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Contingent Capital and Bank Risk-Taking:

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

Richard S. Grossman[2] and Masami Imai[3]

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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 stricter 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. We find that, on average, banks with larger amount of extended liability tended to take on less risk. Notably, these effects are larger for banks with higher leverage, suggesting that contingent capital mitigated moral hazard problem at banks.

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[2] Department of Economics, Wesleyan University, Middletown, CT 06459 and Institute for Quantitative Social Science, Harvard University, Cambridge, MA 02138, rgrossman@wesleyan.edu.
[3] Department of Economics, Wesleyan University, Middletown, CT 06459, mimai@wesleyan.edu.

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). 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.[4] 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 is at risk in case of failure, banks have an incentive not to take risks that might put them out of business.[5] 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.[6]

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 £100,000. Even before governments began to mandate explicit minimum

[4] 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).

[5] 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 2001).

[6] 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.

capital requirements, law, custom, and market forces led to alternative means for providing sufficient levels of capital, primarily though extended shareholder liability.[7]

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.[8] 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.[9]

Theory predicts that such extended liability might have provided an important mechanism to reduce the opportunity of bank owners to shift risk to debt holders (e.g., depositors) as banks owners were by law obligated to shoulder a large costs of failure beyond the initial equity that they 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) will lead to higher share value without limit. Under unlimited liability, the negative returns to shareholders are also unlimited, which means that the shareholders give equal weight to both tails of asset returns when evaluating investment decision.[10] 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

[7] See Berger, Herring, and Szegő (1995) on market capital requirements.
[8] 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).
[9] Technically, shareholders of such a bank would be 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 extent to which the market value differed from the purchase price), the term "double liability" and "triple liability" may have been something of a misnomer. Grossman (2001a).
[10] In practice, however, shareholders' liability is limited to the total of shareholder assets even with unlimited liability.

returns are normally distributed (with a mean zero or slightly positive return), 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 with 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 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 management's discretion. The goal of this paper is to determine whether greater levels of uncalled capital led to a 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,[11] double liability,[12] and contingent capital,[13] there has been little systematic empirical work specifically examining the historical experience with unpaid capital.[14] Second, although unlimited liability and double liability superficially resemble the extended liability provisions

[11] 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).
[12] Macey and Miller (1992, 1993), Jackson (1993), Wilson and Kane (1996), Esty (1998), and Grossman (2001a, 2007).
[13] Kashyap, Rajan, and Stein (2008), Flannery (2009).
[14] See, however, Nanjo and Kasuya (2009).

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. 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.

Third, 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 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 policy makers in extended liability, the historical examination may yield insight for current-day policy.[15]

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. These results are analogous to those of Esty (1998) and Grossman (2001a) who find that double liability rule in the US worked to restrain excessive risk-taking by banks.

[15] See, for example, Ashcraft (2004) on the Federal Reserve's "source of strength" doctrine.

2. Legal Background

The first joint stock bank in Britain was the Bank of England, which was established in 1694.[16] 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.[17] 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 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): 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.[18]

[16] This section deals almost exclusively with the liability laws affecting banks. Hunt (1936) discusses the development of corporation law more broadly.
[17] The 1742 charter specifically enunciated the Bank's "privilege of exclusive banking." Crick and Wadsworth (1936: 11), Thomas (1934: 15).
[18] Partners' liability was to cease three years after they had sold their shares in the bank.

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.[19] The better known of these was the Bank Charter Act (also known as Peel's Act) which, among other things, began the process—continued over several decades--of centralizing all 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 bank-note-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 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.

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

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.[20] One of the reactions was the passage of the Companies Act of 1879, which instituted the principle of "Reserved Liability."[21] 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

[20] 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).
[21] Crick and Wadsworth (1936: 33), Gregory (1936 I: 204ff). Another important part of this Act (section 7) mandated periodic independent audits.

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).

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.[22] The *IMM* did not include separate tables for stocks and bonds, and so distinguishing debt from equity is not a straightforward exercise.[23] Annual data on ordinary 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*.[24]

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.[25] For example, a firm might be established with

[22] Grossman (2002: 124-126, 144) presents a fuller description of *IMM* data.
[23] 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.
[24] A missing latest price suggests that the share was not actively traded in the month.
[25] 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."

£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.[26]

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).

Figures 2 and 3 demonstrate the extent of uncalled capital in a variety of sectors during 1870-1913. Figure 2 presents data on the ratio of uncalled capital to paid-up capital; figure 3 presents data on the ratio of uncalled capital to total market capitalization.[27] In both figures, the ratios are weighted by the sizes of firms: that is, the ratio is the sum of all uncalled capital in the sector divided by the sum of total nominal capital or market capital. The figures report time series graphs for only a few of the seventeen sectors identified by the *IMM*, including banks, insurance companies, and land, mortgage, and financial companies (figure 2 also includes mining firms and figure 3 includes trusts), as well as an average for all firms.

Figures 2 and 3 illustrate the relatively high amount of uncalled capital maintained by banks, insurance, and land, mortgage, and financial companies relative to the market as a

[26] 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.
[27] Each figure has something to recommend it. Since nominal share capital was a widely noted--and infrequently changed--the ratio presented in Figure 2 is not affected by changing share prices. On the other hand, dividing uncalled capital by market capitalization gives, in some sense, a more accurate picture of the absolute size/importance of uncalled capital relative to firm size.

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.[28] Insurance companies, perhaps also because of their large potential liabilities, like banks, had not been permitted to register as limited liability firms until 1862.

Both figures 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.[29] Finally, bank owners also have contingent liability, which

[28] Insurance companies were, like banks, not given equal access to limited liability until 1862.
[29] 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 (Table A1).

we measure by the amount of uncalled capital relative to the book value of subscribed capital.[30]

In addition to estimating the average effects of capital on bank risk-taking, we also examine the interactive effects of these measures. More specifically, we look at the interaction of contingent capital with the capital-to-asset ratio, since contingent capital is irrelevant when capital-to-asset ratio is so large that bank are unlikely to become insolvent (i.e., bank owners are unlikely to be called to provide contingent capital if banks are adequately capitalized).

We measure bank risk in two 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.[31] 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).[32] 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.[33]

[30] We also experiment with the ratio of uncalled capital to paid-in capital. The results are qualitatively similar (Table A2).
[31] 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.
[32] The results are qualitatively similar without this screen or with less stringent screen.
[33] 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 the liability structure has direct effects on the volatility of share prices in addition to its indirect effects through banks' choice of asset risk. That is, the theory predicts that, faced with contingent liability, equity holders can shift less risk to debt holders and thus have smaller incentives to increase asset risk. The outcome of this deliberate choice should be reflected in lower equity volatility. However, relative to limited liability, equity holders with contingent liability face wider range of returns, which translates into higher volatility of equity prices. Hence, the net effect of these competing mechanisms is theoretically ambiguous.

Because of the limitation of share price volatility, we use an alternative measure of risk-taking from bank balance sheets: the ratio of loans to total assets.[34] Our assumption is that loans are riskier and less liquid than other balance sheet assets. Banks with contingent liabilities should have fewer loans than limited liability banks if the risk-reducing incentive of contingent liability is strong.

Descriptive statistics are presented in table 1. As noted above, the number of observations for price volatility is lower than for contingent capital because some bank-year observations drop out because their shares are infrequently traded. We have been unable (so far) to find the year of establishment for some banks, leading to smaller observation for this variable.

Our basic econometric specification is:

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

[34] We also used a measure of cash-to-assets, as a measure of risk-avoidance, which yielded broadly similar results (see Table A3).

Since all three factors reduce the risk-taking incentives of banks, we expect the coefficients on these variables to be negative. The basic specification captures the average effects of these factors, but 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 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. Therefore, the specification of interest includes the interaction terms:

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

The interactions of capital-to-asset ratio to contingent capital and to unlimited liability 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.

5. Results

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. The results based on share price volatility are presented in

Table 2. As predicted, the share price volatility is negatively correlated with the capital-to-asset ratio (i.e., the volatility of share prices 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 higher volatility of share prices.

The coefficient on contingent liability or unlimited liability is not statistically significant. This result contrasts 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 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 3. These results are less ambiguous and more robust than those in Table 2. The coefficient on contingent liability is negative and significant (column 1). And the effects are economically important: 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, 16 percentage points less than that of the former. 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 demand higher capital-to-asset ratio from a bank that holds more opaque assets (i.e., loans). The coefficient on unlimited liability is not significantly different from zero (column 3). When all three factors are included, the results remain qualitatively the same (column 4).

As noted earlier, these specifications yield the simple average effects of liability rules. However, the effects are likely to be highly nonlinear, depending upon a bank's leverage (i.e., the amount of extended liability should matter more when the capital-to-asset ratio is low). 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 (column 5). The results are again qualitatively important. 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. 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 capital-to-asset ratio to unlimited liability is included (column 6), the coefficient on (uninteracted) unlimited liability becomes larger (i.e., more negative) and statistically significant while the coefficient on the interaction of capital-to-asset ratio with unlimited liability is positive. These results suggest that when banks are fully solvent with high capital-to-asset 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. 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. These results are robust to the inclusion of both of the interaction terms (column 7).

bank size (column 8) and establishment year (column 9), and dummies for bank location (column 10),[35] although when we include bank establishment year, we have much smaller sample size. 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. In particular, the risk-reducing effects of strict liability rule are larger among highly leveraged banks.

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.

[35] Ashton-under-Lyne, Barnsley, Bilston, Birmingham, Bolton, Lancashire, Bradford, Bristol, Buckinghamshire, Burton upon trent, Bury, Lancashire, Carlisle, Cornwall, Darlington, Derby, Devon, Glamorganshire, Gloucester, Gloucestershire, Halifax, Hove, Huddersfield, Hull, Kendal, Knaresboro, Knaresborough, Lancashire, Lancaster, Langport, Leamington Spa, Leeds, Leicester, Leicestershire, Lincoln, Liverpool, London, Manchester, Newcastle, Northampton, Nottingham, Oldham, Penzance, Plymouth, Portsmouth, Preston, Rochdale, Settle and Skipton, Sheffield, Southport, Stafford, Stamford, Stourbridge, Swansea, Wakefield, Wales, Warrington, Whitehaven, Wiltshire, Wolverhampton, Worcester City, York, Yorkshire

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

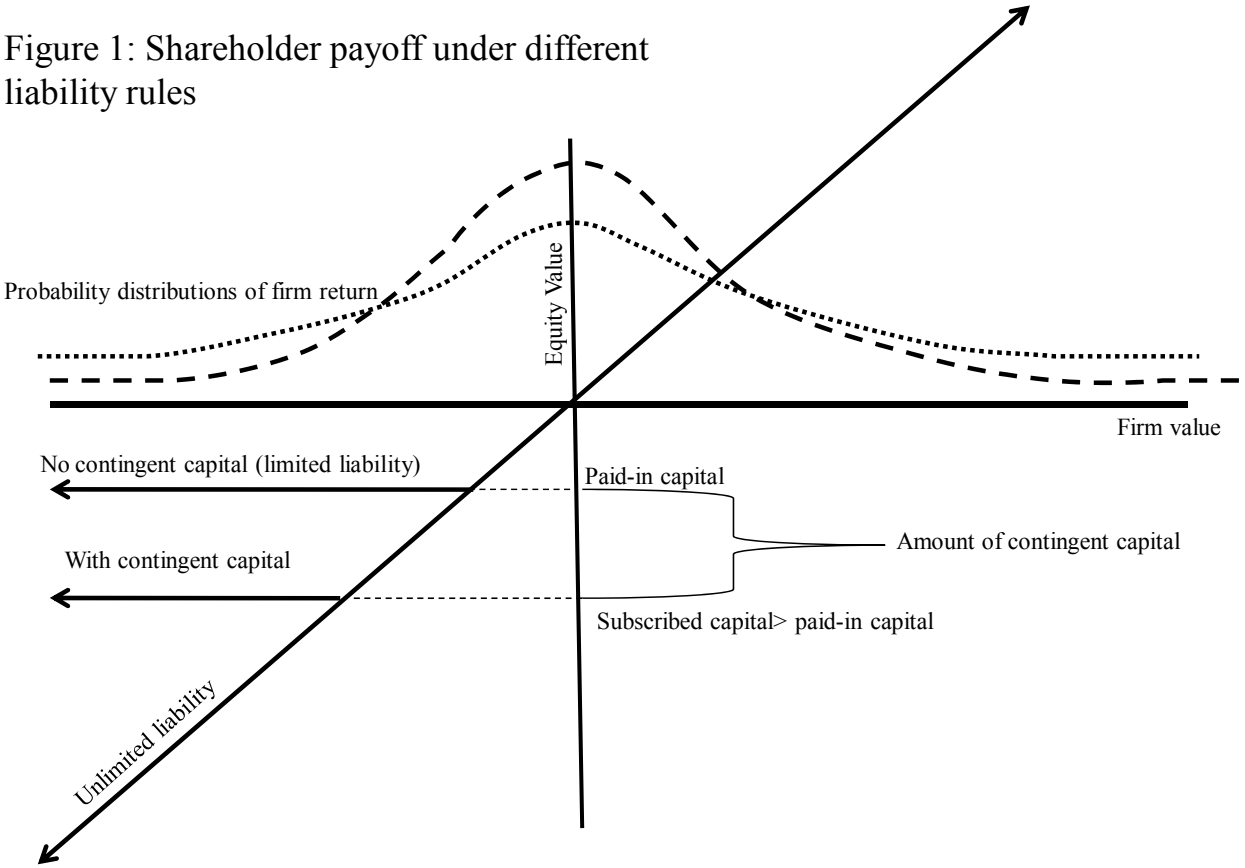
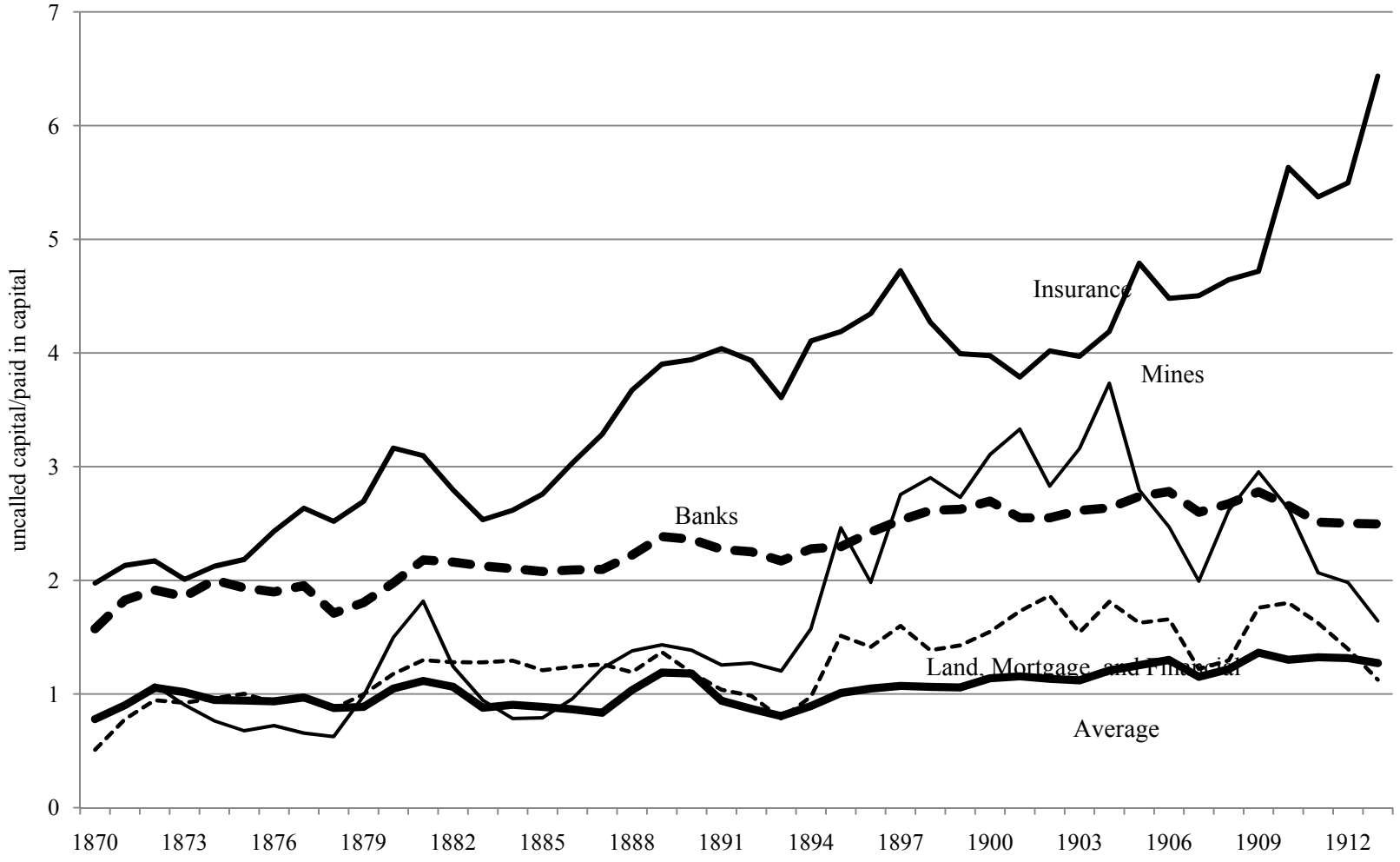


Figure 2: Ratio of uncalled to paid-in capital, selected sectors
(weighted by firm size)



Source: Authors' calculations.

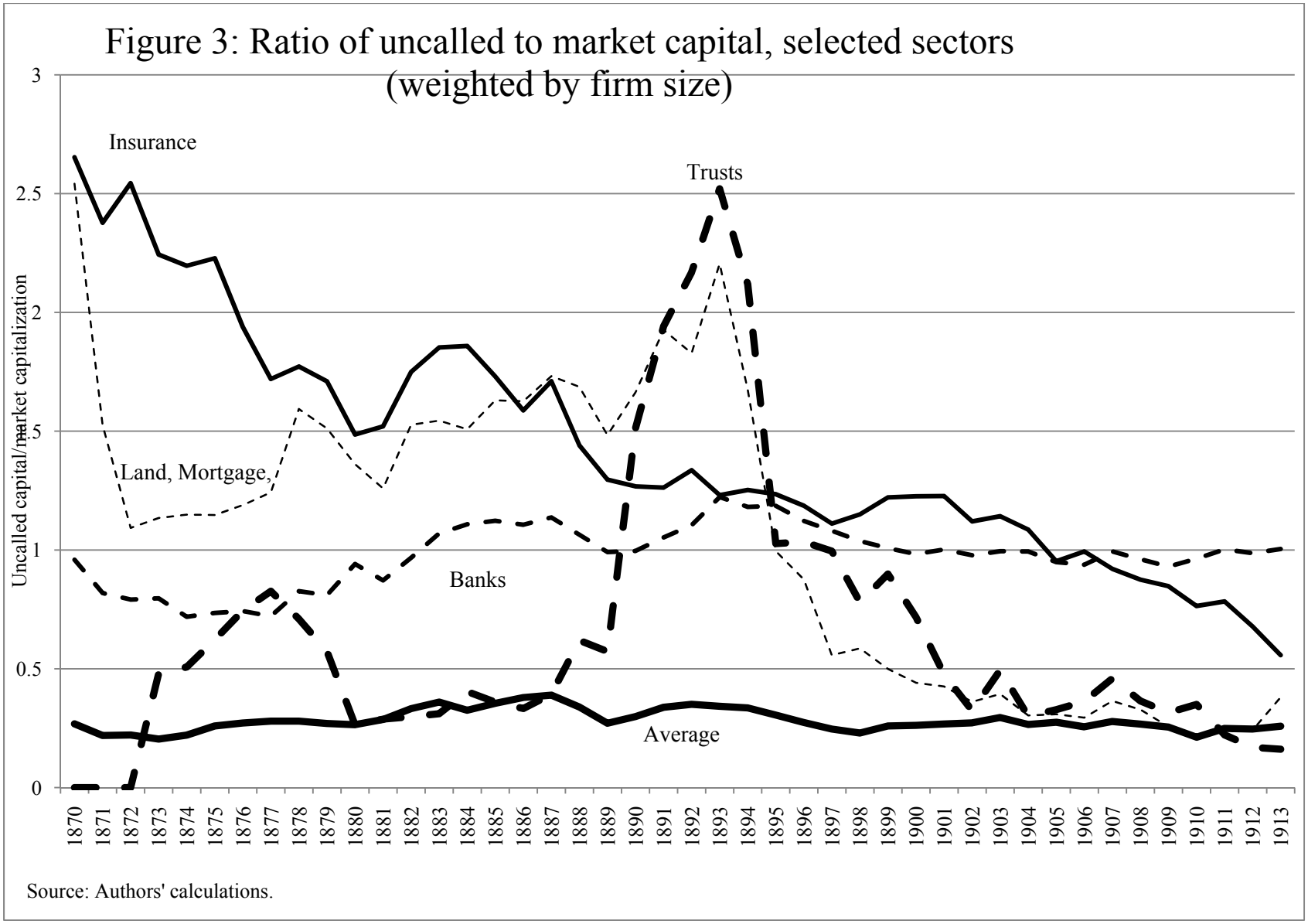


Figure 3: Ratio of uncalled to market capital, selected sectors
(weighted by firm size)
Insurance
Trusts
Land, Mortgage
Banks
Average
Uncalled capital/market capitalization
3
2.5
2
1.5
1
0.5
0
1870
1871
1872
1873
1874
1875
1876
1877
1878
1879
1880
1881
1882
1883
1884
1885
1886
1887
1888
1889
1890
1891
1892
1893
1894
1895
1896
1897
1898
1899
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
Source: Authors' calculations.

Table 1: Summary statistics

Variable		*Mean*	*Std. Dev.*	*Min*	*Max*	*Observations*
SD(return)	overall	0.028709	0.048059	0.002396	0.659997	N = 2100
	between		0.017286	0.00611	0.107589	n = 118
	within		0.045785	-0.06302	0.646762	T = 17.7966
Loans/Assets	overall	0.659571	0.153353	0.118765	1	N = 2631
	between		0.14602	0.227258	0.961063	n = 143
	within		0.077593	0.094671	1.163953	T-bar = 18.3986
(amount-par)/amount	overall	0.695989	0.167493	0	1	N = 2636
	between		0.176886	0	1	n = 143
	within		0.077324	-0.11473	0.930364	T-bar = 18.4336
Capital-to-Assets Ratio	overall	0.257192	0.101886	0.018302	1.55832	N = 2636
	between		0.120739	0.032347	1.080904	n = 143
	within		0.057112	-0.25129	0.939853	T-bar = 18.4336
Unlimited Liability	overall	0.045524	0.208489	0	1	N = 2636
	between		0.114933	0	1	n = 143
	within		0.190009	-0.49993	1.016952	T-bar = 18.4336
ln(Assets)	overall	14.82257	1.368389	8.960981	18.46785	N = 2636
	between		1.508786	9.567628	17.98142	n = 143
	within		0.346344	13.21967	16.12285	T-bar = 18.4336
Establishment Year	overall	1832.196	29.07773	1685	1884	N = 2098
	between		29.13495	1685	1884	n = 102
	within		0	1832.196	1832.196	T-bar = 20.5686
Year	overall	1892.541	9.096628	1878	1912	N = 2636
	between		6.636599	1878	1911	n = 143
	within		7.599106	1875.541	1909.541	T-bar = 18.4336

Table 2: Dependent variable is standard deviation of share price return

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(amount-par)/amount	0.00298			0.00273	-0.0166	0.00272	-0.0168	-0.00524	0.0396	-0.0260
	(0.00810)			(0.00734)	(0.0217)	(0.00733)	(0.0219)	(0.0211)	(0.0289)	(0.0482)
Capital-to-Assets Ratio		-0.0501***		-0.0497***	-0.108*	-0.0501***	-0.109	-0.0997	0.0389	-0.0820
		(0.0168)		(0.0168)	(0.0650)	(0.0174)	(0.0666)	(0.0644)	(0.0722)	(0.104)
Unlimited Liability			-0.00560	-0.00409	-0.00381	-0.00671	-0.00707	-0.00437	0.00249	0.00349
			(0.00875)	(0.00879)	(0.00899)	(0.0138)	(0.0144)	(0.0143)	(0.0148)	(0.0161)
Capital-to-Assets Ratio * (amount-par)/amount					0.0820		0.0825	0.0509	-0.108	0.107
					(0.0857)		(0.0866)	(0.0840)	(0.108)	(0.163)
Capital-to-Assets Ratio * Unlimited Liability						0.00838	0.0105	0.00354	-0.0186	-0.0391
						(0.0491)	(0.0517)	(0.0514)	(0.0495)	(0.0492)
ln(Assets)								-0.00289***	-0.00173	-0.00188
								(0.00108)	(0.00125)	(0.00247)
Establishment Year									5.76e-05*	-2.80e-05
									(3.14e-05)	(3.45e-05)
Constant	0.0205***	0.0318***	0.0226***	0.0299***	0.0436**	0.0300***	0.0438**	0.0848***	-0.0647	0.136*
	(0.00767)	(0.00628)	(0.00549)	(0.00826)	(0.0168)	(0.00826)	(0.0170)	(0.0233)	(0.0634)	(0.0742)
Observations	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	1,682	1,682
R-squared	0.052	0.060	0.052	0.060	0.061	0.060	0.061	0.064	0.055	0.099

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

Table 3: Dependent variable is Loans/Assets

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(amount-par)/amount	-0.177***			-0.177***	-0.474***	-0.179***	-0.506***	-0.457***	-0.466**	-0.394*
	(0.0549)			(0.0578)	(0.128)	(0.0578)	(0.123)	(0.144)	(0.198)	(0.210)
Capital-to-Assets Ratio		0.324**		0.316**	-0.521*	0.289**	-0.636**	-0.618**	-0.600	-0.594*
		(0.125)		(0.121)	(0.283)	(0.124)	(0.267)	(0.283)	(0.417)	(0.354)
Unlimited Liability			-0.0123	-0.0337	-0.0322	-0.201**	-0.251***	-0.221***	-0.213**	-0.161**
			(0.0345)	(0.0363)	(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	0.708***	0.527***	0.582***	0.653***	0.858***	0.660***	0.886***	1.230***	1.206*	0.201
	(0.0451)	(0.0289)	(0.0167)	(0.0534)	(0.0926)	(0.0540)	(0.0898)	(0.158)	(0.620)	(1.068)
Observations	2,631	2,631	2,631	2,631	2,631	2,631	2,631	2,631	2,093	2,093
R-squared	0.130	0.135	0.094	0.171	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

Appendix A

Table A1: Results Based on Book Value of Paid-in Capital for Capital-to-Asset Ratio

Dependent variable is Loans/Assets

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(amount-par)/amount	-0.145***			-0.0817	-0.217***	-0.0876*	-0.236***	-0.232***	-0.267***	-0.205**
	(0.0532)			(0.0496)	(0.0783)	(0.0495)	(0.0806)	(0.0836)	(0.0925)	(0.0948)
Capital-to-Assets Ratio		0.623***		0.580***	-0.115	0.533***	-0.227	-0.306	-0.835*	-0.452
		(0.170)		(0.168)	(0.366)	(0.165)	(0.373)	(0.372)	(0.451)	(0.300)
Unlimited Liability			-0.00918	0.0152	0.00932	-0.147**	-0.167***	-0.164***	-0.171***	-0.121***
			(0.0326)	(0.0301)	(0.0308)	(0.0570)	(0.0575)	(0.0562)	(0.0571)	(0.0363)
Capital-to-Assets Ratio * (amount-par)/amount					1.105*		1.202**	1.172*	2.158***	0.995**
					(0.563)		(0.572)	(0.603)	(0.770)	(0.502)
Capital-to-Assets Ratio * Unlimited Liability						1.378***	1.491***	1.465***	1.561***	1.071***
						(0.352)	(0.336)	(0.327)	(0.352)	(0.204)
ln(Assets)								-0.0108	-0.00838	0.0102
								(0.0122)	(0.0135)	(0.0257)
Establishment Year									-0.000207	0.000435
									(0.000315)	(0.000417)
Constant	0.685***	0.536***	0.582***	0.597***	0.687***	0.605***	0.704***	0.883***	1.247*	-0.0187
	(0.0437)	(0.0200)	(0.0167)	(0.0444)	(0.0596)	(0.0446)	(0.0613)	(0.198)	(0.646)	(0.959)
Observations	2,794	2,794	2,794	2,794	2,794	2,794	2,794	2,794	2,210	2,210
R-squared	0.133	0.188	0.108	0.196	0.207	0.208	0.220	0.226	0.223	0.565

Robust standard errors in parentheses

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

Table A2: Results based on (amount – par)/par for measuring uncalled liability
Dependent variable is Loans/Assets

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(amount – par)/par	-0.0118**			-0.0105**	-0.0143	-0.0108**	-0.0155	-0.00963	-0.00925	-0.0269
	(0.00485)			(0.00517)	(0.0131)	(0.00521)	(0.0131)	(0.0120)	(0.0138)	(0.0172)
Capital-to-Assets Ratio		0.303**		0.281**	0.232	0.253**	0.192	0.149	0.238	-0.0858
		(0.125)		(0.124)	(0.185)	(0.127)	(0.185)	(0.182)	(0.235)	(0.151)
Unlimited Liability			-0.0136	-0.0229	-0.0230	-0.197**	-0.202**	-0.168**	-0.154*	-0.131**
			(0.0345)	(0.0341)	(0.0342)	(0.0906)	(0.0904)	(0.0796)	(0.0860)	(0.0543)
Capital-to-Assets Ratio * (amount-par)/par					0.0164		0.0201	0.00976	0.00980	0.0661
					(0.0431)		(0.0428)	(0.0390)	(0.0490)	(0.0480)
Capital-to-Assets Ratio * Unlimited Liability						0.578**	0.592**	0.519**	0.461**	0.450***
						(0.235)	(0.234)	(0.209)	(0.230)	(0.141)
ln(Assets)								-0.0300***	-0.0256*	-0.00210
								(0.0114)	(0.0146)	(0.0235)
Establishment Year									1.66e-05	0.000478
									(0.000312)	(0.000540)
Constant	0.621***	0.530***	0.582***	0.568***	0.580***	0.574***	0.589***	1.070***	0.955	0.00463
	(0.0243)	(0.0290)	(0.0167)	(0.0367)	(0.0542)	(0.0374)	(0.0545)	(0.196)	(0.698)	(1.203)
Observations	2,622	2,622	2,622	2,622	2,622	2,622	2,622	2,622	2,084	2,084
R-squared	0.122	0.136	0.099	0.154	0.154	0.160	0.161	0.214	0.223	0.585

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

Table A3: Dependent variable is Cash/Assets

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(amount – par)/par	0.00584**			0.00537**	0.00960**	0.00540**	0.00974**	0.00491	0.00452	-1.34e-05
	(0.00227)			(0.00229)	(0.00407)	(0.00231)	(0.00413)	(0.00393)	(0.00383)	(0.00585)
Capital-to-Assets Ratio		-0.0989**		-0.0884**	-0.0353	-0.0854**	-0.0305	-0.00363	-0.00643	-0.00843
		(0.0416)		(0.0408)	(0.0623)	(0.0418)	(0.0639)	(0.0584)	(0.0616)	(0.0761)
Unlimited Liability			-0.0156	-0.0116	-0.0113	0.0103	0.0144	-0.0141	-0.00540	0.00603
			(0.0107)	(0.0110)	(0.0111)	(0.0317)	(0.0321)	(0.0283)	(0.0297)	(0.0303)
Capital-to-Assets Ratio * (amount-par)/par					-0.0183		-0.0188	-0.00997	-0.00359	0.0173
					(0.0147)		(0.0148)	(0.0149)	(0.0148)	(0.0193)
Capital-to-Assets Ratio * Unlimited Liability						-0.0763	-0.0897	-0.0242	-0.0388	-0.0124
						(0.0884)	(0.0884)	(0.0793)	(0.0817)	(0.0877)
ln(Assets)								0.0221***	0.0223***	0.0169***
								(0.00340)	(0.00423)	(0.00473)
Establishment Year									6.03e-05	0.000142
									(0.000197)	(0.000181)
Constant	0.181***	0.217***	0.200***	0.198***	0.185***	0.197***	0.183***	-0.170***	-0.293	-0.376
	(0.0166)	(0.0154)	(0.0134)	(0.0190)	(0.0224)	(0.0192)	(0.0228)	(0.0613)	(0.383)	(0.343)
Observations	2,461	2,461	2,461	2,461	2,461	2,461	2,461	2,461	1,949	1,949
R-squared	0.053	0.046	0.034	0.065	0.067	0.065	0.068	0.178	0.176	0.373

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