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Abstract

Why do some banks fail in financial crises while others survive? This paper answers this question by analysing the consequences of the Dutch financial crisis of the 1920s for 143 banks, of which 37 failed. Banks' choices in balance sheet composition, corporate governance practices and shareholder liability regimes were found to have a significant impact on their chances of experiencing distress. Banks bore a higher probability of failing if, on the eve of the crisis, they: were highly performing; were highly leveraged; had fewer interlocking directorates with non-banks; and concentrated their managerial interlocks with highly profitable banks. Banks which chose to adopt shareholder liability regimes with unpaid capital were more likely to experience distress, but could mitigate this risk by keeping higher portions of their equity unpaid. Receiver operating characteristic analysis shows that interlock characteristics in particular have a high predictive power.

JEL codes: G01; G21; G33; G34; N24

Keywords: financial crises; bank failures; interlocking directorates; shareholder liability; the Netherlands; the interwar period

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1. Introduction

In the early 1920s, after a period of exceptional economic growth, the Dutch economy suffered a protracted recession. Following Fisher's (1933) debt-deflation theory of great depressions, Jonker & Van Zanden (1995) argue that its principal cause was over-indebtedness combined with price deflation. Dutch businesses had benefited greatly from the First World War, a conflict in which the Netherlands remained neutral; a short post-war boom prolonged their prosperity. The large and sustained declines in aggregate demand and prices that followed were the consequence of falling export demand and monetary policy due to the gold standard. Debt-deflation put pressure both on Dutch businesses and on the banking sector that they relied on. Instability for banks has since been widely seen as constituting a financial crisis (Bernanke & James, 1991; Reinhart & Rogoff, 2009). Some banks failed; yet others did not. Jonker & Van Zanden (1995) estimate that 35 banks suffered financial distress in this crisis; De Vries (1989) puts the number closer to 70. Of the 143 banks considered in this paper, a sample that represents approximately 83 per cent of the nominal equity value of their sector, 37 suffered distress at some stage in the crisis.

This paper quantitatively investigates the determinants of this unequalled bank distress in the Netherlands by using discrete choice models to "predict the past". Bank-level accounting and corporate governance data included in a popular contemporary investor manual are used to assess how policy choices influenced the banks' fate. We ask how the banks' choices made before the debt-deflationary shock regarding balance sheet composition, corporate governance practices and shareholder liability regimes affected the banks in this period. Apart from being an unresolved historical question, finding an answer is interesting for four further reasons: (1) it facilitates the economic identification of the roots of bank distress because it forms a quasi-natural experiment of history in that its causes were largely exogenous, but its effects on the banking sector were partly determined endogenously; (2) the absence of prudential supervision in the Netherlands at the time means that this episode illustrates how banks may behave when there is little expectation of state

intervention; (3) we provide a more nuanced understanding of the causes and consequences of banking crises, in that we explore the timing of banks' distress and discriminate between their different strategies for resolving it; and (4) understanding bygone corporate governance practices and shareholder liability regimes aids policymakers who want new solutions to more recent financial disasters. The policy implications of this paper concern: (1) how banks should structure their balance sheet to weather a crisis; (2) how banks should structure their boards of directors to ensure business longevity; (3) how banks should cope with the inter-connectedness of the financial sector and the varying dependence of the industrial sector on their financial services; and (4) how shareholders might encourage bankers to behave in an *ex ante* risk-averse manner through the use of exotic liability regimes.

The Dutch crisis has already seen some important scholarship. De Vries (1989) gives a detailed historical narrative of its unfolding from the perspective of De Nederlandsche Bank (DNB), the Netherlands' bank of issue, which arguably began its journey to becoming a modern central bank in consequence of its actions in the 1920s. Jonker (1989, 1991) finds evidence consistent with the hypothesis that the close ties between bankers and their borrowers via interlocking directorates, a corporate governance structure that emerged in the country in the 1910s, soon extended the crisis from the non-financial to the financial sector. Colvin (2013) describes a case study of a universal bank in which conflicts of interest arising from one such interlock, in particular the accompanying direction of managerial influence, resulted in the near failure of the country's second-largest financial institution. Finally, Colvin (2011) provides evidence that, among the specialist banks for small-scale urban enterprise in the 1920s, those which in some way limited shareholder liability were more likely to fail.

The paper is closely related to various works in banking and finance, as well as in economic history. Most importantly, it relates to work on the causes and consequences of financial crises, a theme which, given recent bank failures, has lately been revived. Of specific relevance are Acharya et al. (2009), arguing that the possibility of state intervention might create moral hazard; Jordan et al.

(2010), claiming that, with such a possibility, the early identification of distressed banks is warranted; and Campello et al. (2010), measuring the impact of credit constraints on firm behaviour. Following Meyer & Pifer (1970), Martin (1977), and Pettaway & Sinkey (1980), we use bank-level accounting data, focusing on measures of capital adequacy, asset quality, managerial relations, earnings and liquidity. The methodology employed follows work which uses discrete choice models to determine why banks fail (Kolari et al., 2002; Kumar & Ravi, 2007). Closest to the Dutch case are writings on: (1) the consequence of management structure for bank performance, such that the size of a bank's board negatively affects costs and efficiency, as claimed by Simpson & Gleason (1999); (2) the risk implications of interlocking directorates between banks and their clients, where Kroszner & Strahan (2001) find that bankers sitting on the boards of their clients cause conflicts of interest, and, for Cooper & Uzun (2010), that bank risk is positively related to bank directors' holding multiple board appointments; and (3) the use of exotic liability regimes in banks, where Esty (1998) finds that banks which abide by stricter liability regimes are less risky, and Grossman & Imai (2013) find that contingent capital is better at reducing risk for banks with higher leverage.

Our principal results are as follows. First, we find that the balance sheet composition of banks before the crisis period had a significant impact on their probability of suffering distress in the 1920s. In particular, banks with lower shares of their assets in the form of long-term loans, and banks which were highly profitable, were at greater risk of suffering distress. We find that banks which suffered distress early and late in the 1920s had different attributes. Specifically, banks with more liquid balance sheets tended to suffer earlier and big banks suffered later. Moreover, general commercial banks are found to have been more likely to suffer distress than those which specialised in mortgage lending.

In testing whether the composition of banks' two-tier board structure had a significant impact on the probability that they would suffer distress, our findings complement the historiography of the Dutch crisis by exploring how interlocking directorates influence banks' performance. Banks with larger boards and more interlocking directorates had a higher probability of suffering. If we control

for the effects of a larger board and the attributes of such interlocks, we find that banks which concentrated their managerial connections in large, profitable, financial firms were more at risk. So were banks which concentrated their managerial interlocks in non-financial firms, but diversified this portfolio throughout many industrial sectors.

In a separate analysis, we find that 96 of the 143 banks in our sample had chosen a liability regime with portions of unpaid shareholder capital, and 22 of the 37 banks which experienced distress during the crisis. Our analysis suggests that banks bearing this extended form of liability adapted their balance sheets to compensate for their lack of equity. Subsequent regression analysis shows that, while banks which chose to extend the liability of their shareholders were more likely to experience distress, they could mitigate this effect by having higher portions of their equity unpaid.

The paper proceeds as follows. First, the historical and institutional context necessary to understand the arguments of this paper is introduced in Section 2. Our bank-level accounting and corporate governance data and the empirical strategy used in the analysis are discussed in Section 3. In Section 4 we define the variables used in our regression exercises and present their descriptive statistics, going on in Section 5 to discuss the results of our regression models for bank failure and resolution in relation to our *a priori* expectations. We next compare in Section 6 how well our regression models could predict the past and in Section 7 conclude by assessing the importance of a bank's corporate governance for its performance during a deflationary recession.

2. Historical and institutional context

At the turn of last century, the Netherlands' banks played second fiddle to the country's capital markets. Commercial banks were nothing like those in neighbouring Germany, where universal banks had emerged as a significant force in the Reich's financial machine (Fohlin, 1999). In fact, the Netherlands went in very little for banking: 64 per cent of the kingdom's money supply in 1913 was in the form of paper money, versus 37 per cent in Germany, 29 per cent in Belgium and just 4 per

cent in Britain (Van Zanden, 1991, p. 125). Jonker (2002) argues that the Netherlands had not produced out banks because its sophisticated financial inheritance could do without them. Amsterdam's merchants had developed a flexible credit source called *prolongatie*, a short-term credit instrument which demanded financial securities – primarily exchange-listed shares – as collateral. This highly liquid on-call money market, which operated in a similar way to modern repurchase agreements (repos), was unique to the Netherlands and outcompeted banks on cost. It enabled firms to meet both short-term and long-term credit requirements, as the instrument could be easily rolled-over.

From about 1911, in particular during the First World War, the country started to look more like a bank-based economy. Just before it, a wave of bank mergers had built sophisticated multi-branch networks with a wide portfolio of clients (Jonker, 1995). The *prolongatie* market gave way to bank finance when Amsterdam's stock exchange closed in 1914 due to the outbreak of war (De Vries, 1976).[1] The war itself and the subsequent short post-war economic boom hastened the move by banks to widen their services; they now took a direct part in industrial ventures, not merely bringing them to market. The regulatory regime at the time remained *laissez faire*: Dutch law did not prohibit commercial banks from engaging in investment banking, imposed no requirement on minimum bank capitalisation, and allowed banks to adopt various exotic shareholder liability regimes. Moreover, the country lacked a modern central bank; while De Nederlandsche Bank (DNB) as bank of issue monopolised the issuing of paper money, it was a private business answerable to shareholders, had no formal duty of regulatory oversight and neither a *de facto* nor a *de jure* function as a lender-of-last-resort in crises.[2]

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[1] Although the *prolongatie* market continued to be used after the war (Euwe, 2010), it never fully recovered.

[2] However, DNB supervised the banking sector in certain informal ways: (1) its governors were traditionally sent news of changes in the board composition of all Dutch financial institutions; and (2) it could choose the financial terms for its short-term debt instrument, access to its bill rediscounting facility. The latter was especially controversial at the time; some private banks complained that it was abusing its position as the Dutch state's bank of issue. With its monopoly over the printing of paper money, it could allegedly offer loans at terms no private bank could match (Communication between the director of the Bond Geld- en Effectenhandel and the Minister of Finance, December 1917,

By tradition, Dutch firms employed a dual board structure similar to the German model, with a management board made up of *directeuren* (executive directors) and supervisory board of *commissarissen* (non-executive directors).[3] Jonker (1989, 1991) uses the number of interlocks between banks and industry to measure their scope. He argues that an increase in interlocks suggests a move towards universal service provision, where banks simultaneously do business as both commercial and investment banks, since banks install directors in the firms which they finance. He argues that bankers sitting on the board of multiple firms positioned themselves as "bearers of capitalism" able to control Dutch economic development.[4] He finds that in the early 1920s interlocks more than doubled, from 200 in 1920 to 431 in 1923. Many of these were due to changes at the Netherlands' second-largest bank, the Rotterdamsche Bankvereeniging (Robaver): from 20 interlocks in 1910 to 127 in 1923.[5] But the trend included many more: De Jong & Röell (2005, p. 497) find that in 1923 the proportion of non-financial exchange-listed firms with no bank interlocks was 40 per cent, while 22 per cent had one interlock, 12 per cent had two, eight per cent had three and 18 per cent more than three.[6]

The structure of Dutch banking changed quite significantly over the first two decades of the twentieth century, with an increase in concentration, the market entry of new banks, and the adoption of a universal banking business model by some incumbents. However, the scale and scope of the Netherlands' banks remained highly diverse. Although the size of the five largest banks increased in

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Archief van de Bond voor de Geld- en Effectenhandel te 's-Gravenhage, Access No. 2.19.042.14, Nationaal Archief (henceforth NA), The Hague).

[3] Members of both boards were normally appointed at shareholders' meetings on the advice of sitting *directeuren* (De Jong & Röell, 2005); as a rule, their appointment could be assumed.

[4] Jonker revisits earlier notions of the relevance of interlocking directorates put forward by Wibaut (1913), who argues that the Netherlands' largest banks were gradually starting to dominate the economy by buying equity stakes in industry and increasing credit supply. Wibaut sees this as a conscious strategy by the bankers to strive for hegemony, which led to a prominent role for them in the decision making process of industrial firms.

[5] This was described on the eve of the crisis by the son of Robaver's president as part of an expansionary strategy to emulate Germany's universal banks (Westerman, 1920).

[6] Most interlocks were between the supervisory boards of banks and non-financial firms (47 per cent), but a substantial portion involved a *directeur* of a bank sitting as a *commissaris* of a non-financial firm (29 per cent).

relation to the rest, they by no means dominated;[7] a host of smaller, often specialised, banks co-existed. These included smaller *algemene banken* (general commercial banks), such as the Rotterdam-based Marx & Co.'s Bank and the Amsterdam-based Bank-Associatie and Algemeene Spaar- en Depositobank. Like Robaver, these too operated as full-service financial firms, but to smaller geographical markets. Other players included: private banking houses, such as Hope & Co.; unit-independent provincial banks offering a narrower range of services, such as bill discounting; and scores of specialist mortgage banks. Cooperative rural banks (*boerenleenbanken*) and banks for small-scale urban enterprise (*middenstandsbanken*) were emerging with the turn of the century. A handful of overseas banks also operated as free-standing companies servicing firms in the Dutch colonies.

Between 1920 and 1924, De Vries (1989) counts the (near-) failure of at least four *algemene banken*, including the country's second-largest bank, 26 provincial banks and two overseas ones. He estimates that at least 200 million guilders was lost between 1920 and 1922, a figure largely confirmed by our research.[8] The history of Marx & Co. and Robaver are particularly enlightening: the former for DNB's (lack of) involvement when it failed in 1922; the latter for the poisonous relationship between the bank and the non-financial firms which it had helped to finance (Colvin, 2013). Jonker (1991, 1995) argues that many banks performed badly because they lacked the knowledge and experience to finance industries. He concludes that the crisis caused a loss in business confidence and eventually to a retreat from the universal banking business model. In addition, Colvin (2011) contends that banks that chose extended shareholder liability regimes – such as double liability, or systems of paid and unpaid capital – stood a better chance of surviving the crisis.

[7] The Netherlands' Big Five comprised: Amsterdamsche Bank, Incasso-Bank, Nederlandsche Handel Maatschappij, Rotterdamsche Bankvereeniging and Twentsche Bank. All five eventually merged into what is now ABN AMRO (De Vries et al., 1999).

[8] This is likely an underestimate of the true damage done: just the 18 banks in our sample which failed outright were valued at 208 million guilders immediately prior to the crisis, approximately 1.2 billion euros in today's money.

The purpose of the present paper is to use quantitative measures to explore the causes of the 1920s crisis. Existing hypotheses here largely rely on narrative histories and case study evidence. While each story is individually convincing, its part in the whole is unclear. How did management structures affect bank performance? How far did the links between banks and clients influence the ability to weather the crisis? And did the various shareholder liability options available to banks militate for or against the effects of debt-deflation? The method and sources used in this paper allow us to put these questions side-by-side in one analysis; we can then judge the relative value of competing hypotheses on the causes and consequences of the Dutch crisis.

3. Data and empirical strategy

We use discrete choice models to estimate whether pre-crisis bank-level characteristics can predict crisis-period performance. Our dataset contains information on a sample of banks extracted from the 1920 and 1921 editions of the *Van Oss Effectenboek*, an investor manual published annually. Our data pertain to the fiscal year 1917, which we choose for two reasons: it is the last stable year preceding the crisis, and it is the year in which bank-level data are available for the largest number of banks. We differentiate between banks which suffered distress and those which did not. Among the former, we distinguish banks which failed outright, from those which were rescued through merger and those which continued after their balance sheet was restructured.

The *Van Oss* investor manuals are very useful sources for the present study because they bring together balance sheets, profit-and-loss accounts and detailed corporate governance information. Moreover, they include the banks' location, year of foundation, corporate statement, stock listing, stock prices and executive compensation levels. Our sample constitutes all the financial institutions for which sufficient data were available in *Van Oss* and includes the vast majority of banks that were listed on Amsterdam's stock exchange during the period, together with other banks which the manual's compilers felt were important enough to mention. Our database comprises 143

unique banks, where we distinguish between general (commercial) banks, specialized mortgage banks and shipping banks that specialized in financing shipping companies. These 143 banks amount to 89 per cent of the banks in the Netherlands counted by *Van Oss*, which come to 83 per cent of the sector's nominal equity capital.[9] Not all the banks listed in the guide are included in the sample; some of them provided incomplete data, because financial information was supplied voluntarily.

We standardised and converted the accounting information detailed in the *Van Oss* to match the categories used in modern balance sheets and profit and loss accounts, in order to facilitate comparative financial ratio analysis. Table 1 shows the balance sheet of Marx & Co as an example of the sector including both non-standardised (Panel A) and standardised (Panel B) balance sheets. Table 2 summarises the relative importance of various balance sheet items for the 143 banks in our sample. Our Data appendix elaborates on the data gathering and conversion process.

In addition to reporting financial accounting data, *Van Oss* supplies comprehensive lists of all the banks' directors, i.e. *directeuren* and *commissarissen*. We digitised and cross-referenced these lists with all other banks and non-financial firms in the same fiscal year to map any interlocking directorates in this period. *Van Oss* also reports the distribution of profits to these directors and supervisors in the form of *tantièmes* (cash compensation). This was the only information about their pay which was published at the time, but it is an imperfect indicator of executive compensation; evidence suggests that banks also remunerated their executives by granting them privileged access to new stock issues – a form of insider dealing permitted by law.[10]

[9] We exclude DNB and Javasche Bank from our sample since they acted as *circulatie banken* (banks of issue) for the Netherlands and the Dutch East Indies, including these banks would substantially increase the percentage of the sector's nominal equity capital covered by our data.

[10] A cursory glance at the new issues books of Robaver reveals that privileged insiders had first rights to any new public offering at a discounted price. These insiders included bank managers, but also past and future customers (Inv. No. 1090-1105, Archief van het Hoofdkantoor van de Rotterdamsche Bank NV, Access No. 2.17.33, NA).

Figure 1 shows the weighted stock price index of distressed and non-distressed banks,[11] along with the Net National Product at factor costs,[12] illustrating the depth of the crisis. The figure confirms that the choice to select 1917 as point of reference for the prediction is justifiable on the grounds that it offers a middle road between setting the date too late and thus already incorporating crisis effects, and setting it too early and not finding results because data are not representative of the pre-crisis conditions. Stock prices typically contain forward-looking information. In 1917, the stock prices are still at levels comparable to previous years and the major changes only set in after 1920. The Net National Product is growing at a stable pace. Dating the crisis period is controversial. Bernanke & James (1991) date it to 1921 to 1922 only, while Colvin (2011) considers the period 1920 to 1927. This much longer period is preferable, because signs of bank distress were observed long after the Dutch economy had stabilised and some problems caused by the crisis took many years to be fully manifest. Figure 1 suggests that the recovery of the banking sector began only in 1926. The longer period encompasses the earliest signs of bank distress before the major failure of Marx & Co.'s Bank in 1922, extends the period beyond the Robaver debacle in 1924 and finally includes the government-backed reorganisation of the *middenstandsbanken* in 1927, which forever changed expectations about the role of the state in crisis resolution in the Netherlands, as such we follow Colvin (2011) and date the crisis from 1920 to 1927.

The four sources used in the construction of the dependent variables, which measure distress through liquidation, merger or reorganisation, are: (1) Kramer (1926), a PhD dissertation on firm reorganisations during the crisis period; (2) De Vries (1989), an official history of DNB in the crisis

[11] Stock prices (including dividends) are weighted to reflect a hypothetical portfolio which includes all the listed financial firms according to the book value of their equity on 31 December 1917. Our index therefore reflects what a possible investor who composed his portfolio in 1918, and kept this portfolio fixed, would observe when looking back at his investments.

[12] Net National Product (NNP) is the sum of employees, proprietors, rental, corporate, interest, and government income less the subsidies which government pays to any of those groups, plus or minus the aggregation discrepancy. 1913 is the base and reference year (1913 = 100). Deflator spliced at 1920-1921. NNP and population from Van der Bie & Smits (2001). Deflator from Van der Bie (1995) for 1913-1920, and Den Bakker et al. (1990) for 1921-1929.

period, using the archives of this bank; (3) DNB (2000), a list of all banks operating in the Netherlands throughout the nineteenth and twentieth centuries; and (4) news and commentary from the financial press compiled by the authors from an online newspaper database.[13] Each has its advantages and disadvantages. Source (4) is particularly useful; unlike the others, it enables us to identify the banks that suffered in the crisis period and needed to be reorganised financially, but did not exit the market altogether through liquidation or merger. Table 3 provides an overview of the complementarity of the sources used.

We supplement our dataset with data on 232 non-financial corporations pertaining to the fiscal year 1917. We use this non-financial accounting data to construct firm characteristics, which are then averaged across the firms that share a managerial connection with a bank through interlocking directorates. This lets us capture any specific interlock characteristics which influence the behaviour of financial corporations in our dataset. Consequently we can quantify the effect of interlocks hypothesised by Jonker (1991) by relating firm characteristics including size, leverage and profitability, to the interlocks held by banks.

The median non-financial firm in our sample has three million guilders in assets, financed by 34 per cent of debt, generating a profit of five per cent. The data on the non-financial sector are dominated by industrial firms (20 per cent) and free-standing companies with foreign agricultural businesses (24 per cent). Indeed, the median profitability of non-financial corporations is driven by the profitability of these overseas agricultural corporations (6.6 per cent). We use this information to estimate the effect the banks' exposure to non-financial firms had on their probability of experiencing distress during the 1920s.

4. Variables and hypotheses

As our core dependent variable indicating distress, we define a dummy variable which equals one if

[13] The Koninklijke Bibliotheek's searchable historical newspaper collection is available at: http://kranten.kb.nl.

and only if a bank experiences distress in the period 1920 to 1927, the core crisis period. We define three mutually exclusive types of distress: liquidation (including bankruptcy), merger and reorganisation. Figure 2 is a timeline of bank distress for the period 1920 to 1927. Notice that the crisis came in two phases: 1920 to 1922 as the first phase of bank distress, when a high proportion of failures were resolved through merger; and 1923 to 1927 as the second, when by far the most crisis-stricken banks looked to financial reorganisation.[14]

The modern literature describing bank failures and their determinants focuses on several categories of explanatory or predictive factor. We selected the most appropriate indicators from it and adapted them to the historical context. Where possible, we also constructed measures similar to those used by contemporary financial observers who directly witnessed the 1920s banking crisis. We define eight categories of dependent variable, inspired by the modern CAMELS Rating System (Thomson, 1991): (1) asset quality; (2) loan book quality; (3) capital adequacy; (4) earnings sufficiency; (5) liquidity and solvency; (6) capital structure; (7) management structure; (8) shareholder liability structure.

Table 4 reports by category concise definitions of all the variables used in the regression analysis. We use the variable of size (natural logarithm of total assets), which proxies for a possible "too big to fail" doctrine and of age (natural logarithm of the difference between the year of foundation and 1917), which proxies for banks' asset selection experience (Tornhill and Amit, 2003). For *loan book quality,* we use the ratio of short-term loans outstanding to total assets (Martin; 1977, Thomson; 1991). With respect to *capital adequacy,* we use a working capital ratio and measure the equity reserves as a proportion of total assets (Cielen, 2004). For *earnings sufficiency,* we use return on assets and a measure of interest rate dependency (Kolari et al., 2002). For liquidity and solvency,

[14] We used alternative specifications of these phases in order to explore the possibility that distress events which became public in 1923 might merely have hidden the banks' problems longer. We find that banks which were seen to be affected by the crisis in 1923 were more likely to: (1) have no interlocking directorates with DNB; and (2) be interlocked with more profitable and bigger non-financials. We conclude, therefore, that banks that experienced distress in 1923 had more in common with banks which experienced distress after 1923.

we capture the liquidity of banks' assets by calculating a current ratio and measure how well banks manage to match the maturity of their assets with the maturity of their financing instruments, a measure popular among contemporaries (Verrijn Stuart, 1921; Klijnveld, 1922; Sternheim, 1925). Additionally, we posit that banks that were stock listed were more liquid (Edelman and Baker, 1990). To capture the effects of differences in *capital structure* we use total leverage (debt to total assets) and deposits to total assets (Zmijewski, 1984).

Two sets of variables are specifically relevant to the Dutch case. First, we quantify the impact of banks' interlocking directorates with industrial firms and other financials in order to reassess the hypotheses advanced in Jonker (1991). Second, we evaluate whether shareholder liability arrangements matter for bank stability, a hypothesis developed in Colvin (2011) for the case of banks set up for small-scale enterprises. We explore these in more detail below.

We argue that management structure may play a significant part in the performance of banks. We introduce managerial influences by looking at the interconnectedness of banks and the connectedness of banks and non-financial firms.[15] Interlocking directorates refer to a corporate governance structure whereby directors serve on the boards of multiple firms. Interlocking directorates measure two things: (1) the relative independence of a bank or firm's board, since banks or firms which have more interlocking directors may have a higher chance of suffering from conflicts of interest of bankers on the board (Kroszner & Strahan, 2001); and (2) the influence of banks, where banks with more interlocks are potentially more powerful in terms of financial and industrial dominance. Jonker (1991) argues that the connectedness of banks and non-financial firms aggravated the crisis by creating conflicts of interest and by exposing them financially to industrials – interlocks were usually the consequence of financial linkages through debt or equity. We use

[15] In the ensuing analysis of interlocking directorates, we treat connections involving either *directeuren* or *commissarissen* as identical; we found that separately measuring interlocks involving each tier of banks' management boards did not affect our results and yielded no additional insight.

measures of asset size, asset size concentration, leverage, profitability and industry concentration averaged across interlocks in order to quantitatively examine Jonker's hypotheses.[16]

Dutch banks were able to adopt various shareholder liability regimes. A substantial majority did not limit liability to shareholders' initial inlay, as is the norm today; they used systems of paid and unpaid share capital, where the unpaid portion could be called if certain conditions were met, such as the threat of liquidation, or, in extreme cases could be recovered in a bankruptcy court. Some 67 per cent of banks chose to adopt some sort of extended liability. A wide variety of such regimes existed, ranging from only one per cent unpaid share capital to the maximum of 100 per cent.[17] The mean bank in our sample had 25 per cent of its share capital left unpaid, suggesting that its shareholders would stand to lose additional assets if it called upon them to put up more money.

The potential effects of these non-standard liability regimes are contradictory. On the one hand, standard asset pricing models view limited liability constructs as a call option because shareholders can walk away from their investment, leaving any remaining debts to creditors; they are uninterested in downside risks (Evans & Quigley, 1995). Extending liability beyond the limited case thus means that shareholders act like debt-holders should their bank call its unpaid share portion; shareholders here are acutely interested in their bank's downside risks and so may be less willing to support risk-loving managers. In line with Esty (1998) and Grossman & Imai (2013), who find that banks with increased liability provisions tend to take fewer risks because shareholders have an incentive to monitor their bank's board, we hypothesise that Dutch banks with unpaid equity capital were probably more risk-averse and thus were less likely to end up in distress.

[16] *Van Oss* lists eleven industrial categories: (1) industrial; (2) agriculture; (3) mining; (4) oil; (5) rubber; (6) shipping; (7) tobacco; (8) tea; (9) railways; (10) tram transport; and (11) various. To calculate the characteristics of the interlocks we use balance sheet characteristics of banks or non-financial firms and construct a value weighted average using total assets at the beginning of 1918 for each. With respect to the size concentration, we use a Herfindahl-index, which uses the portion of each interlock's total assets relative to the total amount of assets of interlocked banks or non-financials. With respect to industry concentration, we use a Herfindahl-index, where the share of banks' interlocks in each industry is used.

[17] Only two banks used the single liability regime in which they left the full equity capital unpaid: Veendammer Hypotheekbank and Vaderlandsche Hypotheekbank.

On the other hand, we surmise that banks which had a higher portion of their equity capital left unpaid faced a higher probability of being liquidated or going bankrupt because their financial resources would be depleted more quickly, rendering them less financially flexible. As a consequence of these banks initially having a large proportion of their capital unpaid and therefore illiquid, we expect that there may be a positive relationship between unpaid equity capital and the probability of overall distress.

Among the second order consequences, there are indications that some banks permitted voluntary equity top-ups to be made by shareholders and that these banks had limited (and fixed) claims on annual dividends; we therefore expect any relationship to be non-linear. Thus we use a dummy variable to capture the effect of the liability regime choice and use the portion of equity capital paid to capture the incremental effect.

5. Understanding bank distress

This analysis is conducted in six parts. First we analyse the determinants discussed above in a univariate setting, distinguishing between different sub-samples on the basis of distress timing and resolution. In the second, we develop our baseline model, comprising core variables popularly used in studies of bank distress. Additionally we investigate whether there are any systematic differences between banks which failed early and those which failed late in the crisis period. In the third exercise, we analyse whether there are systematic differences in the survival of different types of bank and in different geographical markets. In the fourth exercise, we focus on the two categories of variable – management structure and the characteristics of interlocked firms – which are included to investigate the specific hypotheses proposed in this paper and to quantitatively re-evaluate the historiography of the Dutch crisis. In the fifth exercise, we ask how banks' choice of liability regime affects the probability of their distress. Finally, robustness exercises are reported which test the sensitivity of our results to changes in the composition of our sample and to extra control variables

which could not be calculated for the full sample.

Table 5 summarises the mean values for all variables as specified across the full sample of 143 banks and the various sub-samples. We find that general commercial banks make up the largest portion in terms of asset size, while mortgage banks dominate in terms of number. Mortgage banks were highly specialized in long-term funds, unlike general banks, which held approximately equal totals of short- and long-term loans. We find that general banks were better able than mortgage and shipping banks to match the maturity of their assets with their liabilities and held significantly higher amounts in deposits. Furthermore, general banks interlocked with non-financial corporations significantly more directorates than more specialised banks did. We find that banks which chose a regime leaving some portion of shareholder equity unpaid were significantly smaller and more liquid than the others (in terms of assets) and tended to be unlisted. Table 5 also presents statistics for sub-samples for executive pay and by liability regime.

5.1 A univariate analysis of bank distress, timing and resolution

Table 6 reports the mean and median values of all variables as specified across the full sample of 143 banks, categorised by distress experience during the 1920s. We find that banks which experienced distress during this period were younger and more likely to have a stock listing and more in deposits. Additionally we see that banks which did not suffer distress held more working capital, were more liquid, were interlocked with larger non-financial corporations and had a regime which left shareholder equity unpaid. When we separate the early distress events (1920 to 1921) from the late (1923 to 1927), we find that: (1) banks which matched the maturity of their (short-term) assets with that of their (short-term) liabilities were more prone to debt-deflationary shock and subsequently suffered distress earlier; (2) banks which had fewer interlocking directorates experienced distress earlier; and (3) banks which had interlocking directorates with large banks were more likely to experience distress during the latter part of the crisis.

Table 7 reports the mean and median values of all variables as specified across the sub-sample of 37 banks which suffered distress, separated by the manner in which they resolved this. We find that the largest and the smallest banks tended to be reorganised, while the medium-sized ones tended to be liquidated. Additionally, we find that banks which had invested deeply in long-term loans were more likely to be liquidated or reorganised, whereas banks which held substantial deposits were more likely to be reorganised. More important in determining the manner of resolution, however, are the interlocking directorates: (1) banks which had more interlocking directorates were more likely to be liquidated or reorganised than merged; (2) when compared to the banks that were forced to merge, the banks which were liquidated were the ones which concentrated their interlocks with larger banks and were interlocked with highly levered banks; and (3) the banks which were merged were more often interlocked with non-financial corporations.

5.2 Developing a baseline model of distress

A series of seven regressions are reported in Table 8. We examine the effect of five categories of variable independently and then together. Model 1 is concerned with the quality of banks' assets; Model 2 with banks' loan quality; Model 3 with banks' capital adequacy; Model 4 with the sufficiency of banks' earnings; and Models 5 and 6 with liquidity and leverage. Model 7 combines the previous categories and constitutes the baseline model in all further regression analyses. We briefly discuss this baseline model (Model 7) and the fundamental variables below.

Asset quality: We find that larger banks were more likely than others to experience distress in the 1920s. This refutes the claim made by one contemporary observer of the crisis (Verrijn Stuart, 1921) that larger (and possibly better diversified) banks would be better able to weather a crisis. We find that a bank's age is consistently important, even after controlling for potential non-linearity. The relationship suggests that the older banks were more likely to survive the 1920s, each additional year of business reducing by 13 per cent the probability of experiencing distress. A possible explanation is

that their directors had more experience of bank management (for example, in terms of experience of asset selection) and were therefore better equipped to navigate through a crisis.

Loan quality: The quality of a bank's loan book is a very important determinant of crisis-period failure. Banks with a higher proportion of their balance sheet made up of (long-term) loans outstanding had a lower probability of distress – 10 per cent more chance for every one per cent of its loans. Banks investing more in short-term loans were also less likely to experience distress during the 1920s – 0.6 per cent more change for every additional guilder in their short-term loans. Note, however, that this risk reduction is significantly lower than the 12 per cent for their long-term loans; hence it could be argued that short-term loans were inherently more risky in the 1920s, much in line with an inverted-interest yield curve (Harvey, 1989).

Capital adequacy: To begin with, the size of a bank's working capital relative to its liabilities negatively affects the probability that it will experience distress – good working capital ratios signal high quality. Second, we find that banks' financial flexibility in terms of reserves is negatively related to the probability of distress – more reserves indicate a higher level of financial flexibility which can be used to better weather a deflationary shock, where an increase of one per cent in equity reserves (at the median) results in a risk reduction of 75 per cent.

Earnings sufficiency: Banks' dependency on interest income and expenses has virtually no effect on the probability of experiencing distress. However, banks' profitability (returns on assets) increases the probability of distress, implying the riskiness of banks' operational activities (cash flow risk). This may be explained by the theory of "crisis cycles", where periods of modest growth lay the foundation for the next crisis (Thakor, 2012). Supporting the claim of "crisis waves", we find that banks were more profitable and were more highly valued before the crisis of the 1920s; from 1916 to 1919, the stock prices of banks which would go on to experience distress increased by about 10 per cent (0.6 per cent for non-distressed banks). This suggests that the banks which did best out of the post-war settlement had most to lose in any ensuing economic reversal.

Liquidity: With respect to liquidity, we find that banks which were more dependent on less liquid assets were more prone to experience distress during a deflation. The same is found for banks which were better able to match the maturity of their assets; these banks were less prone to the risk of deflation and less likely to experience distress. Moreover, we find that banks which had their stocks listed on Amsterdam's stock exchange were more likely to experience distress, as their liquidity and thus their market liquidity risk increased (Kalev et al., 2003).

Leverage: We find that banks which were more highly levered (in terms of total debt, deposits or bonds) stood a higher chance of falling into distress. This confirms the conjecture of Jonker & Van Zanden (1995) that this was indeed a deflationary crisis. Additionally, we find that holding additional deposits increased the risk of experiencing distress – by 51 per cent for each per cent increase (relative to the asset base).

5.3 Accounting for the effects of region and bank type

We include various dummy variables in Table 8 to capture regional (inter-bank lending and geographic specialisation) and bank type (business model) differences in the experience of the 1920s. We use Model 13, a combination of these, in all subsequent regressions.

Regional fixed effects: Banks located in Zuid-Holland, Noord-Holland and Groningen had a higher probability than banks from other provinces of experiencing distress. With respect to the baseline model, the following changes occur after correcting for regional fixed effects and city fixed effects: (1) there is a significant change in the effect of size when including regional effects, indicating that the largest banks are concentrated in particular regions and cities; and (2) banks' involvement in long-term loans becomes significant after controlling for city fixed effects, indicating that the business of granting loans may have been concentrated in the banks' home cities. When credit takers live close to lenders, it is easier to monitor their progress. Part of the effect of having more reserves as protection against exogenous shocks derives from regional differences. The

leverage effect is significantly influenced by region and city fixed effects, indicating that banks in the same region would lend to each other. Banks' level of leverage also appears to have differed by region.

Bank type fixed effect: Compared to shipping banks, commercial banks and banks which specialised in mortgage business stood a lower chance of going into distress. This can be explained by the business model of any given bank, since mortgage banks were more prone to domestic shocks and shipping banks would have been highly sensitive to the international trade demand.

Controlling for all fixed effects: We find that general commercial banks and, in particular, mortgage banks had a lower probability than shipping banks of going into distress, even after controlling for regional fixed effects. In addition, we find that banks' characteristics – such as having their stock listed in Amsterdam, their asset liquidity, their leverage and the amount of deposits they held – were significantly influenced by their type and their operating region. Thus, we find that it is relevant here to include fixed effects in subsequent regressions, where the type effects in particular show a significant impact in risk reduction in the range of 11 to 21 per cent in the case of the median bank.

5.4 Re-evaluating the causes of the Dutch crisis

Table 10 shows the results of the logistic regressions with respect to our hypotheses, where Model 14 encapsulates the effect of banks' management structure on the probability of experiencing distress during the 1920s; Model 15 focuses on the characteristics of interlocked banks; Model 16 relates to the characteristics of interlocked non-financials; and Model 17 combines all these effects.

Management structure: We find that high board size significantly reduces the probability that a bank would experience distress during the 1920s. We suggest that a larger board signifies increased experience on the part of members; a bank possessing it has more "in-house experience" to cope with crisis situations; consequently a one per cent increase in board size results in a reduction of distress

probability in the range of nine to 19 per cent.[18] Second, we find that the banks which were interlocked with many non-financials were significantly less prone to the effects of the 1920s crisis. In contrast, we find that those banks which were more interlocked with other banks (i.e. which had board members who were directors of other banks), they were significantly more prone to experience distress, indicating a conflict of interest for boards at the time – supporting the claim of Colvin (2013) and much in line also with Ferris et al. (2003).[19] We also find that having a banker from DNB on the board had no significant effect and what effect it had was comparatively small.

Characteristics of interlocked banks: We find that there are diversification properties in having interlocked directors or supervisors, since the average size of the interlock (in terms of total assets) was observed to have a negative effect on the probability of experiencing distress. However, we find that, as banks concentrated their interlocks with primarily large firms, the risk to them increased significantly, inherently increasing the risk profile of their operations by making them dependent on a couple of other big banks. The adverse effect of increased concentration is ten times greater than the effect of an increased size of interlocked banks. We find that the average leverage of interlocked banks, despite being marginally non-significant at standard levels of significance, increases the chance that a bank will experience distress. This finding is best explained by the correlated solvency of the banking sector, which is dependent on the welfare of the industry. This view is supported by the finding that the profitability of interlocked banks before the crisis was an

[18] Board size is constructed as the total number of directors and supervisors on the board of a bank. Making a distinction between directors and supervisors does not yield any systematically different results. The results remain robust after controlling for potential non-linear properties.

[19] In an alternative specification, board independency (measured by the ratio of directors to supervisory board members on the board), has only limited (non-significant) influence on the probability of distress. It can be argued that board size influences the number of interlocks and the relation between the characteristics of the interlocks and the probability of distress. However, removing board size from the analysis in Model 18 has an impact only on the variables of stock listing and liquidity. We argue that the main cause of this is that bankers explicitly prefer to sit on the boards of listed and highly liquid banks, because: (1) there is more money to be earned from stock market trading (pointing to insider trading); (2) there is a reputation effect since banks with high liquidity subsequently manage more assets, which is deemed prestigious.

important factor in determining the probability of distress during the 1920s, since the cash flows of the banks were naturally correlated.

Characteristics of interlocked non-financial firms: We find that banks which were interlocked with highly profitable non-financial corporations (in 1917) were more likely to experience distress. This can be explained by the immense post-war increase in the assets of the industrial sector. The demand for industrial goods immediately following the end of the First World War increased significantly and consequently raised the demand for industrial credit. This rapid growth put considerable strain on the operating risk to non-financial corporations; thus, when entire industries were unable to make due loan payments, their banks suffered. We find that banks which had concentrated their interlocking directorates in a limited number of industries (i.e. were highly concentrated) were less likely to experience distress, the effect ranging from a 20 to a 25 per cent increase in distress probability for each percentage increase in concentration in a particular industrial sector. As the leverage of the interlocked firms increased, the risk of contagion followed, increasing between 26 and 35 per cent for each percentage of leverage increase. Although it is not significant at standard levels of significance, this observation is consistent with the verdict that the 1920s' depression was at root a debt deflationary crisis. Additionally, we find that the level of dilution of control that a bank experiences on the board of interlocked non-financials significantly increased the probability of experiencing distress during the 1920s. Because non-financials had larger boards, banks could exert less influence in board meetings.

In summary, we find evidence that Jonker (1991) was correct in believing that interlocks added to the risk for banks. However, we show that Jonker's ideas can be expressed more precisely in terms of the characteristics of interlocked banks and non-financial firms, such as firm size, leverage, profitability and (industry) concentration.

5.5 Explaining the influence of exotic liability regimes

The Dutch financial sector of the early twentieth century was characterised by a wide variety of banks with different regimes for shareholder liability.[20] Much like the British and Irish banking sectors during the nineteenth century (Hickson and Turner, 2003; Hickson et al., 2005), many banks in the Netherlands, from our evidence, chose some form of shareholder liability regime which left unpaid some portion of the equity capital. We find that 67 per cent of the banks in our sample chose this and that these banks left on average 25 per cent of their equity capital unpaid, even though there is a large variation in the portion of unpaid capital.[21] We argue that the liability regime choice made by the different banks significantly affected their business model, showing that the liability regime choice had a significant effect on the way that profits were redistributed and dividends paid.[22] We define banks as having some form of extended shareholder liability regime if they had a portion of equity capital left unpaid and we capture the incremental effect by calculating the size of this portion.

Table 11 reports that banks with a liability regime in which there was equity capital left unpaid were significantly different in terms of their balance sheet characteristics, management structure and interlocking directorates. Given the number of differences and the size of these differences, it is very likely that banks' liability regime choice determines from the outset how a

[20] The description in this section is based on research collected from annual reports, statutes and investor prospectuses in DNB's archive, for banks operating in the Netherlands (Archive Section No. C.00.01, Archief van De Nederlandsche Bank NV, Access No. 2.25.08, NA).

[21] Some banks compelled all their shareholders to pay only a certain percentage – usually about 20 per cent – which resulted in equal dividend payments for all shareholders. These banks had provisions that, if more of the capital needed to be paid up, they would advertise it in the papers (usually three months before the payment was due). To make sure their shareholders paid the outstanding proportion, banks warned that they would publish the names or at least the registry numbers of the shares of shareholders who failed to pay their dues. If the payments were not received before a certain deadline, these shares would be cancelled and re-sold.

[22] Dividends were sometimes paid according to the portion of equity paid by shareholders; e.g. the Noord-Amerikaansche Hypotheekbank stated that: 'dividends will be distributed among shareholders according to the number of shares they own with a maximum value of five per cent of the value of equity capital paid' (*Algemeen Handelsblad*, 22 June 1916, p. 4). Some banks required their shareholders to pay only a minimum proportion of their shares, sometimes as low as 10 per cent, and permitted them to top this up as they desired. The dividend on the required portion was higher than on the voluntary proportion.

bank is structured and how it executes its business model. This is similarly argued, with different data, in Colvin (2011). Most striking here is that banks with unpaid equity capital have similar levels of profitability and board sizes, but substantially fewer interlocking directorates. Moreover, we find that banks with unpaid equity capital are younger, smaller and tend to be unlisted. We argue that banks which had portions of their equity capital left unpaid were less liquid, due to limited tradability and transferability (Woodward, 1985) and hence did not have their stock listed in Amsterdam.

We subsequently construct a new baseline model using all the balance sheet, management structure and interlock variables which were not affected by the liability regime choice. Table 12 summarises the new baseline model in Model 18. Model 19, which includes all the variables from Model 18, relates to the liability regime choices made by banks, captured by a dummy variable which equals one if and only if there is equity capital left unpaid. Model 21 focuses on the portion of equity capital left unpaid.

We find that banks which chose to extend the liability of their shareholders beyond their paid proportion were more prone to experience distress; this may be explained by reflecting that banks which could call on their shareholders to pay an additional portion of the equity capital had easy access to new financing, an effect which could range between two and nine per cent. Most interestingly, we find that banks which had a higher percentage of their equity capital left unpaid were less likely to experience distress during the crisis, where an increase of unpaid capital by one per cent resulted in a lower probability of distress, with about 32 per cent at the median. This result seems to contradict the previous effect. We can reconcile the two results as follows. First, banks which already had *all* their equity capital paid up had less of an equity buffer to protect them and thus had less capital available to weather a crisis. Second, banks which had *higher* portions of their equity capital left unpaid may have been more closely monitored by their shareholders, as they stood to lose more of their capital if the bank called on their remaining portions of equity. This finding is in line with Esty (1998) and Grossman & Imai (2013), who find that banks with extended liability regimes tend to take less risk because shareholders have an incentive to monitor the board.

In Models 20 and 22 we run a horse race between the liability variables and the bank characteristics that are influenced by the regime choice, in order to measure whether the initial regime choice or the potentially consequential policy choices drive the distress likelihood. We find that the regime effects turn insignificant. This finding is consistent with a notion of path dependency where liability regimes shape bank policies and these policies determine survival chances.

5.6 Additional results and robustness analyses

In this section we report a number of additional results and analyses to determine whether our findings are robust to alternative model specifications and sample selection bias. We develop models which focus on: (1) banks which report executive compensation metrics; (2) banks for which sufficient data are available to calculate annual growth over 1917; (3) a sub-sample of banks excluding non-mortgage banks, which constitute a large portion of our sample and tend to be relatively small and specialised and make up a large portion of our sample; (4) excluding very old banks, as their characteristics might introduce a bias to our estimation, since none of the failing banks were older than 17 years; (5) using an alternative age specification, focusing not on the date of first business but on the date of first incorporation rather than first business; (6) interlocking directorates with the influential private banks Mees & Zoonen, Ooyens & Co., Hope & Co. and Eeghen & Co., since the partners of these private banks were jointly liable with their private capital, giving these banks a strong incentive to pick other banks which were more liquid and less risky; (7) all relationships excluding the variable board size, since it can be argued that banks with bigger boards are more dependent on linkages with other banks; and (8) using a stronger definition of bank distress which excludes reorganisations and mergers and includes only exit from the market through liquidation.

We find that banks which paid their directors more tended to be more likely to experience distress during the 1920s, a result that is closely aligned to theoretical and empirical predications. For

example Fahlenbrach & Stulz, (2011) find that banks with directors whose incentives were better aligned with the interests of shareholders performed worse. Our proxy for incentive alignment, however, is rather crude because the public disclosure of payment to executives was voluntary and our measure of executive payment (*tantièmes*) is imperfectly correlated with total executive pay (see footnote 10). While we find that asset growth does not have a statistically significant impact on the probability of experiencing distress during the 1920s, we argue that the economic magnitude is relevant, because a one per cent increase in growth induces a spike increase in distress probability (11 per cent). This suggests that the banks which benefited most from the short post-war boom suffered most in the ensuing crisis.

With respect to the alternative sub-samples, we find that banks which had interlocking directorates with DNB had a significantly higher probability of failure if they were non-mortgage banks, or young banks. With respect to the alternative age definition, we find no significant differences. With respect to interlocking directorates with large private banks we find results consistent with the idea that sharing a director with one of these banks is reassuring. We argue that these private banks chose their interlocking directorates according to the characteristics of the public banks, in particular: (1) their liquidity, for which the coefficient in Model 30 becomes significantly higher than Model 17, the private bank variable picking up part of the liquidity aspect; (2) having a stock listing, where, once we control for interlocking directorates with these private banks, it reduces risk to have a stock listing – banks appear to benefit from the additional liquidity and access to financing.

The variables capturing bank size, liquidity and stock listing are significantly affected by the size of a bank's board. However, our primary results hold good with respect to interlocking directorates and the appropriate characteristics. When using our narrower definition of distress, we find that the results for interlocking directorates and the appropriate characteristics are only strengthened. In summary, we find that our results are robust to these alternative specifications; our

main results on banks' balance sheet characteristics, management structure and interlocking directorates hold in all robustness exercises carried out.

6. Predicting the past

The regression models of the previous section help in understanding the consequences for banks of the 1920s deflation, or more specifically, how bank characteristics set before the crisis period influenced their ensuing fate. What these analyses fail to do is discriminate between models, to identify which better explains the crisis. Given what we know through hindsight, which group of variables is more useful when predicting the past? On which indicators should contemporaries have based their investment decisions?

A way of assessing the fit of binomial regression models popular in medical analysis is to ascertain what proportion of true positives it classifies as being positive (called the "sensitivity" of the model) and what proportion of true negatives it classifies as being negative (called its "specificity").[23] As a crude measure, a model's sensitivity and specificity can be calculated for a probability threshold. Such an exercise would provide a cross-tabulation of observed and predicted outcomes if the probability is, say, 0.5 or more, and a false outcome otherwise. As such a threshold is rather arbitrary, a better idea is to measure the sensitivity and specificity of all possible combinations. We can then plot the true positive fraction (sensitivity) against the false positive fraction (1 – specificity) for key models in our regression analysis. The curve in such a graph is called the receiver operating characteristic (ROC). The bottom left corner of the plot space corresponds to a combination of zero per cent sensitivity and 100 per cent specificity; the top right corner represents the reverse. The best possible combination can be found in the top left corner, with 100 per cent sensitivity and specificity, or a perfect prediction. Any model that traces an ROC curve

[23] Metz (1978) describes the method used here in the context of medical statistics. A variant is used in Taylor (2012) as a means of assessing the predictive ability of his models of global financial crises.

above the 45-degree line has a better predictive ability than tossing an unbiased coin. The larger the area under the ROC curve (abbreviated to AUC), the better the predictive ability of the model.

Figure 3 plots the ROC curves of our key regression models; Table 14 reports the AUC values for these models. The analysis suggests that: (1) the addition of region and bank type fixed effects improves the power of our distress prediction; (2) the characteristics of interlocked banks appear to be more important than the characteristics of interlocked non-financial firms in predicting which banks suffer in the crisis; and (3) the overall liability regime choice appears to be more important than the portion of shareholder capital which remains unpaid in the prediction, but only by a very small amount. Overall, the best group of models with which to predict the past appear to be those that include information about the managerial structure and the characteristics of interlocked firms; an AUC value above 0.8 signifies a good model fit.

7. Conclusion

We find that balance sheet characteristics, bank management structure and interlocking directorates have had a significant impact on the probability of a bank's survival during the 1920s banking crisis in the Netherlands. In particular, we find that the characteristics of the financial firms with which a bank shares managerial ties have a high predictive power. We argue that banks should take the following measures to increase their ability to survive a crisis: (1) limit the size of their operations, as larger banks carry more risk on their balance sheet because it is more difficult for them to maintain a diversified portfolio; (2) limit their leverage, as banks which are more leveraged bear more risk, either from the terms attached to the short-term credits, or from their dependence on immediately-callable deposits; and (3) carefully monitor the sources of their profit, as a bank's cash flow can be used as a predictor of crisis-cycles. Additionally, we argue that a bank should benefit from the experience added by augmenting its board, increasing the dominance of financial firms over industry and increased interbank relationships.

However, risks are inherent in these policies and a bank should: (1) limit the concentration of its inter-connectedness with other banks, big banks in particular; (2) limit its concentration on banks which are extremely profitable, because cash flows in the financial sector are highly correlated; (3) dilute the dominance of the financial sector over the industrial sector, as banks which focus their dominance on larger industrial firms are more at risk; and (4) avoid fragmenting their dominance across different industrial sectors. Moreover, we argue that a bank should be free to use extended liability regimes to incentivise *ex ante* good behaviour, using large portions of its equity capital to limit risk and increase shareholder monitoring. These findings not only improve our understanding of this particular crisis, but also provide evidence for financial economists and regulators interested in the efficacy of corporate governance structures and practices when formal banking regulation is absent.

Data appendix

This appendix describes with the aid of an example how the accounting and governance data collected from *Van Oss* were standardised and converted to consistent categories across all firms: we use Marx & Co.'s Bank, probably the most high-profile casualty in the early part of the 1920s crisis.

Table 1, Panel A shows the 1918 balance sheet of Marx & Co.'s Bank, as published at the time. The bank's assets are noted on the left-hand panel and are divided into: *Aand. in portef.* (unplaced equity); *Kassa* (cash held in the firm); *Wiss., coupons en spec* (short-term loans); *Bankiers* (cash held at banks); *Effecten* (investments in financial assets); *Fondsen af te leveren* (deliverable funds); *Voorschot. in rek.-crt. tegen effecten en beleeningen op effecten* (advances against financial assets and/or accounts payable); *Voorschot. tegen goed., hyp of borgst.* (advances against goods, mortgages or bail); *Saldo's rek.-crt* (net accounts receivable); *Gebouwen en safes* (building and safes); and *Meubilair* (furniture). The bank's liability structure is listed in the right-hand panel and is divided into: *Kapitaal* (nominal equity capital); *Reserve* (equity reserves); *Personeelfonds* (funds

available for employees); *Bankiers* (cash stored by other banks); *Effecten in beleening gegeven* (invested funds under management from third parties); *Saldo's r.crt. en dep.* (net accounts payable and deposits); *Id. v. rek. v. derden* (net payable accounts from third parties); *Accepten en traites* (accepted short term loans); *Dividend* (dividends); and *Onverdeeld* (retained profits).

Table 1, Panel B depicts the same balance sheet converted to standardised categories which are consistent across all the sampled banks. Assets are divided into: fixed assets, financial assets and current assets; and the equity and liability structure consists of equity capital, provisions and long- and short-term liabilities. The difference between equity reserves and provisions is the nature of the reservation. Cases in which the purpose of a reserve was clearly stated have been classified as a provision. In some cases, the item *aandeelhouders* (shareholders) was found on the left-hand side of the balance sheet. This signalled there is unpaid equity capital, which the bank could call upon in times of need. This item was subtracted from the balance sheet and the nominal equity capital was subsequently lowered. The same procedure was followed for all 143 banks in our sample and the 234 non-financial firms that were used in the calculation of the interlock characteristics.

For the governance data, we compiled a list of all directors and supervisors on the boards of all banks and non-financial corporations at the start of 1918. This yielded 1,269 individuals sitting on the boards of 143 banks and 1,625 individuals sitting on the boards of 234 non-financial corporations. Subsequently, we cross-referenced each individual and found that each bank had on average seven interlocks with other banks and non-financial corporations. We count multiple interlocks with one bank (or non-financial) as only one interlock.

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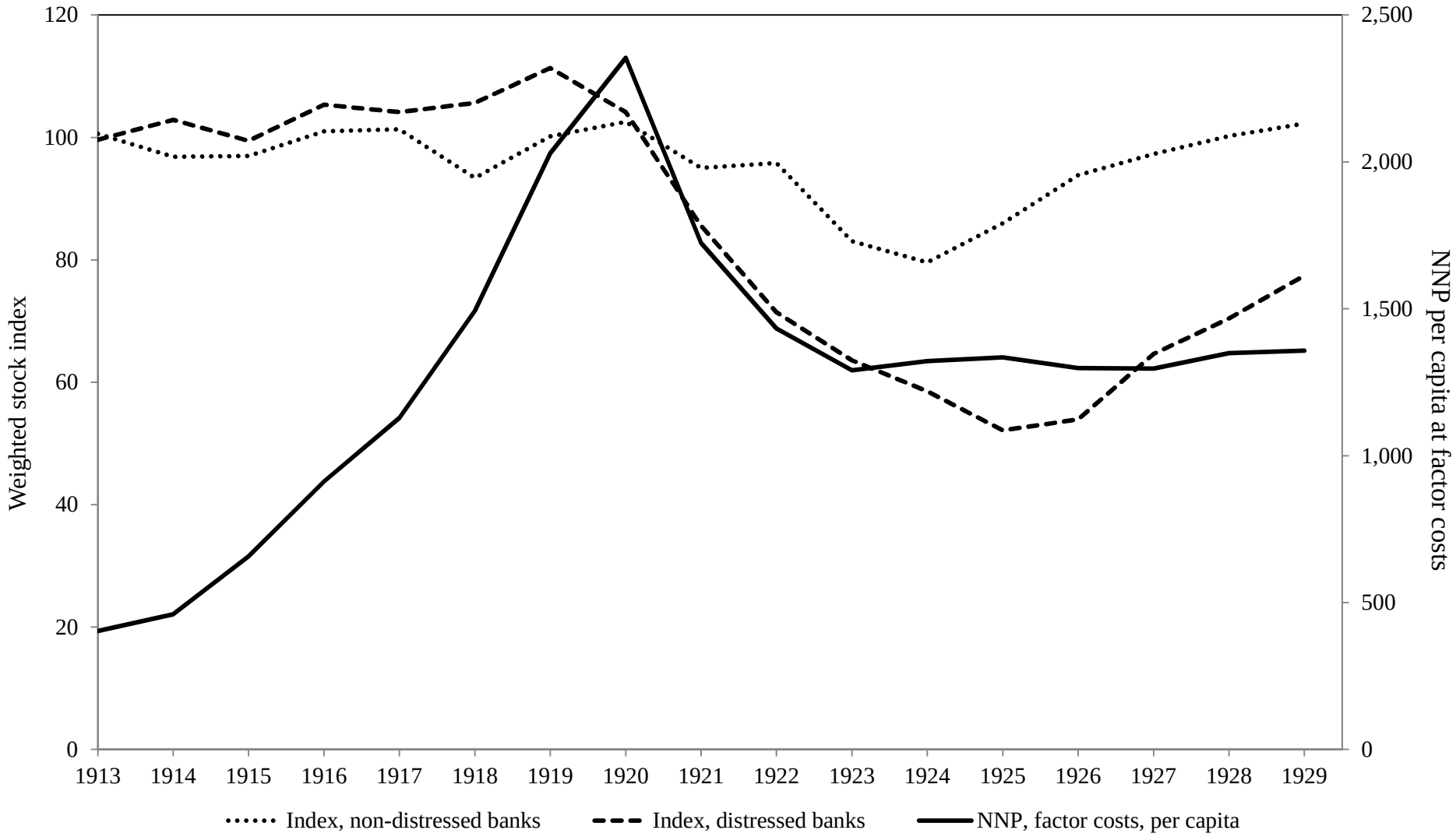
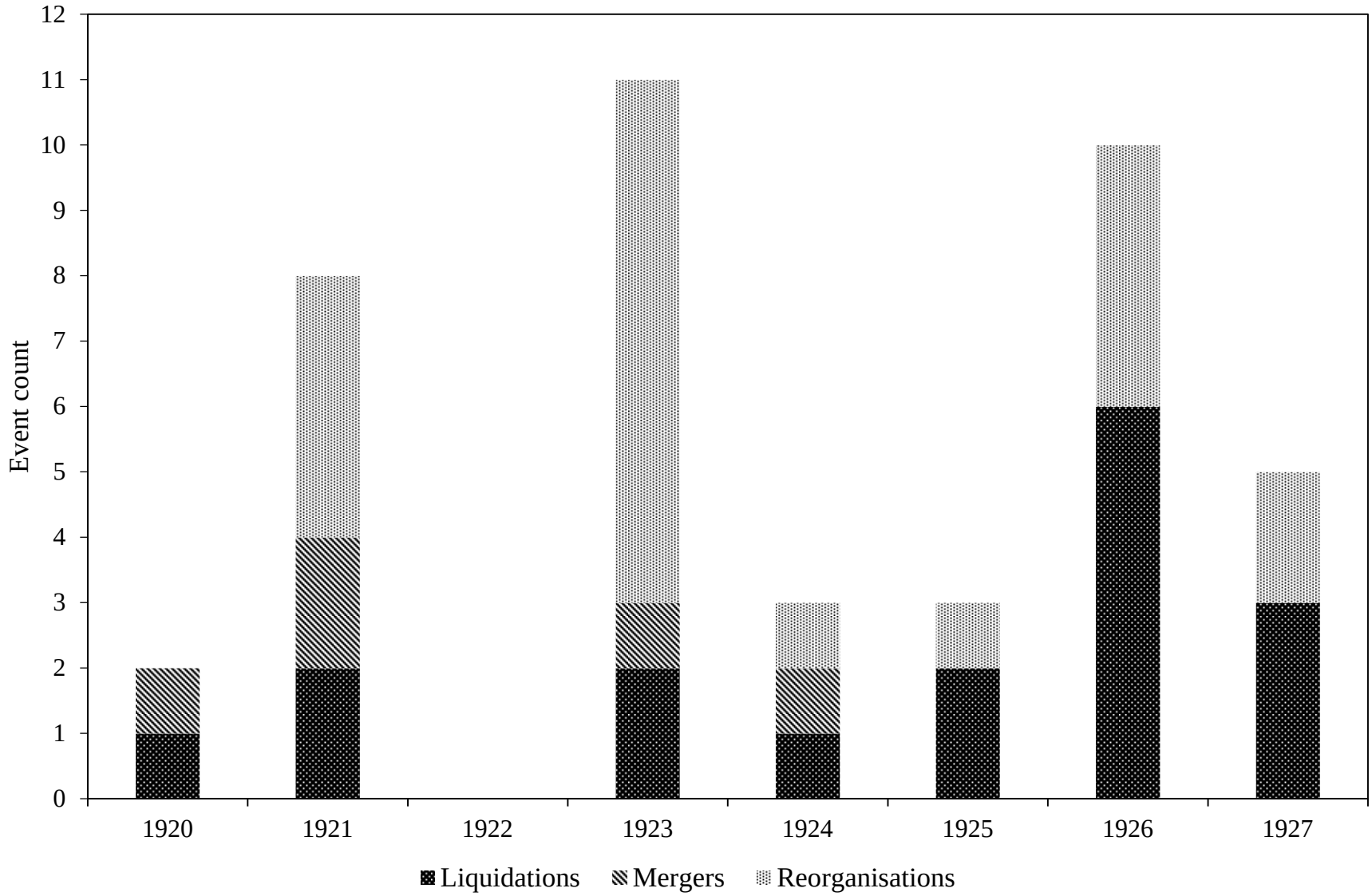
Figure 1: Indices of stock prices of non-distressed and distressed banks, and Net National Product (NNP) per capita, for the period 1913 to 1929



Source: See footnotes 11 and 12.

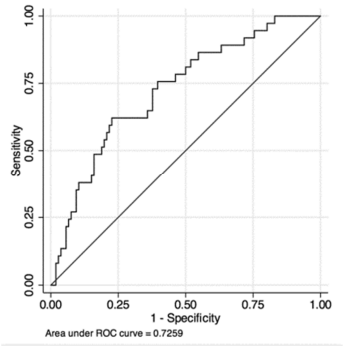
Figure 2: Timeline depicting the number of failures per year, and method of resolution, for the period 1920 to 1927



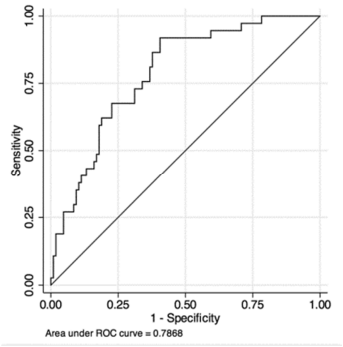
Source: Table 3.

Figure 3: Receiver operating characteristic (ROC) curves for key regression models

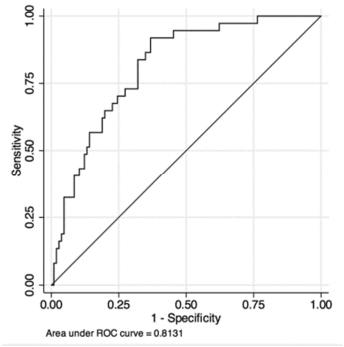
Model 7



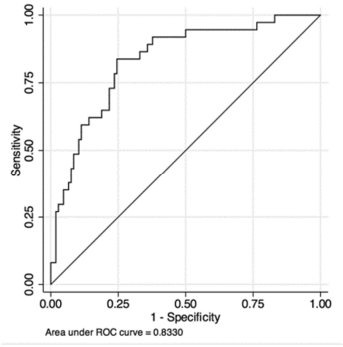
Model 13



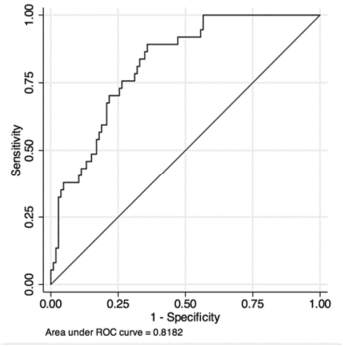
Model 14



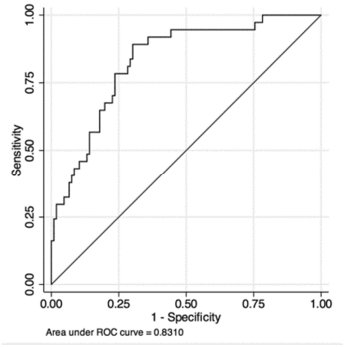
Model 15



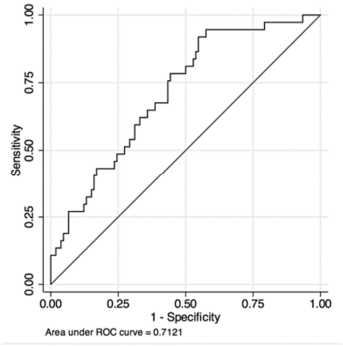
Model 16



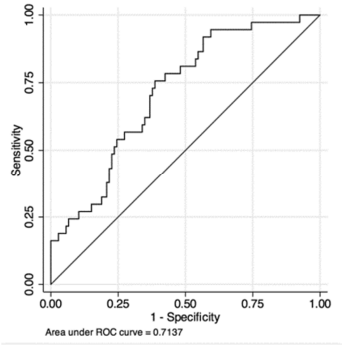
Model 17



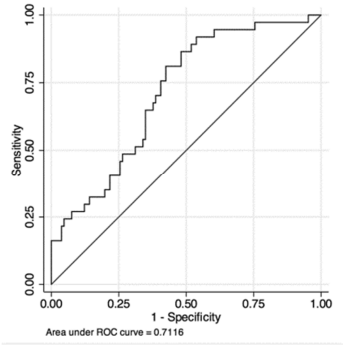
Model 18



Model 19



Model 21



Note: See Section 6 for explanation of methodology and Table 14 for AUC values.

Table 1: Balance sheet of Marx & Co.'s Bank, 1 January 1918
Panel A: Contemporary categories

	Assets	Liabilities	
Aand. in portef.	4,000,000	12,000,000	Kapitaal
Kassa	756,252	1,700,000	Reserve
Wiss., coupons en spec.	12,220,201	99,743	Personeelfonds
Bankiers	4,442,787	8,412,586	Bankiers
Effecten	1,437,820		
Fonds af te leveren	557,910	1,979,900	Effect in beleening gegeven
		19,007,074	Saldo's r.ct en dep.
Voorschott. in rek-crt. tegen effecten		-	Id. v. rek. v. derden
en beleeningen op effecten	12,367,254	2,651,034	Accepten en traites
		660,000	Dividend
Id. tegen goed., hyp. of borgst.	6,107,550	7,747	Onverdeeld
Saldo's rek.-crt.	4,178,309		
Gebouw en safes	450,000		
Meubilair	1		
Total assets	46,518,085	46,518,085	Total liabilities

Panel B: Converted standardized categories

	Assets	Liabilities	
Fixed assets	450,001	8,000,000	Equity capital
Long-term debt	-	1,707,747	Reserves
Equity investment	1,437,820	99,743	Provisions
Short-term debt	34,873,315	-	Bonds and mortgages
Receivables	-	27,419,661	Deposits
Cash	5,199,039	-	Other long-term liabilities
Other non-cash	557,910	2,651,034	Short-term credits
		660,000	Payables
		1,979,900	Other short-term liabilities
Total assets*	42,518,085	42,518,085	Total liabilities*

Note:* Total assets and liabilities quoted in coverted standardized balance sheets do not necessarily equal those in contemporary balance sheets. This is because they have been adjusted to reflect shareholder capital that has either not been placed, or not yet been called.

Table 2: Relative importance of balance sheet items for full 143-bank sample, 1 January 1918

Balance sheet item	Full sample	Distressed banks	Non-distressed banks
Assets			
Fixed assets	1%	1%	1%
Long-term debt	30%	27%	31%
Equity investment	10%	4%	12%
Short-term debt	31%	36%	29%
Receivables	14%	18%	13%
Cash	13%	14%	13%
Other non-cash	0%	0%	0%
Liabilities			
Equity capital	11%	13%	11%
Reserves	5%	4%	5%
Provisions	2%	1%	2%
Bonds and mortgages	28%	24%	29%
Deposits	16%	13%	17%
Other long-term liabilities	1%	2%	0%
Short-term credits	35%	39%	34%
Payables	1%	1%	1%
Other short-term liabilities	1%	2%	1%
Combined size of balance sheets (in guilders)	3,174,630,341	821,772,686	2,352,857,655

Table 3: Complementarity of sources used to identify distress events

Event	Source	All banks	General banks	Mortage banks	Shipping banks
Distress	Kramer	9	7	1	1
	De Vries	10	10	0	0
	DNB	7	7	0	0
	Newspapers	35	17	14	4
	All sources	*37*	*19*	*14*	*4*
Liquidation	Kramer	0	0	0	0
	De Vries	4	4	0	0
	DNB	7	7	0	0
	Newspapers	15	5	10	0
	All sources	*18*	*7*	*10*	*1*
Merger	Kramer	0	0	0	0
	De Vries	2	2	0	0
	DNB	0	0	0	0
	Newspapers	4	2	2	0
	All sources	*6*	*4*	*2*	*0*
Reorganisation	Kramer	9	7	1	1
	De Vries	4	4	0	0
	DNB	0	0	0	0
	Newspapers	18	10	5	3
	All sources	*13*	*8*	*2*	*3*

Note: See Section 3 for discussion of sources.

Table 4: Definitions of all variables used in analysis

Variable	Unit	Definition
Asset quality		
Bank size	Guilders	Balance sheet size
Bank age	Years	Bank age
Loan book quality		
Long-term loans	Ratio	Sum of all loans outstanding (long-term) to equity and cash
Short-term loans	Ratio	Sum of all loans outstanding (short-term) to equity and cash
Capital adequacy		
Working capital	Ratio	Current assets minus current liabilities to total assets
Equity reserves	Ratio	Size of the equity reserves to total assets
Earnings sufficiency		
Interest dependency	Ratio	Receivable interest minus payable interest to total equity
Return on assets	Ratio	Profits to total assets
Liquidity and solvency		
Asset liquidity	Ratio	Current assets to total assets
Maturity matching	Ratio	Current liabilities to financial assets
Stock listing	Ratio	Listed on the Amsterdam stock exchange
Capital structure		
Leverage	Ratio	Total debt to total assets
Deposits	Ratio	Total deposits to total assets
Management structure		
Board size	Number	Total number of members of the board of directors
Interlock with DNB	Dummy	Dummy equals one if interlock with DNB
Total interlocks with banks	Number	Total number of bank-bank interlocks
Total interlocks with non-banks	Number	Total number of bank-firm interlocks
Characteristics of interlocked banks		
Size of interlocked banks	Guilders	Average total assets of interlocked banks
Size concentration of interlocked banks	Ratio	Herfindahl-index in terms of size
Leverage of interlocked banks	Ratio	Average leverage of interlocked banks
Profitability of interlocked banks	Ratio	Average profitability of interlocked banks
Characteristics of interlocked non-banks		
Size of interlocked non-banks	Guilders	Average total assets of interlocked non-financials
Size concentration of interlocked non-banks	Ratio	Herfindahl-index in terms of firm size concentration
Leverage of interlocked non-banks	Ratio	Average leverage of interlocked non-financials
Profitability of interlocked non-banks	Ratio	Average profitability of interlocked non-financials
Industry concentration of interlocked non-banks	Ratio	Herfindahl-index in terms of industry concentration
Shareholder liability structure		
Liability regime choice	Dummy	Dummy equals one if bank has unpaid capital
Unpaid capital	Ratio	Proportion of share capital that is unpaid
Robustness variables		
Executive pay	Guilders	Size of cash compensation to directors
Asset growth	Guilders	Change in total assets over financial year
Interlock with influential private bank	Dummy	Dummy equals one if bank is interlocked with influential private bank*

Note: * = Influential private banks defined here are Mees & Zoonen, Ooyens & Co, Hope & Co or Eeghen & Co.

Table 5: Mean values of all variables for full sample and various sub-samples

Variable	Full sample (N=143)	General banks (N=64)	Mortgage banks (N=71)	Shipping banks (N=8)	Liability sub-sample (N=96)	Executive pay sub-sample (N=103)
Asset quality						
Bank size	22,200,212	36,298,688	10,781,098	10,757,047	11,252,017	28,218,275
Bank age	20.448	21.906	19.845	14.125	20.448	17.948
Loan book quality						
Long-term loans	0.617	0.213	0.945	0.932	0.788	0.629
Short-term loans	0.151	0.323	0.011	0.013	0.047	0.156
Capital adequacy						
Working capital	0.094	-0.043	0.198	0.260	0.243	0.035
Equity reserves	0.038	0.056	0.023	0.031	0.029	0.035
Earnings sufficiency						
Interest dependency	-0.025	-0.087	0.044	-0.146	-0.016	-0.037
Return on assets	0.022	0.019	0.024	0.029	0.023	0.026
Liquidity and solvency						
Asset liquidity	0.903	0.881	0.922	0.916	0.921	0.918
Maturity matching	0.166	0.336	0.029	0.033	0.060	0.183
Stock listing	0.287	0.500	0.127	0.000	0.063	0.282
Capital structure						
Leverage	0.834	0.740	0.908	0.929	0.918	0.867
Deposits	0.061	0.135	0.002	0.000	0.023	0.073
Management structure						
Board size	10.972	10.141	11.549	12.500	5.896	11.534
Interlock with DNB	0.196	0.234	0.155	0.250	0.195	0.204
Total interlocks with banks	6.643	6.922	6.239	8.000	3.135	6.816
Total interlocks with non-banks	4.860	6.141	3.662	5.250	0.792	5.301
Characteristics of interlocked banks						
Size of interlocked banks	48,327,297	55,925,277	40,029,808	61,183,675	37,361,717	52,066,475
Size concentration of interlocked banks	0.238	0.232	0.235	0.314	0.220	0.232
Leverage of interlocked banks	0.796	0.768	0.816	0.847	0.817	0.790
Profitability of interlocked banks	0.021	0.018	0.023	0.025	0.023	0.023
Characteristics of interlocked non-banks						
Size of interlocked non-banks	12,420,766	12,948,794	10,892,287	21,761,799	12,586,527	11,894,797
Size concentration of interlocked non-banks	0.135	0.123	0.141	0.183	0.121	0.139
Leverage of interlocked non-banks	0.269	0.273	0.260	0.322	0.251	0.271
Profitability of interlocked non-banks	0.052	0.052	0.050	0.066	0.044	0.053
Industry concentration of interlocked non-banks	0.260	0.222	0.279	0.400	0.231	0.282
Shareholder liability structure						
Liability regime choice	0.671	0.391	0.887	1.000	1.000	0.689
Equity capital unpaid	0.256	0.124	0.354	0.449	0.382	0.283
Robustness variables†						
Executive pay	66,833	123,137	22,329	29,131	24,587	66,833
Asset growth	0.084	0.164	0.025	0.029	0.045	0.117
Interlock with influential private bank	0.147	0.141	0.155	0.125	0.073	0.147

Note: † Robustness variables pertain to smaller sub-samples, as defined in the table.

Table 6: Univariate statistics for distressed and non-distressed banks, with discrimination between early and late distress timing

Variable	Full sample by distress event					Distressed bank sub-sample by distress timing††				
	Distressed banks (N=37)		Non-distressed banks (N=106)		Equality of means	Early distress (N=10)		Late distress (N=27)		Equality of means
	(mean)	*(median)*	*(mean)*	*(median)*	*(t-value)*	*(mean)*	*(median)*	*(mean)*	*(median)*	*(t-value)*
Asset quality										
Bank size	22.210.073	6.729.630	22.196.770	6.721.506	-0.061	6.938.013	5.381.055	27.866.391	8.040.495	0.974
Bank age	14,270	12,000	22,604	19,000	3.304***	10,700	9,500	15,593	13,000	1.169
Loan book quality										
Long-term loans	0,543	0,887	0,643	0,915	1.28	0,498	0,543	0,560	0,894	0.37
Short-term loans	0,181	0,010	0,140	0,001	-0.911	0,164	0,123	0,187	0,001	0.226
Capital adequacy										
Working capital	0,038	0,139	0,113	0,101	1.123	-0,124	-0,150	0,099	0,164	2.014
Equity reserves	0,033	0,028	0,040	0,025	0.59	0,032	0,014	0,033	0,030	0.031
Earnings sufficiency										
Interest dependency	-0,043	-0,016	-0,019	-0,003	0.23	-0,017	0,000	-0,052	-0,020	-0.27
Return on assets	0,030	0,028	0,019	0,018	-0.991	0,029	0,023	0,031	0,033	0.302
Liquidity and solvency										
Asset liquidity	0,885	0,885	0,910	0,950	1.246	0,878	0,890	0,887	0,883	0.298
Maturity matching	0,203	0,033	0,154	0,030	-1.042	0,387	0,331	0,135	0,030	-2.556*
Stock listing	0,405	0,000	0,245	0,000	-1.773*	0,500	0,500	0,370	0,000	-0.699
Capital structure										
Leverage	0,846	0,897	0,830	0,906	-0.397	0,819	0,841	0,856	0,915	0.818
Deposits	0,094	0,000	0,050	0,000	-1.697*	0,075	0,030	0,101	0,000	0.448
Management structure										
Board size	10,378	11,000	11,179	11,000	0.404	9,500	10,500	10,704	11,000	0.919
Interlock with DNB	0,243	0,000	0,179	0,000	-0.901	0,300	0,000	0,222	0,000	-0.478
Total interlocks with banks	6,595	5,000	6,660	6,000	-0.231	3,500	2,000	7,741	6,000	2.167**
Total interlocks with non-banks	4,135	2,000	5,113	2,500	0.6	1,200	1,000	5,222	3,000	1.929***
Characteristics of interlocked banks										
Size of interlocked banks	36.585.199	17.379.746	52.425.954	16.666.360	1.259	33.963.697	5.848.889	37.556.125	17.903.493	0.195
Size concentration of interlocked banks	0,248	0,271	0,235	0,210	-0.514	0,092	0,000	0,306	0,355	2.699**
Leverage of interlocked banks	0,805	0,859	0,793	0,862	-0.507	0,752	0,801	0,825	0,864	0.918
Profitability of interlocked banks	0,027	0,029	0,019	0,025	-1.202	0,030	0,028	0,025	0,030	-0.588
Characteristics of interlocked non-banks										
Size of interlocked non-banks	9.340.940	3.138.672	13.495.800	4.896.561	1.035	3.400.993	854.068	11.540.920	4.902.762	1.677**
Size concentration of interlocked non-banks	0,117	0,000	0,142	0,000	0.448	0,000	0,000	0,160	0,000	1.966***
Leverage of interlocked non-banks	0,231	0,271	0,282	0,320	0.995	0,195	0,086	0,245	0,286	0.656
Profitability of interlocked non-banks	0,051	0,027	0,052	0,053	-0.136	0,044	0,013	0,054	0,050	0.443
Industry concentration of interlocked non-banks	0,216	0,000	0,276	0,000	0.702	0,000	0,000	0,296	0,000	2.415***
Shareholder liability structure										
Liability regime choice	0,595	1,000	0,698	1,000	1.166	0,500	0,500	0,630	1,000	0.699
Unpaid capital	0,215	0,192	0,271	0,310	-1.353	0,197	0,067	0,221	0,270	-0.327
Robustness variables†										
Executive pay	96354	26478	57865	12880	-1.186	11707	7969	124570	46253	1.105
Asset growth	0,133	0,045	0,066	0,042	-1.302	0,196	0,109	0,109	0,041	-0.803
Interlock with influential private bank	0,081	0,000	0,170	0,000	1,410	0,000	0,000	0,111	0,000	1.331***

Note: †=Robustness variables pertain to smaller sub-samples, as defined in Table 5. ††=Banks defined as early distress did so between 1920 and 1922; banks defined as late distress did so between 1923 and 1927.

Table 7: Univariate statistics for full sample of banks that experienced distress, with distrimination between types of resolution

Variable	Distressed bank sub-sample by resolution type						Equality of means		
	Liquidation (N=18)		Reorganisation (N=13)		Merger (N=6)		Liquidation vs. Reorganisation	Liquidation vs. Merger	Reorganisation vs. Merger
	(mean)	*(median)*	*(mean)*	*(median)*	*(mean)*	*(median)*	*(t-value)*	*(t-value)*	*(t-value)*
Asset quality									
Bank size	11,591,480	6,403,691	41,806,700	8,040,495	11,606,491	4,926,147	1.132	0.002	-0.759
Bank age	11.889	8.000	15.000	15.000	19.833	12.500	1.092	0.841	0.508
Loan book quality									
Long-term loans	0.577	0.895	0.554	0.800	0.418	0.282	-0.137	-0.732	-0.622
Short-term loans	0.183	0.001	0.195	0.112	0.145	0.067	0.117	-0.259	-0.424
Capital adequacy									
Working capital	0.094	0.143	0.019	0.099	-0.087	-0.080	-0.717	-0.965	-0.561
Equity reserves	0.034	0.014	0.033	0.030	0.028	0.024	-0.152	-0.333	-0.471
Earnings sufficiency									
Interest dependency	-0.004	-0.083	-0.083	-0.016	-0.073	0.000	-0.6	-0.36	0.09
Return on assets	0.033	0.031	0.032	0.039	0.020	0.009	-0.165	-1.442	-1.318
Liquidity and solvency									
Asset liquidity	0.871	0.878	0.911	0.903	0.869	0.844	1.379	-0.044	-1.17
Maturity matching	0.132	0.031	0.221	0.070	0.380	0.233	0.994	1.386	0.996
Stock listing	0.333	0.000	0.462	0.000	0.500	0.500	0.705	0.707	0.148
Capital structure									
Leverage	0.839	0.890	0.853	0.934	0.851	0.896	0.3	0.188	-0.038
Deposits	0.074	0.000	0.126	0.000	0.086	0.000	0.914	0.192	-0.462
Management structure									
Board size	10.611	11.000	10.769	10.000	8.833	8.500	0.125	-1.022	-0.92
Interlock with DNB	0.167	0.000	0.308	0.000	0.333	0.000	0.876	0.847	0.106
Total interlocks with banks	7.278	6.500	7.231	5.000	3.167	2.500	-0.022	-2.034*	-1.318
Total interlocks with non-banks	3.056	2.500	6.462	2.000	2.333	1.500	1.344	-0.505	-1.563
Characteristics of interlocked banks									
Size of interlocked banks	33,916,223	19,705,082	53,438,670	17,903,493	8,076,271	6,611,938	1.037	-2.607**	-2.492**
Size concentration of interlocked banks	0.302	0.324	0.246	0.271	0.090	0.000	-0.652	-1.991*	-1.782*
Leverage of interlocked banks	0.870	0.899	0.780	0.848	0.667	0.729	-1.242	-1.427	-0.813
Profitability of interlocked banks	0.028	0.032	0.023	0.022	0.029	0.031	-0.756	0.04	0.938
Characteristics of interlocked non-banks									
Size of interlocked non-banks	11,238,042	1,287,956	9,606,962	9,172,080	3,073,252	2,145,276	-0.335	-1.911*	-1.57
Size concentration of interlocked non-banks	0.151	0.000	0.048	0.000	0.167	0.000	-1.499	0.127	1.009
Leverage of interlocked non-banks	0.203	0.253	0.282	0.307	0.206	0.143	1.081	0.031	-0.695
Profitability of interlocked non-banks	0.061	0.038	0.048	0.057	0.028	0.014	-0.66	-1.485	-0.911
Industry concentration of interlocked non-banks	0.212	0.000	0.200	0.000	0.264	0.000	-0.094	0.298	0.361
Shareholder liability structure									
Liability regime choice	0.611	1.000	0.615	1.000	0.500	0.500	0.023	-0.46	-0.451
Unpaid capital	0.202	0.204	0.247	0.305	0.182	0.096	-0.606	0.21	0.591
Robustness variables†									
Executive pay	54541	22558	147736	42240	47331	7350	0.917	-0.136	-0.541
Asset growth	0.058	0.029	0.148	0.123	0.327	0.206	0.945	1.634	1.098
Interlock with influential private bank	0.056	0.000	0.154	0.000	0.000	0.000	0.833	-0.569	-1.477

Note: †=Robustness variables pertain to smaller sub-samples, as defined in Table 5.

Table 8: Logistic regressions of bank distress using balance sheet characteristics, marginal effects

Variable	Asset quality	Loan quality	Capital adequacy	Earnings sufficiency	Liquidity	Leverage	Baseline model
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
Bank size	0.043***						0.002
	(4.564)						(0.086)
Bank age	-0.122***						-0.096***
	(-5.358)						(-57.683)
Long-term loans		-0.101**					-0.102***
		(-2.214)					(-3.190)
Short-term loans		-0.006					-0.076
		(-0.204)					(-0.722)
Working capital			-0.140				-0.265
			(-1.457)				(-1.132)
Equity reserves			-0.759***				-0.338
			(-2.783)				(-1.561)
Interest dependency				-0.009			-0.041
				(-0.789)			(-1.232)
Return on assets				1.944			1.466**
				(0.863)			(2.113)
Stock listing					0.158***		0.143
					(6.038)		(1.400)
Asset liquidity					-0.360		-0.554
					(-0.457)		(-1.351)
Maturity matching					-0.117		-0.436***
					(-0.840)		(-4.122)
Leverage						0.164	0.369*
						(1.070)	(1.898)
Deposits						0.502***	0.278
						(8.806)	(1.612)
Observations	143	143	143	143	143	143	143
of which distressed	*37*	*37*	*37*	*37*	*37*	*37*	*37*
Pseudo R-squared	0.053	0.009	0.013	0.013	0.026	0.023	0.105

Note: The dependent variable is a binominal variable that equals one if and only if a bank has gone in distress during the period 1920-1927. Bank size and bank age are logaritmic transformations. Marginal effects are calculated at the median. Robust z-statistics, clustered by bank type, are reported in parentheses. Significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Logistic regressions of bank distress by region and type, marginal effects

Variable	Baseline model (incl. Region FE) *(8)*	Baseline model (incl. City FE) *(9)*	Baseline model (incl. Type FE) *(10)*	Baseline model (incl. City FE & Region) *(11)*	Baseline model (incl. Type & City FE) *(12)*	Baseline model (incl. Type & Region FE) *(13)*
Region FE						
Noord-Holland	0.413			0.433**		0.381
	(1.518)			(2.067)		(1.475)
Zuid-Holland	0.359			0.473**		0.345
	(0.955)			(2.114)		(0.935)
Groningen	0.471			0.447		0.441
	(1.411)			(1.372)		(1.490)
City FE						
Amsterdam		0.037		-0.050	0.007	
		(0.655)		(-0.738)	(0.093)	
Rotterdam		-0.046		-0.170	-0.086	
		(-0.163)		(-0.632)	(-0.291)	
Den Haag		-0.038		-0.162*	-0.010	
		(-0.376)		(-1.673)	(-0.101)	
Type FE						
General banks			-0.167**		-0.188***	-0.112
			(-2.178)		(-5.718)	(-1.294)
Mortgage banks			-0.268***		-0.280***	-0.214***
			(-10.389)		(-10.865)	(-6.180)
General characteristics						
Bank size	-0.005	0.005	-0.006	0.005	0.001	-0.011
	(-0.238)	(0.108)	(-0.318)	(0.138)	(0.018)	(-0.640)
Bank age	-0.107***	-0.101***	-0.090***	-0.101***	-0.095***	-0.100***
	(-44.777)	(-9.182)	(-6.928)	(-29.432)	(-4.982)	(-6.513)
Long-term loans	-0.057	-0.078***	-0.065	-0.061**	-0.063	-0.021
	(-1.163)	(-3.223)	(-0.678)	(-1.991)	(-0.666)	(-0.157)
Short-term loans	-0.100	-0.062	-0.089	-0.094	-0.082	-0.113
	(-0.714)	(-0.637)	(-0.836)	(-0.735)	(-0.720)	(-0.737)
Working capital	-0.343	-0.245	-0.341	-0.262	-0.317	-0.406
	(-1.005)	(-0.786)	(-1.344)	(-0.707)	(-0.848)	(-1.031)
Equity reserves	-0.333*	-0.409	-0.322	-0.398	-0.410	-0.317
	(-1.701)	(-0.988)	(-1.121)	(-1.504)	(-0.803)	(-1.240)
Interest dependency	-0.028*	-0.043	-0.022	-0.023	-0.023	-0.016
	(-1.813)	(-1.390)	(-1.212)	(-0.941)	(-1.023)	(-1.073)
Return on assets	1.239**	1.702**	1.407***	1.121*	1.584***	1.179**
	(1.977)	(2.213)	(2.929)	(1.915)	(3.251)	(2.526)
Stock listing	0.077*	0.122	0.172**	0.080	0.160*	0.108***
	(1.719)	(1.179)	(2.231)	(1.490)	(1.955)	(3.360)
Asset liquidity	-0.542*	-0.473	-0.680*	-0.488*	-0.633***	-0.669***
	(-1.871)	(-1.352)	(-1.841)	(-1.680)	(-3.150)	(-3.704)
Maturity matching	-0.415**	-0.401***	-0.539***	-0.377**	-0.520***	-0.516***
	(-2.336)	(-2.880)	(-6.659)	(-2.404)	(-3.174)	(-2.706)
Leverage	0.388***	0.383	0.449***	0.343	0.414	0.454***
	(2.577)	(1.569)	(2.999)	(1.470)	(1.613)	(3.250)
Deposits	0.517***	0.312**	0.232	0.460***	0.243	0.446***
	(6.975)	(2.056)	(1.415)	(8.482)	(1.608)	(7.056)
Observations	143	143	143	143	143	143
of which distressed	*37*	*37*	*37*	*37*	*37*	*37*
Region FE	YES	NO	NO	YES	NO	YES
City FE	NO	YES	NO	YES	YES	NO
Type FE	NO	NO	YES	NO	YES	YES
Pseudo R-squared	0.153	0.109	0.130	0.161	0.134	0.170

Note: Model 8 specifies the baseline model with region fixed effects, model 9 includes city fixed effects, model 10 includes bank-type fixed effects, and models 11-13 incorporate all fixed effects. Model 13 is used in subsequent regressions. All specifications include clustered standard errors at the bank type level. Bank size and bank age are logaritmic transformations. Marginal effects are calculated at the median. Robust z-statistics, clustered by bank type, are reported in parentheses. Significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Logistic regressions of bank distress using management and interlock characteristics, marginal effects

Variable	Management structure	Characteristics of interlocked banks	Characteristics of interlocked non-banks	Combined model
	(14)	*(15)*	*(16)*	*(17)*
Management structure				
Board size	-0.102**	-0.131**	-0.168***	-0.208***
	(-2.408)	(-2.128)	(-8.845)	(-3.638)
Interlock with DNB	-0.008	0.005	0.006	0.019
	(-0.116)	(0.111)	(0.090)	(0.411)
Total interlocks with banks	-0.010		-0.046	
	(-0.338)		(-1.425)	
Total interlocks with non-banks	-0.106***	-0.100**		
	(-2.952)	(-2.341)		
Characteristics of interlocked banks				
Size of interlocked banks		-0.024***		-0.022
		(-2.814)		(-1.081)
Size concentration of interlocked banks		0.222***		0.202***
		(2.916)		(2.883)
Leverage of interlocked banks		0.301		0.233
		(1.396)		(0.444)
Profitability of interlocked banks		5.744***		5.468***
		(3.239)		(4.448)
Characteristics of interlocked non-banks				
Size of interlocked non-banks			0.001	0.000
			(0.067)	(0.024)
Size concentration of interlocked non-banks			0.367***	0.235***
			(4.428)	(2.725)
Leverage of interlocked non-banks			-0.364	-0.313
			(-0.726)	(-0.447)
Profitability of interlocked non-banks			0.779**	0.528
			(2.125)	(1.153)
Industry concentration of interlocked non-banks			-0.341***	-0.277**
			(-3.397)	(-2.535)
General characteristics				
Bank size	0.054**	0.050**	0.043*	0.033***
	(2.451)	(2.269)	(1.869)	(2.934)
Bank age	-0.123***	-0.124***	-0.128***	-0.125***
	(-10.317)	(-8.969)	(-9.137)	(-6.990)
Long-term loans	-0.103	-0.093	-0.072	-0.070
	(-0.775)	(-0.779)	(-0.773)	(-0.583)
Short-term loans	-0.114	-0.070	-0.134	-0.091
	(-0.923)	(-0.498)	(-0.971)	(-0.610)
Working capital	-0.301	-0.280	-0.350	-0.346
	(-0.683)	(-0.631)	(-0.782)	(-0.779)
Equity reserves	-0.425*	-0.297***	0.021	0.066
	(-1.765)	(-2.607)	(0.125)	(0.192)
Interest dependency	0.001	0.035	-0.002	0.020
	(0.077)	(0.548)	(-0.154)	(0.343)
Return on assets	1.021	0.743	1.254	0.857
	(1.247)	(0.964)	(0.965)	(0.738)
Stock listing	0.174***	0.178***	0.187***	0.177***
	(8.444)	(4.719)	(9.696)	(6.083)
Asset liquidity	-0.608***	-0.715***	-0.549***	-0.655**
	(-9.997)	(-4.955)	(-3.157)	(-2.339)
Maturity matching	-0.568**	-0.568**	-0.553*	-0.539
	(-2.092)	(-2.434)	(-1.749)	(-1.379)
Leverage	0.288*	0.362***	0.513***	0.534***
	(1.693)	(3.732)	(3.850)	(3.070)
Deposits	0.404***	0.466***	0.322***	0.412***
	(3.589)	(7.518)	(4.254)	(3.000)
Observations	143	143	143	143
of wich distressed	*37*	*37*	*37*	*37*
Region FE	YES	YES	YES	YES
Type FE	YES	YES	YES	YES
Pseudo R-squared	0.215	0.256	0.231	0.262

Note: Model 14 estimates the effect of board characteristics, model 15 and 16 relates to interlock characteristics, where model 17 combines the previous models. Bank size and bank age are logaritmic transformations. Marginal effects are calculated at the median. All specifications include bank type and region fixed effects. Robust z-statistics, clustered by bank type, are reported in parentheses. Significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 11: Univariate statistics of liability regime choices

Variable	Liability sub-sample (N=96) *(mean)*	Non-liability sub-sample (N=47) *(mean)*	Equality of means *(t-value)*
Asset quality			
Firm size	11,252,017	44,562,483	2.498**
Firm age	18	26	1.945*
Loan book quality			
Long-term loans	0.788	0.267	-8.237***
Short-term loans	0.047	0.363	5.991***
Capital adequacy			
Working capital	0.243	-0.212	-9.462***
Equity reserves	0.029	0.057	2.158**
Earnings sufficiency			
Interest rate dependency	-0.016	-0.045	-0.378
Return on assets	0.023	0.020	-0.233
Liquidity and solvency			
Asset liquidity	0.921	0.866	-2.837***
Maturity matching	0.060	0.383	7.177***
Stock listing	0.063	0.745	10.219***
Capital structure			
Leverage	0.918	0.663	-7.159***
Deposits	0.023	0.140	4.724***
Management structure			
Board size	5.896	10.851	0.02
Total interlocks with banks	3.135	8.170	2.254**
Total interlocks with non-banks	0.792	8.383	3.904***
Interlock with DNB	0.195	0.234	0.822
Characteristics of interlocked banks			
Size of interlocked banks	37,361,717	70,725,078	2.355**
Size concentration of interlocked banks	0.220	0.276	1.378
Leverage of interlocked banks	0.817	0.753	-1.628
Profitability of interlocked banks	0.023	0.018	-0.884
Characteristics of interlocked non-banks			
Size of interlocked non-banks	12,586,527	19,164,442	2.869***
Size concentration of interlocked non-banks	0.121	0.165	1.223
Leverage of interlocked non-banks	0.251	0.306	1.77*
Profitability of interlocked non-banks	0.044	0.069	2.705***
Industry concentration of interlocked non-banks	0.231	0.321	1.485
Robustness variables			
Executive pay	24,587	160,569	3.229***
Asset growth	0.045	0.171	2.628**

Note: Robustness variables pertain to smaller sub-samples, as defined in Table 5.

Table 12: Logistic regressions of bank distress using liability choices, marginal effects

Variable	Baseline model	Liability regime choice	Liability regime choice plus baseline	Unpaid capital	Unpaid capital plus baseline model
	(18)	*(19)*	*(20)*	*(21)*	*(22)*
Shareholder liability structure					
Liability regime choice		0.096***	0.026		
		(20.510)	(0.218)		
Unpaid capital				-0.320***	-0.082
				(-11.400)	(-0.464)
General characteristics					
Bank size			0.034**		0.035***
			(2.417)		(2.821)
Bank age			-0.124***		-0.122***
			(-8.387)		(-7.998)
Long-term loans			-0.073		-0.069
			(-0.703)		(-0.555)
Short-term loans			-0.098		-0.099
			(-0.838)		(-0.684)
Working capital			-0.331		-0.317
			(-0.651)		(-0.646)
Equity reserves			0.089		0.065
			(0.224)		(0.193)
Interest dependency	0.062***	0.062***	0.021	0.062**	0.020
	(4.605)	(2.690)	(0.338)	(2.213)	(0.323)
Return on assets	1.118	0.841	0.835	0.808	0.930
	(0.491)	(0.549)	(0.774)	(0.576)	(0.693)
Stock listing			0.165***		0.161***
			(5.514)		(7.177)
Asset liquidity			-0.643**		-0.598
			(-2.139)		(-1.470)
Maturity matching			-0.534		-0.506
			(-1.301)		(-1.101)
Leverage			0.564**		0.565**
			(2.134)		(2.370)
Deposits			0.416***		0.420***
			(3.106)		(3.296)
Management structure					
Board size	-0.137***	-0.149***	-0.207***	-0.140**	-0.205***
	(-2.936)	(-3.031)	(-3.603)	(-2.354)	(-3.874)
Interlock with DNB	0.063*	0.061**	0.021	0.066***	0.023
	(1.867)	(2.111)	(0.595)	(2.873)	(0.556)
Characteristics of interlocked banks					
Size of interlocked banks			-0.022		-0.022
			(-1.089)		(-1.078)
Size concentration of interlocked banks	0.149***	0.136***	0.200***	0.115***	0.196***
	(3.753)	(3.857)	(2.611)	(3.065)	(2.832)
Leverage of interlocked banks	0.043	0.052	0.231	0.045	0.230
	(0.495)	(0.807)	(0.441)	(0.725)	(0.450)
Profitability of interlocked banks	4.078***	4.149***	5.423***	4.106***	5.336***
	(22.595)	(19.038)	(5.197)	(14.960)	(4.547)
Characteristics of interlocked non-banks					
Size of interlocked non-banks			0.000		0.000
			(0.022)		(0.045)
Size concentration of interlocked non-banks	0.135*	0.166**	0.235***	0.158	0.233***
	(1.659)	(1.976)	(2.803)	(1.581)	(2.787)
Leverage of interlocked non-banks			-0.315		-0.321
			(-0.449)		(-0.456)
Profitability of interlocked non-banks			0.510		0.488
			(0.987)		(0.930)
Industry concentration of interlocked non-banks	-0.190**	-0.227***	-0.276**	-0.220***	-0.275**
	(-2.354)	(-2.798)	(-2.451)	(-2.638)	(-2.480)
Observations	143	143	143	143	143
of which distressed	*37*	*37*	*37*	*37*	*37*
Pseudo R-squared	0.107	0.114	0.262	0.122	0.262

Note: Bank size and bank age are logaritmic transformations. Marginal effects are calculated at the median. All specifications include bank type and region fixed effects. Robust z-statistics, clustered by bank type, are reported in parentheses. Significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 13: Logistic regressions of bank distress checking for robustness, marginal effects

Variable	Executive pay sub-sample	Asset growth sub-sample	Non-mortage sub-sample	Age < 50 years sub-sample	Age < 20 years sub-sample	Age < 17 years (median) sub-sample	Bank age (alternative definition)	Interlock with influential private banks	Excluding board size	Excluding mergers	Excluding reorganisations
	(23)	*(24)*	*(25)*	*(26)*	*(27)*	*(28)*	*(29)*	*(30)*	*(31)*	*(32)*	*(33)*
Robustness variables											
Executive pay	0.162*										
	(1.684)										
Asset growth		0.114									
		(1.235)									
Interlock with influential private bank								-0.399***			
								(-3.151)			
General characteristics											
Bank size	-0.109	0.013	0.045***	0.064***	0.092*	0.303***	0.022**	0.022	0.020	0.056*	-0.016
	(-1.331)	(1.064)	(7.512)	(5.033)	(1.924)	(5.668)	(2.277)	(1.362)	(1.477)	(1.884)	(-0.481)
Bank age	-0.168***	-0.163***	-0.097***	-0.119***	-0.051	-0.026	-0.064***	-0.109***	-0.106***	-0.109***	-0.085
	(-5.043)	(-13.978)	(-10.426)	(-4.468)	(-0.494)	(-0.158)	(-4.605)	(-3.030)	(-6.665)	(-4.598)	(-1.556)
Long-term loans	-0.018	0.028	0.013	-0.099	-0.217	-1.030**	-0.163	-0.056	-0.081	-0.057	-0.113
	(-0.159)	(1.015)	(0.164)	(-0.570)	(-1.308)	(-2.473)	(-1.241)	(-0.991)	(-0.625)	(-0.764)	(-1.359)
Short-term loans	0.109	-0.052	-0.166***	-0.107	-0.198*	-0.422	-0.158	-0.077	-0.116	0.043	-0.053
	(1.635)	(-0.364)	(-98.735)	(-0.604)	(-1.707)	(-1.011)	(-1.061)	(-0.823)	(-0.732)	(0.391)	(-0.639)
Working capital	0.198**	-0.357	-0.440***	-0.298	-0.350	-0.324	-0.337	-0.238	-0.391	-0.136	-0.318
	(2.058)	(-0.633)	(-9.277)	(-0.629)	(-0.968)	(-0.568)	(-0.771)	(-0.993)	(-0.725)	(-0.539)	(-0.748)
Equity reserves	2.558***	-0.068	-0.081	-0.312	-0.074	-1.603	-0.165	0.379	-0.212	-0.146	0.434***
	(2.801)	(-0.229)	(-0.125)	(-0.483)	(-0.108)	(-1.266)	(-0.550)	(1.205)	(-0.583)	(-0.851)	(55.997)
Interest dependency	0.009	0.009	-0.469**	0.019	0.031*	0.067	0.037	-0.020	0.012	-0.044	0.030***
	(0.066)	(0.135)	(-1.961)	(0.350)	(1.956)	(1.011)	(0.684)	(-0.227)	(0.147)	(-0.407)	(5.368)
Return on assets	-1.173	0.161	0.050	1.178	2.894***	1.937***	1.304	1.833***	1.309	1.475	0.249
	(-0.567)	(0.244)	(0.034)	(1.233)	(3.109)	(3.134)	(0.945)	(3.478)	(1.322)	(1.352)	(0.311)
Stock listing	0.242**	0.148**	0.122	0.219***	0.333***	0.050	0.217***	-0.480*	-0.787***	-0.540	-0.706***
	(2.266)	(2.129)	(0.778)	(14.377)	(5.002)	(0.687)	(7.962)	(-1.778)	(-2.769)	(-1.442)	(-3.823)
Asset liquidity	0.461	-0.632***	0.255	-0.744*	-0.624	-0.469**	-0.706***	0.283***	0.176***	0.131	0.192***
	(1.515)	(-2.861)	(0.485)	(-1.947)	(-1.494)	(-2.391)	(-2.811)	(3.469)	(3.924)	(1.065)	(10.047)
Maturity matching	0.068	-0.545	-0.329	-0.619	-0.716*	-1.171**	-0.513	-0.407*	-0.595	-0.541***	-0.432
	(0.273)	(-1.592)	(-1.030)	(-1.232)	(-1.824)	(-2.164)	(-1.280)	(-1.659)	(-1.320)	(-2.734)	(-1.213)
Leverage	0.999	0.465**	0.626	0.498**	0.817***	0.161	0.596***	0.494***	0.510***	0.236**	0.459**
	(1.618)	(2.393)	(1.367)	(2.435)	(4.083)	(0.289)	(3.079)	(3.873)	(3.785)	(2.049)	(2.291)
Deposits	-0.269**	0.295	0.291***	0.285***	-0.274***	-1.507***	0.390***	0.106*	0.423**	0.297***	-0.134
	(-2.559)	(0.950)	(3.590)	(2.774)	(-6.704)	(-11.756)	(4.043)	(1.844)	(2.483)	(4.129)	(-1.490)
Management structure											
Board size	-0.268**	-0.014	-0.216***	-0.213***	-0.340***	-0.720***	-0.171***	-0.243***		-0.152	-0.117***
	(-2.050)	(-0.136)	(-7.966)	(-3.473)	(-4.902)	(-4.898)	(-2.903)	(-4.521)		(-1.578)	(-3.134)
Interlock with DNB	-0.006	-0.007	0.085*	-0.047***	-0.088	-0.129***	0.019	0.011	-0.015	0.018	0.007
	(-0.090)	(-0.107)	(1.935)	(-4.044)	(-1.470)	(-4.904)	(0.321)	(0.336)	(-0.297)	(0.258)	(0.071)
Characteristics of interlocked banks											
Size of interlocked banks	-0.016	-0.015	-0.049**	-0.022*	0.000	-0.122***	-0.023	-0.001	-0.027	-0.011***	-0.015
	(-0.699)	(-0.727)	(-2.142)	(-1.688)	(0.002)	(-5.356)	(-1.042)	(-0.047)	(-1.146)	(-3.011)	(-1.130)
Size concentration of interlocked banks	0.379**	0.192**	0.127**	0.124	0.427***	0.877***	0.193**	0.202***	0.176**	0.195	0.243***
	(2.418)	(2.505)	(2.556)	(1.584)	(6.392)	(3.601)	(2.196)	(3.148)	(2.250)	(1.571)	(5.984)
Leverage of interlocked banks	-0.275	0.152	1.015***	0.198	-0.372	-2.332***	0.289	-0.049	0.282	0.262	0.129
	(-0.735)	(0.256)	(2.640)	(0.464)	(-0.681)	(-4.602)	(0.525)	(-0.122)	(0.489)	(1.501)	(0.422)
Profitability of interlocked banks	11.962***	5.435***	3.704***	4.584***	4.075***	8.018**	4.687***	4.812***	5.617***	3.168**	4.291**
	(3.477)	(5.470)	(2.932)	(2.770)	(3.039)	(2.537)	(3.062)	(3.197)	(4.330)	(2.201)	(2.291)
Characteristics of interlocked non-banks											
Size of interlocked non-banks	0.018	-0.001	0.030	0.001	0.015	0.017*	-0.003	0.010	-0.002	0.004	-0.001
	(0.709)	(-0.049)	(1.365)	(0.084)	(1.034)	(1.809)	(-0.222)	(0.705)	(-0.129)	(0.210)	(-0.198)
Size concentration of interlocked non-banks	-0.427***	0.244***	-0.213***	0.292***	1.076***	1.335***	0.223**	0.231**	0.213*	-0.012	0.612**
	(-8.557)	(9.408)	(-5.189)	(4.047)	(3.400)	(4.074)	(2.258)	(2.049)	(1.828)	(-0.065)	(2.357)
Leverage of interlocked non-banks	-0.718	-0.297	-0.471	-0.349	-0.805	-1.200***	-0.208	-0.614	-0.252	-0.311	-0.441
	(-0.999)	(-0.433)	(-0.623)	(-0.494)	(-0.929)	(-2.833)	(-0.272)	(-0.916)	(-0.354)	(-0.491)	(-1.322)
Profitability of interlocked non-banks	-0.306	0.388	-1.088	0.552	-0.627	-0.553	0.721	0.254	0.454	0.581	0.715
	(-0.218)	(1.522)	(-1.379)	(0.945)	(-0.906)	(-0.772)	(1.030)	(0.491)	(0.986)	(0.670)	(1.547)
Industry concentration of interlocked non-banks	0.171***	-0.288*	-0.057	-0.385*	-0.842**	-0.889**	-0.297**	-0.202	-0.280**	-0.187	-0.342
	(3.893)	(-1.763)	(-0.221)	(-1.842)	(-2.184)	(-2.367)	(-2.432)	(-1.164)	(-2.332)	(-1.256)	(-1.607)
Observations	103	139	72	133	87	68	143	143	143	143	143
of wich distressed	*37*	*28*	*23*	*37*	*37*	*37*	*37*	*37*	*37*	*31*	*24*
Region FE	NO	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES
Type FE	NO	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES
Pseudo R-squared	0.307	0.277	0.236	0.269	0.336	0.461	0.230	0.227	0.247	0.196	0.322

Note: Marginal effects are calculated at the median. All specifications include bank type and region fixed effects. Robust z-statistics, clustered by bank type, are reported in parentheses. Significance levels are indicated as follows: *** p<0.01, ** p<0.05, * p<0.1. The mean (median) age calculated on an alternative data source is 23.5 (19).

Table 14: Receiver operating characteristic analysis

Model number	Model description	Pseudo R-squared	AUC
Fixed effects			
7	Baseline model	0.105	0.726
13	Region and type effects	0.170	0.787
Management and interlock characteristics			
14	Managerial structure	0.215	0.813
15	Interlocked banks	0.256	0.833
16	Interlocked non-banks	0.231	0.818
17	Combined model	0.262	0.831
Liability regime choice			
18	Baseline model	0.107	0.712
19	Liability regime choice	0.114	0.714
21	Unpaid capital	0.122	0.712

Note: AUC (area under the ROC curve) is a measure of discrimination, or the ability of a test to correctly classify two groups. It ranges between 0 and 1, where values above 0.5 signify a fit that is better than a coin toss. Values between 0.9 and 1 should be considered excellent; between 0.8 and 0.9 good; and between 0.7 and 0.8 fair.

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