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Contingent Capital and Bank Risk-Taking:

Evidence from British Equity Markets before World War I[1]

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ABSTRACT

The recent financial turmoil highlights the incentive of highly leveraged financial institutions to take excessive risk, given the protection of limited liability. During the nineteenth and early twentieth century, many banks operated under liability rules which obligated shareholders to bear larger costs of bank insolvency in the form of contingent, or even unlimited liability. This paper examines the empirical relationship between the size of banks' contingent liability and their risk-taking behavior using data on British banks from 1878-1912. We find that banks with more contingent liability appear to have taken less risk. We also find evidence that the risk-reducing effects of contingent liability were larger for banks with higher leverage, suggesting that contingent capital mitigated moral hazard problem at banks.

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1. Introduction

From the enactment of the first commercial banking codes in the nineteenth century to the adoption of the Basel and Basel II accords in recent years, to the anticipated adoption of Basel III, policy makers have argued that holding increased amounts of capital promotes bank "soundness and stability" (Basel Committee on Banking Supervision 1988, 2004). [4] Capital has several stability-enhancing properties. First, unlike debt, equity provides a buffer against a shortfall in cash flow: if earnings fall, dividends can be suspended without catastrophic consequences, freeing up funds to pay depositors and other creditors.[5] Second, if a bank is forced to close, capital serves as a reserve that can be called upon to liquidate unpaid debts. Third, higher holdings of capital can encourage banks to undertake less risk: because the capital may be partially or completely wiped out risk in case of failure, banks have an incentive not to take risks that might put them out of business.[6] Fourth, because banks know more about their operations than their investors (information asymmetry), the decision to hold more capital—i.e., to subject owners to a greater loss in case of failure—can signal to depositors and investors that the bank will undertake less risk than it otherwise might.[7]

Although the stabilizing role of bank capital is widely recognized by economists and policy-makers, establishing a regulatory framework that ensures that banks have sufficient capital to weather large shocks has proven to be difficult. The value of bank capital changes

[4] Bank capital (or lack thereof) played an important role in making the banking system vulnerable to systemic shocks during the recent financial crisis. See Demirguc-Kunt, Detragiache, and Merrouche (2010).
[5] Debt service cannot be so easily suspended. This is especially important, given that banks are among the most highly leveraged firms in the world: the average debt-to-equity ratio in US agriculture is about one; the average in manufacturing is about two; the average in banking is over nine. Troy (2004).
[6] This presupposes that the incentives of bank managers shareholders are aligned (i.e., assuming no principal-agent problem). Glassman and Rhodes (1980). The incentive effect can be even more powerful when shareholder liability is not limited (Grossman 2001a).
[7] Finally, banks hold capital because government regulations force them to do so. Such government regulation is typically justified on the grounds that it promotes soundness and stability in the banking sector: that is, for all the reasons cited above.

over time and is notoriously difficult to measure given the inherent opacity of bank assets. The historical experience suggests that the difficulty in measuring bank capital may create environment in which regulators are tempted to forbear insolvent banks (e.g., the US Saving and Loans Crisis in the 1980s and Japan's decade long banking crisis in the 1990s).[8] It has also been emphasized that bank capital regulation is prone to failure due to the strong influence of political capture (e.g, Barth, Caprio, and Levine, 2006).

The earliest national banking codes, enacted in Canada, England, Finland, Japan, Sweden, and the United States, established minimum capital requirements ranging from just over £5000 to as much as £100,000. Even before governments began to mandate explicit minimum capital requirements, law, custom, and market forces led to alternative means for providing sufficient levels of capital as an additional protection for bank creditors, primarily though extended shareholder liability.[9]

The oldest and most well-known system of extended liability is unlimited liability, under which partners bear unlimited liability for the obligations of a failed firm. In England and Sweden, banks that issued currency during the nineteenth century were typically subject to unlimited liability.[10] In the United States, state law often mandated that banks chartered under their authority be subject to "double" liability: that is, in case of the bank's failure, shareholders would be liable for twice the amount they had originally paid for their shares; some states mandated "triple" liability.[11]

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[8] See, for example, Kane (1989) on the S&L crisis and Fukao (2003) on the Japanese experience.
[9] See Berger, Herring, and Szegő (1995) on market capital requirements.
[10] In countries in which government-sponsored central banks maintained a monopoly on note issue, banks were frequently incorporated with the same liability rules as governed non-financial corporations. Grossman (2001b).
[11] Technically, shareholders of such a bank were liable to pay in an additional amount equal to the par value of their shares (shareholders subject to triple liability would be liable for an additional payment equal to twice the par value of their shares). To the extent that the market value differed from the par value and the market value differed from the purchase price, the terms "double liability" and "triple liability" are misnomers. Grossman (2001a).

Theory predicts that extended liability will reduce the opportunity to shift risk to debt holders (e.g., depositors), since bank owners under such a regime are obligated by law to shoulder failure costs that are potentially well in excess of the initial equity contributed. Figure 1 illustrates shareholder payoffs under a variety of liability rules. In all cases, there is no upward limit on shareholder returns: positive returns on investment projects (i.e., higher firm value) lead to higher share value without limit. Under unlimited liability, the negative returns to shareholders are also unlimited, implying that the shareholders give equal weight to both tails of asset returns when evaluating investment decision.[12] Under limited liability, negative returns to shareholders are limited to the amount of paid-in capital, thereby altering the bank's risk preference; that is, if bank returns are normally distributed (with a mean around zero), bank owners operating under limited liability can increase their expected return by engaging in higher-risk projects (i.e., those with a higher variance). Such risk-shifting incentives are mitigated by contingent liability, since it raises the size of the potential negative payoff to shareholders. Thus, those operating with larger amounts of contingent liability give greater weight to the extremes of the tails of the returns—hence, avoiding high-variance (i.e., high-risk) projects. Esty (1998) and Grossman (2001a) demonstrate that such strict liability ruled played an important role in reducing moral hazard problem in the US banking sector.

In this paper, we consider another mechanism for imposing contingent liability upon bank shareholders which was common in Britain during the late nineteenth and early twentieth century: uncalled capital. Under this system, firms issued equity with a nominal value, all or part of which might have been required to be paid in by subscribers at the time of the initial offering. Shares which were only partly paid carried with them a contingent liability for the unpaid portion of the share and could be called in by the firm at the

[12] In practice, however, shareholders' liability is limited to their wealth--even under unlimited liability.

management's discretion. As in the case of unlimited and double liability, such extended liability is likely to induce bank shareholders to become more risk averse.[13] Even in the absence of an actual capital call, the threat of such a call might render such shares less liquid which, in turn, gives shareholders additional incentive to monitor managers for excessive risk-taking. The goal of this paper is to determine whether greater levels of uncalled capital reduced bank risk-taking.

There are several reasons to examine the consequences of uncalled liability. First, despite the fact that the scholarly literature has recently shown in intense interest in unlimited liability,[14] double liability,[15] and contingent capital[16]--in part, as a result of the recent financial meltdown—there has been little systematic empirical work specifically examining the historical experience with unpaid capital.[17] Second, unlike unlimited liability, but similar to double and triple liability, the extent of liability is explicitly stated: in the case of unlimited liability, the contingent liability could well exceed the total wealth of some shareholders, as it famously did during the failure of the City of Glasgow Bank in 1879, where the calls upon each shareholder was £2750 on each £100 share. Fourth, examining uncalled liability rather than unlimited or double liability, may prove empirically more tractable, since the extent of the contingent liability varied from firm to firm. Finally, given recent interest shown by

[13] Although unlimited liability and double liability superficially resemble the extended liability provisions of uncalled capital, in fact, there are important differences. Both limited liability and double liability formally come into play only if the institution in question is being wound up. Shareholders in both types of firms can be solicited for additional funds--either to bolster a foundering firm or to promote growth of a healthy one—however, they are under no obligation to do so. On the other hand, those owning shares with unpaid capital are obligated to meet capital calls under all circumstances, whether or not the firm is in actual liquidation. Because calling up uncalled capital of an on-going concern is much simpler than calling upon unlimited or double liability in the case of bankruptcy—which involves a court procedure—it is, in a sense, a less rare occurrence and one which shareholders are therefore more likely to anticipate

[14] Halpern *et al* (1980), Easterbrook and Fischel (1985), Carr and Mathewson (1988), Hansmann and Kraakman (1991, 1992a, 1992b), Grossman (1995), Hickson and Turner (2003a, 2003b, 2005), Acheson and Turner (2006).

[15] Macey and Miller (1992, 1993), Jackson (1993), Wilson and Kane (1996), Esty (1998), and Grossman (2001a, 2007).

[16] Kashyap, Rajan, and Stein (2008), Flannery (2009).

[17] See, however, Nanjo and Kasuya (2009).

policy makers in extended liability, the historical examination may yield insight for current-day policy.[18]

Briefly, we find that, on average, banks with larger amount of contingent liability tended to take on less risk. Notably, these effects are larger for banks with a smaller amount of paid-in capital at stake, suggesting that contingent capital mitigated moral hazard problem at banks that are less able to weather negative shocks on the value of assets. These results are analogous to those of Esty (1998) and Grossman (2001a) who find that double liability rules in the US worked to restrain excessive risk-taking by banks.

2. The evolution of contingent liability in law and practice

The first joint stock bank in Britain was the Bank of England, which was established in 1694.[19] Prior to that, banking services had been rendered by a number of different agents, including scriveners, goldsmiths, moneylenders, and participants in the daily meetings of London merchants, although none had received any charter, sanction, or official recognition from the government. In 1708, during the War of Spanish Succession, in return for a fresh loan to the government, a new charter was granted which, among its other provisions, prohibited associations of more than six individuals from carrying on a banking business in England and Wales.[20] Thus, the earliest banks in England were partnerships with unlimited liability.

Banking crises in the early nineteenth century brought home to policy makers the fragility of a banking system composed primarily of small banks. This realization, combined

[18] See, for example, Ashcraft (2004) on the Federal Reserve's "source of strength" doctrine.
[19] This section deals almost exclusively with the liability laws affecting banks. Hunt (1936) and Cook (1950) discuss the development of corporation law more broadly.
[20] The 1742 charter specifically enunciated the Bank's "privilege of exclusive banking." Crick and Wadsworth (1936: 11), Thomas (1934: 15).

with the declining importance of the Bank of England in funding government expenditures, led to the passage of a series of laws which gradually eroded the Bank's monopoly on joint stock banking (Broz and Grossman 2004, Grossman 2010): an 1826 law allowed the establishment of note-issuing joint stock banks outside of a 65-mile radius of London; by 1833, joint stock banks without note-issuing privileges were allowed within the 65-mile exclusion zone. Although these laws were viewed as something of a watershed at the time in that they allowed the formation of banking corporations, their provisions were quite modest: no minimum capital requirements were specified, nor were banking corporations granted limited liability.

Two pieces of legislation in 1844 further changed the character of English banking, both regularizing the mechanism for creating joint stock banks while at the same time setting limits upon bank activities in order to reduce the riskiness of their operations.[21] The better known of these was the Bank Charter Act (also known as Peel's Act, after the Prime Minister, Sir Robert Peel) which, among other things, began the process—continued over several decades--of centralizing the banknote issue within the Bank of England. Because banknotes are highly liquid, and subject to over-issue, by gradually divesting commercial banks of the privilege of note issue, the law reduced their exposure to banknote-related risk. And, when banks were eventually allowed to incorporate with limited liability, remaining note-issues were exempted from the limited liability provision.

The second, the Joint Stock Banking Act, established England's first banking code, specifying a detailed set of regulations for the establishment and management of joint stock banks. Minimum share denominations were to be £100, in order to encourage shareholding by the wealthy—who would be able to afford future capital calls. For the first time, minimum

[21] The text of both laws is reprinted in Gregory (1929).

capital requirements were set: banks were to have £100,000 in subscribed capital, half of which had to be paid up before it could begin operation.

In some sense, the notion of "uncalled capital" in an unlimited liability bank is counter-intuitive: if liability is joint and several, then individual partners can be sued for the debts of the partnership as a whole and liability will not be limited to the amount of uncalled capital. Nonetheless, uncalled capital may have served an important role: the unlimited liability of partners would only be relevant in the case of a liquidation of the firm; uncalled capital could be called in under much less dire conditions.

The provisions of the Joint Stock Banking Act were severe relative to existing law: no new joint stock bank was established during the subsequent five years and only seven were formed during the 13 years following its enactment, compared with well over 100 established formed during the previous 13-year period. The 1857 Joint Sock Banking Companies Act repealed the code of 1844, essentially subjecting banks to the new joint stock company law (which had been enacted the previous year), aside from limited liability provisions. Legislation in the following year granted joint stock banks the right to incorporate with limited liability; consolidating legislation enacted in 1862 made limited liability readily available for banks and also eliminated the £100 minimum share denomination.

The changes in banking law led to the rapid growth of limited liability banking, both through the establishment of new institutions and the conversion of unlimited liability banks into limited liability institutions. Nonetheless, many of the larger, well-established joint stock banks were reluctant to incorporate under limited liability (Crick and Wadsworth 1936: 32-33).

The failure of the unlimited City of Glasgow Bank in 1878 again raised the question of the advisability of limited liability banking.[22] One of the reactions was the passage of the Companies Act of 1879, which instituted the principle of "Reserved Liability."[23] Section 5 of the Act allowed banks, both limited and unlimited, to divide their uncalled capital into two parts, one to be callable at the discretion of the directors and a second as "reserved liability," only to be called up in the event that the firm was wound up. Under the terms of the Act, unlimited liability banks were allowed to increase their nominal capital, as long as the entire increase was allocated to reserved liability. Both limited and unlimited banks could reclassify a portion of their uncalled capital as reserve liability. Many banks took advantage of this in the subsequent decade (Gregory 1936 I: 206ff).

The greatest risk to shareholders with contingent liability was that part or all of the uncalled capital could be called. If the firm's liquidation was handled by the bankruptcy court, shareholders became parties to the case and could be compelled to pay the uncalled capital by the court. Uncalled liability, along with high share denomination, was seen as ensuring that shares remained in the hands of the well-to-do, who would be willing and able to monitor the activities of managers and cautious in how the business was run. According to Jefferys (1938 [1977]: 174-5):

> The very existence of a large uncalled portion on each share was a direct incentive to interest in the activities of the company. If there was any doubt about the honest running of the concern, or the promises of the prospectus not being fulfilled, the shareholders attempted to use legal methods to absolve them of the necessity of paying up their shares.

[22] This development had a parallel with developments among non-banking firms following the Overend, Gurney crisis of 1866. The 1867 Companies Act allowed companies to reduce their capital and share values, thereby reducing the proportion of unpaid capital. Few older companies took advantage of this provision, although newer companies tended to issue shares of lower denomination with a small unpaid portion. Jefferys (1946: 46).
[23] Crick and Wadsworth (1936: 33), Gregory (1936 I: 204ff). Another important part of this Act (section 7) mandated periodic independent audits.

And, in fact, two shareholders in Overend, Gurney sued—unsuccessfully--to have their names removed from the roster of shareholders in the wake of capital calls made on their shareholders after the firm's failure due to gross mismanagement (Campbell 1895: 879ff.).

A downside of uncalled liability is that even in the absence of liquidation or an actual capital call, it could impose substantial costs upon shareholders, particularly in the liquidity of shares and in their usefulness as collateral. Testifying in the aftermath of the Overend, Gurney crisis, banker and statistician William Newmarch presented the example of a company founded with £50 shares, the management of which subsequently realized that it only required £25 to be paid in:

> There is then an uncalled margin of £25, which hangs over the heads of the persons who are on the register of the company, and looking at the events of the last nine or ten months, the practical result is, that shares in the kind of companies mentioned have become almost entirely unmarketable, and for the very obvious reason that the buyer, while he will be perfectly content to embark in a concern where £25 is paid up, where only £5 or £10 more can in any way be called up, he is exceedingly unwilling to embark in a concern where the uncalled liability is represented by £25 per share. (Parliament (1867: Q. 525))
>
> I should think that at this moment there is between 20 and 30 millions of actually paid-up money, which is more or less in a state of suspended animation, in consequence of the unmarketable character of the shares. (Q. 528)

This view was reinforced by Manchester merchant and Salford mayor, Henry Pochin:

> I think that [overhanging liability] is a great public damage; the shares of many companies are incapable of being negotiated in any form, the property being as far as paid-up capital is concerned, just as unavailable as if it were at the bottom of the sea. It cannot be dealt with; it cannot be sold in the market. No banker will look at it, and the consequences are very serious and very considerable, having regard to what I believe to be the real value of those shares (Q. 2298)

He argued that bankers would not take securities with uncalled liability as collateral for loans, since if the borrowers defaulted, the bank would have to seize the contingent liability, which might outweigh the value of the shares (Q. 2311).[24]

Uncalled liability was also useful to companies attempting to raise capital under less dire circumstances. Rather than calling in capital, the management used uncalled capital in two ways: (1) as collateral for bank loans or for debentures to be sold in the security markets; and (2)by issuing new shares with even lower amounts of paid-up capital. *The Shareholder Guardian* (August 12, 1864) complained that: "The pernicious practice has grown up whenever additional working capital is required, of not making calls on the existing shares but of issuing new ones and requiring a small payment to be made on them" (quoted in Jefferys (1938 [1977]: 181).[25]

3. Data

Bank balance sheet data from 1878-1912 were gathered from the *Economist* banking supplement; share data were taken from the *Investor's Monthly Manual (IMM)*, which published comprehensive tables on securities traded on British—and some foreign--exchanges.[26] The *IMM* did not include separate tables for stocks and bonds, and so distinguishing debt from equity is not a straightforward exercise.[27] Annual data on ordinary

[24] He further noted that those who held such shares felt compelled to leave funds that could otherwise be used in profitable endeavors lying idle in the bank as insurance against calls (Q. 2301).
[25] We intend to take up the consequences of this form of raising additional capital in future work.
[26] Grossman (2002: 124-126, 144) presents a more complete description of *IMM* data.
[27] Fixed income securities were sometimes distinguishable by the title of the issue (which might, for example, include a maturity or an interest rate) or by listing the nominal amount of the issue rather than the number of shares in the column titled "number of shares or amount of stock" (i.e., £100,000 versus 100,000) or by the designation "stock" rather than an amount in the column devoted to the nominal amount of the share. It is possible that some securities that carried the designation "stock" in the amount column were, in fact, fully paid £100 shares and so the data presented in this section may not represent all fully paid shares. We are grateful to John Turner for clarifying the *IMM* nomenclature.

shares were gathered from the December issue of the *IMM*, including the number of shares outstanding, the nominal amount of each share, and the amount paid-in on each share. We also collected monthly data on share prices from this source so as to compute the volatility of share prices. Information was not collected on shares for which any of this information was omitted in the *IMM*.[28]

At the time of establishment, company promoters declared the nominal amount of the firm's capital, the number of shares into which it would be divided, and the portion of each share that would be paid-in by subscribers.[29] For example, a firm might be established with £1,000,000 capital divided into 10,000 shares of £100 each, with £50 pounds per share paid-in. Upon issue, subscribers would pay £50, with another £50 payable at the discretion of the directors.[30]

During the late nineteenth and early twentieth century there were no statutory requirements as regards share denominations or proportion of shares paid up. These were, rather, determined by the organizers at the outset. Frequently, organizers stated how much they intended to call up of a firm's nominal capital in the firm's prospectus, although it is unlikely that these intentions were legally binding. The proportion of capital paid up varied for a variety of reasons, including common practice within an industry and current opinion as to what share characteristics were conducive to promoting financial stability (Jefferys 1946: 46-48).

Figure 2 demonstrates the extent of uncalled capital in a variety of sectors during 1870-1913, presenting data on the ratio of uncalled capital to paid-up capital. The ratio is

[28] A missing latest price suggests that the share was not actively traded in the month.
[29] These were considered among the most crucial decisions made by company promoters. Jefferys (1946: 45) notes that by "the eighties and nineties these considerations were no longer to the fore."
[30] Under the Joint Stock Bank Act of 1844, a nominal share amount of £100 with £50 paid in would have been common. These minimum share denomination and paid-in requirements were eliminated in 1862.

weighted by firm size: that is, the ratio is the sum of all uncalled capital in the sector divided by the sum of total nominal capital. The figure reports time series graphs for only a few of the seventeen sectors identified by the *IMM*, as well as the average for all firms.

Figure 2 illustrates the relatively high amount of uncalled capital maintained by banks, insurance, and land, mortgage, and financial companies relative to the market as a whole. The high proportion of uncalled capital can be seen as a market-imposed requirement to engender confidence in sectors where leverage was high and the physical assets were either meager or inaccessible to creditors. Insurance companies, which like banks had large potential liabilities, had not been permitted to register as limited liability firms until 1862.

Figure 2 can be interpreted as suggesting that the introduction of reserved liability in 1880 increased in the relative amount of uncalled capital. In the course of establishing reserved liability, many banks raised the nominal value of their capital without changing the paid-in amount. During the entire period, changes in paid-in capital that were not associated with a stock split or with a change in the nominal capital of a firm were no more common in banking than in any other industry, occurring in about 2 percent of company-year observations.

4. Methodology

Our working hypothesis is that the more capital bank owners have at stake, the greater their incentive to avoid risk. Shareholders in banks operating under unlimited liability—which we capture with a dummy variable--have the greatest potential loss (all of their personal assets) and should, in theory, be the most risk-averse. Shareholders in banks operating under limited liability have at stake the total amount of equity capital, measured by

the ratio of market value of capital to total assets: the smaller the capital-to-asset ratio, the greater incentive for risk-taking.[31] Finally, bank owners also have contingent liability, which we measure in two ways: (1) by the amount of uncalled capital relative to the book value of subscribed capital; and (2) by the amount of uncalled capital relative to the value of paid-in capital.[32]

We measure bank risk—our dependent variable--in four ways. First, following Saunders, Strock, and Travlos (1990) and Esty (1998), among others, we use the volatility of share prices. More specifically, we compute the standard deviation of monthly changes in share prices for a given year for each bank, which we match up with annual data on bank liability characteristics.[33] This measure has several limitations. First, some banks are privately owned, and thus their shares are not traded; we drop these banks from our sample. Second, even when banks are publicly traded, shares are not transacted every month, presumably because these shares are not especially liquid. Following Esty (1998), we screen out bank-year observations in which fewer than 11 prices are observed (out of 12 months).[34] After dropping the 580 observations for the reasons discussed above, we are left with 2636 bank-year observations that contain information on capital-to-asset ratio, liability status (limited or unlimited), and the amount of contingent capital.[35]

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[31] We also use the ratio of paid-in capital (in book value) to assets to measure capital-to-asset ratio as a robustness check. The results are qualitatively similar, and thus not reported to conserve space.

[32] There is no correct method for specifying the denominator in a measure of contingent capital. We focus our attention the ratio of uncalled liability to subscribed capital and to paid-in capital, which seems to have been the focus of market participants at the time. One could also measure uncalled capital relative to market capitalization, since as market valuations increased, a set amount of uncalled capital should have decreased in importance to shareholders. We have experimented with this measure, although the results are generally not significant.

[33] One possible objection to this procedure is the assumption that the true volatility of prices can be captured only with 12 observations. As a check, we compute standard deviation based on 24 month of share price data to construct bi-annual panel. The results are qualitatively similar.

[34] The results are qualitatively similar without this screen or with a less stringent screen.

[35] Because the data are panel, we adjust standard errors by using STATA's cluster option.

Another potential problem with this measure, as noted by Esty (1998), is that contingent liability makes shares riskier, since compared with limited liability, equity holders with contingent liability face wider range of returns for a given asset risk. Hence, given this direct positive effects of contingent liability on share price volatility, even if contingent liability reduces asset risk (which in turn reduces the volatility of share price returns), the net effect of these competing mechanisms is theoretically ambiguous.

Because of the limitation of share price volatility, we also use three alternative measures of risk-taking from bank balance sheets: the ratio of loans to total assets, the ratio of cash to total assets, and the rate of growth of assets. Our assumption is that loans are riskier and less liquid—and that cash is less risk and more liquid-- than other balance sheet assets, primarily securities.[36] Banks with substantial contingent liabilities should have a smaller proportion of their assets in loans and a larger proportion of their assets in cash than limited liability banks if the risk-reducing incentive of contingent liability is strong. We also measure risk-taking by the rate at which a bank's assets expand in a given year under the theory that, all other things being equal, banks that engage in riskier activities will grow more rapidly than banks behaving in a more conservative manner (Grossman 2001a, 2007). Descriptive statistics are presented in Table A1.

With these four measures of risk as dependent variables, we estimate the following regression equation:

$$Risk_{it} = \beta_0 + \beta_1 Capital_{it} + \beta_2 Unlimited_{it} + \beta_3 Contingent\ Liability_{it} + \varepsilon_{it}$$

[36] We also attempt to use the fraction of the asset portfolio in cash and government securities, however, the *IMM* doesn't provide data on government securities holdings until relatively late in the period, rendering our data set quite small.

Since all three factors reduce the incentive for banks to take risk, we expect the coefficients on each of these variables to be negative. All specifications include year specific effects.[37] Standard errors are clustered by banks.

5. Results

The results based on share price volatility are presented in Table 1. Columns 1-7 use the ratio of uncalled capital to paid up capital as our measure of contingent liability, and columns 8-12 employ the ratio of uncalled capital to subscribed (nominal) capital. We also control for bank size (columns 5 and 10), establishment year (columns 6 and 11), when it is available, and dummies for bank location (columns 7 and 12).

As predicted, share price volatility is typically negatively correlated with the capital-to-asset ratio (i.e., share price volatility is larger for more highly leveraged banks). Although this result is consistent with the view that a bank with higher capital-to-asset ratio makes more prudent decisions, it is also consistent with a simpler channel that higher leverage causes greater share price volatility. The coefficients on contingent liability and unlimited liability, however, are for the most part not statistically significant. This result contrasts with that of Esty (1998), which shows that the strict liability rule is correlated with lower share price volatility. Our results suggest that in the case of British banks during the late nineteenth and early twentieth century, the risk-reducing effects of a strict liability rule might not have been large enough to offset its direct positive effects on share price volatility.

The results based on loan-to-asset ratio are displayed in Table 2. Column 1 shows that the loan-to-assets ratio is strongly negatively correlated with the amount of contingent

[37] As a first pass at the data, we ran several specifications with bank fixed effects, but the results are all insignificant largely due to the fact that the independent variables do not have rich within-bank variation. As a result, we focus only on the results without bank fixed effects but with year fixed effects.

liability, measured as the ratio of uncalled liability to subscribed capital. A similar correlation is present when we employ the ratio of uncalled liability to paid-in capital as our measure uncalled liability (column 8). These results are statistically robust even when we control for the capital-to-assets ratio and an indicator for unlimited liability (columns 5 and 9), bank size (column 6), and establishment year (column 7). In some specifications, the estimated coefficients on contingent liability are not significant, however they are qualitatively similar.

The estimated risk-reducing effects of contingent liability are economically important: based on columns 1-6, comparing a bank with no contingent liability (i.e., (amount-par)/amount=0) with a bank with 100% contingent capital ((amount-par)/amount=1), the latter's loan-to-asset ratio is, on average, 12-17 percentage points less than that of the former. Taken as a group, these results suggest that extension of bank owners' liability beyond the paid-in amount was an important mechanism to restrain banks from excessive risk-taking.

Interestingly, the loan-to-asset ratio is positively correlated with the capital-to-asset ratio (column 2), suggesting that well-capitalized banks seem to have taken more risk than poorly capitalized banks. One possible explanation is that markets demanded higher capital-to-asset ratio from bank holding more opaque assets (i.e., loans). The coefficient on unlimited liability is not significantly different from zero, although its signs are negative in all specifications, as expected.

The results for cash-to-asset ratio are displayed in Table 3. When measured by the ratio of uncalled capital to paid-in capital, contingent liability is positively correlated with cash-to-asset ratio (column 8); these results are generally robust (columns 9-12). Hence, the balance sheet of banks with contingent liability tended to be less risky and more liquid.

Interestingly, the cash-to-asset ratio is negatively correlated with the capital-to-asset ratio and unlimited liability status in some specifications. Again, it might be the case that markets demand higher capital-to-asset ratio unlimited liability from a bank with illiquid balance sheet.

Table 4 shows the results for asset growth. In one specification (column 8), contingent liability is negative correlated with asset growth, however, this result is not robust. Nonetheless, the results strongly indicate that the other forms of risk capital made banks more cautious as suggested by the negative coefficients on capital-to-asset ratio and unlimited liability.

Nonlinearity

In addition to estimating the average effects of contingent capital on bank risk-taking, we also examine the interactive effects of these measures. Theory predicts that the effects of unlimited liability and contingent liability are heterogeneous, depending on how leveraged a bank is. One the one hand, when leverage is high and insolvency more likely, a bank with no extended liability has strong incentives to take risk which can be effectively shifted onto debt holders. With large extended liability that could adversely affect personal wealth of bank equity holders in case of insolvency, however, such risk-shifting incentives are attenuated. On the other hand, when leverage is low and insolvency is unlikely, extended liability is unlikely to be demanded and thus less relevant to the bank's choice of asset risk. Hence, the effects of extended liability on bank risk-taking depend crucially on capital-to-asset ratio.

Econometrically, we look at the interaction of contingent capital and unlimited liability with the capital-to-asset ratio as follows:

$$Loans_{it} = \beta_0 + \beta_1 Capital_{it} + \beta_2 Unlimited_{it} + \beta_3 Contingent\ Liability_{it}$$
$$+ \beta_4 Capital_{it} \times Unlimited_{it} + \beta_5 Capital_{it} \times Contingent\ Liability_{it} + \varepsilon_{it}$$

These interactions capture the possibility that extended liability is less relevant when banks are more adequately capitalized. We therefore expect β_4 and β_5 to be positive and statistically significant.

The results are presented in Table 5. As expected, the coefficient on the interaction of capital-to-asset ratio and contingent liability is positive and significant while that on (un-interacted) contingent liability remains negative. Thus, the risk-reducing effects of contingent liability seem to be highly nonlinear, depending upon a bank's leverage (i.e., the amount of extended liability matters more when the capital-to-assets ratio is low).

The results are again qualitatively important. Based on column 1, for a bank with relatively high capital-to-asset ratio (say 0.35 which is one standard deviation above the average), the impact of an increase in the ratio of contingent to subscribed capital from 0 to 0.5 (i.e., switching from limited liability to double liability) is only 0.5*(-0.474 + 0.35*1.273) = -0.015 (and statistically insignificant), while for a bank with low capital-to-asset ratio (say 0.15, one standard deviation below the average) the effect of the same change in contingent capital is 0.5*(-0.474 + 0.15*1.273) = -0.14.[38] This is consistent with the view that contingent liability keeps bankers from shifting risk to debt holders when their bank is near insolvency.

When the interaction of the capital-to-assets ratio with unlimited liability is included (column 2), the coefficient on (uninteracted) unlimited liability becomes larger (i.e., more

[38] We obtain similar calculation if we use the coefficient estimates on columns 3-6)

negative) and statistically significant (in Table 4) while the coefficient on the interaction of the capital-to-assets ratio with unlimited liability is positive. These results suggest that when banks are fully solvent with high capital-to-assets ratio, unlimited liability is irrelevant, whereas it plays an important role in reducing bank asset risk when capital asset ratio is low. Again the effects are economically important. Based on column 2, for a well capitalized bank (capital-to-asset ratio = 0.35), the effect of converting from limited to unlimited liability is only -0.201 + 0.35*0.555 = -0.007, whereas for a poorly capitalized bank (capital-to-asset ratio = 0.15), the effect is -0.201 + 0.15*0.555 = -0.118.

In sum, the risk-reducing effects of strict liability rule are larger among highly leveraged banks, since contingent capital and unlimited liability are irrelevant to risk-attitude of banks when the capital-to-assets ratio is so large that banks are unlikely to become insolvent (i.e., bank owners are unlikely to be called to provide contingent capital if banks are adequately capitalized).

6. Conclusion

Does imposing more strict liability rules make banks behave more prudently? This paper exploits pre-World War I data, when British banks operated with varying levels of extended liability, to address this question. Our results suggest that banks which operated under more strict liability rules—particularly more highly leveraged banks—undertook less risk than counterparts operating with lower levels of contingent liability. These results are consistent with both the predictions of economic theory as well as the findings of empirical literature that focuses on the consequences of double liability in the United States. Our results have an important implication for current day policy makers: namely that extending bank

shareholders' liability can protect taxpayers by directly reducing the taxpayer's share of bank resolution costs and, more importantly, by altering the risk-shifting incentives of banks.

Our results also suggest an agenda for research on British economic history. If the institution of extended liability functioned well as a device to mitigate the moral hazard problem in the British banking sector before WWI, what led to its decline and eventual demise? It might also be fruitful to probe the factors underlying the evolution of liability rules, as well the factors—e.g., convention, market—that determined individual firms' contingent capital choices.

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Figure 1: Shareholder payoff under different liability rules

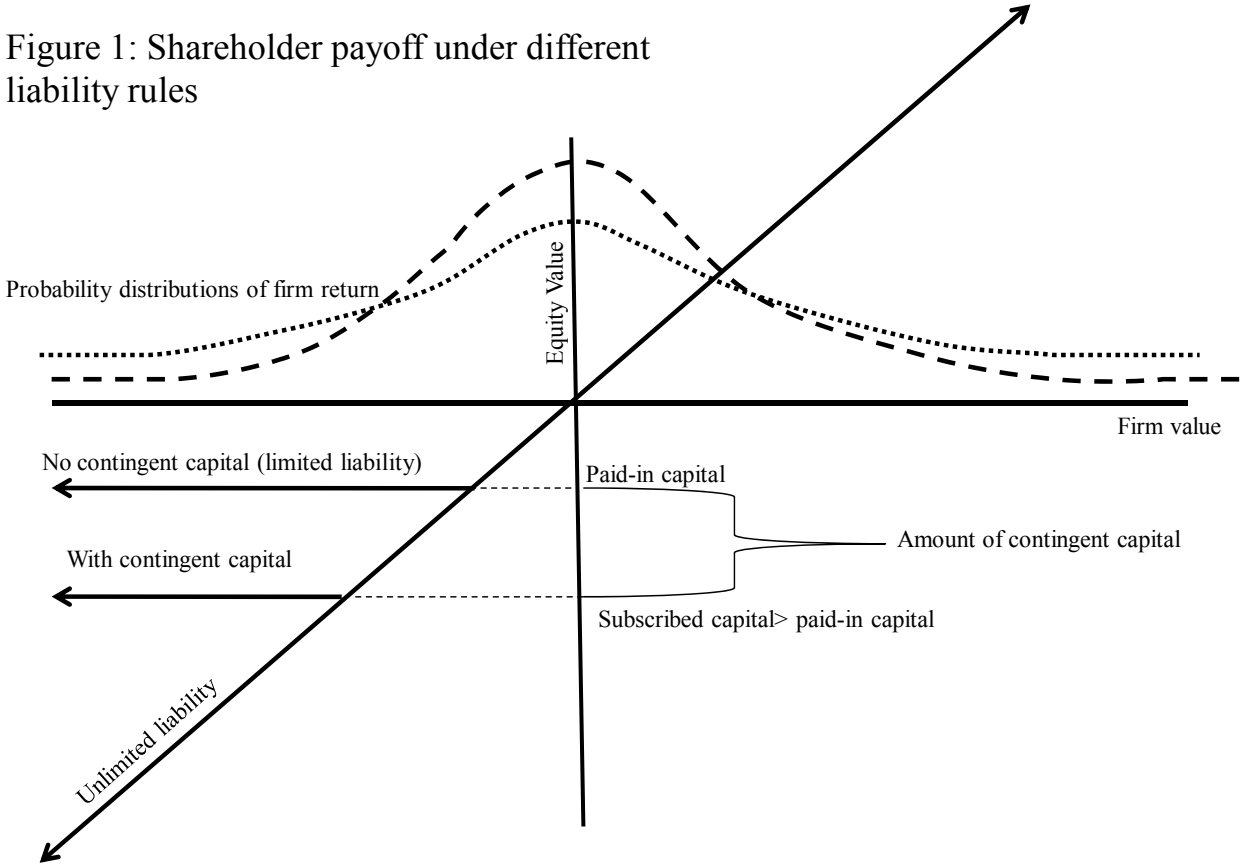
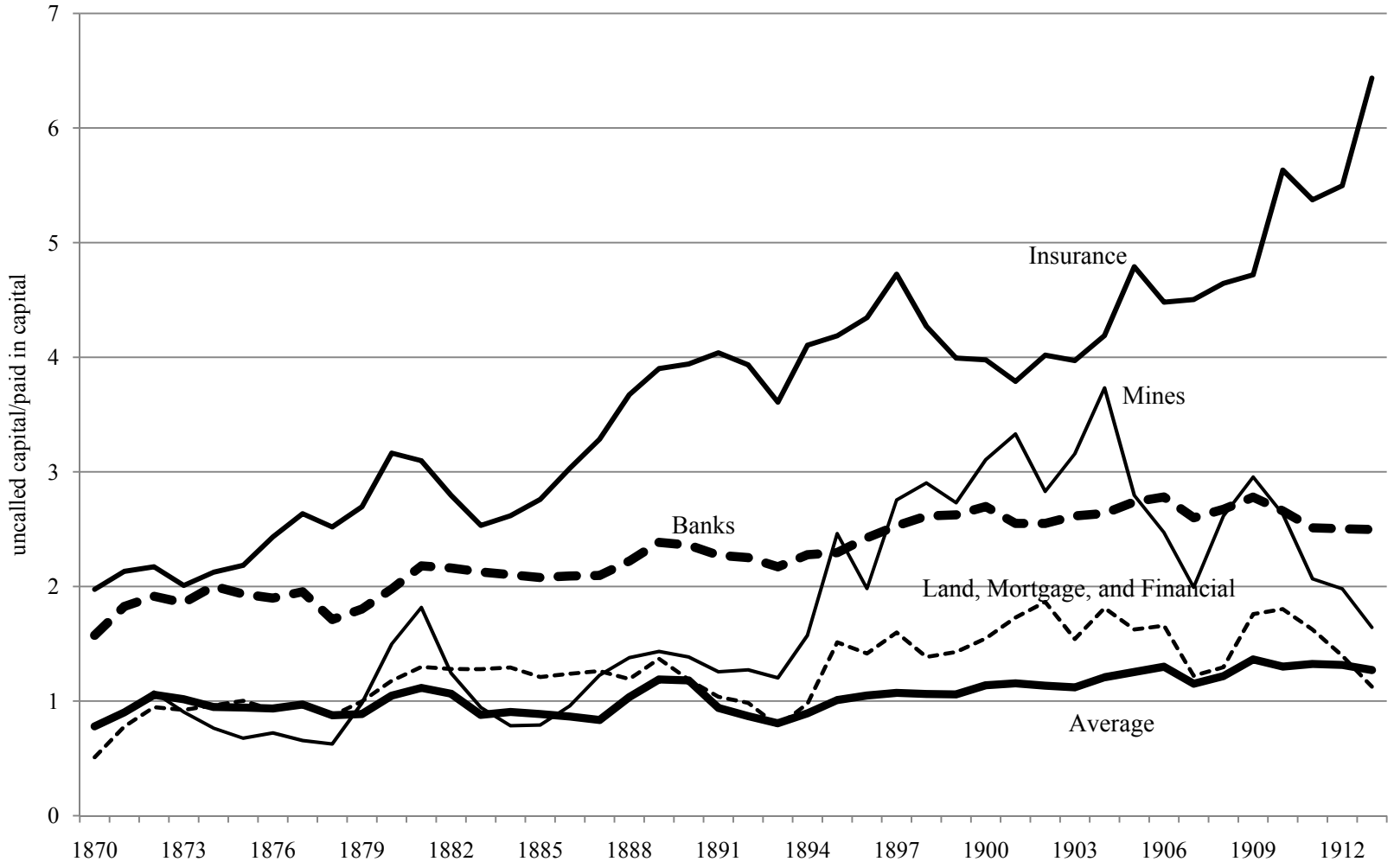


Figure 2: Ratio of uncalled to paid-in capital, selected sectors, 1870-1913
(weighted by firm size)



Source: Authors' calculations.

Table 1: Standard Deviation of Share Price Return

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(amount-par)/amount	0.00263			0.00230	0.00531	0.0105	0.00348					
	(0.00772)			(0.00693)	(0.00703)	(0.0115)	(0.0158)					
(amount-par)/par								0.00139	0.00112	0.00133	0.00191*	0.000757
								(0.000928)	(0.000930)	(0.000912)	(0.00114)	(0.00230)
Capital-to-Assets Ratio		-0.0532***		-0.0528***	-0.0627***	-0.0395**	-0.00782		-0.0498***	-0.0603***	-0.0335**	-0.00725
		(0.0167)		(0.0167)	(0.0192)	(0.0193)	(0.0232)		(0.0175)	(0.0193)	(0.0164)	(0.0227)
Unlimited Liability			-0.00632	-0.00474	-0.00426	-0.00361	-0.00952		-0.00427	-0.00386	-0.00337	-0.00887
			(0.00873)	(0.00879)	(0.00900)	(0.0106)	(0.00845)		(0.00880)	(0.00899)	(0.0105)	(0.00852)
ln(Assets)					-0.00215**	-0.000683	-0.00212			-0.00240**	-0.000929	-0.00250
					(0.00106)	(0.00122)	(0.00192)			(0.00102)	(0.00110)	(0.00250)
Establishment Year						5.71e-05**	-4.35e-05				6.09e-05**	-4.81e-05
						(2.72e-05)	(2.77e-05)				(2.99e-05)	(3.35e-05)
Constant	0.0629***	0.0738***	0.0647***	0.0721***	0.107***	-0.0456	0.144**	0.0602**	0.0695***	0.110***	-0.0488	0.157*
	(0.0236)	(0.0227)	(0.0225)	(0.0237)	(0.0294)	(0.0576)	(0.0680)	(0.0231)	(0.0234)	(0.0291)	(0.0597)	(0.0863)
Location dummy												
Observations	2,103	2,103	2,103	2,103	2,103	1,683	1,683	2,103	2,103	2,103	1,683	1,683
R-squared	0.049	0.058	0.049	0.059	0.061	0.052	0.099	0.052	0.061	0.063	0.057	0.100

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Loans-to-Assets Ratio

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(amount-par)/amount	-0.177***			-0.177***	-0.152**	-0.124*	-0.123					
	(0.0549)			(0.0578)	(0.0588)	(0.0700)	(0.0804)					
(amount-par)/par								-0.0118**	-0.0105**	-0.00703	-0.00653	-0.00999
								(0.00485)	(0.00517)	(0.00488)	(0.00544)	(0.00644)
Capital-to-Assets Ratio		0.324**		0.316**	0.257*	0.363**	0.120		0.281**	0.203	0.298	0.117
		(0.125)		(0.121)	(0.141)	(0.175)	(0.134)		(0.124)	(0.147)	(0.186)	(0.134)
Unlimited Liability			-0.0123	-0.0337	-0.0229	-0.0204	0.00116		-0.0229	-0.0108	-0.0136	0.00559
			(0.0345)	(0.0363)	(0.0330)	(0.0342)	(0.0234)		(0.0341)	(0.0303)	(0.0318)	(0.0211)
ln(Assets)					-0.0242**	-0.0200	-0.00406			-0.0305***	-0.0260*	-0.00425
					(0.0110)	(0.0133)	(0.0246)			(0.0113)	(0.0143)	(0.0244)
Establishment Year						-4.25e-05	0.000467				9.92e-06	0.000441
						(0.000308)	(0.000552)				(0.000308)	(0.000552)
Constant	0.708***	0.527***	0.582***	0.653***	1.039***	1.022	0.0746	0.621***	0.568***	1.065***	0.960	0.0573
	(0.0451)	(0.0289)	(0.0167)	(0.0534)	(0.187)	(0.663)	(1.221)	(0.0243)	(0.0367)	(0.201)	(0.696)	(1.250)
Location dummy	no	no	no	no	no	no	yes	no	no	no	no	yes
Observations	2,631	2,631	2,631	2,631	2,631	2,093	2,093	2,622	2,622	2,622	2,084	2,084
R-squared	0.130	0.135	0.094	0.171	0.209	0.208	0.584	0.122	0.154	0.209	0.218	0.577

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Cash-to-Assets Ratio

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(amount-par)/amount	0.0319			0.0295	-0.00122	-0.00276	0.00514					
	(0.0290)			(0.0299)	(0.0247)	(0.0297)	(0.0321)					
(amount-par)/par								0.00584**	0.00537**	0.00258	0.00368*	0.00414*
								(0.00227)	(0.00229)	(0.00198)	(0.00199)	(0.00244)
Capital-to-Assets Ratio		-0.0989**		-0.0981**	-0.0359	-0.0293	0.0315		-0.0884**	-0.0332	-0.0192	0.0373
		(0.0416)		(0.0409)	(0.0372)	(0.0400)	(0.0527)		(0.0408)	(0.0369)	(0.0385)	(0.0535)
Unlimited Liability			-0.0156	-0.0122	-0.0236**	-0.0201*	-0.00362		-0.0116	-0.0213**	-0.0168*	0.00190
			(0.0107)	(0.0117)	(0.00927)	(0.0104)	(0.0106)		(0.0110)	(0.00902)	(0.0100)	(0.0103)
ln(Assets)					0.0231***	0.0234***	0.0183***			0.0223***	0.0223***	0.0166***
					(0.00348)	(0.00431)	(0.00489)			(0.00340)	(0.00421)	(0.00481)
Establishment Year						4.88e-05	0.000150				6.14e-05	0.000137
						(0.000199)	(0.000182)				(0.000196)	(0.000178)
Constant	0.177***	0.217***	0.200***	0.196***	-0.169**	-0.272	-0.404	0.181***	0.198***	-0.165***	-0.292	-0.373
	(0.0260)	(0.0154)	(0.0134)	(0.0284)	(0.0652)	(0.390)	(0.344)	(0.0166)	(0.0190)	(0.0602)	(0.383)	(0.341)
Location dummy	no	no	no	no	no	no	yes	no	no	no	no	yes
Observations	2,461	2,461	2,461	2,461	2,461	1,949	1,949	2,461	2,461	2,461	1,949	1,949
R-squared	0.037	0.046	0.034	0.051	0.173	0.168	0.366	0.053	0.065	0.177	0.175	0.371

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Asset Growth

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(amount-par)/amount	0.0126			0.00939	0.0110	-0.0253	-0.0264*					
	(0.0148)			(0.0152)	(0.0155)	(0.0161)	(0.0139)					
(amount-par)/par								0.00141	0.00107	0.00118	-0.00143	-0.00163
								(0.00141)	(0.00143)	(0.00149)	(0.00116)	(0.00135)
Capital-to-Assets Ratio		-0.0462*		-0.0456*	-0.0492**	-0.0658***	-0.00394		-0.0401	-0.0424*	-0.0579***	-0.00571
		(0.0239)		(0.0237)	(0.0234)	(0.0206)	(0.0430)		(0.0246)	(0.0242)	(0.0198)	(0.0424)
Unlimited Liability			-0.0201**	-0.0188**	-0.0182**	-0.0168*	-0.00945		-0.0186**	-0.0182**	-0.0143*	-0.00719
			(0.00777)	(0.00802)	(0.00799)	(0.00848)	(0.00854)		(0.00790)	(0.00787)	(0.00810)	(0.00833)
ln(Assets)					-0.00149	0.00140	-0.00571*			-0.000886	0.00265	-0.00576*
					(0.00224)	(0.00235)	(0.00325)			(0.00232)	(0.00225)	(0.00334)
Establishment Year						3.14e-05	-7.09e-05				2.86e-05	-7.56e-05
						(9.98e-05)	(8.34e-05)				(0.000100)	(8.51e-05)
Constant	0.0192	0.0364***	0.0278**	0.0298*	0.0532	-0.0156	0.227	0.0299***	0.0378***	0.0523	-0.0456	0.222
	(0.0158)	(0.0122)	(0.0108)	(0.0171)	(0.0368)	(0.172)	(0.154)	(0.00857)	(0.0103)	(0.0375)	(0.176)	(0.160)
Location dummy	no	no	no	no	no	no	yes	no	no	no	no	yes
Observations	2,526	2,526	2,526	2,526	2,526	2,022	2,022	2,518	2,518	2,518	2,014	2,014
R-squared	0.055	0.057	0.056	0.059	0.060	0.065	0.118	0.057	0.061	0.061	0.066	0.117

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Interaction Effects (Loans-to-Assets Ratio)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
(amount-par)/amount	-0.474***	-0.179***	-0.506***	-0.457***	-0.466**	-0.394*
	(0.128)	(0.0578)	(0.123)	(0.144)	(0.198)	(0.210)
Capital-to-Assets Ratio	-0.521*	0.289**	-0.636**	-0.618**	-0.600	-0.594*
	(0.283)	(0.124)	(0.267)	(0.283)	(0.417)	(0.354)
Unlimited Liability	-0.0322	-0.201**	-0.251***	-0.221***	-0.213**	-0.161**
	(0.0361)	(0.0900)	(0.0858)	(0.0791)	(0.0881)	(0.0619)
Capital-to-Assets Ratio * (amount-par)/amount	1.237***		1.355***	1.253***	1.329**	1.038*
	(0.424)		(0.402)	(0.467)	(0.632)	(0.568)
Capital-to-Assets Ratio * Unlimited Liability		0.555**	0.724***	0.658***	0.627***	0.534***
		(0.234)	(0.210)	(0.195)	(0.221)	(0.156)
ln(Assets)				-0.0227**	-0.0184	-0.00250
				(0.0106)	(0.0128)	(0.0232)
Establishment Year					-2.17e-05	0.000483
					(0.000307)	(0.000511)
Constant	0.858***	0.660***	0.886***	1.230***	1.206*	0.201
	(0.0926)	(0.0540)	(0.0898)	(0.158)	(0.620)	(1.068)
Location dummy	no	no	no	no	no	Yes
Observations	2,631	2,631	2,631	2,631	2,093	2,093
R-squared	0.192	0.177	0.201	0.234	0.230	0.595

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

Table A1: Summary Statistics

Variable		*Mean*	*Std. Dev.*	*Min*	*Max*	*Observations*
SD of Stock Return	overall	0.028	0.048	0.000	0.658	N = 2103
	between		0.018	0.000	0.108	n = 118
	within		0.046	-0.062	0.646	T = 17.822
Loan-to-Asset Ratio	overall	0.660	0.153	0.119	1.000	N = 2631
	between		0.146	0.227	0.961	n = 143
	within		0.078	0.095	1.164	T-bar = 18.3986
Cash-to-Asset Ratio	overall	0.157	0.080	0.000	1.758	N = 2461
	between		0.074	0.020	0.597	n = 140
	within		0.049	-0.124	1.715	T-bar = 17.5786
Asset Growth	overall	0.035	0.085	-0.588	0.689	N = 2526
	between		0.051	-0.141	0.223	n = 140
	within		0.078	-0.449	0.640	T = 18.0429
(amount - par)/amount	overall	0.696	0.167	0.000	1.000	N = 2636
	between		0.177	0.000	1.000	n = 143
	within		0.077	-0.115	0.930	T-bar = 18.4336
(amount - par)/par	overall	3.126	1.959	0.000	24.000	N = 2627
	between		1.918	0.000	10.429	n = 142
	within		0.780	-4.303	21.445	T-bar = 18.5
Unlimited Liability	overall	0.046	0.208	0.000	1.000	N = 2636
	between		0.115	0.000	1.000	n = 143
	within		0.190	-0.500	1.017	T-bar = 18.4336
Capital-toAsset Ratio	overall	0.257	0.102	0.018	1.558	N = 2636
	between		0.121	0.032	1.081	n = 143
	within		0.057	-0.251	0.940	T-bar = 18.4336
ln(Asset)	overall	14.823	1.368	8.961	18.468	N = 2636
	between		1.509	9.568	17.981	n = 143
	within		0.346	13.220	16.123	T-bar = 18.4336
Establishment Year	overall	1832.196	29.078	1685	1884	N = 2098

	between		29.135	1685	1884	n = 102
	within		0.000	1832.196	1832.196	T-bar = 20.5686
Year	overall	1892.541	9.097	1878	1912	N = 2636
	between		6.637	1878	1911	n = 143
	within		7.599	1875.541	1909.541	T-bar = 18.4336