

For Richer, For Poorer: Banker's Skin-in-the-game and Risk Taking in New England, 1867-1880*

Peter Koudijs[†] Laura Salisbury[‡]

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Abstract

We study whether banks are riskier if managers have less skin-in-the-game. We focus on New England between 1867 and 1880 and consider the introduction of marital property laws that reduced skin-in-the-game for newly wedded bankers. We find that banks with managers who married after a legal change were riskier: they had less liquidity and higher leverage, and they were more likely to lose deposits in the 1873-1878 Depression. This effect was most pronounced for bankers in the middle of the wealth distribution. We find no evidence that reducing skin-in-the-game increased capital investment at the county level.

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[†]Stanford University and NBER, koudijs@stanford.edu.

[‡]York University and NBER, lsalisbu@yorku.ca.

1 Introduction

The credit crisis of 2007/2008 demonstrated that banks have a tendency to take excessive risks, both in terms of the activities they undertake and their reliance on financial leverage. This poses significant costs to society. Blinder (Wall Street Journal, May 28, 2009), among others, argues that excessive risk taking is largely the result of the asymmetric compensation structure of bank managers: “heads you become richer than Croesus; tails, you get no bonus.” In support of this view, Bebchuck, Cohen and Spamann (2010) document that top-executives at Bear Stearns and Lehman Brothers made much more money before the crisis (in the form of bonuses and the selling of stock) than they lost afterwards when their firms collapsed.¹ Such an asymmetric payoff incentivizes risk taking.

Raising equity requirements is a potential solution: if shareholders carry more of the downside, they will attempt to force bank managers to limit risks. However, agency problems can make this difficult to implement.² Bank managers might be able to hide the risks they take, pushing potentially negative outcomes into the future. If their compensation depends on short term performance and there are no claw-back mechanisms, they will be tempted to shift risks to shareholders (Admati and Hellwig, 2012, p. 122-125). A dominant view in the current policy debate is therefore that to make the financial sector safer, people making the final decisions should have more skin-in-the-game.³ In this paper, we study whether increasing bankers’ skin-in-the-game leads to safer banks. The existing evidence on this question is inconclusive. The literature often points to the fact that investment banks were much safer before the 1980s when they were still partnerships with unlimited liability. However, the regulation of the financial system as a whole was much tighter at the time, reducing risks in general. In the context of the credit crisis of 2007/2008, Fahlenbrach and Stulz (2011) find no evidence that U.S. banks managed by CEOs whose incentives were better aligned with the interests of shareholders performed any better. Berger, Imbierowicz and Rauch (2015) even find that banks where mid-level managers and non-CEO top executives held more stock were more likely to fail.

¹Bhagat and Bolton (2014) report similar findings for a larger sample of banks. Cziraki (2016) provides further supportive evidence.

²In response to the problems at Deutsche bank in Fall 2016, Martin Wolf remarked that “the idea that shareholders control banks is a myth; it is management that is responsible” (Financial Times, October 4, 2016)

³Examples include Hill and Painter (2015, p. 190), Kay (2015, p. 279), and Luyendijk (2015, p. 254)

The analysis is complicated by the fact that a manager's skin-in-the-game is likely endogenous. Managers invest other people's money and have an incentive to shirk or appropriate free cash flows. Outside investors will try to align incentives by adjusting managers' skin-in-the-game (Mirrlees 1975, Jensen and Meckling 1976). The optimal level depends on to the severity of the incentive problems and uncertainty about the firm's cash flows. For example, if managers are risk averse and cash flows highly uncertain, less skin-in-the-game is required (Holmstrom 1979, Holmstrom and Milgrom 1987).⁴ On the other hand, if cash flow uncertainty requires outside investors to delegate more decision making to managers, more skin-in-the-game might be necessary (Prendergast 2002). Thus, managers' incentives are designed in a way that is related to the characteristics of the investment project. In this view of the world, empirical correlations are not informative about the causal impact of skin-in-the-game on risk taking (Cheng, Hong and Scheinkman 2015).

In this paper, we study a setting in which we can isolate a part of bankers' skin-in-the-game that is exogenous and measure its impact on risk taking. We study the operation of National Banks in New England between 1867 and 1880. At the time, New England banks were closely held, and bank CEOs (called presidents) held large equity positions. The shares had double liability – if a bank became insolvent, the Comptroller of the Currency could seize additional assets up to the value of the initially paid-in capital to make creditors whole. The quantity of assets that could be seized depended on the marital regime in place when a banker got married. During the 1840s, states in New England introduced married women's property laws that changed the treatment of a wife's assets. For couples married before such a law was enacted, virtually the entire household's wealth could be seized for the payment of a husband's double liability. For couples married after, the wife's assets were fully protected from seizure. Therefore, we can compare the risk taking of bankers who, as a function of the marital regime, had more or less skin-in-the-game, while operating in the same regulatory environment and at the same time and place.

We expect that the effect of a married women's property law on risk taking depends on bankers' wealth. We illustrate this with a simple model. A banker married before the introduction of a law had an incentive to limit risk taking, as all of the household's assets were on the line if the bank failed. A banker married after the passage of a law may have had an incentive to increase risk

⁴Related, Becker (2006) finds that managers who were ex ante less wealthy (and arguably more risk averse) have smaller stock positions in their firms.

taking, as the wealth that he did not put into the bank was partially protected. We expect this effect to be small for relatively poor bankers. Banks had a minimum size requirement, and a banker with insufficient personal assets would have needed to invest jointly with his wife in order to meet this requirement, thus relinquishing any protection of his wife's property. We also expect the effect to be small for relatively rich bankers. The gross benefits from risk taking stem from the ability to invest a larger quantity of assets. If a bank can only attract deposits (or invest) locally (a reasonable assumption in the context of unit banking), this puts a cap on the quantity of assets that a banker can potentially access. Thus, a richer or poorer banker operating in the same market will experience similar gross gains from risk taking. At the same time, the potential costs of risk taking always increase with wealth, as wealthier bankers have more to lose. This means that a rich banker needs a relatively large share of household wealth to be protected before he is willing to take on more risk. In sum, we expect the effect of married women's property laws to be less pronounced for bankers in the tails of the wealth distribution.

The empirical evidence suggests that reducing skin-in-the-game increases bank risk taking. Banks managed by presidents married after the law change had riskier balance sheets, with fewer liquid assets and higher leverage ratios, and were more likely to lose deposits in the 1873-1878 Depression, even after taking the lower liquidity and higher leverage ratios into account. We document that this effect is not simply driven by age differences. All estimates include county fixed effects, which suggests that regional differences in marriage patterns and economic circumstances cannot explain the results. We find that the effect of reducing skin-in-the-game was least pronounced for bankers with low or high levels of wealth, for whom married women's property laws arguably had the smallest impact. Interestingly, we do not find that the protection of wives' assets impacted capital accumulation at the county level, suggesting that the downside of increased banker liability was limited.

The context that we consider differs from today in two key ways. First, in the 1860s and 1870s there was no deposit insurance, and banks were too small to be considered "too-big-to-fail". This means that moral hazard problems induced by (implicit) government guarantees only played a marginal role. Second, individual depositors had a clear incentive to monitor the banks themselves, potentially exerting discipline on banks' management (Calomiris and Kahn 1991; Diamond and Rajan 2000, 2001). Rather than a weakness, we see this as a strength of the paper. We are able

to isolate the effect of bank CEOs' skin-in-the-game on bank behavior absent bailout expectations and under close scrutiny of depositors.

Our paper is related to a large literature on the impact of banker's ownership and compensation schemes on risk taking. Mehran, Morrison and Shapiro (2011) and Becht, Bolton and Roll (2011) provide extensive overviews of recent work studying the 2007/2008 credit crisis. Gorton and Rosen (1995) study the U.S. financial system in the 1980s and find a non-linear effect between manager ownership and risk taking, with most risk taking at banks with moderate manager ownership. Demsetz, Saidenberg and Strahan (1997) look at the early 1990s and document that manager ownership only matters for risk taking at banks with low franchise value. Most closely related to our paper are Carlson and Calomiris (2015) and Wei and Yermack (2011). The former studies the impact of manager ownership on bank risk taking in 37 cities in the southern and western parts of the U.S. in the 1890s. The paper finds that banks with higher manager ownership had safer assets and were less likely to fail. At the same time, they took on higher leverage. To deal with endogeneity, the paper instruments manager ownership with the turnover of bank CEOs. Wei and Yermack (2011) study the impact of the disclosure of CEOs' "inside debt" positions on equity and bond prices for listed non-financial firms. Inside debt is defined as pensions and other deferred compensation. Upon an SEC mandated disclosure of CEOs' inside debt positions in 2007, the equity prices of firms with higher inside debt fell, while bond prices increased, indicating that more inside debt was associated with less firm risk.

Compared to the literature, our measure of skin-in-the-game is solely based on a banker's personal situation and is unrelated to bank characteristics. There is an important caveat: it is possible that certain types of bank presidents self-selected into specific banks. In particular, bank presidents married after the law change were arguably better able to cope with risk and may have been a good match for riskier banks. We provide some evidence that this is not a first order concern. First of all, bank presidents were not hired in a competitive labor market that would have matched banks and bank presidents based on risk tolerance. Bank presidents were usually prominent local businessmen and their appointment seems to have been the result of the status they enjoyed in the community and their knowledge of the local economy (Lamoreaux 1994). Second, when analyzing changes in bank management, we do not find any evidence that banks with riskier balance sheets were more likely to appoint a bank president married after the law change. Finally, even if the

selection of bank president was fully endogenous, our results would still imply that only individuals with limited skin-in-the-game would consider taking on additional risk.

This paper is also related to a historical literature that looks at the impact of shareholder liability on bank performance. Until the 1930s, depending on the state they were located, shareholders in U.S. banks regulated at the state level either had limited or some form of additional liability (usually double) (Macey and Miller 1992).⁵ Esty (1998) analyzes a sample of 84 banks for three U.S. states from 1910 to 1915 and suggests that stricter liability led to less investment in risky assets. Using aggregate state level data, Grossman (2001) shows that during periods of financial stability state banks in double liability states were less likely to fail. Mitchener and Richardson (2013), again using aggregate state level data, document that double liability was associated with banks taking on less leverage. Since states subject to greater economic risks were more likely to introduce additional liability, it is not straightforward to interpret these state-level correlations (Grossman 2007). The key difference between our paper and this literature is that we focus on the personal liability of bank managers, not that of general shareholders. In addition, our analysis is based on within-county differences between individual banks. This way we can isolate the effect of skin-in-the-game and we can ensure that the effects we document are not driven by underlying economic conditions.⁶

Finally, this paper is related to Koudijs and Salisbury (2016) who document the impact of similar changes in marriage laws on household investment in the U.S. South in the 1840s. Taken together, the results suggest that changes in skin-in-the-game induced by new marriage legislation had an important effect on economic behavior.

The remainder of this paper is structured as follows. Section I provides historical details. Section 2 proposes a model to understand the impact of additional personal liability on risk taking. Section 3 discusses the new dataset constructed for this paper. Section 4 presents the empirical results. Section 5 concludes.

⁵These “state” banks only became important after 1885, outside the period studied in this paper.

⁶Turner (2014) reports qualitative evidence from 19th century U.K.. suggesting that unlimited liability for shareholders made British banks safer.

2 Historical Background

2.1 New England Banking

We study the commercial banking sector in New England between 1865 and 1879. All banks were unit banks (that is, they did not have any additional branches) and predominantly did business in their local town or city. We focus on so-called national banks that were all regulated at the national level by the Comptroller of the Currency (OCC).⁷ Banks faced the following regulations.

First, there was a minimum size requirement. A bank was required to have a minimum dollar amount of paid-in capital that depended on the population of the town or city a bank was located in; \$50,000 for places with less than 6,000 inhabitants, \$100,000 for cities between 6,000 and 50,000 inhabitants, and \$200,000 for cities larger than that (National Banking Act, 1864, Sect. 71; Fulford 2015). If a bank's losses exceeded its retained earnings, the bank could not automatically write down its paid-in capital. It had to obtain explicit permission from the OCC that could otherwise force the bank to raise fresh capital from existing shareholders. Those shareholders who were unwilling or unable to pay in additional capital would lose the ownership of their shares (National Banking Act, 1864, Sect. 13 and 15).

Second, there were restrictions on the amount of banknotes a bank could issue. There was no central bank at the time that could print money. Instead, the national banks were allowed to issue banknotes up to 90% of the value of (federal) government securities they had on the books. These bonds had to amount to at least \$30,000 or one third of paid-in capital, whichever was largest.

Third, there were cash or liquidity requirements. Outside of Boston, banks had to hold 15% of deposits as reserves, 60% of which could be in the form of deposits with so-called reserve city banks in Boston and New York. Banks in Boston had to hold 25% of deposits as reserves, 50% of which could be as deposits with central reserve city banks in New York (Champ 2011). In the absence of a central bank, reserves took the form of short-term securities issued by the Treasury and Greenbacks.

Finally, the OCC put restrictions on the type of loans national banks could make. They could

⁷In addition to the national banks, there were also state regulated banks. These only started to play an important role in the mid-1880s (Fulford 2015). In particular, in 1879 there were a total of 544 National Banks in New England, with a joint capital of \$164.43 million. In the same year there were 40 State banks and trust companies with a combined capital of \$7.10 million *Annual Report of the Comptroller of the Currency* 1879, p. V-VI

discount bills of exchange and other forms of commercial paper. In this case, another agent had extended a short term loan (say a loan from a merchant to its client), which the bank took at a discount. This was considered relative safe as both borrower and loan originator were liable for the loan's repayment. The bank could also make loans on personal security, so-called accommodation loans where only the borrower guaranteed repayment. These loans were also typically short term, but were frequently rolled over (James 1978, Lamoreaux 1994, p. 68-9). These loans were considered to be more risky and through this instrument a single individual could not borrow more than the equivalent of 10% of the bank's paid-in capital. The National Banking Law did not allow banks to make loans on the collateral of real estate or on shares issued by the bank. However, a bank could take real estate or bank stock as additional security for previously contracted debt.⁸

There was no deposit insurance. The OCC also did not impose any capital requirements. Instead, the OCC tried to ensure the stability of the system by imposing (proportional) double liability on shareholders. If a bank became insolvent, the OCC could seize a proportional share of the deficit from each shareholder, up to the amount of capital paid-in.⁹ For example, if a shareholder bought a share with a par-value of \$100 at a price of \$90 and the bank would become insolvent with a deficit of \$50 per share, the shareholder would lose a total of \$140, independent of whether other shareholders were able to pay the additional \$50. Possibly as a result, the average national bank does not appear very risky, at least by modern standards. The average deposit-to-capital ratio, our measure of leverage, was relatively low at 60% (with the 5th (95th) percentile at 11% (143%)). These numbers are somewhat misleading, as many shareholders actually had large personal debts outstanding at the bank, sometimes collateralized with bank stock. This means that the effective leverage of the banks was likely higher. Also, the economic environment of the 1870s was much more volatile than today, reducing the amount of leverage banks were willing to take on (Wicker 2000).

The OCC strictly enforced shareholders' double liability. Upon insolvency the OCC would appoint a receiver who would then pursue stockholders.¹⁰ The Supreme Court confirmed this authority in 1868 (75 U.S. 498). This levy was hard to escape: if shareholders who knew a bank to be insolvent had transferred their shares to someone else, this transaction was considered void (1

⁸National Banking Act, 1864, Sect. 8, 28, 29 and 35

⁹National Banking Act, 1864, Sect. 7, 9, 12, 16, 21

¹⁰National Banking Act, 1864, 50. Ball (1881, p. 258-264) gives an overview of the exact legal procedure.

Hughes 158). Between 1870 and 1879 the OCC made total assessments of \$6.8 million, of which 41% was eventually collected (Macey and Miller 1992). This means that, although the OCC actively tried to collect on shareholders' double liability, equity holders did manage to shield some of their wealth.

The OCC mandated a particular governance structure. Each bank had a board of directors that were elected by the shareholders in an annual meeting. There had to be at least five directors who appointed a president from their own ranks that acted as the CEO of the bank. Day-to-day operations were supervised by the cashier, who often had to sign a bond that obliged him to pay a significant amount of money if he did not fulfil his duties. Formally, each director (including the president) had to own at least 10 shares in the bank (each with a par value of \$100): this would amount to a stake of 2% in a bank with \$50,000 paid-in capital.¹¹

The informal governance structure, at least in New England, was more specific. New England was one of the most industrialized areas on the country and starting in the early 19th century there was a significant amount of demand for outside capital to allow the factories to grow.¹² In response, factory owners and their economic allies set up banks to raise money in the form of deposits than could then be invested into their businesses in the form of accommodation loans. Lamoreaux (1994) refers to this as “insider lending”. Hilt (2015) confirms that this state of affairs persisted into the 1870s. This gave rise to a particular ownership structure. Banks were typically closely held by local insiders who, as president or director, owned a significant number of shares.¹³ As said, a significant share of loans extended by the banks went to president and directors.

Formally, bank presidents did not have more authority than the other directors. However, in practice the other directors delegated most decision making to the bank president, only sporadically attending board meetings. Lamoreaux (1994, p. 107-8) indicates that this “opened the door to opportunistic behavior on part of the bank’s active managers”.

¹¹National Banking Act, 1864, Sect. 8, 9

¹²In 1860 (1880), manufacturing in New England accounted for 28.0% (16.3%) of total U.S. production, whereas only 10.0% (8.1%) of the population lived in this part of the country (Niemi 1974).

¹³We are currently in the process of collecting additional data on presidents' share ownership. Preliminary results indicate that bank presidents held on average 20% of all outstanding shares.

2.2 The Depression of 1873-1878

After the Civil War the U.S. economy was booming, with real industrial production increasing by 46%. Part of this growth was related the expansion of the railroad network in the West. This attracted a lot of capital. When the boom ended a number of financial institutions, in particular investment banks like Philadelphia based Jay Cooke & Co., failed due to loan defaults and the failure of (guaranteed) stock and bond underwriting for the railroads. This led to a nationwide financial crisis, centered on New York. The stock market fell 25% in a week and the New York stock exchange was closed for a period of 10 days (Sprague 1910; Mixon 2008). This proved the start of a long lived Depression that would last until 1878. It is not well understood why the Panic of 1873 had such long-lasting effects, but the answer seems to lie in a combination of the deleveraging of the financial sector (in particular the investment banks of the time), and the concurrent decision of the U.S. government to return to the Gold Standard (which would eventually happen in 1879) which led to a contraction of monetary policy (Friedman 1990).

In real terms, industrial production was not much affected by the Depression. However, the Panic did set into motion a process of deflation (enforced by the decision to go back on the Gold Standard) and in nominal terms industrial production fell by 34.7% between 1873 and 1878 (Figure 1, Davis 2004). This had an important impact on the New England manufacturers who had extensively used credit to fund of their post-Civil War expansion (Hilt 2015). The dollar value of production did not keep up with their debt burden. This meant that the amount of bad loans on the National Banks' balance sheets increased significantly. The OCC annual reports indicate that between 1876 and 1878 the National Banks had to write down 8.2% of the outstanding loan portfolio in 1873. However this masks significant heterogeneity across banks. Lamoreaux (1994, p. 110-1) documents how the failure of a large industrial firm in Rhode Island led three large national banks to write down their paid-in capital with 80%, 50% and 40%.

2.3 General Downside Protection

Double liability meant that, as large shareholders, bank presidents had a large exposure to downside risk. There were some general forms of personal downside protection that would have limited liability, but these were either limited or hard to obtain.

First, there was a federal bankruptcy regime in place between March 1867 and September 1878. The Civil War had forced many borrowers into default and a temporary federal bankruptcy regime was set up to facilitate an orderly workout of these insolvencies that often spanned multiple states. A borrower could file for bankruptcy if he could repay at least 50% of his debts and at least half of the creditors approved.¹⁴ Upon bankruptcy, a debtor had to surrender all assets to a creditor-appointed assignee who was to liquidate the estate. If the borrower fully cooperated he could obtain a discharge of any remaining unsecured debt. In addition, the law exempted \$500 of personal property from the seizure of creditors (Warren 1935). These came on top of homestead exemptions that ranged between \$0 (Rhode Island) and \$800 (Massachusetts) (Farnham 1938). The federal bankruptcy system was set to expire in 1873, but was renewed for another five years in response to the Panic of that year (Warren 1935, p. 120-1). The exempted amounts (at most \$1,300) were relatively small compared to the total wealth that the bank presidents reported during the 1870 census: the 1st percentile is at \$2,500; the 5th percentile at \$8,000, and the median at \$56,000.

For the elite, there was an additional form of bankruptcy regime: testamentary trusts. Since the beginning of the 19th century, “the Brahmin Caste of New England” had bequeathed a substantial fraction of their wealth in the form of family trusts. A Massachusetts Supreme Court ruling in 1823 established that the assets in these trust funds could not be seized by the beneficiaries’ creditors. An 1875 Federal ruling even allowed trusts to protect the income these assets generated. As a result, some the elite’s wealth was protected in bankruptcy. At the very least, it would survive intact and could be passed on to the next generation. Setting up a testamentary trust was costly. Their use, therefore, appears to have been limited outside the upper classes (Dobkin Hall 1973, in particular p. 236 and 309).

2.4 The Introduction of Married Women’s Property Laws

In this environment of limited downside protection, the introduction of married women property laws arguably had a first order impact on people’s financial situation. Until the 1840s marriages had been governed by traditional common law. This stipulated that, upon marriage, husband

¹⁴In 1868 the minimum repayment rate was changed to 30%. In 1873, the minimum fraction of creditors that needed to approve was reduced to a quarter, as long as they represented at least a third of all claims.

and wife were legally one. The husband automatically became possessed of the personal property a wife brought into the marriage. The real estate she owned remained her separate property, but the husband had the right to the associated profits. Creditors could lay claim on the wife's personal property and income flows derived from her real estate as payment for the husband's debts (Warbasse 1987, p. 7-9). A couple had the option to sign a prenuptial agreement protecting the wife's property from the claims of a husband's creditors. In New England, however, there was considerable uncertainty whether prenuptial agreements would be enforced in court (Salmon 1986, p. 120). As a result, prenuptial agreements seem to have been seldom used (Warbasse 1987, p. 188. Appendix A has more details). In the same vein, post-nuptial agreements between spouses were generally hard to enforce in court and not generally used.

As a response to these problems, states in New England were comparatively early in passing state laws amending the common law so that, for all new marriages, the wife's property (either acquired before or after marriage) would always be protected from creditors, irrespective of whether there was a prenuptial agreement (Salmon 1986, p. 139-40; Warbasse 1987, p. 188). Underlying these changes was a growing belief that wives' interests in marriage should be better protected (Warbasse 1987). Table 1 gives an overview of the different laws that were passed. Some laws (such as the first law passed by Connecticut in 1845) only protected the proceeds of a wife's real estate. Other laws (such as the one passed in Maine in 1844) also protected personal property. In the end, all states in New England passed laws that protected all of a wife's assets. Massachusetts and New Hampshire were relatively late in the introduction of this legislation as they had first opted to pass laws that gave prenuptial agreements full legal standing (in 1845 and 1847 respectively).¹⁵

The case law confirms that the courts consistently enforced the new laws: creditors were successfully barred from taking the wife's property in satisfaction of the husband's debts. However, this was only the case for couples married after the law. The new legislation did not apply retroactively. This would have been unconstitutional as the contracts clause of the federal constitution stipulated that states could not pass laws that would impair existing contracts. This could only be done at the federal level (as was the case with the introduction of federal bankruptcy code in 1867). The case law indicates that judges closely followed this stipulation.

¹⁵For consistency, we use the dates from Table 1 in the empirical analysis. Results are robust to using the earlier dates for Massachusetts and New Hampshire.

In sum, the introduction of the new legislation generated a relatively clean break in the marriage regime. Before the passing of the marriage laws the enforcement of prenuptial agreements was uncertain – this was one of the key reasons for introducing the laws in the first place – and few couples seem to have had them. Afterwards, a wife’s property was protected from a husband’s creditors by default, independent of whether there was a prenuptial agreement or not. This provided an important change in bank presidents’ skin-in-the-game. Before the passing of the law, there was a (temporary) bankruptcy regime in place. However, exemptions only covered small amounts that, for the bankers in our sample, were substantially lower than the amounts that would be protected through the married women’s property laws.

3 Model

3.1 Setup

We assume that a bank is managed by a single banker i . For simplicity, we assume that the banker’s household is only bank equity holder. We also assume, for simplicity, that the banker has unlimited liability. That is, the regulator can seize all non-exempt assets.

A banker has wealth w . Of this, a fraction α belongs to the wife and, after the passing of a law, cannot be seized by the regulator. Fraction $1 - \alpha$ belongs to the husband and can always be seized. We can think of $\alpha = 0$ as a banker married before a law is enacted and $0 < \alpha < 1$ as one married after a law is enacted. By law, a bank is required to hold at least κ in capital. Thus, only individuals with household wealth $w \geq \kappa$ will manage a bank.

We assume that the banker is risk-averse with log utility. The banker can either invest the endowment w into the bank as equity (s) or he can keep it outside the bank in a riskless storage technology. Whenever he puts money in the bank and the bank fails (negative equity), the money is always lost and is not protected by the bankruptcy or marriage laws.

A bank can invest in a linear production technology with stochastic payout

$$\tilde{R} \in \{\mu - \sigma_j, \mu + \sigma_j\}$$

For simplicity, we assume that each payout occurs with equal probability. Expected returns are

positive: $\mu > 0$. A bank can chose between two projects $j \in \{1, 2\}$ that have the same expected payout μ but where $\sigma_1 < \sigma_2$. To guarantee that in the bad state of the world the project leads to a loss, we assume that $\mu - \sigma_j < 1$. Furthermore, we assume that

$$(\mu - \sigma_j)(\mu + \sigma_j) > \mu$$

This guarantees that even in autarky the banker will find it optimal to invest in the risky project. These assumptions imply that $\mu - \sigma_j > 1/2$ and

$$(\mu - 1)^2 < \sigma_j^2 < \mu(\mu - 1)$$

A bank can fund this investment through capital s_i and deposits d_i . Per unit of deposits the bank incurs a managements cost of ε . We assume that ε is close to zero and we will ignore it most of the time. There is a continuum of depositors who are risk neutral and who each have $v(k)$ available to deposit in the bank. In the aggregate, depositors can make resources $V = \int v(k) \geq w$ available. Depositors receive an interest rate ρ that compensates them for any potential risks; in expectation depositors receive the same utility that they would get from investing all their money in the risk-free asset. Crucially, depositors are atomistic and they cannot cooperate in disciplining the bank by setting the total amount of deposits they are willing to lend. In addition, the banker cannot ex ante commit to implementing project $j = 1$. Depositors cannot observe the actual project choice and interest payments cannot be made contingent on the actual project choice.

The following tables summarize the balance sheets of the bank and banker, respectively.

Bank Balance Sheet	
Assets	Liabilities
Investments I_i	Capital w_i
	Deposits $d_i \leq V$

Banker's Balance Sheet

Assets	Liabilities
Capital bank $s_i \leq w_i$	Net-wealth w_i
Risk free asset	
$(w_i - s_i)$	

3.2 Banker's Decision under No Protection

Bankers married before the passage of a property law have unlimited liability. The banker must choose whether or not to issue risky deposits (i.e. deposits that cannot be repaid in full if the investment project fails). In addition, he must choose which project to invest in.

If the banker issues risky deposits (i.e. $d > \frac{1}{2}(\mu - \sigma_j)(s + d) + (w - s)$), he will have to pay depositors a risk premium ρ , which leaves them indifferent between lending to the bank and storing their assets as (risk-free) cash. This interest rate is pinned down by

$$\begin{aligned}
 d &= \frac{1}{2}(1 + \rho)d + \frac{1}{2}[(\mu - \sigma_j)(s + d) + (w - s)] \\
 (1 + \rho)d &= 2d - (\mu - \sigma_j)(s + d) - (w - s)
 \end{aligned}$$

Here, $j \in \{1, 2\}$ is the project depositors expect the banker to invest in.

Lemma 1 *If the banker issues risky deposits, he will choose the riskier project ($j = 2$).*

Proof. See appendix. ■

This follows from the fact that the banker cannot commit to investing in the less risky project. He knows that, in the bad state of the world, the bank will fail anyway and he will be left with nothing. His payout in the good state of the world is larger if he invests in the risky project, so he has a clear incentive to do this.

So, under risky deposits, banker's payout in the good state of the world is given by

$$\begin{aligned}
 \widehat{\Pi}_g &= (\mu + \sigma_2)(s + d) - (1 + \rho)d + (w - s) \\
 &= 2\mu(s + d) - 2d + 2(w - s)
 \end{aligned}$$

His payout in the bad state of the world is given by

$$\hat{\Pi}_b = 0$$

If the banker issues risk free deposits, depositors will be paid back in full whether the project fails or succeeds; thus, they do not require a risk premium and will earn the risk free rate on their deposits. For simplicity, we set this equal to 1. The good and bad state consumption are given by:

$$\begin{aligned}\Pi_g &= (\mu + \sigma_j)(s + d) - d + (w - s) \\ \Pi_b &= (\mu - \sigma_j)(s + d) - d + (w - s)\end{aligned}$$

Lemma 2 *If the banker issues risk free deposits, he will choose the less risky project ($j = 1$).*

Proof. See appendix. ■

In this case, the banker has downside exposure. So, as he is risk averse, he will always choose the less risky project.

Proposition 3 *Under no protection, the banker chooses risk free deposits. He will invest $s = w$ of his own assets in the bank, and he will attract $d = \frac{\mu(\mu-1)-\sigma_1^2}{\sigma_1^2-(\mu-1)^2}w$ in deposits. The banker will invest in the less risky project ($j = 1$).*

Proof. See appendix. ■

The reason is intuitive: if none of the banker's assets are protected, then issuing risky deposits would leave the banker with nothing if the investment project fails. The banker is sufficiently risk averse that this is never optimal.

3.3 Banker's Decision under Protection

3.3.1 When does a property law induce more risk taking?

We first ignore the bank's minimum capital requirement and solve for the banker's choice between risky and risk-free deposits given α . We show that, under protection, the banker will prefer risk-free deposits if $\alpha < \alpha^*$ and risky deposits when $\alpha > \alpha^*$, where α^* is a function of μ , σ , V , and w . We show that α^* is an increasing function of w , which means that preferring risky deposits becomes

less likely as w increases. In other words, being married under a property law is more likely to affect the preferences of bankers with lower w .

We first consider the case of risky deposits, showing that it is optimal never to invest the wife's wealth in the bank. We then solve for the case of risk-free deposits. Finally, we derive the conditions under which it is optimal to opt for risky deposits.

Proposition 4 *Suppose the minimum capital requirement is not binding. If a banker issues risky deposits, his wife will not invest any of her property in the bank.*

Proof. See appendix. ■

The intuition behind this result is that, if the bank issues risky deposits, it is not optimal for the wife to carry any additional liability, to ensure positive consumption in the bad state of the world. Given that the banker's wife does not invest in the bank, the banker can invest at most his own wealth $(1 - \alpha)w$. The interest rate on risky deposits is therefore pinned down by

$$\begin{aligned} d &= \frac{1}{2}(1 + \rho)d + \frac{1}{2}[(\mu - \sigma_j)(s + d) + (1 - \alpha)w - s] \\ (1 + \rho)d &= 2d - [(\mu - \sigma_j)(s + d) + (1 - \alpha)w - s] \end{aligned}$$

As before, under risky deposits, the banker will choose the riskier project ($j = 2$). The payout to the banker in the good state of the world is given by

$$\Pi_g = (\mu + \sigma_2)(s + d) - (1 + \rho)d + [(1 - \alpha)w - s] + \alpha w$$

Plugging in for the interest rate we can rewrite this as

$$\Pi_g = 2(\mu - 1)(s + d) + (2 - \alpha)w$$

The payout in the bad state of the world is given by

$$\Pi_b = \alpha w$$

Proposition 5 *Suppose the minimum capital requirement is not binding. If the banker issues risky*

deposits, he will invest $s = (1 - \alpha)w$ in the bank, and he will issue $d = V$ in deposits. He will pick the riskier project ($j = 2$).

Proof. See appendix. ■

The intuition here is straightforward. If the banker has issued risky deposits, all of his personal assets will be lost if the bank fails (whether he has invested them in the bank or not). Given that the return he gets from investing in the bank is higher than the risk-free rate, it is thus optimal for him to invest all of his assets in the bank. If the banker issues risk free deposits, we obtain the same result as we did for the no protection case (see Proposition 3).

To determine the circumstances under which it will be optimal to issue risky deposits, we compare the banker's utility under risky and risk-free deposits (noting that s and d under risk free deposits are the same under protection and no protection).

Proposition 6 *There exists an $\alpha^*(\mu, \sigma_1, V, w)$ such that the banker will issue risky deposits if $\alpha > \alpha^*$, and he will issue risk free deposits if $\alpha < \alpha^*$.*

Proof. See appendix ■

Lemma 7 *There exists a Ω such that the cutoff α^* is strictly increasing in w over the interval $[0, \Omega V]$, and is bounded below by 0. When $w > \Omega V$, risk free deposits are always optimal.*

Proof. See appendix. ■

Intuitively, this means that the passage of property law is less likely to induce a banker to switch from risk free to risky deposits as the banker becomes more wealthy. Why do bankers require a larger degree of protection in order to switch to risky deposits when they are wealthier? Recall that we are modelling variation in w conditional on market size (V). Thus, the upside from issuing risky deposits are similar for all values of w – this is the return on investing V if the project succeeds. However, risky deposits become more costly for bankers (relative to risk free deposits) the more personal wealth they have at risk if the project fails. Hence the need for a greater degree of protection among wealthier bankers in order to induce them to opt for risky deposits.

3.3.2 When is the minimum capital constraint binding?

In the previous section, we learned that a banker prefers to segregate his wife's wealth and issue risky deposits if α is sufficiently large. However, if α is *too* large, the banker will be unable to both segregate his wife's assets and meet the minimum capital requirement. Recall that a banker is required to invest at least $s = \kappa$ in the bank. Thus, all bankers have household wealth equal to at least κ . To manage a bank without his wife also investing, the banker needs to have $(1 - \alpha)w > \kappa$.

Proposition 8 *If $\alpha > \bar{\alpha} \equiv 1 - \frac{\kappa}{w}$, the banker's wife must invest her assets in the bank, or the household must exit the market. So, a banker with $\alpha > \bar{\alpha}$ will choose risk free deposits after a property law is passed.*

Proof. This is straightforward: the capital requirement is binding if $(1 - \alpha)w < \kappa$, which rearranges to give the above expression for $\bar{\alpha}$. If the banker's wife's wealth is invested in the bank, she is personally liable for the bank's losses, so the problem becomes identical to the problem under no protection of women's assets. ■

Clearly, $\bar{\alpha}$ is increasing in w , so wealthier bankers are less likely to be bound by the minimum capital requirement.

3.4 Summary: Impact of Property Law

We are interested in knowing when being married under a property law will induce a change in the bank's risk profile, which we model as switching from issuing risk free to risky deposits. In order for this to occur, two conditions must hold:

$$\alpha > \alpha^*$$

$$\alpha < \bar{\alpha}$$

The first condition becomes more restrictive as w increases, and the second condition becomes less restrictive as w increases. Going to the extremes, we know that $\bar{\alpha} \rightarrow 0$ as $w \rightarrow \kappa$, so the restriction $\alpha < \bar{\alpha}$ will be violated for all $\alpha > 0$ for sufficiently small values of w . On the other hand, for sufficiently large values of w , it will be impossible to find $\alpha < 1$ that is sufficient to

induce the banker to switch to risky deposits. There is scope for property laws to affect behavior for intermediate values of w .

In figure 2, we illustrate the effect of a property law on risk taking, as implied by our model. Notice that the relationship between banker's wealth and the probability of issuing risky deposits (assuming $\alpha \sim U[0, 1]$) is non-monotonic. For low values of w , the banker is more likely to be precluded (by minimum capital requirements) from managing a bank unless his wife also owns bank equity; such a banker will continue to issue risk free deposits even if his wife's assets are legally separate from his own. For high values of w , the protection afforded by a married women's property act is unlikely to be sufficient to induce the banker to switch to risky deposits; thus, there is a smaller impact on the behavior of such bankers as well.

What are the key differences between risky and risk-free deposits? First, if deposits are risky, this implies that there are more of them (relative to bank capital); thus, a bank with risky deposits also has higher leverage. Second, if a banker opts for risky deposits, he will have an incentive to choose the project with the riskiest return. Practically, this may mean extending loans rather than holding cash, implying less liquidity. Finally, a bank with risky deposits will fail in the bad state of the world, while a bank with risk free deposits will survive.

In sum, we expect that banks with presidents married after the introduction of a new marriage law are (1) more highly levered, (2) make riskier investments and (3) suffer larger losses in bad states of the world, and that these effects are more pronounced for bankers in the middle of the wealth distribution.

4 Data Description

4.1 Sources

Data on bank's balance sheets and their performance come from two sources. First, we use the annual (printed) reports from the Office of the Comptroller of the Currency (OCC). This data is based on self-reported information the banks sent to the OCC (Robertson 1995). These reports have complete coverage and provide a snapshot of the banks' balance sheets on practically the same day (usually in early October) each year. The reported data contain the bank's most important balance sheet items, but lack detailed information on the banks' loan book and specific asset holdings. In

addition, there is no information about profits and losses. The 1873 report was made right before the onset of the Panic of 1873 and we take this as the final pre-crisis year.

Second, we use Ancestry.com and Familysearch.org to reconstruct personal information about the Bank Presidents, in particular their date(s) of marriage to determine whether they were married before or after the passage of a married women’s property law, their age and the personal and real estate wealth that they reported in the 1870 census. We are able to find this information for 497 of all 696 Bank Presidents active between 1867 and 1873. This determines the scope of the final sample that we use. There are a total of 523 banks active in New England between 1867 and 1873. In 338 cases, the banker’s personal information is available for each and every year. This number is higher when we consider individual years. For example, of all 504 New England banks active in 1873, there is complete information in 391 cases.¹⁶ In the end, of the potential 3,452 bank-year observations covering 1867-1873, the banker’s personal information is available in 2,550 cases.

Finally, we use the county level censuses of 1870 and 1880 to construct information about capital formation at the county level (Haines and ICPSR 2010). In particular, we collect information on manufacturing capital per worker and farm capital per acre.

4.2 Variables

For the pre-crisis period (up to 1873), we construct a number of variables that measure a bank’s ex-ante risk taking on both the liability and asset side. For consistency, every variable is defined in such a way that higher values indicate more risk taking.

To capture banks’ leverage we use the OCC reports to calculate deposits or loans over capital. We do not use the regular definition of assets over capital because a significant fraction of assets consisted of safe government debt that backed the issuance of banknotes. The deposits-to-capital ratio captures to what degree the bank used borrowed money to fund its non-banknote related operations. Deposits include both retail and interbank deposits. The loans-to-capital ratio indicates whether the banks used this funding to invest in potentially risky projects, instead of putting it into safe assets. Loans include all loans and discounts made by the bank.

To capture risk taking on the asset side we first consider the cash-to-deposits ratio (“liquidity”)

¹⁶The discrepancy comes from the fact that banks change presidents: a bank that is active between 1867 and 1873 may have multiple presidents, not all of whom can be linked to census and marriage records.

reported in the OCC reports. The higher this ratio, the less reserves a bank has and the more vulnerable to runs. Sprague (1910, p. 6-15), in his classic work on financial crises under the National Banking system, argues that the cash-to-deposits ratio was a key risk factor in the Panic of 1873. We define cash as actual cash items plus deposits at other banks. In addition to cash, banks also had gold specie in their vaults. Since the U.S. was not on the Gold Standard (it would only adopt it in 1879), specie did not count as cash. Gold was usually held to secure special deposits. Following Sprague (1910, p. 14), we therefore deduct gold holdings from deposits to arrive at an accurate measure of cash-to-deposits. Banks that just got started often had a small depositor base. Since the variable is constructed as a ratio, this generates a number of extreme outliers. To remedy this, we Winsorize this variable at the 2.5th and 97.5th percentile.

To evaluate bank performance during the period 1873-1880, we look at the change in log deposits. In the absence of deposit insurance or bailouts, it is likely that the institutions that perform the worst lose most deposits.

Throughout the analysis we control for bank size. The size of a bank's balance sheet is potentially endogenous and therefore not an ideal control variable. We therefore control for the amount of paid-in capital that was set by the regulator and which is pseudo-exogenous. We include county fixed effects in our main specifications; there are a total of 61 counties in our data. Since banks in Boston faced regulatory requirements to hold higher cash reserves, we also include a Boston dummy in the regressions (Suffolk county encompasses a number of banks outside the City of Boston). In some specifications, we include bank fixed effects. Out of a total of 178 changes in bank presidency, there are only 79 instances (covering a total of 77 banks) where the personal information of both the outgoing and incoming bank president is available. These estimates therefore have limited statistical power and we interpret them with caution.

5 Empirical Results

In this section, we present the empirical results. We first provide information about the representativeness of the final sample that we use. Second, we provide some insights on how bank presidents are selected into specific banks. In particular, we examine whether a bank's balance sheet variables can predict whether a new bank president is married before or after the introduction of a married

women’s property law. Third, we study whether banks with managers married after the passing of a law have riskier balance sheets between 1867 and 1873. Fourth, we examine whether these banks performed worse during the Depression of 1873-1878. In addition to estimating average effects, we also study the heterogeneity of the effect in the bankers’ wealth distribution. Finally, we study whether, at the county level, the protection of spousal wealth increased capital accumulation.

5.1 Representativeness of Sample

Of the total 3452 bank-year observations covering 1867-1873, the banker’s personal information from censuses and marriage records is available in 2550 cases. Table 2 reports summary statistics for the most important bank variables for the full and restricted sample that we use. The table shows that our restricted sample is broadly representative. The only substantial difference between samples is the number of banks located in Massachusetts. This is driven by the fact that, in many cases, we cannot uniquely identify Boston bankers in the censuses and marriage records as there are too many possible matches. We omit these banks from our sample.

5.2 Selection of Bankers

Next, we analyze (1) what type of bankers got married before or after the passage of a law and (2) into what type of banks they were selected. In Table 3, we explore the personal characteristics of bank presidents who were married before or after the introduction of a married women’s property law, in particular their wealth and age. We construct a “protection” dummy for each bank president in our data between 1867 and 1873 that indicates whether he was married before (0) or after (1) the introduction of a law. We then regress this protection dummy on the banker’s age and total wealth, as reported in the 1870 census. The table shows that bankers married after the passage of a law tended to be younger and poorer; untabulated results indicate that they were on average 54 years old (versus 61 years for those married before) and had a median wealth of \$52,000 (versus \$68,000). The latter seems to be a pure age effect. When we control for age, the correlation between the timing of marriage and a banker’s wealth disappears. In sum, we find, unsurprisingly, that bankers married after the passing of law tended to be younger. In all bank-level regressions we therefore control for banker’s age and, to account for any non-linearities, age-squared.

In Table 4, we investigate whether bankers whose wives’ wealth was protected through a married

women’s property law were more or less likely to be selected into particular banks. Out of all 178 changes in bank presidency between 1867 and 1873, the personal information of the incoming banker is available in 144 cases. We regress protection status on the size of the bank (as captured by the amount of paid-in capital) and our two main measures of risk taking: the cash-to-deposits ratio (liquidity) and the deposit-to-capital ratio (leverage). All variables are lagged by one year to ensure that we do not pick up new policies instituted by the new bank president. Table 4 indicates that there is no significant relation between a banker’s protection status and the three bank level variables. This suggests that banks and bank presidents were not matched on risk preferences; the riskiest banks did not necessarily appoint bank presidents with a higher risk tolerance.

5.3 Ex-ante Risk Taking

How did the married women’s property laws affect bankers’ risk taking in the years leading up to the Panic of 1873? In Table 5, we explore whether bankers married after the passage of a law held less cash against deposits and had more leverage. We use annual bank level-data between 1867 and 1873, including year fixed effects and clustering standard errors at the bank level. We control for the banker’s age, age-squared and the bank’s paid-in capital. We report estimates using county or bank fixed effects.

The table indicates that bankers married after the passage of a law held lower cash reserves and took on more leverage. In the specifications with county fixed effects, the coefficients are statistically significant (at least at the 10% level) and economically important. Bankers married after the passage of a law had a cash-to-deposit ratio that was 6.5 percentage points lower and a deposit-to-capital ratio that was 8.4 percentage points higher, with full sample averages of 77% and 46% respectively. The loan-to-capital ratio was also 7.6% higher (with a full sample average of 96%). This suggests that bankers used the increased leverage to make more loans, instead of investing the additional deposits in safe assets or cash.

In the specifications with bank fixed effects, the coefficient estimates for the deposit and loan-to-capital ratios are smaller and statistically insignificant. The effect on the cash-to-deposit ratio is larger, though, and statistically significant. We interpret this to mean that a newly appointed bank president did try to alter the risk profile of the bank, but was only successful in changing a bank’s cash position, possibly because converting cash into other types of assets was more straightforward

than attracting more deposits.

In Figure 3, we test our model’s prediction that the passage of a married women’s property law should lead to the strongest effect on risk taking in the middle of the banker’s wealth distribution. The figures plot Cash/Deposits (Panel A) and Deposits/Capital (Panel B) against bankers’ wealth levels, differentiating between those married before or after the passage of a law. All variables are residualized against year and county fixed effects, a Boston dummy, bankers’ age and age-squared and banks’ paid-in-capital. We use local mean smoothing (Nadaraya 1964, Watson 1964) to calculate kernel-weighted means at the 5th, 10th, ..., 95th percentile of the bankers’ wealth distribution.¹⁷ Smoothing with higher order polynomials yields qualitatively similar results.

The results are consistent with the theoretical framework we laid out in Section 3. Bankers married after the passage uniformly took on more risk, but the effect is most pronounced in the middle of the wealth distribution. For both relatively poor and rich bankers the passage of a law does not significantly increase risk taking.

5.4 Ex-post Performance

How did the married women’s property laws affect bank performance during the Panic of 1873 and the ensuing Depression? We restrict our sample to banks that were present in the sample in 1873. For each bank we determine whether its 1873 president was married before or after the passage of a law. We then investigate whether banks that had a president married after the introduction of a law fared worse. The outcome variable we focus on is the log-change in deposits after 1873.

Results are in Table 6. We consider both the period 1873-1874, which captures the immediate impact of the Panic of 1873, and 1873-1880, which captures the impact of the ensuing Depression. As before, we include county fixed effects, and control for the bankers’ age and age-squared and the bank’s paid-in capital. We find that for both periods, bankers married after the law change had less deposit growth. For 1873-1874, growth was 8.4% lower (with a full sample average of 2.2%); for 1873-1880, it was 18.2% lower (with a full sample average of 30.4%). When we control for the cash-to-deposits and the deposits-to-capital ratio in 1873, the negative coefficient for the 1873-1880 period drops by about a quarter, suggesting that the drop in deposits is largely driven by other

¹⁷We use Stata’s `lpoly` command with an automated “rule-of-thumb” bandwidth and a standard Epanechnikov kernel.

factors such as a worse quality of loans or an overall reduction in the trust of depositors in the bank.

In Figure 4, we investigate whether the effect of the passage of a married women’s property law is strongest in the middle of the wealth distribution, as suggested by our model. We focus on log-changes of deposits between 1873 and 1880. We construct the figure in the same way as figure 3. We find that for poor bankers, deposit growth was similar for those married before or after the passage of a law. The difference between the two groups opens up in the middle of the wealth distribution. Contrary to our model and Figure 3, this difference is also visible for richer bankers. One interpretation is that bankers lost a significant fraction of their wealth that they kept outside the bank between 1873 and 1878 and that this led them to take on more risk as they now had less to lose.

5.5 County-level Results

So far, we have shown that bankers married after the passage of a married women’s property law took on more risk. In particular, their banks had higher leverage and held a smaller fraction of deposits in the form of cash. In addition, they performed worse during the Depression of 1873-1880. We therefore conclude that reducing skin-in-the-game indeed makes banks riskier.

This does not necessarily mean that reducing skin-in-the-game was a bad thing. It is possible that bankers married before the passing of a law were too conservative, foregoing investing in projects that, from a social point of view, had positive net present value. The reduction of skin-in-the-game could therefore have led to more productive investment.

This argument has some theoretical shortcomings, especially in the light of our result that banks run by protected bankers were more highly levered. Modigliani and Miller (1958) point out that, in the absence of frictions, the capital structure of a firm should not matter for its investment decisions. Applied to the national banks of the 1870s: if bank presidents were unwilling to lever to up to increase investment, they could always have retained earnings to make the investments they deemed profitable. Alternatively, other individuals might have been able to start a bank and issue equity to fund profitable projects. Since there was no tax subsidy for debt at the time and deposits were not insured, it is not obvious that an increased reliance on equity should have increased the cost of capital, although other frictions (such as differences in the informational sensitivity of equity

and deposits) may have still played a role.

To gain more insight into the question whether the passing of a married women’s property law led to more credit provision, we do the following. For each county in New England, we sum up the amount of paid-in capital of (1) all banks and (2) those banks whose presidents were married after the passing of a law (“protected capital”) and divide it by the number of county inhabitants. We then regress two measures of aggregate capital formation at the county level, manufacturing capital per worker and farm capital per acre, on these two bank capital measures.

Results are in Table 7. We use log variables in all regressions, so coefficients reflect elasticities. Panel A shows that there is a statistically significant correlation between bank capital and capital formation at the county level.¹⁸ A one standard deviation increase in total bank capital per capita is associated with an increase in manufacturing capital per worker of about 11%, and an increase in farm capital per acre of 19%. At the same time, the coefficient on protected capital is close to zero, indicating that it does not matter whether a bank president’s capital is protected or not. Apparently, the higher leverage ratios picked by bankers married after a married women’s property law did not translate into increased credit provision.

In Panel B we regress the log-changes in manufacturing capital per worker and farm capital per acre between 1870 and 1880 on the log of total and protected capital. There is some evidence that counties that relied more on protected capital fared worse in this decade, with a higher reduction in capital investment, although for the case of farm capital the effect is economically small and not very tightly estimated. A one standard deviation increase in protected capital is associated with a drop in manufacturing capital per worker and farm capital per acre of about 7% and 3%, respectively. So, even though the passage of the married women’s property laws did not lead to increase in credit provision, there is some evidence that it made the financial system less stable, leading to larger declines in county’s capital formation during the Depression of 1873-1878.

6 Conclusion

In this paper, we investigate whether increasing banker’s skin-in-the-game reduces incentives for risk taking. Our results confirm this hypothesis. Bankers married before the passing of a married women

¹⁸This result is consistent with the findings in Fulford (2015) who uses the discontinuity in the banks’ minimum size requirement to argue that at least a part of this relationship was causal.

property law, whose entire household wealth was potentially liable in the event of bank failure, took less risk than those married after the passage of a law, whose wives' wealth was protected. Bankers with more skin-in-the-game took on less leverage, held more cash against deposits, and were less likely to lose deposits after the Panic of 1873. This has important implications for today: our results suggest that individual bankers' skin-in-the-game can importantly influence risk taking in financial institutions.

Apart from highlighting that skin-in-the-game matters for risk taking, the paper's results also underscore that we should evaluate a banker's skin-in-the-game in the context of his entire personal financial situation. We write down a simple model that predicts that, in our setting, the largest effect of a married women's property law should come from the middle of the wealth distribution. We confirm this prediction in the data. Relatively poor bankers were not much affected by a law because the OCC's minimum size requirement likely forced them to invest most of their household wealth in the bank, where it would not be protected in case of failure. Rich bankers were largely unaffected because, even if their wives' wealth was protected, they still had substantial wealth on the line. This means that, in terms of policy, one size does not fit all. The optimal amount of skin-in-the-game depends on how much a banker has to lose in bad states of the world. Bankers who, through marriage or independent wealth, face a comfortable cushion should have more skin-in-the-game.

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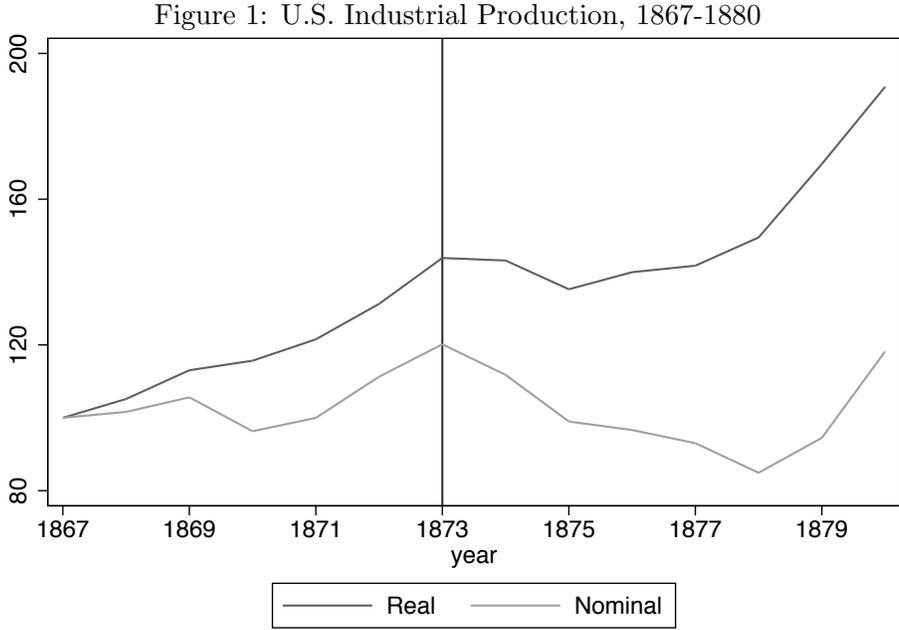
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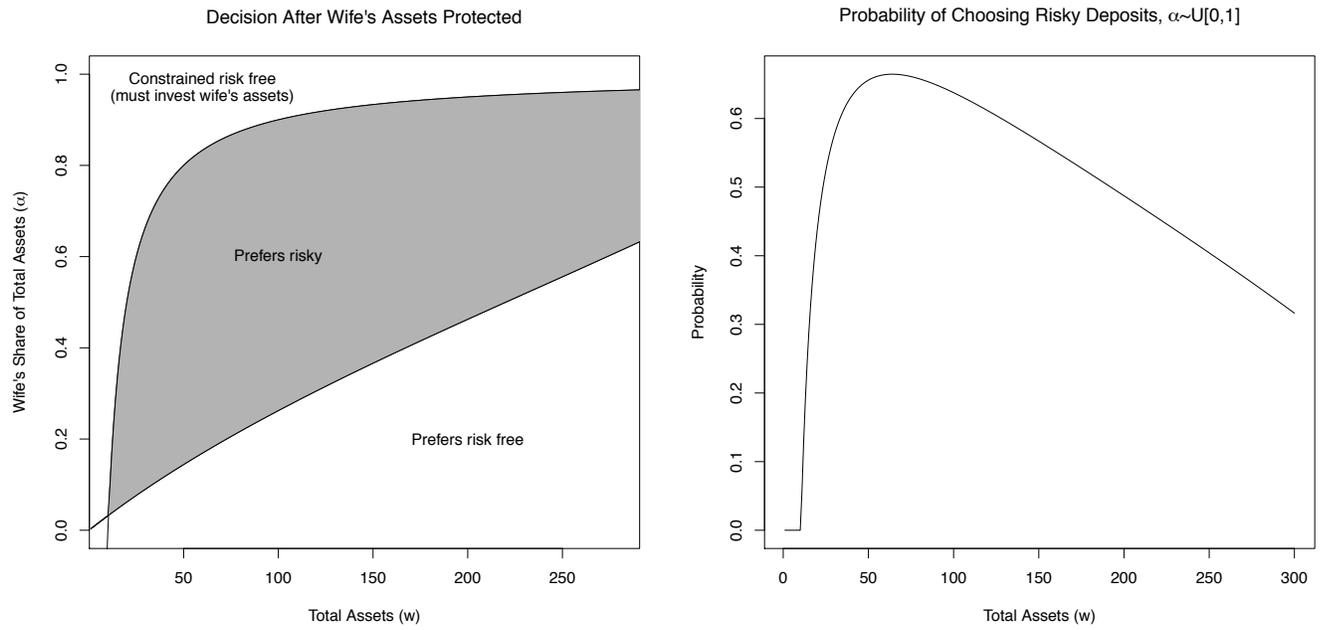
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7 Figures and Tables



Note. Source: Davis (2004)

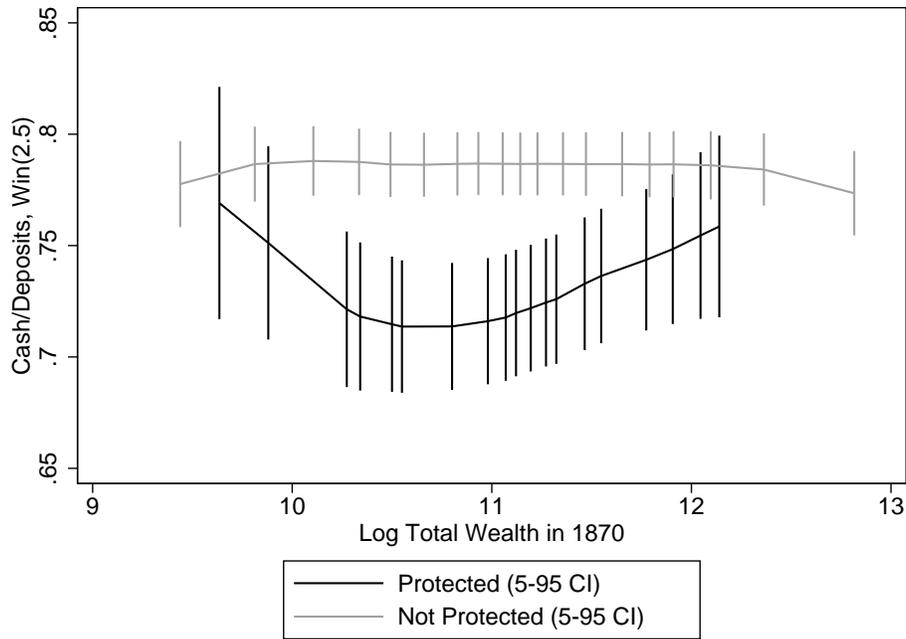
Figure 2: Impact of Protection on Bank Risk Taking: Theoretical Predictions



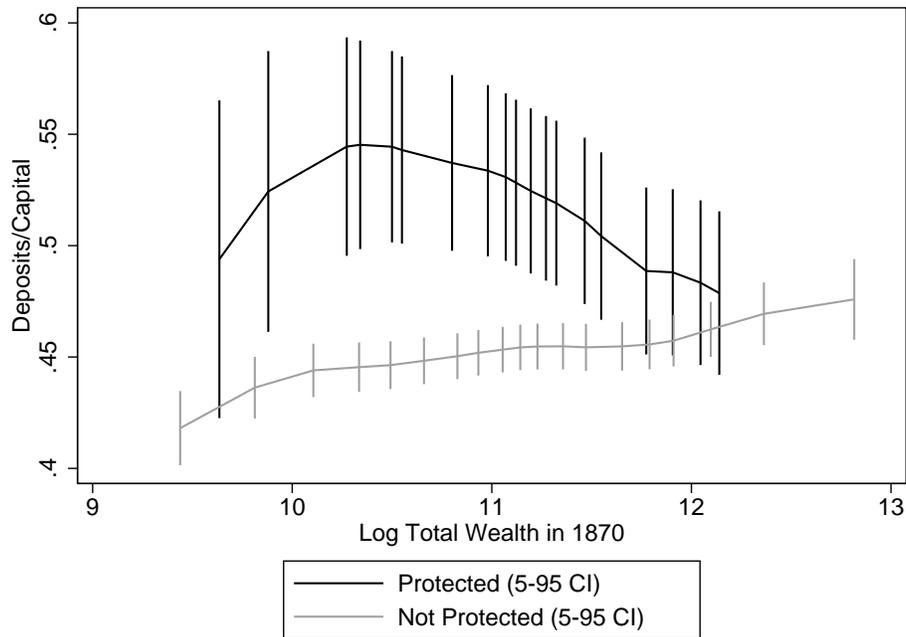
Note. Parameter values: $V = 1000$, $\kappa = 10$, $\mu = 1.5$; $\sigma = 0.6$.

Figure 3: Liquidity and Deposits over Capital: Heterogeneous Effects

Panel A: Cash/Deposits and Banker Wealth

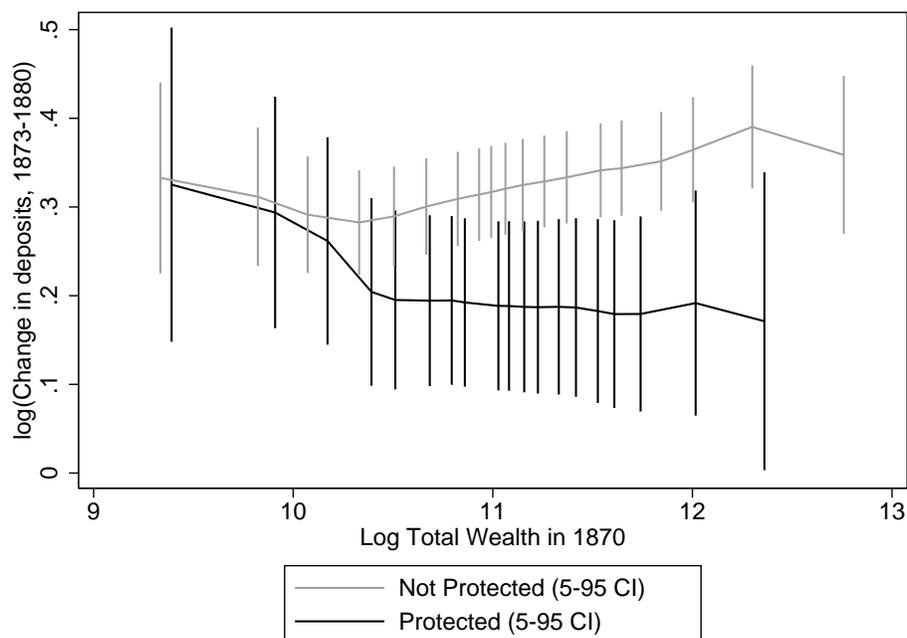


Panel B: Deposits/Capital and Banker Wealth



Note. Bank-year observations, 1867-1873 (pre-Panic). We plot a banker's risk taking against his household wealth, as reported in the 1870 census. Cash/Deposits is winsorized at the 2.5th and 97.5th percentile. All variables are residualized against year and county fixed effects, a Boston dummy, bankers' age and age-squared and banks' paid-in-capital. We use local mean smoothing to calculate kernel-weighted means at the 5th, 10th, ..., 95th percentile of the bankers' wealth distribution. We use Stata's `lpoly` command with an automated "rule-of-thumb" bandwidth and a standard Epanechnikov kernel. Confidence intervals (5th-95th percentile) are based on standard errors clustered at the individual bank level.

Figure 4: Change in Deposits, 1873-1880: Heterogeneous Effects



Note. Bank level observations. We plot a bank’s log change in deposits between 1873 and 1880 against a banker’s household wealth, as reported in the 1870 census. All variables are residualized against county fixed effects, a Boston dummy, bankers’ age and age-squared and banks’ paid-in-capital. We use local mean smoothing to calculate kernel-weighted means at the 5th, 10th, ..., 95th percentile of the bankers’ wealth distribution. We use Stata’s `lpoly` command with an automated “rule-of-thumb” bandwidth and a standard Epanechnikov kernel.

Table 1: Dates of Passage of Married Women's Property Laws

State	Date of Introduction
CT	June 22, 1849
ME	March 22, 1849
MA	May 5, 1855
NH	July 2, 1860
RI	February 8, 1844
VT	November 20, 1861

Note. Sources: Kelly (1882), Individual state's statutes

Table 2: Summary Statistics of All Banks and Banks in our Final Sample

Panel A. All Banks

Variable	N	Mean	SD	Min	Max
Log(Total Bank Assets)	3452	13.22	0.870	11.06	16.12
Log(Paid-in Capital)	3452	12.25	0.830	10.82	14.91
Deposits/Capital	3452	0.490	0.380	0	4.710
Loans/Capital	3452	0.980	0.280	0.0400	3.290
Cash/Deposits, Win(2.5)	3452	0.760	0.430	0.140	2.180
log(Change in deposits, 1873-1874)	502	0.0200	0.340	-1.330	1.140
log(Change in deposits, 1873-1880)	494	0.280	0.510	-1.330	2.240
CT	3452	0.160	0.370		
MA	3452	0.420	0.490		
ME	3452	0.120	0.330		
NH	3452	0.0800	0.270		
RI	3452	0.130	0.330		
VT	3452	0.0800	0.280		

Panel B. Banks in our Final Sample

Variable	N	Mean	SD	Min	Max
Log(Total Bank Assets)	2743	13.20	0.830	11.32	16.12
Log(Paid-in Capital)	2743	12.23	0.800	10.82	14.91
Deposits/Capital	2743	0.480	0.370	0	4.710
Loans/Capital	2743	0.970	0.270	0.0400	3.290
Cash/Deposits, Win(2.5)	2743	0.760	0.420	0.140	2.180
log(Change in deposits, 1873-1874)	412	0.0200	0.350	-1.330	1.140
log(Change in deposits, 1873-1880)	406	0.300	0.530	-1.330	2.240
CT	2743	0.180	0.380		
MA	2743	0.410	0.490		
ME	2743	0.130	0.340		
NH	2743	0.0900	0.280		
RI	2743	0.110	0.320		
VT	2743	0.0800	0.280		

Note. N/A

Table 3: Protection Status and Banker Characteristics

	(1)	(2)	(3)	(4)
		Protection		
Age	-0.014*** (0.001)	-0.056*** (0.011)		-0.055*** (0.011)
Age Squared		0.000*** (0.000)		0.000*** (0.000)
Log(Total HH wealth, 1870)			-0.045*** (0.014)	-0.011 (0.013)
Observations	669	669	669	669
Adjusted R^2	0.135	0.158	0.015	0.158

Note. Individual bankers. We regress a banker's protection status (0: married before; 1: married after the passing of a married women property law) on a banker's age, age-squared and the total household wealth reported in the 1870 census. Linear probability model. Standard errors in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Selection of bankers into banks

	(1)	(2)	(3)	(4)	(5)	(6)
	Protection	Protection	Protection	Protection	Protection	Protection
L.Log(Paid-in Capital)	0.017 (0.047)			0.007 (0.053)	0.021 (0.054)	-0.099 (0.110)
L.Deposits/Capital		0.115 (0.147)		0.153 (0.193)	0.184 (0.199)	0.224 (0.276)
L.Cash/Deposits, Win(2.5)			-0.018 (0.082)	0.044 (0.112)	0.079 (0.103)	0.074 (0.170)
Observations	144	144	144	144	144	144
Adjusted R^2	-0.006	-0.002	-0.007	-0.015	0.049	-0.090
State FE					Y	
County FE						Y

Note. New bank presidents, first year in office. We regress a banker's protection status (0: married before; 1: married after the passing of a married women property law) on a bank's size (measured by log paid-in capital), Deposits/Capital and Cash/Deposits, all lagged by one year. Cash/Deposits is winsorized at the 2.5th and 97.5th percentile. Linear probability model. Standard errors in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Liquidity, and Deposits and Loans over Capital

	Cash/Deposits		Deposits/Capital		Loans/Capital	
	(1)	(2)	(3)	(4)	(5)	(6)
Protection	-0.065*	-0.103**	0.084**	0.037	0.076***	0.050
	(0.034)	(0.050)	(0.042)	(0.030)	(0.026)	(0.033)
Age	-0.010	0.007	-0.006	-0.005	0.001	-0.004
	(0.010)	(0.011)	(0.013)	(0.007)	(0.008)	(0.009)
Age Squared	0.000	-0.000	0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(Paid-in Capital)	-0.172***	-0.105	0.000	-0.331***	0.028	-0.030
	(0.034)	(0.075)	(0.024)	(0.078)	(0.018)	(0.065)
Observations	2721	2721	2721	2721	2721	2721
Adjusted R^2	0.342	0.761	0.345	0.852	0.357	0.816
Year FE	Y	Y	Y	Y	Y	Y
County FE	Y		Y		Y	
Bank FE		Y		Y		Y

Note. Bank-year observations, 1867-1873 (pre-Panic). We regress a bank's Cash/Deposits, Deposits/Capital and Loans/Capital on a banker's protection status (0: married before; 1: married after the passing of a married women property law) and a number of control variables. Log(Paid-in Capital) measures a bank's size. All estimates include a Boston dummy. Cash/Deposits is winsorized at the 2.5th and 97.5th percentile. Standard errors (clustered at the individual bank level) in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Change in Deposits, 1873-1880

	log(Δ Dep., 1873-1874)	log(Δ Dep., 1873-1880)	
	(1)	(2)	(3)
Protection	-0.079*	-0.187***	-0.137**
	(0.045)	(0.068)	(0.065)
Cash/Deposits, Win(2.5)			0.318***
			(0.090)
Deposits/Capital			-0.283***
			(0.080)
Age	0.004	-0.005	-0.006
	(0.014)	(0.020)	(0.019)
Age Squared	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Log(Paid-in Capital)	0.038	-0.038	-0.010
	(0.032)	(0.048)	(0.048)
Observations	412	406	406
Adjusted R^2	0.048	0.114	0.208
County FE	Y	Y	Y

Note. Bank level observations. We regress the log change in deposits between 1873 and 1874 or 1873 and 1880 on a banker's protection status (0: married before; 1: married after the passing of a married women property law) and a number of control variables. Log(Paid-in Capital) measures a bank's size. All estimates include a Boston dummy. Cash/Deposits is winsorized at the 2.5th and 97.5th percentile.

Table 7: Protection and County-Level Outcomes

Panel A: Protection and Capital Formation at the County level

	Log(Mfg. Capital per wkr.)		Log(Farm Capital per acre)	
	(1)	(2)	(3)	(4)
Log(Protected bank capital per cap.)	0.001 (0.006)	0.007 (0.006)	-0.000 (0.009)	0.003 (0.008)
Log(All bank capital per cap.)	0.134*** (0.039)	0.116** (0.044)	0.276*** (0.057)	0.159** (0.062)
Observations	61	61	61	61
Adjusted R^2	0.176	0.383	0.307	0.518
State FE		Y		Y

Panel B: Protection and Changes in Capital Formation, 1870-1880

	log(Δ Mfg. Capital per wkr., 1870-1880)		log(Δ Farm Capital per acre, 1870-1880)	
	(1)	(2)	(3)	(4)
Log(Protected bank capital per cap.)	-0.012** (0.006)	-0.013* (0.007)	-0.003 (0.005)	-0.008 (0.005)
Log(All bank capital per cap.)	-0.018 (0.039)	-0.015 (0.049)	0.027 (0.032)	0.055 (0.038)
Constant	0.175 (0.136)	0.167 (0.196)	-0.215* (0.110)	-0.242 (0.155)
Observations	60	60	61	61
Adjusted R^2	0.070	0.121	-0.020	0.098
State FE		Y		Y

Note. County level regressions. Panel A: We regress manufacturing and farm capital, as reported in census year 1870, on (1) the total amount of paid-in capital invested in the national banks and (2) the total amount of paid-in capital managed by a bank president married after the passing of a law, both measured in 1869. We normalize manufacturing capital by the number of manufacturing worker, farm capital by the number of acres, and bank capital by the number of inhabitants. If the protection status (0 or 1) of a banker is missing, we impute it with the average fraction of paid-in capital in that state, which is managed by bankers married after the passing of a law. All variables are in logs. Counties are weighted by the fraction of banks' paid-in capital for which the protection status of the banker is available. Panel B: We regress the log change in county capital formation between census years 1870 and 1880 on the same set of variables, applying the same set of weights. Standard errors in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

A Proofs

Proof. of Lemma 1.

Suppose depositors believed that the banker would select project 1. Then, they would charge a risk premium ρ pinned down by the following:

$$(1 + \rho)d = 2d - (\mu - \sigma_1)(s + d) - (w - s)$$

In either case, the banker's payout in the bad state will be

$$\hat{\Pi}_b = 0$$

In the good state, his payout will be following, where σ_j is the standard deviation of returns for the project the banker actually selects:

$$\hat{\Pi}_g = (\mu + \sigma_j)(s + d) - (1 + \rho)d + (w - s)$$

Conditional on ρ , this is always increasing in σ_j . Thus, the banker always has an incentive to invest in the riskier project, regardless of what depositors believe ex ante. Because the banker cannot commit to investing in the less risky project, he will invest in the riskier project (and depositors will expect him to invest in the riskier project) in equilibrium.

■

Proof. of Lemma 2.

Under risk free deposits, good and state consumption can be rewritten as

$$\begin{aligned}\Pi_g &= \frac{\sigma}{\sigma - (\mu - 1)}w \\ \Pi_b &= \frac{\sigma}{\sigma + (\mu - 1)}w\end{aligned}$$

See proof of Proposition 3 for this derivation. Notice that both good and bad state consumption are decreasing in σ ; thus, the banker will choose the less risky project.

■

Proof. of Proposition 3.

The banker will not choose risky deposits, as $\Pi_b = 0$, which leaves the banker with $U = -\infty$. Thus, he will always choose risk free deposits.

Under risk free deposits, the good and bad state consumption are given by

$$\begin{aligned}\Pi_g &= (\mu + \sigma)(s + d) - d + (w - s) \\ \Pi_b &= (\mu - \sigma)(s + d) - d + (w - s)\end{aligned}$$

This can be rewritten using $I = s + d$ as

$$\begin{aligned}\Pi_g &= [(\mu - 1) + \sigma]I + w \\ \Pi_b &= [(\mu - 1) - \sigma]I + w\end{aligned}$$

Taking the FOC wrt I we get that

$$\frac{\sigma + (\mu - 1)}{\Pi_g} = \frac{\sigma - (\mu - 1)}{\Pi_b}$$

and therefore

$$I = \frac{\mu - 1}{\sigma^2 - (\mu - 1)^2}$$

which is larger than one as long as

$$\mu(\mu - 1) > \sigma^2$$

Administering deposits have a proportional cost ε . The banker will therefore first use his own wealth and then issue deposits to reach investment level I . Therefore $s = w$ and

$$d = \frac{\mu(\mu - 1) - \sigma^2}{\sigma^2 - (\mu - 1)^2}$$

■

Proof. of Proposition 4

1. Risky deposits, wife's wealth invested in the bank

We can think of this as the couple jointly investing in the bank. Even if only a fraction of the wife's wealth is invested in the bank, she is personally liable for any losses and her wealth (to the extent that it is not already invested in the bank) is not protected. Therefore, α will not play a role here.

The interest rate is pinned down by

$$\begin{aligned} d &= \frac{1}{2}(1 + \rho)d + \frac{1}{2}[(\mu - \sigma)(s + d) + \max(w - s - e, 0)] \\ (1 + \rho)d &= 2d - (\mu - \sigma)(s + d) - \max(w - s - e, 0) \end{aligned}$$

The payout in the good state of the world is given by

$$\begin{aligned} \widehat{\Pi}_g &= (\mu + \sigma)(s + d) - (1 + \rho)d + (w - s) \\ &= 2\mu(s + d) - 2d + \max(w - s - e, 0) + (w - s) \end{aligned}$$

The payout in the bad state of the world is given by

$$\widehat{\Pi}_b = \min(e, w - s) = e + \min(0, w - s - e)$$

We now show that in equilibrium we will have that $s = w - e$; the household invests all of its wealth up to the exempt amount. The intuition is that (since the wife is also investing) all wealth can be seized anyway (except e), so the banker may as well invest it in the bank where it receives a higher risk-adjusted return.

- (a) $w - s - e < 0$

This case implies that $s > w - e$. In this case the interest rate is determined as

$$(1 + \rho)d = 2d - (\mu - \sigma)(s + d)$$

and the good state payout as

$$\begin{aligned} \widehat{\Pi}_g &= 2\mu(s + d) - 2d + (w - s) \\ &= 2(\mu - 1)d + (2\mu - 1)s + w \end{aligned}$$

The bad state payout is given by

$$\widehat{\Pi}_b = w - s < e$$

The FOC wrt d is still always positive. Therefore, $d = V$. The FOC wrt s is given by

$$\frac{2\mu - 1}{\widehat{\Pi}_g} - \frac{1}{\widehat{\Pi}_b}$$

This is always negative, since

$$\begin{aligned} 2(\mu - 1)V + (2\mu - 1)s + w &> (2\mu - 1)(w - s) \\ 2(\mu - 1)V + 2(2\mu - 1) &> 2(\mu - 1)w \end{aligned}$$

This will always hold as $V > w$. This implies that $s > w - e$ can never be optimal.

(b) $w - s - e \geq 0$

This implies that $s \leq w - e$. The interest rate is pinned down by

$$\begin{aligned} d &= \frac{1}{2}(1 + \rho)d + \frac{1}{2}[(\mu - \sigma)(s + d) + (w - s - e)] \\ (1 + \rho)d &= 2d - (\mu - \sigma)(s + d) - (w - s - e) \end{aligned}$$

The payout in the good state of the world is given by

$$\begin{aligned} \widehat{\Pi}_g &= (\mu + \sigma)(s + d) - (1 + \rho)d + (w - s) \\ &= 2\mu(s + d) - 2d + (w - s - e) + (w - s) \\ &= 2(\mu - 1)(s + d) + 2w - e \end{aligned}$$

The payout in the bad state of the world is given by

$$\widehat{\Pi}_b = e$$

In this case, the FOCs wrt d and s are both $2(\mu - 1) > 1$. Therefore, we have that $d = V$ and $s = w - e$. This means that the good state payout can be rewritten as:

$$\begin{aligned} \widehat{\Pi}_g &= 2(\mu - 1)(V + w - e) + 2w - e \\ &= 2(\mu - 1)V + 2\mu w - (2\mu - 1)e \end{aligned}$$

2. Proof that is optimal to not invest the wife's wealth in the bank

The wife will never invest her wealth in the bank as long as

$$\begin{aligned} \Pi_g \Pi_b &> \widehat{\Pi}_g \widehat{\Pi}_b \\ \alpha w \{2(\mu - 1)V + 2\mu w - \alpha(2\mu - 1)w\} &> e \{2(\mu - 1)V + 2\mu w - (2\mu - 1)e\} \end{aligned}$$

This will always hold. To show this, we factor out $\alpha w - e$

$$\begin{aligned}
\Pi_g \Pi_b - \widehat{\Pi}_g \widehat{\Pi}_b &= (\alpha w - e) [2(\mu - 1)V + 2\mu w] - \alpha w [\alpha w(2\mu - 1)] + e [e(2\mu - 1)] \\
&= (\alpha w - e) [2(\mu - 1)V + 2\mu w] - (2\mu - 1) [(\alpha w)^2 - e^2] \\
&= (\alpha w - e) [2(\mu - 1)V + 2\mu w] - (2\mu - 1)(\alpha w + e)(\alpha w - e) \\
&= (\alpha w - e) [2(\mu - 1)V + 2\mu w - (2\mu - 1)(\alpha w + e)] \\
&= (\alpha w - e) [2(\mu - 1)(V - e) + 2(1 - \alpha)\mu w + (\alpha w + e)]
\end{aligned}$$

Since $\alpha w - e > 0$ all terms are positive. This means that it is optimal for the wife never to invest her wealth in the bank.

■

Proof. of Proposition 5

The banker solves the following optimization problem:

$$\max_{s,d} \frac{1}{2} \log \Pi_g + \frac{1}{2} \log \Pi_b$$

Both FOCs are directly proportional to $2(\mu - 1) > 0$ and therefore the banker sets both s and d at its maximal value:

$$\begin{aligned}
d &= V \\
s &= (1 - \alpha)w
\end{aligned}$$

From here we can write the payout in each state as:

$$\begin{aligned}
\Pi_g &= 2(\mu - 1)V + [2\mu - \alpha(2\mu - 1)] w \\
\Pi_b &= \alpha w
\end{aligned}$$

■

Proof. of Proposition 6

For a risky contract to be optimal we need that

$$\alpha w \{2(\mu - 1)V + [2\mu - \alpha(2\mu - 1)] w\} > \zeta w^2$$

This condition can be rewritten as the following quadratic

$$f(\alpha) = \alpha^2(2\mu - 1)w - 2\alpha[(\mu - 1)V + \mu w] + \zeta w < 0$$

Denote α^* and α^{**} the smallest and largest root to this quadratic equation. Given the shape of the quadratic, risky deposits will be optimal for

$$\alpha^* < \alpha < \alpha^{**}$$

We first show that $\alpha^{**} \geq 1$ for any parameter values. To do this we show that the derivative of f wrt α at $\alpha = 1$ is weakly negative:

$$\left. \frac{\delta f(\alpha)}{\delta \alpha} \right|_{\alpha=1} = 2(\mu - 1)(w - V) \leq 0$$

Therefore, the condition that $\alpha > \alpha^*$ is sufficient for risky deposits to be optimal.

■

Proof. of Lemma 7

From the proof of Proposition 6, we saw that α^* is the smaller of the two values that solve the following equation:

$$\alpha^2(2\mu - 1)w - 2\alpha[(\mu - 1)V + \mu w] + \zeta w = 0$$

Thus, by the quadratic formula:

$$\alpha^* = \frac{(\mu - 1)V + \mu w - \sqrt{((\mu - 1)V + \mu w)^2 - (2\mu - 1)\zeta w^2}}{(2\mu - 1)w}$$

Define:

$$A \equiv \frac{(\mu - 1)V + \mu w}{(2\mu - 1)w}$$

$$B \equiv \frac{((\mu - 1)V + \mu w)^2 - (2\mu - 1)\zeta w^2}{(2\mu - 1)^2 w^2}$$

And notice that:

$$\alpha^* = A - B^{1/2}$$

$$\Rightarrow \frac{\partial \alpha^*}{\partial w} = \frac{\partial A}{\partial w} - \frac{B^{-1/2}}{2} \frac{\partial B}{\partial w}$$

It straightforward to show that

$$\frac{\partial A}{\partial w} = \frac{-(\mu - 1)V}{(2\mu - 1)w^2}$$

Also notice that B simplifies to:

$$B = \frac{(\mu - 1)V + \mu w}{(2\mu - 1)^2 w^2} - \frac{\zeta}{2\mu - 1} = A^2 - \frac{\zeta}{2\mu - 1}$$

$$\Rightarrow \frac{\partial B}{\partial w} = 2A \frac{\partial A}{\partial w}$$

Thus,

$$\frac{\partial \alpha^*}{\partial w} = \frac{\partial A}{\partial w} \left(1 - AB^{-1/2} \right)$$

We know that $\partial A / \partial w < 0$. So, if $AB^{-1/2} > 1$, it follows that $\partial \alpha^* / \partial w > 0$. This is the case:

$$AB^{-1/2} = \frac{(\mu - 1)V + \mu w}{\sqrt{((\mu - 1)V + \mu w)^2 - (2\mu - 1)\zeta w^2}}$$

$$> \frac{(\mu - 1)V + \mu w}{\sqrt{((\mu - 1)V + \mu w)^2}} = 1$$

Therefore, α^* is strictly increasing in w .

To calculate a lower bound on α^* , we take the limit as $w \rightarrow 0$. When $w = 0$, $\alpha^* = \frac{0}{0}$; thus, by

l'Hopital's rule:

$$\begin{aligned}
\lim_{w \rightarrow 0} \alpha^* &= \frac{\mu - \frac{1}{2}B^{-1/2} \left(2\mu((\mu-1)V + \mu w) - 2\zeta w(2\mu-1) \right)}{2\mu-1} \Big|_{w=0} \\
&= \frac{\mu - \frac{1}{2}((\mu-1)V)^{-1} (2\mu(\mu-1)V)}{2\mu-1} \\
&= \frac{\mu - \mu}{2\mu-1} = 0
\end{aligned}$$

A solution for α^* does not exist when

$$[(\mu-1)V + \mu w]^2 < (2\mu-1)\zeta w^2$$

in which case, it is always optimal for the banker to pick risk free deposits. This will be the case when

$$w < \frac{\mu-1}{\underbrace{\sqrt{(2\mu-1)\zeta} - \mu}_{\Omega}} V$$

Note that Ω is a positive number as

$$\begin{aligned}
(2\mu-1)\zeta &> \mu^2 \\
\frac{(2\mu-1)\sigma^2}{\sigma^2 - (\mu-1)^2} &> \frac{\mu^2\sigma^2 - \mu^2(\mu-1)^2}{\sigma^2 - (\mu-1)^2} \\
\sigma^2 &< \mu^2
\end{aligned}$$

■