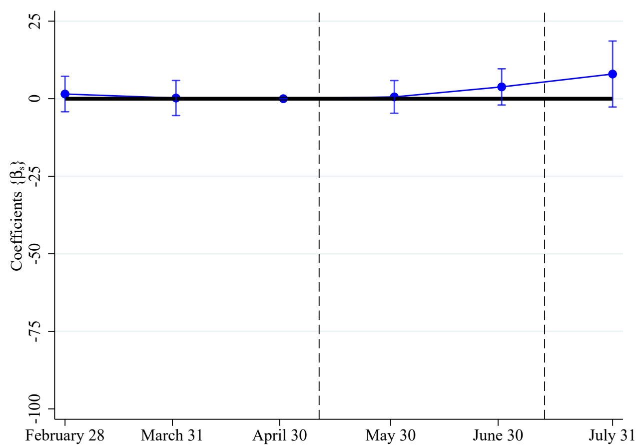


Notes: The above figures display the sequence of coefficients $\{\beta_s\}$ that results from estimating the model:

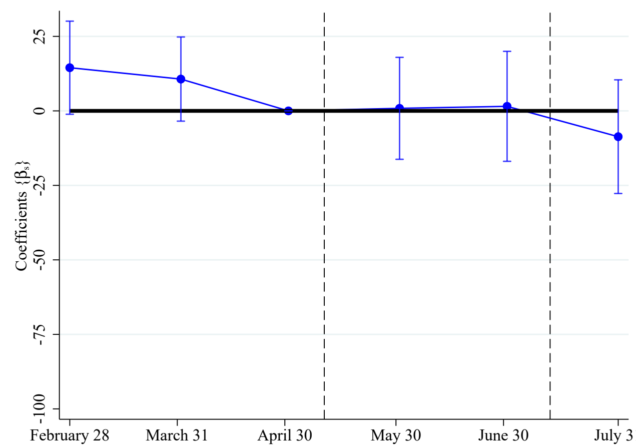
$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{s \neq \text{April 31}} \beta_s \times \mathbb{I}[s = t] \times \text{Failed} + \sum_{s \neq \text{April 31}} \mu_s \times \mathbb{I}[s = t] \times X_b + \epsilon_{bt}$$

Figure A.12: ***Asset Dynamics for Failed Banks.*** *Notes: 95% confidence intervals.*

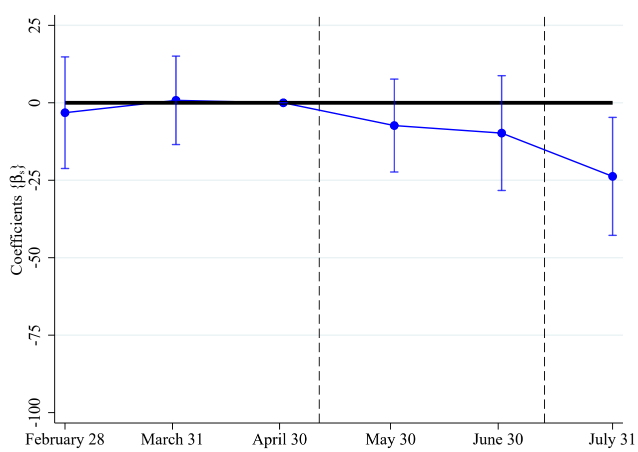
(a) *Total Credit.*



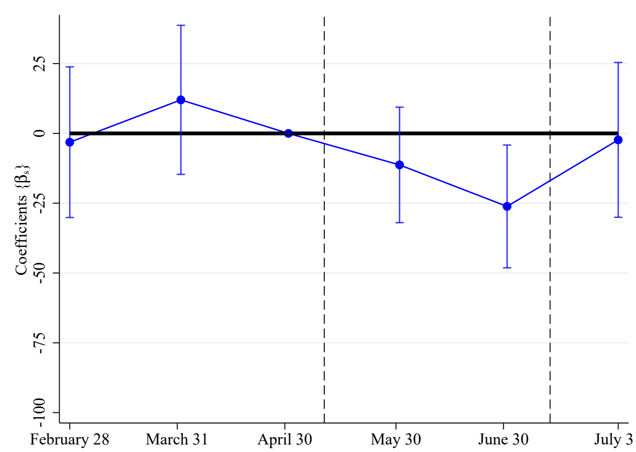
(b) *High quality liquid assets.*



(c) *Low quality liquid assets.*



(d) *Interbank Claims.*

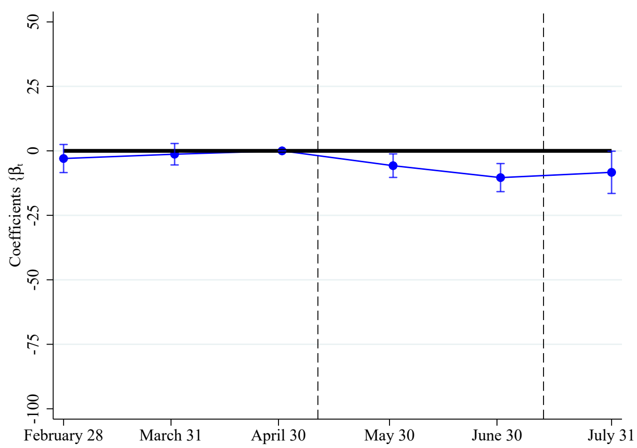


Notes: The above figures display the sequence of coefficients $\{\beta_s\}$ that results from estimating the model:

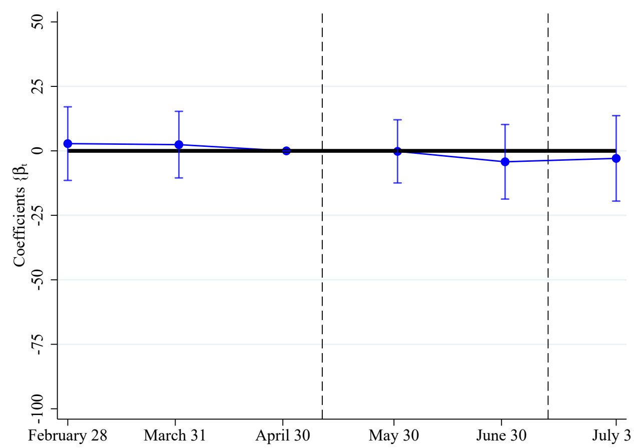
$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{s \neq \text{April 31}} \beta_s \times \mathbb{I}[s = t] \times \text{Failed} + \sum_{s \neq \text{April 31}} \mu_s \times \mathbb{I}[s = t] \times X_b + \epsilon_{bt}$$

Figure A.13: ***Deposit Dynamics for Foreign Deposit Banks. Impulse Response.*** *Notes: 95% confidence intervals.*

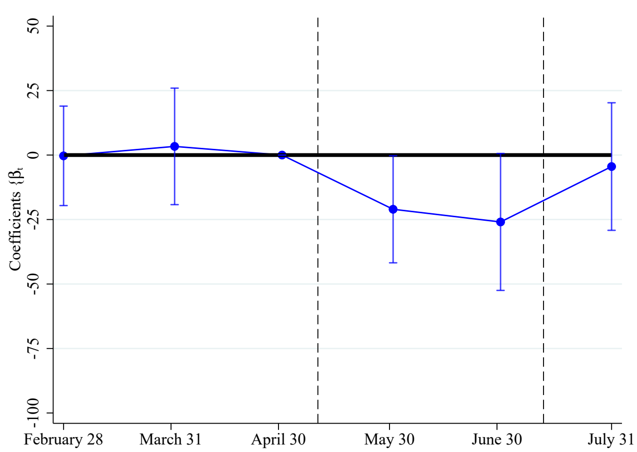
(a) *Total deposits.*



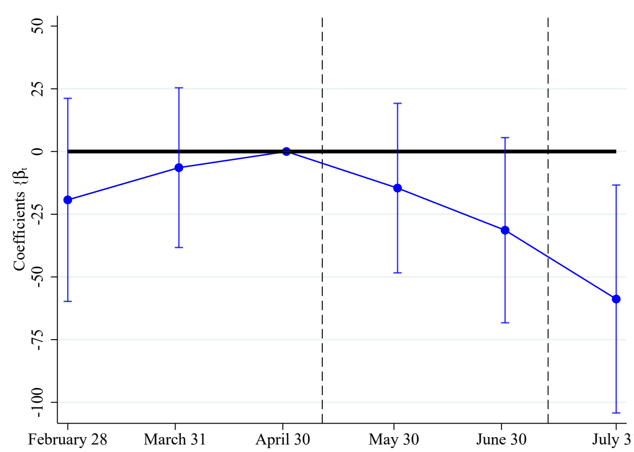
(b) *Time deposits.*



(c) *Demand deposits.*

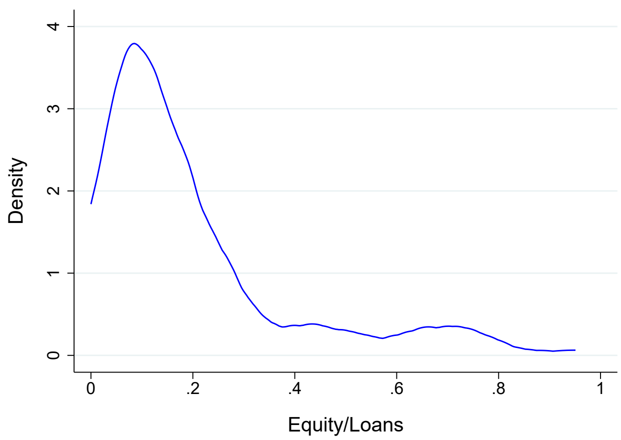


(d) *Interbank deposits.*

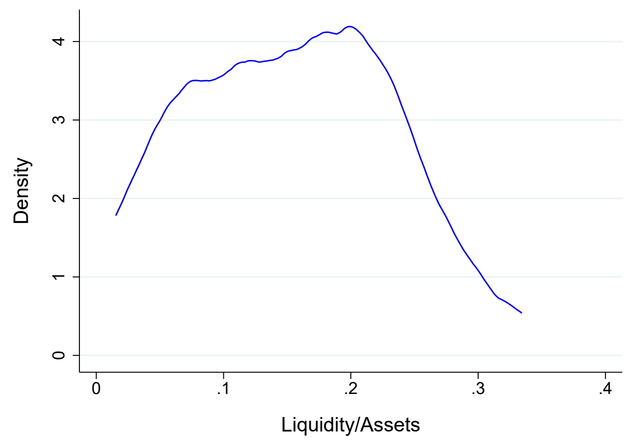


Notes: The above figures display the sequence of coefficients $\{\beta_s\}$ that results from estimating the model:

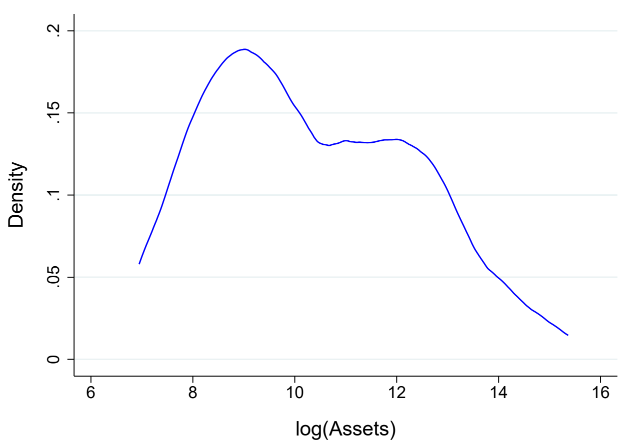
$$\ln y_{bt} = \gamma_b + \gamma_{\theta t} + \sum_{s \neq \text{April 31}} \beta_s \times \mathbb{I}[s=t] \times \text{Foreign} + \sum_{s \neq \text{April 31}} \mu_s \times \mathbb{I}[s=t] \times X_b + \epsilon_{bt}$$



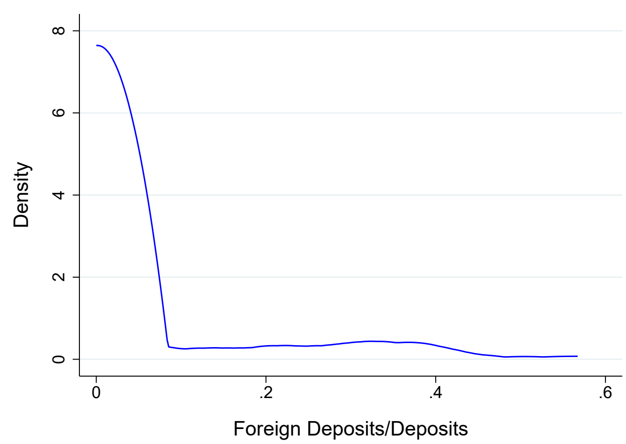
(a) *Leverage.*



(b) *Liquidity.*



(c) *Size*



(d) *Foreign Deposits.*

Figure A.14: *This figure plots kernel densities for the ratio of bank equity to total credit, liquid assets to total assets, the logarithm of total assets and the ratio of foreign deposit to total deposits. The ratio's are calculated as the bank-level average between September 1929 and September 1930. Data are restricted to banks reporting balance sheets reported in October 1931.*

A.5 Supplementary Tables

Table A.1: ***Statistics for the 50 largest banks***

		Share of						
Name	Total Assets	Liquid Assets	Illiquid Assets	Interbank Assets	Deposits	Domestic Bank Deposits	Any Foreign Funding	Banktype
Deutsche Bank	4,812	.64	.3	.09	.83	.06	1	Berlin Bank
Darmstaedter und Nationalbank	2,443	.62	.31	.13	.89	.09	1	Berlin Bank
Dresdner Bank	2,399	.62	.31	.12	.89	.11	1	Berlin Bank
Commerz- u. Privat-Bank	1,732	.65	.31	.09	.83	.09	1	Berlin Bank
Preusische Staatsbank (Seehandlung)	1,190	.56	.3	.19	.96	.39	1	Landesbank
Deutsche Girozentrale, Dt. Kommunalbk.	1,143	.72	.23	.16	.38	.36	1	Girozentrale
Bayerische Hypotheken- u. Wechselbank	1,060	.86	.11	.03	.22	.01	1	Regional Bank
Bayerische Vereinsbank	705	.78	.17	.07	.31	.05	1	Regional Bank
Reichs-Kredit-Gesellschaft A.-G.	681	.55	.38	.21	.86	.14	1	Berlin Bank
Landesbank der Prov. Westfalen	537	.85	.11	.06	.37	.32	0	Girozentrale
Nassauische Landesbank	475	.76	.18	.12	.45	.14	0	Landesbank
Direkt. d. Nassauischen Landesbank	475	.75	.19	.13	.45	.14	0	Girozentrale
Berliner Handelsgesellschaft	463	.6	.31	.19	.85	.07	1	Berlin Bank
Allgem. Deutsche Kredit-Anstalt	406	.68	.26	.07	.82	.06	1	Regional Bank
Barm. Bk.-B. hinsberg	404	.67	.29	.1	.79	.08	1	Regional Bank
Bayer. Gemeindebank	392	.71	.27	.22	.39	.33	0	Girozentrale
Bayerische Staatsbank	392	.59	.33	.16	.9	.25	1	Landesbank
Mitteldeutsche Landesbank	386	.61	.3	.24	.46	.36	0	Girozentrale
Girozentrale Hannover, oefftl. Bankanst.	316	.68	.19	.15	.51	.37	0	Girozentrale
Girozentrale Sachsen, oeffentl. Bankanst.	282	.36	.48	.35	.85	.53	0	Girozentrale
Deutsche Bau und Bodenbank	249	.63	.34	.16	.66	.26	1	Regional Bank
Saechsische Staatsbank	246	.55	.36	.14	.89	.12	1	Landesbank
Landesbank der Provinz Hannover	225	.75	.2	.18	.4	.22	0	Landesbank
Brandenb. Provinzialbank und Girozentrale	224	.67	.24	.24	.52	.39	0	Girozentrale
Hannov. Landeskreditanstalt	206	.86	.13	.05	.1	.04	0	Landesbank
Braunschweig. Staatsbank	206	.66	.29	.19	.58	.05	0	Landesbank
Berl. Stadtbk.	202	.39	.4	.42	.88	.19	0	Girozentrale
Hessische Girozentrale	199	.83	.14	.13	.4	.33	0	Girozentrale
Landesbank. d. Prov. Ostpreussen	185	.92	.04	.02	.17	.04	0	Landesbank
Kommunalbk. f. Schlesien, oefftl. Bankanst.	178	.77	.2	.09	.46	.29	0	Girozentrale
Landeskreditkasse Kassel	172	.84	.11	.08	.16	.1	0	Landesbank
Badische Girozentrale	168	.81	.14	.1	.53	.34	0	Girozentrale
Thueringische Staatsbank	164	.62	.32	.12	.73	.07	0	Landesbank
Wuerttembergische Girozentrale	161	.71	.18	.18	.6	.54	0	Girozentrale
Deutsche Landesbankenzentrale A.-G.	159	.52	.33	.41	.48	.37	1	Landesbank
Provinzialbank Pommern (Girozentrale)	157	.7	.22	.12	.41	.24	0	Girozentrale
Giro-Z. (Kommunalbk.) f. d. Ostmark.	151	.8	.08	.12	.26	.21	0	Girozentrale
Hessische Landesbank	147	.77	.12	.02	.19	.13	0	Landesbank
Deutsche Unionbank	118	.67	.2	.12	.87	.09	1	Regional Bank
Provinzialbank Oberschles.	113	.87	.07	.04	.33	.26	0	Girozentrale
Bank fuer auswaetrigen handel	106	.79	.19	.13	.86	.08	1	Regional Bank
Vereinsbank in Hamburg	101	.69	.26	.05	.72	.07	1	Regional Bank
Landesbank d. Prov. Schleswig-Holstein	101	.86	.11	.02	.23	.11	0	Landesbank
Deutsche Effecten und Wechsel AG	82	.6	.29	.15	.69	.1	1	Regional Bank
Staatliche Kreditanstalt Oldenburg	78	.83	.09	.08	.27	.12	0	Landesbank
Westfalenbank A.-G.	66	.8	.17	.12	.88	.03	1	Regional Bank
Westholsteinische Bank	58	.56	.4	.07	.91	.05	0	Regional Bank
Mecklenburgische Depositenbank	52	.51	.35	.16	.88	.02	0	Regional Bank
Anhalt-Dessauische Landesbank	47	.73	.21	.02	.81	.06	0	Regional Bank
Oldenburgische Spar- u. Leih-Bank	44	.77	.17	.04	.84	.09	0	Regional Bank
Hallescher Bankverein	42	.78	.18	.01	.74	.03	0	Regional Bank
Oldenburgische Landesbank	38	.69	.26	.09	.86	.04	0	Regional Bank

This table shows key characteristics for the 50 largest banks in our sample. Total assets, total deposits (both in million Reichsmark), equity to credit, liquid assets to total assets, and the foreign deposit ratio are calculated as the mean for the period September 1929 to September 1930. Change in deposits during the crisis is calculated as the average monthly change from September 1930 to September 1931.

Table A.2: *List of Major Distressed Banks.*

Bank	Event Date	Event
Gewerbebank AG	June 1931	Failed/Distr. merger
Allgem. Deutsche Kredit-Anstalt	July 1931	Gov. Aid
Darmstaedter und Nationalbank	July 1931	Failed/Distr. merger
Dresdner Bank	July 1931	Gov. Aid
Landesbank d. Rheinprovinz	July 1931	Failed/Gov. Aid
Hallescher Bankverein v. Lullisch, Kaempf u. Co., K. a. A.	August 1931	Gov. Aid
Bank fuer Handel und Gewerbe	September 1931	Failed
Leipziger Immobilienges. Bk. Grundbesitz A.-G.	September 1931	Failed
Leipziger Kredit-Bank	September 1931	Failed/Gov. Aid
Hollandische Kreditbank AG	October 1931	Failed
Rheinische Bauernbank A.-G.	October 1931	Failed/Gov. Aid
Vorschuss- u. Spar-Vereins-Bk. In Luebeck	November 1931	Failed
Anhalt-Dessauische Landesbank	December 1931	Gov. Aid/Distr. merger
Commerz-Bank in Luebeck	December 1931	Gov. Aid
Deutsche Bank	February 1932	Gov. Aid
Duisburger Bankverein A.-G.	February 1932	Failed
Wernigeroeder Bank	February 1932	Failed
Staedte u. Staatsbank d. Oberlausitz K. a. A.	June 1932	Failed
Bernburger Bank	July 1932	Failed
Westfalenbank A.-G.	August 1932	Gov. Aid

This table lists the major banks that failed, bailed out, or merged by government intervention between June 1931 and August 1932. The data are collected from Born (1967), Schnabel (2009), and Saling.

Table A.3: *Comparison of Failing and Non-Failing Banks.*

		Failing Banks		Non-Failing Banks		Difference
		Average	Std.Dev.	Average	Std.Dev.	
Total assets (mil. RM)		239.5	665.2	212.3	562.0	-27.1
Share of illiquid assets	All	0.7	0.1	0.7	0.1	-0.0
	Loans	0.6	0.2	0.5	0.2	-0.1*
	Covered Bonds	0.1	0.2	0.2	0.3	0.1
Share of liquid assets	All	0.2	0.1	0.3	0.1	0.1
	High quality	0.0	0.0	0.0	0.0	0.0
	Low quality	0.1	0.1	0.1	0.1	0.0
	Interbank	0.0	0.0	0.1	0.1	0.1**
Deposits	All	0.7	0.2	0.7	0.2	-0.0
	Demand	0.2	0.2	0.2	0.1	-0.0
	Time	0.5	0.1	0.4	0.2	-0.1
	Domestic Interbank	0.1	0.1	0.1	0.1	0.0
Observations		15		108		123

xxx

Table A.4: ***Deposit Flows from April 1931 though July 1931 for Failed Banks—Regional Banks Only***.

Dependent variable	Regular		Interbank		Demand		Time		Total	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Failed	-0.7	-0.3	-78.1**	-89.2***	-7.6	-4.7	-7.3	-9.6	0.9	-0.5
	(4.0)	(4.2)	(29.7)	(30.1)	(7.6)	(7.4)	(7.2)	(7.3)	(3.9)	(3.9)
Leverage		-1.4		-1.7		-4.8**		-2.5		-2.3**
		(1.2)		(8.7)		(2.1)		(2.1)		(1.1)
Liquidity		13.2		-79.6		2.6		16.2		1.7
		(10.6)		(76.0)		(18.8)		(18.3)		(9.8)
Size		0.5		7.4		1.9		-0.6		0.7
		(0.8)		(5.6)		(1.4)		(1.3)		(0.7)
Foreign Funding		-7.5		-84.0**		7.7		-17.0*		-13.0**
		(5.5)		(39.5)		(9.8)		(9.5)		(5.1)
Number of Banks	76	76	76	76	76	76	76	76	76	76
Bank Type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.00044	.043	.085	.17	.013	.17	.014	.12	.00067	.14

This table reports results from estimating

$$\ln y_{b\text{July 31}} - \ln y_{b\text{April 31}} = \theta_b + \beta \times X_b + \epsilon_b$$

The model is estimated using the cross-section of banks for which we have data in March 1931. Robust standard errors are clustered at the bank level in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table A.5: ***Asset Flows from April 1931 though July 1931 for Failed Banks.***

Dependent variable	Low		High		All Liquid		Interbank	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Failed	-40.0***	-35.8**	-29.1	-27.6	-31.2**	-26.9**	8.7	-3.9
	(15.2)	(14.6)	(18.3)	(18.7)	(12.6)	(12.3)	(22.3)	(21.3)
Leverage		7.8*		4.8		7.1**		-2.0
		(4.1)		(5.3)		(3.5)		(6.0)
Liquidity		47.4*		-12.1		25.5		-103.8***
		(25.8)		(33.0)		(21.7)		(37.6)
Size		2.3		2.1		3.5		-5.4
		(2.5)		(3.2)		(2.1)		(3.7)
Foreign Funding		-37.8**		4.7		-20.4		-15.0
		(15.9)		(20.4)		(13.4)		(23.3)
Mean	119	119	119	119	119	119	119	119
Number of Banks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Type FE	.057	.18	.022	.037	.051	.15	.0013	.15

This table reports results from estimating

$$\ln y_{b\text{July 31}} - \ln y_{b\text{April 31}} = \theta_b + \beta \times X_b + \epsilon_b$$

The model is estimated using the cross-section of banks for which we have data in March 1931. Robust standard errors are clustered at the bank level in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

Table A.6: ***Deposit Flows from April 1931 though July 1931 for Distressed Banks.***

Dependent variable	Regular		Interbank		Demand		Time		Total	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Failed	1.1	-0.6	-39.7*	-44.3**	4.1	7.3	-6.1	-7.8	0.9	0.1
	(4.1)	(4.1)	(20.8)	(21.0)	(11.9)	(11.3)	(7.3)	(7.1)	(3.3)	(3.3)
Leverage		0.4		-1.5		-6.3*		0.9		-0.9
		(1.3)		(6.8)		(3.7)		(2.3)		(1.1)
Liquidity		-19.5**		-44.0		85.0***		-42.2***		-10.4
		(8.4)		(42.7)		(23.0)		(14.4)		(6.7)
Size		0.7		8.5**		3.8*		-1.5		0.6
		(0.8)		(4.1)		(2.2)		(1.4)		(0.7)
Foreign Funding		-0.5		-52.3**		-8.0		-4.6		-6.9*
		(5.1)		(26.2)		(14.2)		(8.8)		(4.1)
Number of Banks	119	119	119	119	119	119	119	119	119	119
Bank Type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	.00061	.051	.031	.082	.001	.16	.0062	.13	.00063	.062

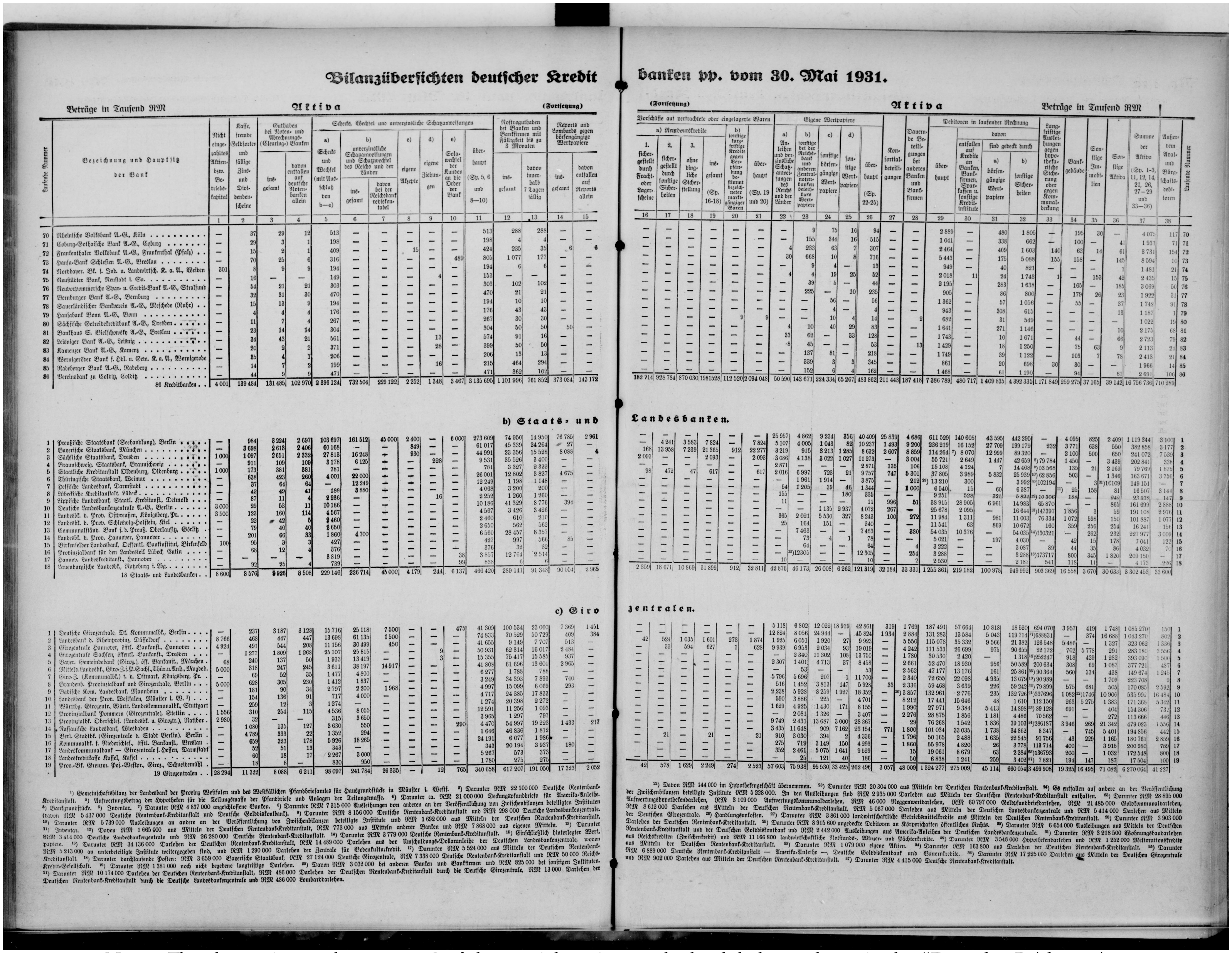
This table reports results from estimating

$$\ln y_{b\text{July 31}} - \ln y_{b\text{April 31}} = \theta_b + \beta \times \text{Distressed}_b + \epsilon_b$$

The model is estimated using the cross-section of banks for which we have data in March 1931. Robust standard errors are clustered at the bank level in parentheses; *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

A.6 Data Appendix

Figure A.15: *Bank Assets Reported in "*Deutscher Reichsanzeiger und Preussischer Staatsanzeiger*" for May 30, 1931.*



Bilanzübersichten deutscher Kreditbanken pp. vom 30. Mai 1931.

Beträge in Tausend RM — Aktiva (Fortsetzung)

b) Staats- und Landesbanken.

c) Girozentralen.

Notes: The above picture shows page 2 of the special section on the bank balance sheets in the "*Deutscher Reichsanzeiger und Preussischer Staatsanzeiger*" for May 30, 1931. We obtain the digital copies from Kling (2016) and manually digitize the underlying data.

Figure A.16: *Example Balance Sheet.*

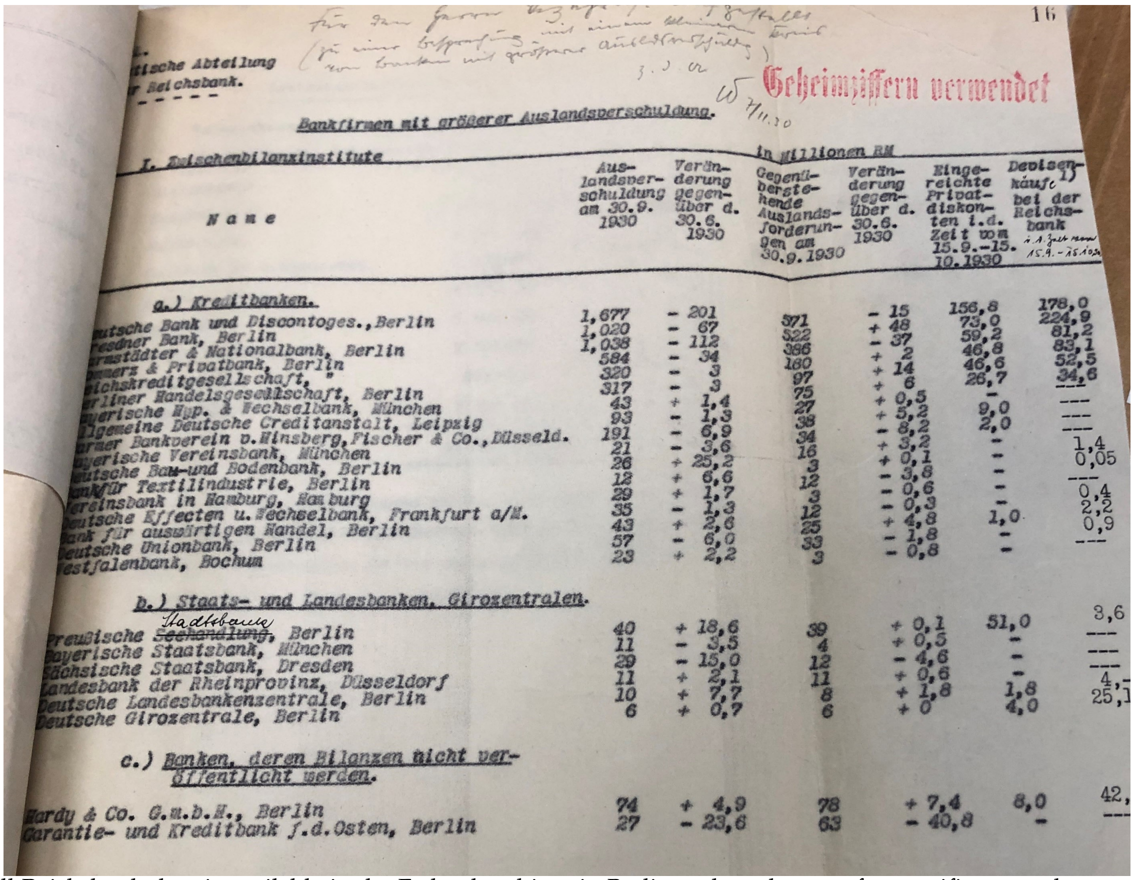
Balance sheet of the Deutsche Bank
April, 1930 (simplified)

Assets		**Liabilities**	
Cash	65,987	Equity	285,000
Due from clearing and central banks	42,520	Reserves	160,000
of which from domestic clearing banks	32,066	Total Deposits	4,854,773
Bills of exchange, treasury notes, promissory notes, etc.	1,355,366	by maturity	
of which non-interest bearing treasury notes	326,391	of which due within 7 days	1,856,179
dicountable at the Reichsbank	323,924	of which due between 7 days and 3 months	2,251,751
of which are own acceptances	-	of which due after 3 months	99,820
of which are own relations	-	by type of depositor	
of which are promissory notes to the order of customers	-	of which from domestic banks	361,350
of which all others	1,028,975	of which from regular depositors	3,846,400
Funds due from banks	375,226	other types	647,023
of which due within 7 days	251,418	Acceptances	202,146
Lombard credit (against stocks and other liquid assets)	151,809	Long term liabilities	105,000
Advances against goods and shipping	642,824	of which mortgage backed commercial paper	-
of which covered by finished goods and produce	55,487	of which all other	105,000
of which covered by securities	235,717	Other liabilities	45,111
of which not covered	314,385	**Total liabilities**	**5,652,030**
of which other	605,589		
of which not covered by speific products	37,235		
Total securities	77,613		
of which treasury securities	3,964		
of which other securities discountable	5,922		
of which marketable	49,995		
of which all others	17,732		
Equity investments	79,483		
Holdings of banks and firms	37,604		
Credit lines	2,712,147		
of which credit lines to banks	174,260		
of which covered by marketable securities	664,717		
of which covered by other securities	1,241,371		
Direct mortgages	-		
Bank property (branches)	99,111		
Other properties	12,340		
Other assets	-		
Total assets	**5,652,030**		

Off balance sheet assets		Off balance sheet liabilities	
Bank guarantees	362,142	Guarantees & transfer endorsments	838,705

Notes: This table report a simplified version of the information contained in the balcne sheets in the "*Deutscher Reichsanzeiger und Preussischer Staatsanzeiger*" by translating the balance sheet for "Deutsche Bank" from April 1930.

Figure A.17: ***Confidential Reichsbank Data for Foreign Funding.***



16

tische Abteilung
r Reichsbank.

Geheimziffern verwendet

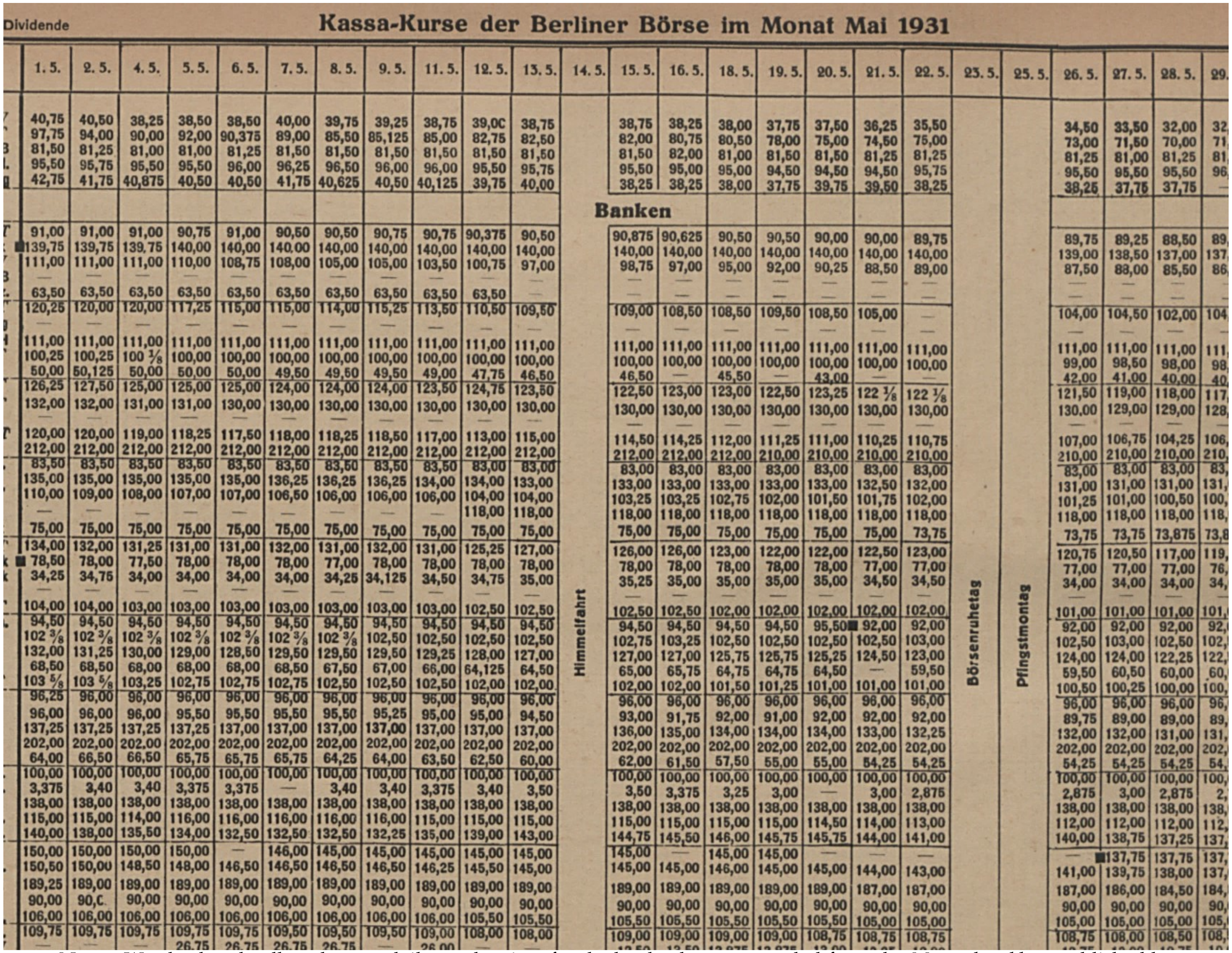
Bankfirmen mit größerer Auslandsverschuldung.

I. Zwischenbilanzinstitute — in Millionen RM

Name	Auslandsverschuldung am 30.9.1930	Veränderung gegenüber d. 30.6.1930	Gegenüberstehende Auslandsforderungen am 30.9.1930	Veränderung gegenüber d. 30.6.1930	Eingereichte Privatdiskonten i.d. Zeit vom 15.9.–15.10.1930	Devisenkäufe bei der Reichsbank 1)
a.) Kreditbanken.						
utsche Bank und Discontoges., Berlin	1,677	- 201	571	- 15	156,8	178,0
esdner Bank, Berlin	1,020	- 67	522	+ 48	73,0	224,9
rmstädter & Nationalbank, Berlin	1,038	- 112	386	- 37	59,2	81,2
mmerz & Privatbank, Berlin	584	- 34	180	+ 2	46,8	83,1
ichskreditgesellschaft, "	320	- 3	97	+ 14	46,6	52,5
rliner Handelsgesellschaft, Berlin	317	- 3	75	+ 6	26,7	34,6
yerische Hyp. & Wechselbank, München	43	+ 1,4	27	+ 0,5	-	---
lgemeine Deutsche Creditanstalt, Leipzig	93	- 1,3	38	+ 5,2	9,0	---
rmer Bankverein v.Hinsberg,Fischer & Co.,Düsseld.	191	- 6,9	34	- 8,2	2,0	---
yerische Vereinsbank, München	21	- 3,6	16	+ 3,2	-	1,4
utsche Bau-und Bodenbank, Berlin	26	+ 25,2	3	+ 0,1	-	0,05
nk für Textilindustrie, Berlin	12	+ 6,6	12	- 3,8	-	---
reinsbank in Hamburg, Hamburg	29	+ 1,7	3	- 0,6	-	0,4
utsche Effecten u.Wechselbank, Frankfurt a/M.	35	- 1,3	12	- 0,3	-	2,2
nk für auswärtigen Handel, Berlin	43	+ 2,6	25	+ 4,8	1,0	0,9
utsche Unionbank, Berlin	57	- 6,0	33	- 1,8	-	---
estfalenbank, Bochum	23	+ 2,2	3	- 0,8	-	
b.) Staats- und Landesbanken, Girozentralen.						
Preußische ~~Seehandlung~~ Stadtbank, Berlin	40	+ 18,6	39	+ 0,1	51,0	3,6
Bayerische Staatsbank, München	11	- 3,5	4	+ 0,5	-	---
Sächsische Staatsbank, Dresden	29	- 15,0	12	- 4,6	-	---
Landesbank der Rheinprovinz, Düsseldorf	11	+ 2,1	11	+ 0,6	-	4,-
Deutsche Landesbankenzentrale, Berlin	10	+ 7,7	8	+ 1,8	1,8	25,1
Deutsche Girozentrale, Berlin	6	+ 0,7	6	+ 0	4,0	
c.) Banken, deren Bilanzen nicht veröffentlicht werden.						
Hardy & Co. G.m.b.H., Berlin	74	+ 4,9	78	+ 7,4	8,0	42,
Garantie- und Kreditbank f.d.Osten, Berlin	27	- 23,6	63	- 40,8	-	---

Notes: All Reichsbank data is available in the Federal archives in Berlin and can be seen for specific research purposes with special dispensation from the archives. For the data described above, see, for instance, Reichsbank archival data: R 2501 "Deutsche Reichsbank": 6479, 6480, 6482, 6484, 6491-2, 6559, 6634, 6709, 6746, 7712.

Figure A.18: *Daily stock prices for the Berlin stock exchange from the "***Monatskurblatt***"*.



Dividende

Kassa-Kurse der Berliner Börse im Monat Mai 1931

1. 5.	2. 5.	4. 5.	5. 5.	6. 5.	7. 5.	8. 5.	9. 5.	11. 5.	12. 5.	13. 5.	14. 5.	15. 5.	16. 5.	18. 5.	19. 5.	20. 5.	21. 5.	22. 5.	23. 5.	25. 5.	26. 5.	27. 5.	28. 5.	29.
40,75	40,50	38,25	38,50	38,50	40,00	39,75	39,25	38,75	39,0C	38,75	Himmelfahrt	38,75	38,25	38,00	37,75	37,50	36,25	35,50	Börsenruhetag	Pfingstmontag	34,50	33,50	32,00	32,
97,75	94,00	90,00	92,00	90,375	89,00	85,50	85,125	85,00	82,75	82,50		82,00	80,75	80,50	78,00	75,00	74,50	75,00			73,00	71,50	70,00	71,
81,50	81,25	81,00	81,00	81,25	81,50	81,50	81,50	81,50	81,50	81,50		81,50	82,00	81,00	81,50	81,50	81,25	81,25			81,25	81,00	81,25	81,
95,50	95,75	95,50	95,50	96,00	96,25	96,50	96,00	96,00	95,50	95,75		95,50	95,00	95,00	94,50	94,50	94,50	95,75			95,50	95,50	95,50	96,
42,75	41,75	40,875	40,50	40,50	41,75	40,625	40,50	40,125	39,75	40,00		38,25	38,25	38,00	37,75	39,75	39,50	38,25			38,25	37,75	37,75	—
												Banken												
91,00	91,00	91,00	90,75	91,00	90,50	90,50	90,75	90,75	90,375	90,50		90,875	90,625	90,50	90,50	90,00	90,00	89,75			89,75	89,25	88,50	89,
■139,75	139,75	139.75	140,00	140,00	140.00	140,00	140,00	140,00	140,00	140,00		140,00	140,00	140,00	140,00	140,00	140,00	140,00			139,00	138,50	137,00	137,
111,00	111,00	111,00	110,00	108,75	108,00	105,00	105,00	103,50	100,75	97,00		98,75	97,00	95,00	92,00	90,25	88,50	89,00			87,50	88,00	85,50	86,
—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—			—	—	—	
63,50	63,50	63,50	63,50	63,50	63,50	63,50	63,50	63,50	63,50	—		—	—	—	—	—	—	—			—	—	—	—
120,25	120,00	120,00	117,25	115,00	115,00	114,00	115,25	113,50	110,50	109,50		109,00	108,50	108,50	109,50	108,50	105,00	—			104,00	104,50	102,00	104,
—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—			—	—	—	—
111,00	111,00	111,00	111,00	111,00	111,00	111,00	111,00	111,00	111,00	111,00		111,00	111,00	111,00	111,00	111,00	111,00	111,00			111,00	111,00	111,00	111,
100,25	100,25	100 1/8	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00		100,00	100,00	100,00	100,00	100,00	100,00	100,00			99,00	98,50	98,00	98,
50,00	50,125	50,00	50,00	50,00	49,50	49,50	49,50	49,00	47,75	46,50		46,50	—	45,50	—	43,00	—	—			42,00	41,00	40,00	40,
126,25	127,50	125,00	125,00	125,00	124,00	124,00	124,00	123,50	124,75	123,50		122,50	123,00	123,00	122,50	123,25	122 1/8	122 1/8			121,50	119,00	118,00	117,
132,00	132,00	131,00	131,00	130,00	130,00	130,00	130.00	130,00	130,00	130,00		130,00	130,00	130,00	130,00	130,00	130,00	130,00			130.00	129,00	129,00	128,
—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—			—	—	—	—
120,00	120,00	119,00	118,25	117,50	118,00	118,25	118,50	117,00	113,00	115,00		114,50	114,25	112,00	111,25	111,00	110,25	110,75			107,00	106,75	104,25	106,
212,00	212,00	212,00	212,00	212,00	212,00	212,00	212,00	212,00	212,00	212,00		212,00	212,00	212,00	210,00	210,00	210,00	210,00			210,00	210,00	210,00	210,
83,50	83,50	83,50	83,50	83,50	83,50	83,50	83,50	83,50	83,00	83,00		83,00	83,00	83,00	83,00	83,00	83,00	83,00			83,00	83,00	83,00	83,
135,00	135,00	135,00	135,00	135,00	136,25	136,25	136,25	134,00	134,00	133,00		133,00	133,00	133,00	133,00	133,00	132,50	132,00			131,00	131,00	131,00	131,
110,00	109,00	108,00	107,00	107,00	106,50	106,00	106,00	106,00	104,00	104,00		103,25	103,25	102,75	102,00	101,50	101,75	102,00			101,25	101,00	100,50	100,
—	—	—	—	—	—	—	—	—	118,00	118,00		118,00	118,00	118,00	118,00	118,00	118,00	118,00			118,00	118,00	118,00	118,
75,00	75,00	75,00	75,00	75,00	75,00	75,00	75,00	75,00	75,00	75,00		75,00	75,00	75,00	75,00	75,00	75,00	73,75			73,75	73,75	73,875	73,8
134,00	132,00	131,25	131,00	131,00	132,00	131,00	132,00	131,00	125,25	127,00		126,00	126,00	123,00	122,00	122,00	122,50	123,00			120,75	120,50	117,00	119,
■ 78,50	78,00	77,50	78,00	78,00	78,00	77,00	78,00	78,00	78,00	78,00		78,00	78,00	78,00	78,00	78,00	77,00	77,00			77,00	77,00	77,00	76,
34,25	34,75	34,00	34,00	34,00	34,00	34,25	34,125	34,50	34,75	35,00		35,25	35,00	35,00	35,00	35,00	34,50	34,50			34,00	34,00	34,00	34,
—	—	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—	—			—	—	—	—
104,00	104,00	103,00	103,00	103,00	103,00	103,00	103,00	103,00	102,50	102,50		102,50	102,50	102,00	102,00	102,00	102,00	102,00			101,00	101,00	101,00	101,
94,50	94,50	94,50	94,50	94,50	94,50	94,50	94,50	94,50	94,50	94,50		94,50	94,50	94,50	94,50	95,50■	92,00	92,00			92,00	92,00	92,00	92,
102 3/8	102 3/8	102 3/8	102 3/8	102 3/8	102 3/8	102 3/8	102,50	102,50	102,50	102,50		102,75	103,25	102,50	102,50	102,50	102,50	103,00			102,50	103,00	102,50	102,
132,00	131,25	130,00	129,00	128,50	129,50	129,50	129,50	129,25	128,00	127,00		127,00	127,00	125,75	125,75	125,25	124,50	123,00			124,00	124,00	122,25	122,
68,50	68,50	68,00	68,00	68,00	68,50	67,50	67,00	66,00	64,125	64,50		65,00	65,75	64,75	64,75	64,50	—	59,50			59,50	60,50	60,00	60,
103 5/8	103 5/8	103,25	102,75	102,75	102,75	102,50	102,50	102,50	102,00	102,00		102,00	102,00	101,50	101,25	101,00	101,00	101,00			100,50	100,25	100,00	100,
96,25	96,00	96,00	96,00	96,00	96,00	96,00	96,00	96,00	96,00	96,00		96,00	96,00	96,00	96,00	96,00	96,00	96,00			96,00	96,00	96,00	96,
96,00	96,00	96,00	95,50	95,50	95,50	95,50	95,25	95,00	95,00	94,50		93,00	91,75	92,00	91,00	92,00	92,00	92,00			89,75	89,00	89,00	89,
137,25	137,25	137,25	137,25	137,00	137,00	137,00	137,00	137,00	137,00	137,00		136,00	135,00	134,00	134,00	134,00	133,00	132,25			132,00	132,00	131,00	131,
202,00	202,00	202.00	202,00	202,00	202,00	202,00	202,00	202,00	202,00	202,00		202,00	202,00	202,00	202,00	202,00	202,00	202,00			202,00	202,00	202,00	202,
64,00	66,50	66,50	65,75	65,75	65,75	64,25	64,00	63,50	62,50	60,00		62,00	61,50	57,50	55,00	55,00	54,25	54,25			54,25	54,25	54,25	54,
100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00		100,00	100,00	100,00	100,00	100,00	100,00	100,00			100,00	100,00	100,00	100,
3,375	3,40	3,40	3,375	3,375	—	3,40	3,40	3,375	3,40	3,50		3,50	3,375	3,25	3,00	—	3,00	2,875			2,875	3,00	2,875	2,
138,00	138,00	138,00	138,00	138,00	138,00	138,00	138,00	138,00	138,00	138,00		138,00	138,00	138,00	138,00	138,00	138,00	138,00			138,00	138,00	138,00	138,
115,00	115,00	114,00	116,00	116,00	116,00	116,00	116,00	115,00	115,00	115,00		115,00	115,00	115,00	115,00	114,50	114,00	113,00			112,00	112,00	112,00	112,
140,00	138,00	135,50	134,00	132,50	132,50	132,50	132,25	135,00	139,00	143,00		144,75	145,50	146,00	145,75	145,75	144,00	141,00			140,00	138,75	137,25	137,
150,00	150,00	150,00	150,00	—	146,00	145,00	145,00	145,00	145,00	145,00		145,00	—	145,00	145,00	—	—	—			—	■137,75	137,75	137,
150,50	150,00	148,50	148,00	146,50	146,50	146,50	146,50	146,25	145,50	145,00		145,00	145,00	146,00	145,00	145,00	144,00	143,00			141,00	139,75	138,00	137,
189,25	189,00	189,00	189,00	189,00	189,00	189,00	189,00	189,00	189,00	189,00		189,00	189,00	189,00	189,00	189,00	187,00	187,00			187,00	186,00	184,50	184,
90,00	90,C.	90,00	90,00	90,00	90,00	90,00	90,00	90,00	90,00	90,00		90,00	90,00	90,00	90,00	90,00	90,00	90,00			90,00	90,00	90,00	90,
106,00	106,00	106,00	106,00	106,00	106,00	106,00	106,00	106,00	105,50	105,50		105,50	105,50	105,50	105,50	105,50	105,00	105,00			105,00	105,00	105,00	105,
109,75	109,75	109,75	109,75	109,75	109,50	109,50	109,50	109,00	108,00	108,00		109,00	109,00	109,00	109,00	108,75	108,75	108,75			108,75	108,00	108,50	108,
—			26,75	26,75	26,75	26,75	—	26,00		—		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]

Notes: We also hand-collect data on daily stock prices for the banks that were traded from the *Monatskursblatt*, published by the *Berliner Börsenpapiere* for 1931. These are monthly publications that contain daily stock- and bond-price information for stocks traded on the Berlin Stock Exchange. It tracks closing trading prices for each day of the month. Not all the banks in our sample are publicly traded or listed in on the Berlin exchange. We are able to match daily stock prices with balance sheet information from 24 banks covered in the *Reichsanzeiger*.