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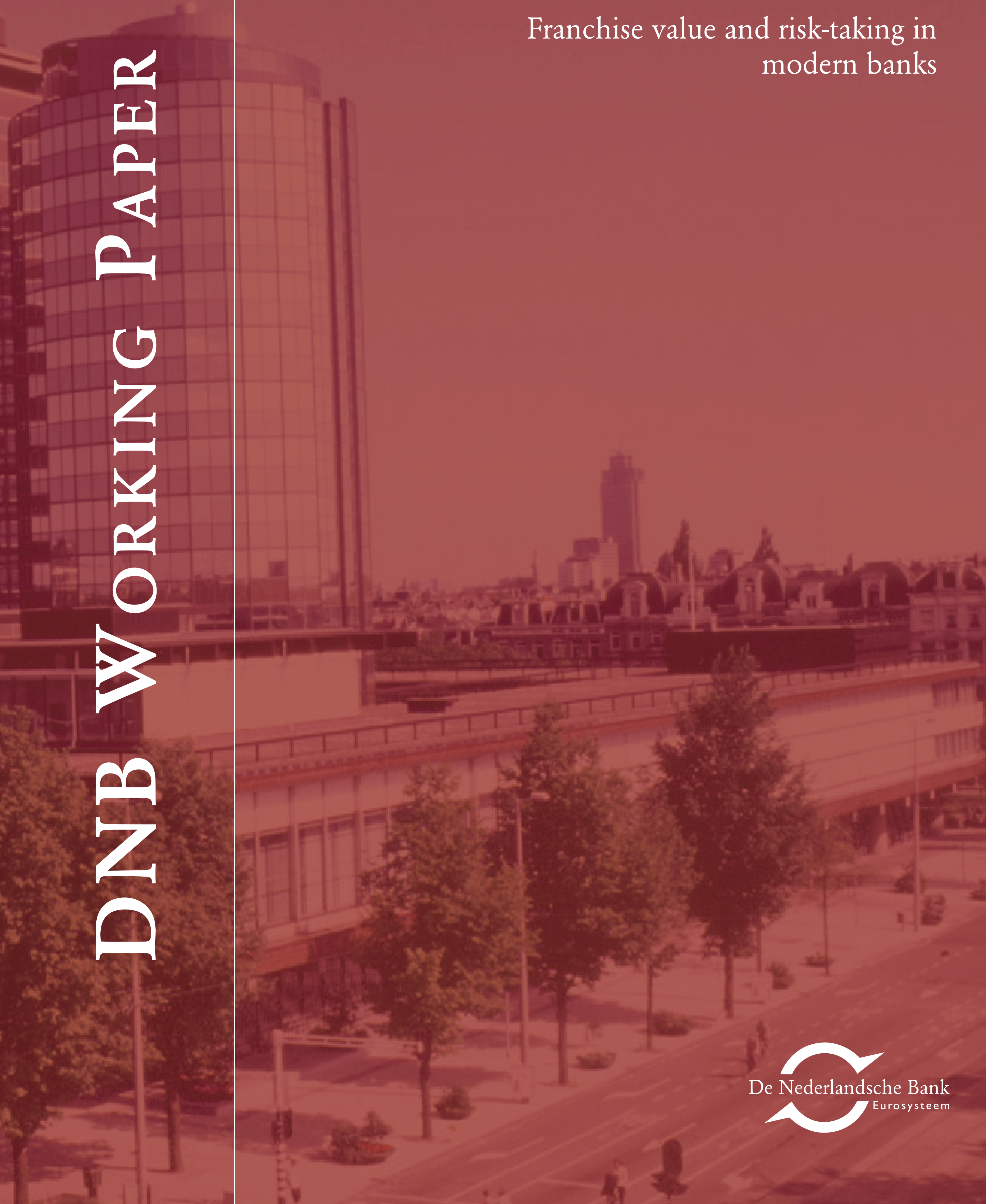

DNB WORKING PAPER

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Natalya Martynova, Lev Ratnovski and Razvan Vlahu *

* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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De Nederlandsche Bank NV
P.O. Box 98
1000 AB AMSTERDAM
The Netherlands

Franchise Value and Risk-Taking in Modern Banks

Natalya Martynova
University of Amsterdam

Lev Ratnovski
International Monetary Fund

Razvan Vlahu
De Nederlandsche Bank

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Abstract

Traditional theory suggests that high franchise value limits bank risk-taking incentives. Then why did many banks with exceptionally valuable franchises get exposed to new financial instruments, resulting in significant losses during the crisis? This paper attempts to reconcile theory and evidence. We consider a setup where a bank takes risk by levering up, to invest in risky market-based instruments. High franchise value allows the bank to borrow more, so it can take risk on a larger scale. This offsets lower incentives to take risk of given size. As a result, a bank with a higher franchise value may have higher risk-taking incentives. The proposed effect is stronger when a bank can expand the balance sheet using inexpensive senior funding (such as repos), and when it can achieve high leverage thanks to better institutional environment (with more protection of creditor rights). This framework captures well the stylized patterns of bank risk-taking in the run-up to the crisis.

Keywords: Banks, Risk-taking, Franchise value, Bank capital, Repo markets, Crises.

JEL Classifications: G21, G24, G28.

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1 Introduction

The recent crisis revealed a surprising amount of risk-taking in financial institutions with exceptionally valuable franchises. Before the crisis, AIG was one of only three AAA-rated companies in the U.S. It started selling credit default swap (CDS) protection on senior tranches of collateralized debt obligation in 2005 and lost over \$100 billion – 10% of assets – in 2008 (AIG Annual Report, 2007), wiping out shareholder equity and triggering a bailout. UBS in Switzerland had a unique wealth management franchise, with a stable return on allocated capital in excess of 30% (UBS Annual Report, 2007). It rapidly, over just two years, accumulated a large portfolio of CDS, lost over \$50 billion in 2008, and had to be rescued. Washington Mutual, once called "The Walmart of Banking", lost \$22 billion on subprime exposures and was liquidated. Similar investments-related disasters occurred in many other previously-profitable banks in U.S. and Europe.

Significant risk-taking in institutions with a high franchise value seems to contradict the traditional predictions of corporate finance models.[1] Shareholders are protected by limited liability and have incentives to take risk to maximize their option-like payoff (Jensen and Meckling, 1976). But as the shareholder value increases, shareholders internalize more of the downside, so their risk-taking incentives decline. A bank's franchise value belongs to its shareholders and is lost in the bankruptcy, so a high franchise value should reduce bank risk-taking. Therefore it is puzzling why profitable banks chose to become exposed to risky and untested market-based instruments and on such a large scale.

This paper attempts to reconcile theory and evidence. Our key observation is that in Jensen and Meckling-type models, firms choose the risk of a portfolio of a given size. Yet bank risk-taking in the run-up to the crisis took a different form. Banks levered up – expanded the balance sheet – to undertake additional, risky market-based investments. The investments had skewed returns: they offered modest gains ("alpha") in normal times, but incurred significant and correlated losses in downturns.[2] The risks were accumulated alongside banks' traditional

[1] We understand franchise value as long term bank profitability (a ratio of a discounted stream of future bank profits to bank size).

[2] The risky investments included carry trade reliant on short term wholesale funding (Gorton, 2010), selling protection on senior tranches of asset backed securities through CDS contracts (Acharya and Richardson,

'core' business, which remained stable and prudent.

We show that when banks take risk by levering up to take *additional risk*, rather than by manipulating their core portfolio, the traditional result that high franchise value reduces bank risk-taking incentives does not always hold. The reason is that high franchise value allows the bank to borrow more and take risk on a larger scale. Larger scale offsets lower incentives to take risk of given size. As a result, a bank with a high franchise value may have higher – not lower – incentives to take risk.

The novel effect where franchise value contributes to bank risk-taking holds for a range of parameter values. It is more likely to arise when it is easier for banks to lever up. This may be a result of better institutional environment with more protection of creditor rights. This could explain why most banks affected by the crisis were in advanced economies. And the effect is more likely to arise when the funding for banks' market-based investments is senior to the funding for their core business. This highlights the role of repo market arrangements in pre-crisis vulnerability (repos are senior to the rest of bank funding; Gorton and Metrick, 2012; Acharya and Öncü, 2013). Thus, the comparative statics of our model are consistent with the stylized patterns of bank risk-taking in the run-up to the crisis.

Our analysis lends itself to a number of extensions. In one extension, we show that a bank may strategically exert effort to increase the value of its core business in order to take large market-based gambles alongside it. A bank then combines prudent risk management in its core activity (e.g., lending or wealth management) with risky market-based activities. While the literature has often associated this seeming inconsistency with a "clash of cultures" between conservative bankers and risk-loving traders (Froot and Stein, 1998), we explain it based purely on shareholder value maximization.

In another extension, we consider the effects of bank capital and capital requirements. We find that higher capital *per se* does not necessarily reduce bank risk-taking, because higher capital today may allow the bank to borrow more in the future. Binding capital requirements may reduce bank risk-taking, but only if they include a sufficiently high capital charge on

2009), undiversified exposures to housing (Shin, 2009), etc. Acharya et al. (2009) call these investments "the manufacturing of tail risk".

market-based investments, or a leverage ratio.

The paper relates to the literature on the link between bank franchise value and risk-taking. The accepted first-order effect is that franchise value reduces bank risk-taking incentives (Keeley, 1990; Demsetz et al., 1996; Repullo, 2004; among others). But a number of papers caution that the relationship is more complex. First, there are dynamic effects where banks take risk in order to generate franchise value (Blum, 1999; Hellmann et al., 2000; Matutes and Vives, 2000). Second, high franchise value makes capital requirements less binding, so that the bank is less averse to occasional losses (Calem and Rob, 1999; Perotti et al., 2011). Our model proposes a novel effect, closely linked to the pre-crisis experience, where franchise value enables banks to borrow and take risk on a larger scale.

It is notable that the emerging empirical literature on bank performance around the 2008 crisis is not conclusive on the effects of bank capital. On the one hand, Beltratti and Stulz (2012) find in a sample of banks from advanced and emerging economies that, in most but not all specifications, higher pre-crisis capital improved bank performance during the 2008 crisis. And Berger and Bouwman (2013) show that higher capital improved U.S. banks' performance during multiple banking crises (but not specifically during the 2008 crisis, for which the results are nuanced). On the other hand, studies that focus on banks in advanced economies during the 2008 crisis only offer different insights. Huang and Ratnovski (2009) use OECD data and find no relationship between pre-crisis bank capital and performance during the crisis. They suggest that any positive impact of bank capital on performance is driven by banks with extremely low capital, and any equity above 4% of assets did not improve bank stability. Camara et al. (2010) use European data and verify that well-capitalized banks took more risk before the 2008 crisis. IMF's GFSR (2009) uses a sample of 36 major global banks and finds that banks that were intervened in during the crisis had statistically higher capital metrics (risk-weighted or not) before the crisis. All the latter effects are consistent with the main message of our paper.[3]

Our paper also relates to the literature on the effect of institutional environment on risk-taking. The positive relationship between the quality of institutional environment and the

[3] Also, on pre-crisis data, Barth et al. (2006) find no relationship between bank capital ratios and stability. Bichsel and Blum (2004), Lindquist (2004), Jokipii and Milne (2008), and Angora et al. (2009) also find no or negative relationship between bank capital and performance pre-crisis.

severity of crises was recently documented in the international economics literature (Giannonne et al., 2011; Gourinchas et al., 2011). We explain why this may be the case. Stronger institutional environment offers better protection to creditor rights (Laeven, 2001; La Porta et al., 2003; Boyd and Hakenes, 2012) and thus allows banks to become more levered, with higher incentives to take risk.

There are parallels between our analysis and those of Myers and Rajan (1998) and Adrian and Shin (2014). Myers and Rajan (1998) point to an unintended effect of asset liquidity, which creates moral hazard by increasing managers' ability to trade assets in their own interest. Our framework points to an unintended effect of bank franchise value: it enables bankers to borrow more and take more risk. Adrian and Shin (2014) offer a framework where the leverage of financial intermediaries is procyclical: the level of bank equity is fixed, but banks can borrow more during upturns, thanks to lower risk weights. Our paper expands on this, suggesting that the expansion of bank balance sheets during upturns may take form of risky market-based gambles, consistent with the evidence from the financial crisis.[4]

Finally, it is useful to elaborate why the effects identified in our paper apply primary to "modern" banks, i.e., may have come to the fore only recently. In the past, financial markets were not as developed, which limited the size of market-based gambles that banks could engage in. Only since the 1990s, with the deepening of financial markets that followed deregulation and financial innovation revolution, have the problems of risky market-based activities of banks become acute (Morrison and Wilhelm, 2007; Boot, 2014).

The paper is structured as follows. Section 2 sets up the model. Section 3 solves the model with an exogenous cost of funding. Section 4 endogenizes the cost of funding. Section 5 offers extensions. Section 6 discusses implications. Section 7 concludes.

[4]Another related paper is Boot and Ratnovski (2014). They also consider the interaction between relationship banking and market-based bank activities. Boot and Ratnovski study how banks may opportunistically misallocate capital to market-based "trading", as a consequence of a conflict between the long-term nature of banking and the short-term nature of trading. Our paper focuses on a different issue: how market-based activities can be used for risk-shifting, depending on the value of the relationship banking business.

2 The Model

Consider a bank which operates in a risk-neutral economy with three dates $(0, 1, 2)$ and no discounting. The bank has no initial capital, has to borrow in order to invest, and maximizes its expected profit.

The bank is endowed with access to a valuable *core* project. This project is profitable, not scalable, and safe. Think about this as the relationship banking business. For 1 unit invested at date 0, the core project produces $R > 1$ with certainty at date 2. We call the NPV of the core project, $R - 1$, its *franchise value*.[5]

At date 1, the bank may in addition undertake a risky market-based investment. Think about this as carry trade (e.g., the accumulation of a portfolio of senior collateralized debt obligation using wholesale funding). The investment is scalable and has binary returns. For X units invested at date 1, it produces at date 2 a positive return $(1 + \alpha)X$ with probability p (where $\alpha > 0$), and 0 with probability $1 - p$. The risky investment has a negative NPV, so the bank would only engage in it for the purpose of risk-shifting:

$$p(1 + \alpha) < 1. \tag{1}$$

And even for a successful risky investment, the return obtained is lower than the return on the core project:

$$\alpha < R - 1. \tag{2}$$

This setup mimics real-world bank risk-taking strategies which generate a small positive return most of the time, but can lead to catastrophic losses with a small probability. The bank's project choice is not verifiable; as a result, the bank cannot commit not to undertake the risky value-destroying investment.[6]

[5] Since the size of the core project is normalized to 1, $R - 1$ represents the project's profitability (a ratio of profit to project size), consistent with our definition of franchise value. Note that franchise value is not related to bank size.

[6] It is useful to describe the relevance of these assumptions. In practice some market-based investments may be valuable or have different return distributions. But in this model we focus on the bank's incentives to opportunistically undertake value-destroying, tail risk-like projects. The assumption that the market-based investment has a negative NPV is convenient for exposition purposes. We can obtain similar results in a set-up

The bank funds itself with debt. It attracts 1 unit of funds for the core project at date 0 against the interest rate r_0, and may attract X units of funds for the market-based investment at date 1 against the interest rate r_1. We call the two groups of creditors "date 0" and "date 1" creditors. All funds are repaid at date 2 if the bank is solvent (the payoff from projects exceeds the total amount owed). If the bank is insolvent, it is liquidated and all assets go to creditors. In Section 3, we solve a simplified version of the model setting $r_0 = r_1 = 0$. This allows us to showcase our main result most immediately. Exogenous interest rates can be rationalized through deposit insurance with risk-insensitive premiums, or through "too-big-to-fail" implicit government guarantees on the debt of large banks (O'Hara and Shaw, 1990). In Section 4, we solve the model with endogenous interest rates, and verify that our results hold.

The final ingredient of the model is that the bank is subject to a leverage constraint, driven by the owner-manager's incentives to engage in moral hazard. We use the Holmstrom and Tirole (1997) formulation, where the owner-manager can run the bank normally or, immediately after date 1, convert the bank's assets into private benefits. The manager would run the bank normally when:

$$\Pi \geq b(1 + X), \tag{3}$$

where Π is the shareholder return when assets are employed for normal business, and $b(1 + X)$ is the initial value of assets $1 + X$ multiplied by the conversion factor b ($0 < b < 1$) of assets

where the risky investment has a positive NPV, but bank failures have negative externalities (e.g., 'systemic risk'). Banks' traditional lending is indeed usually more profitable than marked-based investments. For example, in 2000-2007, the U.S. banks' net interest rate margin on lending was 3.25%, while gross returns on trading assets were 2% (and negative during the crisis; NY Fed, 2012). This is probably because banks enjoy some market power in lending due to asymmetric information (Petersen and Rajan, 1995; Dell'Ariccia and Marquez, 2006). The bank's investment decision may be not verifiable when it is difficult to write contracts limiting investments in innovative financial products (commitments in such contracts are easy to evade by designing new, previously unspecified products).

into private benefits.[7] We assume that:

$$R - 1 \geq b, \tag{4}$$

so that the leverage constraint (3) is not binding when the bank engages only in the core project, and:

$$p\alpha < b, \tag{5}$$

so that the constraint becomes more binding in higher X.[8]

The timeline is summarized in Figure 1.

3 Exogenous Cost of Bank Funding

3.1 Bank Strategy

Assume that $r_0 = r_1 = 0$ (we relax this assumption in the next section). Consider the bank's incentives to undertake the risky investment alongside its core project. The bank's profit when it invests only in the core project is $\Pi_0 = R - 1$, where R is the return of the core project and 1 is the repayment to creditors. When the bank undertakes the risky investment on a small scale, $X \leq R - 1$, it always repays its creditors in full at date 2 from the returns on the core project. The bank's expected profit is:

$$\Pi_1^{X \leq R-1} = R + p(1+\alpha)X - (1+X) = R - 1 + X[p(1+\alpha) - 1], \tag{6}$$

[7]The fact that firms can borrow only a certain fraction of their net worth is a standard feature of corporate finance models. For banks, this can be thought of as an economic capital requirement (Allen et al., 2011). There are many ways to interpret the payoff to moral hazard $b(1+X)$. It can represent savings on abstaining from the owner-manager's effort, limits on the pledgeability of revenues (Holmstrom and Tirole, 1998), the possibility of absconding (Calomiris and Kahn, 2001; Martin and Parigi, 2011), cash diversion (Hart, 1995; Burkart and Ellingsen, 2004), or even looting (Akerlof and Romer, 1993; Boyd and Hakenes, 2012). Bank creditors anticipate that the bank may engage in moral hazard and limit the amount of money that they are willing to lend to the bank.

[8]These assumptions are based on the observation that traditional banks (with relationship rents and a fixed customer base) are often not capital constrained, while market-based activities require a substantial equity commitment (as obtained through partnerships in early investment banking, or from full partners in hedge funds). A lower b ($b < p\alpha$) would enable the bank to undertake the market-based risky investment on an infinite scale, while a higher b ($b > R - 1$) would make the bank unable to raise funds even for its core lending activity.

where R is the return on the core project, $p(1+\alpha)X$ is the return from the risky investment, and $1+X$ is repayment to date 0 and date 1 creditors. From (1), $\Pi_1^{X\leq R-1} < \Pi_0$: since the risky investment has negative NPV, the bank has no incentives to undertake it when it fully internalizes the downside.

When the bank undertakes the risky investment on a larger scale, $X > R-1$, the bank's profit is:

$$\Pi_1 = p[R + (1+\alpha)X - (1+X)] = p\,(R - 1 + \alpha X)\,, \tag{7}$$

where p is the probability of success of the risky investment, $R-1$ is the return on the core project, and αX is the return on the risky investment when it succeeds. With additional probability $1-p$ the risky investment fails, the bank cannot repay its creditors in full, and the value of equity is zero.

The bank has incentives to undertake the risky investment when $\Pi_1 > \Pi_0$, corresponding to:

$$X > X_{\min} = \frac{(1-p)\,(R-1)}{p\alpha}. \tag{8}$$

This implies that the bank only undertakes the risky investment if it can do that on a sufficient scale. The intuition is that risk-taking has a fixed cost (i.e., the loss of the core project's franchise value $R-1$ in bankruptcy with probability $1-p$), while the benefits of risk-taking (i.e., the additional return α) are proportional to the scale of the risky investment. (Note that from (1) $X_{\min} > R-1$).

Now consider the bank's ability to lever up to undertake the risky investment. When the bank undertakes the risky investment on scale X, the leverage constraint (3) becomes:

$$p\,(R - 1 + \alpha X) \geq b(1+X), \tag{9}$$

where $p\,(R-1+\alpha X)$ is the bank's profit (same as Π_1 in (7)) and $b(1+X)$ is the payoff from moral hazard. This gives the maximum scale of the bank's risky investment:

$$X \leq X_{\max} = \frac{p\,(R-1) - b}{b - p\alpha}. \tag{10}$$

We can now summarize the bank's strategy as follows:

Lemma 1 *The bank undertakes risky investment when* $X_{\min} < X_{\max}$*. The interval* $(X_{\min}, X_{\max}]$ *is non-empty when* b *is low:*

$$b < b_{\max} = \frac{p\alpha(R-1)}{p\alpha + (1-p)(R-1)}. \tag{11}$$

Whenever the bank undertakes the risky investment, it does so at its maximum possible scale $X_{\max}$*, since* $\partial\Pi_1/\partial X > 0$.

Proof. See Appendix. ■

Figure 2 illustrates the bank's strategy.

3.2 Franchise Value and Bank Risk-Taking

We now ask how franchise value affects bank risk-taking in our framework. Consider the effects on bank risk-taking of R, where $R-1$ represents the franchise value of the bank's core project. Note that:

$$\frac{\partial b_{\max}}{\partial R} = \frac{p^2\alpha^2}{[p\alpha + (1-p)(R-1)]^2} > 0, \tag{12}$$

meaning that with a higher R the bank can undertake the risky investment for a wider range of parameter values. Note also that:

$$\frac{\partial X_{\max}}{\partial R} = \frac{p}{b - p\alpha} > 0, \tag{13}$$

from (5). This means that with a higher R the bank can undertake the risky investment on a larger scale.

We can now summarize with our first main result.

Proposition 1 *The bank undertakes risky investment when the leverage constraint is sufficiently lax, corresponding to low private benefits of moral hazard:* $b < b_{\max}$*. Higher fran-*

chise value expands the range of parameter values where the bank undertakes risky investment ($\partial b_{\max}/\partial R > 0$) and increases the scale of the risky investment ($\partial X_{\max}/\partial R > 0$).

Figure 3 illustrates the relationship between franchise value and bank risk-taking.

The intuition is that when b is small, the leverage constraint is less binding, so an increase in the bank's franchise value increases its ability to borrow substantially. Then, the possibility to undertake the risky investment on a larger scale (higher $X_{\max}$) offsets lower incentives to take risk of given size (higher $X_{\min}$).[9] This result sheds light on the reasons why banks with exceptionally high franchise value were in the center of the universe of new and risky financial instruments before the recent crisis. The high franchise value allowed such banks to borrow and take market-based exposures at an exceedingly large scale, which was sufficient to compensate for the risk of a loss of a core franchise.

4 Endogenous Cost of Bank Funding

This section introduces risk-sensitive debt and shows that the results of Proposition 1 continue to hold. We also obtain new results on the effects of debt seniority on bank risk-taking.

4.1 Setup

Consider two tranches of bank debt: the tranch attracted for the core project at date 0 against the interest rate r_0 and the tranch attracted for the risky investment at date 1 against the interest rate r_1. The interest rates are not anymore exogenous, but determined by the creditors' break even conditions, which depend on date 2 repayments.

When the bank is solvent, the creditors are repaid in full. When the bank is insolvent (which happens when the risky investment fails), it is liquidated and the remaining assets R are distributed among the creditors according to their seniority. The two tranches of debt may have different seniority. We capture the seniority of date 1 creditors by a parameter θ: the share of their investment that they receive in bankruptcy. That is, in bankruptcy, date 1 creditors are

[9] Note that from (8), $\frac{\partial X_{\min}}{\partial R} = \frac{1-p}{p\alpha} > 0$.

repaid θX and date 0 creditors $R-\theta X$, where $0<\theta<\min[R/X,\ 1]$ ($\theta>R/X$ is not credible). A higher θ represents more senior date 1 debt.

In practice, θ is determined by contractual arrangements between the bank and its creditors. For example, if date 1 debt is secured (as in repos), or is scheduled to be repaid immediately before date 0 debt, it would be more senior (Brunnermeier and Oehmke, 2013). In the analysis, we treat θ as exogenous. As will become apparent, making θ endogenous, when the bank is able to set θ after date 0 debt is attracted, would lead the bank to choose the highest possible θ (e.g., attract all new funding in the form of repos), and thus make our risk-taking results even more pronounced.

4.2 Bank Strategy

We start by replicating the results of Proposition 1. When the bank undertakes the risky investment on a low scale, $X\le\frac{R-1}{\theta}$, it internalizes the losses and as a result has no incentives for risk-taking.[10] When the bank undertakes the risky investment on a larger scale, $X>\frac{R-1}{\theta}$, its profit is (similar to (7)):

$$\begin{aligned}\Pi_1 &= p\{R-(1+r_0)+X[(1+\alpha)-(1+r_1)]\}= \\ &= p[R-(1+r_0)+X(\alpha-r_1)], \qquad (14)\end{aligned}$$

where p is the probability of success of the risky investment, and $[R-(1+r_0)+X(\alpha-r_1)]$ is the payoff in case of success. With additional probability $1-p$ the risky investment fails, the bank cannot repay creditors in full, and the value of equity is zero. The bank has incentives to undertake the risky investment when $\Pi_1>\Pi_0=R-(1+r_0)$, corresponding to:

$$X>X^{\theta}_{\min}=(1-p)\frac{R-(1+r_0)}{p(\alpha-r_1)}. \qquad (15)$$

We now derive the bank's ability to lever up to undertake the risky investment. The leverage

[10]Date 0 creditors' claim on the bank is risk-free since the bank is able to repay them in full at date 2 from the returns of the core project upon the failure of risky investment: $R-1-\theta X>0$. However, from (1): $\Pi_1^{X\le\frac{R-1}{\theta}}=R-1+p(1+\alpha)X-(1+r_1)X<R-1=\Pi_0$, which means that there is no risk-shifting.

constraint (3) takes the form (similar to (9)):

$$p[R-(1+r_0)+X(\alpha-r_1)]\geq b(1+X), \tag{16}$$

where $[R-(1+r_0)+X(\alpha-r_1)]$ is the payoff in case of success, and $b(1+X)$ is the payoff to moral hazard. This limits the scale of the risky investment to:

$$X\leq X^{\theta}_{\max}=\frac{p(R-1-r_0)-b}{b-p(\alpha-r_1)}. \tag{17}$$

The interest rate r_1 is obtained from the break-even condition for date 1 bank creditors:

$$p(1+r_1)X+(1-p)\theta X=X, \tag{18}$$

giving:

$$r_1=\frac{(1-p)(1-\theta)}{p}. \tag{19}$$

By substituting the value for r_1 from (19) into (15) and (17), we obtain:

$$X^{\theta}_{\min} = (1-p)\frac{R-(1+r_0)}{p\alpha-(1-p)(1-\theta)}, \tag{20}$$

$$X^{\theta}_{\max} = \frac{p[R-(1+r_0)]-b}{b-[p\alpha-(1-p)(1-\theta)]}. \tag{21}$$

We can show the following:

Lemma 2 *The bank undertakes risky investment when $X^{\theta}_{\min}<X^{\theta}_{\max}$, and it does that at the maximum possible scale $X^{\theta}_{\max}$. The interval $(X^{\theta}_{\min}, X^{\theta}_{\max}]$ is non-empty when b is low and θ is high:*

$$\theta > \theta_{\min}=1-\frac{p\alpha}{1-p}\ , \ \textit{and} \tag{22}$$

$$b < b^{\theta}_{\max}=\frac{(R-1-r_0)(\theta-\theta_{\min})}{R-1-r_0+\theta-\theta_{\min}}. \tag{23}$$

Proof. See Appendix. ■

As before, the bank undertakes the risky investment when the private benefits b are small. Observe that $b^\theta_{\max} < b_{\max}$, where $b_{\max}$ is given in (11). Endogenous funding rates reduce the bank's ability to lever up, since the bank's cost of debt is no longer subsidized. In addition, the incentives to undertake the risky investment depend on the seniority θ of date 1 creditors. A high θ reduces the interest rate r_1, making the risky investment more attractive.[11]

To complete the model, we endogenize the interest rate required by date 0 creditors. They receive only a share of the bank's liquidation value R when the risky investment fails. Anticipating that, they choose $r_0 > 0$ whenever they expect the bank to undertake at date 1 the risky investment financed by senior debt. Alternative $r_0 = 0$ is based on the belief that only core investment is made. Since the lower interest rate only increases incentives to take risk, $r_0 = 0$ provides negative payoff for date 0 creditors, and is out of equilibrium. Formally, from the date 0 creditors' break-even condition:

$$p(1 + r_0) + (1 - p)(R - \theta X) = 1, \tag{24}$$

we obtain:

$$r_0 = \frac{1-p}{p} \cdot \frac{(R-1)[\theta - (1-p)\theta_{\min} - b] - b\theta}{(1-p)\theta_{\min} + b}, \tag{25}$$

with $\theta_{\min}$ given in (22). Note that the franchise value is sufficient to repay date 0 creditors: $R - 1 - r_0 \geq 0$. For a detailed derivation of r_0, see Appendix.

4.3 Franchise Value and Bank Risk-Taking

Consider again the effect of R, where $R - 1$ represents the franchise value of the bank's core project, on bank risk-taking. From (23):

$$\frac{\partial b^\theta_{\max}}{\partial R} = \frac{\left(1 - \frac{\partial r_0}{\partial R}\right)(\theta - \theta_{\min})^2}{(R - 1 - r_0 + \theta - \theta_{\min})^2}, \tag{26}$$

[11] Note that repaying interest r_1 upon success is feasible ($r_1 < \alpha$) when $\theta > \theta_{\min}$. When seniority of new funds θ is low, the bank cannot attract funds for the risky investment.

where:

$$\frac{\partial r_0}{\partial R} = \frac{1-p}{p} \cdot \frac{\theta - (1-p)\theta_{\min} - b}{(1-p)\theta_{\min} + b} > 0. \tag{27}$$

This implies that $\frac{\partial b^{\theta}_{\max}}{\partial R} > 0$. Recall that the bank undertakes the risky investment for $b < b^{\theta}_{\max}$. Thus, high franchise value makes the bank more likely to engage in risky investment. Note also that:

$$\frac{\partial X^{\theta}_{\max}}{\partial R} = \frac{p\left(1 - \frac{\partial r_0}{\partial R}\right)}{b - (1-p)(\theta - \theta_{\min})} > 0, \tag{28}$$

meaning that the scale of the risky investment increases in bank franchise value R.[12] These replicate the result of Proposition 1.

Proposition 2 *The bank undertakes risky investment when the leverage constraint is sufficiently lax, corresponding to low private benefits of moral hazard: $b < b^{\theta}_{\max}$, and the cost of attracting new funds is sufficiently low, corresponding to high seniority of date 1 creditors: $\theta > \theta_{\min}$. Higher franchise value expands the range of parameter values where the bank undertakes risky investment ($\partial b^{\theta}_{\max}/\partial R > 0$) and increases the scale of the risky investment ($\partial X^{\theta}_{\max}/\partial R > 0$).*

Proof. See Appendix. ■

4.4 Debt Seniority and Bank Risk-Taking

Consider now the effects on bank risk-taking of θ, the seniority of date 1 creditors. A higher θ reduces the interest rate required by date 1 creditors:

$$\frac{\partial r_1}{\partial \theta} = -\frac{1-p}{p} < 0, \tag{29}$$

and increases the interest rate required by date 0 creditors:

$$\frac{\partial r_0}{\partial \theta} = \frac{1-p}{p} \cdot \frac{R - 1 - b}{(1-p)\theta_{\min} + b} > 0. \tag{30}$$

[12] From (20) note also that: $\frac{\partial X^{\theta}_{\min}}{\partial R} = \frac{1 - \frac{\partial r_0}{\partial R}}{\theta - \theta_{\min}} > 0$. However, the possibility to undertake the risky investment on a larger scale (higher $X^{\theta}_{\max}$) offsets lower incentives to take risk of given size (higher $X^{\theta}_{\min}$).

From (23):

$$\frac{\partial b^{\theta}_{\max}}{\partial \theta} = \frac{(R-1-r_0)^2 - \frac{\partial r_0}{\partial \theta} \cdot (\theta - \theta_{\min})^2}{(R-1-r_0+\theta-\theta_{\min})^2} > 0. \tag{31}$$

Higher r_0 lowers the cost of losing the value of the core project in case of bank failure. Lower r_1 means that the bank can get higher return from the risky investment, which enhances its attractiveness. Thus, higher debt seniority makes the bank more likely to engage in risky investment.

Also note that:

$$\frac{\partial X^{\theta}_{\max}}{\partial \theta} = \frac{-p\frac{\partial r_0}{\partial \theta}[b-(1-p)(\theta-\theta_{\min})] + p(1-p)(R-1-r_0)}{[b-(1-p)(\theta-\theta_{\min})]^2} > 0. \tag{32}$$

A higher r_0 lowers, while a lower r_1 increases the bank's ability to lever up. We find that, overall, the latter effect dominates: a higher θ increases the scale at which the bank can undertake the risky investment.

We can now summarize our second main result:

Proposition 3 *When the leverage constraint is sufficiently lax, corresponding to low private benefits of moral hazard ($b < b^{\theta}_{\max}$), higher seniority of date 1 creditors expands the range of parameter values where the bank undertakes risky investment ($\partial b^{\theta}_{\max}/\partial\theta > 0$) and increases the scale of the risky investment ($\partial X^{\theta}_{\max}/\partial\theta > 0$).*

Proof. See Appendix. ■

Figure 4 illustrates the relationship between date 1 debt seniority and bank risk-taking.

Proposition 3 highlights the role of bank funding arrangements in creating incentives for risk-shifting. When a bank can make new funding senior (e.g., through the use of repos), it increases the incentives to use new funds for large market-based gambles. There are two reasons: First, higher seniority of new funds makes pre-existing bank funding more expensive, reducing the cost of putting the bank's franchise value at risk. Second, higher seniority makes the new funds cheaper, increasing the returns to the market-based investment.

5 Extensions

In the previous sections we showed how franchise value can increase bank risk-taking incentives by increasing the bank's ability to borrow. Here we offer two extensions of our model to deepen the intuition. First, we consider the case when the bank has to exert effort to improve the performance of the core project (which can also be interpreted as effort to decrease risk in the core project). Second, we consider the role of bank capital. To simplify exposition, we go back to the assumption of exogenous interest rates on bank funding: $r_0 = r_1 = 0$. (Endogenizing the interest rates would not affect the results.)

5.1 Effort in the Core Project

Consider the case when the bank's core project is also risky, and the bank needs to exert effort to increase the probability of its success. We analyze how the presence of the risky market-based investment opportunity affects the bank's incentives to exert such effort.

Formally, assume that the return on the core project is R with probability e and 0 otherwise (as opposed to a certain return R in the main model). The probability e corresponds to the bank's effort, which carries a private cost $ce^2/2$, with $c > R - 1$ to ensure interior solution. The bank exerts effort at date 0, and the date 2 realization of the core project (whether it will succeed or not) becomes known immediately afterwards. The timeline is summarized in Figure 5.

We first derive the bank's optimal effort in the absence of the risky market-based investment. The bank's payoff from investing in the core project only:

$$\Pi_0^e = e(R-1) - ce^2/2$$

is maximized for:

$$e = e_0 = \frac{R-1}{c}. \tag{33}$$

Consider now the case when, at date 1, the bank may undertake a risky investment in addition to the core project. Recall that at date 1 the cost of effort for the core project is sunk, and the future realization of the core project is known. Then, the bank's investment strategy is as follows. If the core project's observed returns are R, the incentive problem of the bank is identical to the one in the basic model. When $b < b_{\max}$, the bank makes a risky investment of size $X_{\max}$, with $X_{\max}$ and $b_{\max}$ given in (10) and (11), respectively. If the core project fails, the bank cannot raise funds for the risky investment and has zero payoff.

At date 0, the bank chooses e to maximize the expected joint payoff from the core and risky investments:

$$\Pi_1^e = ep(R - 1 + \alpha X_{\max}) - \frac{ce^2}{2}, \tag{34}$$

giving:

$$e = e_1 = \frac{p(R - 1 + \alpha X_{\max})}{c}, \tag{35}$$

where $\partial e_1 / \partial X_{\max} > 0$.

Proposition 4 *When the leverage constraint is sufficiently lax, corresponding to low private benefits of moral hazard ($b < b_{\max}$), the presence of the risky market-based investment opportunity increases bank incentives to exert effort in the core project: $e_1 > e_0$.*

Proof. See Appendix. ■

The intuition for this result is as follows. The bank's effort increases the expected value of the core project, and through this the borrowing capacity. This allows the bank to gamble with the risky investment on a larger scale. Therefore, access to risky market-based investments increases the bank's incentives to exert effort. In equilibrium, a bank runs a deliberately safe (and profitable) core project, which enables it to take risk on a larger scale in market-based activities.

5.2 Bank Capital

Our model did not have explicit bank capital. The bank was financed entirely with debt, and derived implicit equity from the NPV of its core project. Now we allow the bank to be financed with both debt and inside equity. Formally, assume that at date 0 the owner-manager is endowed with wealth $k < 1$, which he puts as equity into the bank, and only finances the rest ($1 - k$ for the core project and X for the market-based investment) with debt.

As before, when the bank undertakes the risky investment on a sufficient scale, $X > R+k-1$, it can shift some of the losses to the creditors. We can rewrite $X_{\min}$ and $X_{\max}$ (from (8) and (10), respectively) to account for explicit equity:

$$X^k_{\min} = \frac{(1-p)(R+k-1)}{p\alpha}, \tag{36}$$

$$X^k_{\max} = \frac{p(R+k-1) - b(1-k)}{b - p\alpha}. \tag{37}$$

We can characterize the bank's strategy as follows:

Lemma 3 *The bank undertakes risky investment when $X^k_{\min} < X^k_{\max}$, and it does that at the maximum possible scale $X^k_{\max}$. The interval $(X^k_{\min}, X^k_{\max}]$ is non-empty when b is low:*

$$b < b^k_{\max} = \frac{p\alpha(R+k-1)}{p\alpha(1-k) + (1-p)(R+k-1)}. \tag{38}$$

Proof. Similar to that of Lemma 1. ■

Observe from (8) and (10) that $X_{\min} < X^k_{\min}$ and $X_{\max} < X^k_{\max}$. Capital k reduces the bank's incentives to take risks of a given scale, but allows the bank to borrow more and make larger bets. As with the franchise value, higher capital enables the bank to undertake the risky investment for a wider range of parameter values:

$$\frac{\partial b^k_{\max}}{\partial k} = \frac{(p\alpha)^2 R}{[p\alpha(1-k) + (1-p)(R+k-1)]^2} > 0. \tag{39}$$

Also the scale of the risky investment $X^k_{\max}$ is increasing in bank capital k (from (5)):

$$\frac{\partial X^k_{\max}}{\partial k} = \frac{p+b}{b-p\alpha} > 0. \tag{40}$$

In addition, $b^k_{\max} > b_{\max}$, with $b_{\max}$ given in (11), meaning that when the bank is partially funded with capital, it can achieve leverage sufficient for risk-taking for a more binding leverage constraint.

We can summarize the results on bank capital as follows:

Proposition 5 *The bank undertakes risky investment when the leverage constraint is sufficiently lax, corresponding to low private benefits of moral hazard: $b < b^k_{\max}$. Higher bank capital expands the range of parameter values for which the bank undertakes risky investment ($\partial b^k_{\max}/\partial k > 0$) and increases the scale of the risky investment ($\partial X^k_{\max}/\partial k > 0$).*

One way to interpret this result is as follows. In static frameworks that focus on the risk of a given portfolio, high capital reduces bank risk-taking incentives. But in a dynamic context, more equity today may enable the bank to borrow more tomorrow to gamble on a larger scale. Then, higher bank capital increases rather than mitigates banks risk-taking incentives. This relates to the assertions of practitioners that banks face pressure to "put to risk" their "unused" capital.

Note that the observation of possible unintended effects concerns capital levels, not capital requirements. In the context of our model, binding capital requirements (such as a leverage ratio) would play a role similar to an increased b, reducing the ability of a bank to lever up. As a result, high enough capital requirements, which make $b > b^k_{\max}$, would be effective in removing from the bank the ability to undertake risky market-based investments.

6 Discussion

Our analysis offers useful insights into risk-taking incentives of modern banks and their impact on financial stability.

(i) Higher franchise value and more capital are not panacea against bank risk-taking. Banks with a high franchise value or high capital can borrow and rapidly accumulate new risks. Therefore, bank risk-taking should be thought of as a dynamic concept. Regulators need to consider not only bank risk today, but also the ability of a bank to increase risk going forward. Such "dynamic" effects become particularly relevant when banks have better access to market-based investment opportunities.

(ii) The bank's ability to lever up for risky investments can be limited through capital requirements. But to the extent that risk in market-based investments may be underestimated, e.g. when investments with skewed returns have little observable risk in good times, capital requirements may need to include a high enough charge on market-based assets, or a not risk-weighted leverage ratio.

(iii) Better institutional environment does not guarantee prudent behavior of banks. In particular, better protection of creditor rights enables banks to borrow more, which can lead to more risk-taking.

(iv) The banks' incentives to undertake risky market-based investments depend on the funding options available to them. When banks have access to senior funding (such as repos), these incentives are higher. This points to the importance of repo market reforms (such as possible limitations on the use of repos, Acharya and Öncü, 2013; or taxes on repos to make them less attractive, Perotti and Suarez, 2011).

(v) Our analysis also offers insights into the relationship between bank competition and financial stability. A common view is that low competition increases franchise value and reduces bank risk-taking incentives. But there are also counterarguments, based on general equilibrium effects (Boyd and De Nicolo, 2005), or that absent competition banks become less efficient and as a result unstable (Carlson and Mitchener, 2006; Calomiris and Haber, 2013). Our paper suggests another reason why restricting competition may not make banks safer. Lack of competition enables banks to accumulate franchise value, and at the same time prevents them from expanding their core business by poaching customers of other banks. Our results suggest that this may push banks to "use" their high franchise value by borrowing and investing in potentially risky, market-based activities.[13]

(vi) An important observation is that our results do not rely on the too-big-to-fail (TBTF)

[13] This is reminiscent of the reasons that drove German *Landesbanken*, which had a protected by limited-in-scope business model, to become exposed to structured credit securities originated in U.S. prior to the crisis. See Hufner (2010) for a discussion of the underlying causes of the German banking sector problems. Also see Akins et al. (2014) who show that a lack of competition increased bank fragility during the recent crisis.

effects. A common argument is that implicit bailout guarantees for large banks insulate their shareholders from downside risk realizations and give them incentives to take more risk. However one can be somewhat skeptical that TBTF drove much of bank risk-taking in the run-up to the crisis. TBTF guarantees affect mostly bank debt; during the crisis, bank shareholders lost a lot of value. Our results explain how excessive risk-taking in valuable (but not necessarily large) banks can arise even absent TBTF, as a result of their higher capacity to borrow.

7 Conclusions

This paper examined the relationship between bank franchise value and risk-taking. We showed that when banks take risk by levering up rather than altering their core portfolio, the traditional result that high franchise value reduces bank risk-taking incentives does not always hold. The reason is that high franchise value allows the bank to borrow more, so it can take risk on a larger scale. Larger scale offsets lower incentives to take risk of given size. As a result, a bank with a high franchise value may have higher – not lower – risk-taking incentives.

Our results highlight that neither high franchise value or capital, nor a good institutional environment are panacea against bank risk-taking. In fact, they may enable banks to borrow more and take risk on a larger scale, especially when banks have access to cheap senior funding such as repos. The paper fits well stylized patterns of bank risk-taking in the run-up to the crisis. Fundamentally, we also highlight that regulators should consider bank risk in a dynamic context, with a special focus on the potential for rapid asset growth.

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A Proofs

A.1 Proof of Lemma 1

The bank has incentives and ability to undertake the risky investment when $X_{\min} < X_{\max}$. Substituting from (8) and (10) and rearranging terms gives immediately:

$$b < \tfrac{p\alpha(R-1)}{p\alpha+(1-p)(R-1)}.$$

The bank's profit is increasing in X ($\frac{\partial \Pi_1(X)}{\partial X} = p\alpha > 0$), so the bank chooses $X = X_{\max}$ whenever $X_{\min} < X_{\max}$.

A.2 Proof of Lemma 2

The bank undertakes the risky investment when $X^{\theta}_{\min} < X^{\theta}_{\max}$. From (15) $X^{\theta}_{\min} > 0$ when:

$$\theta > \theta_{\min} = 1 - \frac{p\alpha}{1-p}. \tag{41}$$

For $\theta \leq \theta_{\min}$, $X = 0$. Further we focus on the case $\theta > \theta_{\min}$.

The denominator of $X^{\theta}_{\max}$ (from (21)) is positive given (5). The nominator of $X^{\theta}_{\max}$ is positive, if $b < p(R-1-r_0)$. From (20), (21), and (22), $X^{\theta}_{\min} < X^{\theta}_{\max}$ gives:

$$\frac{R-1-r_0}{\theta-\theta_{\min}} < \frac{p(R-1-r_0)-b}{b-(1-p)(\theta-\theta_{\min})},$$

which implies:

$$b < \frac{(R-1-r_0)(\theta-\theta_{\min})}{R-1-r_0+\theta-\theta_{\min}} = b^{\theta}_{\max}. \tag{42}$$

Thus, when $\theta > \theta_{\min}$ and $b < b^{\theta}_{\max}$, $X^{\theta}_{\min} < X^{\theta}_{\max}$ implying that $X_{\max} > 0$. $X_{\max}$ is the scale of risky investment (profit function in (14) increases with X). Otherwise, the bank invests only in the core project.

Next, we show that $b^{\theta}_{\max} < b_{\max}$, where $b_{\max}$ is given in (11). From (11), (22), and (23),

$b^{\theta}_{\max} < b_{\max}$ if:

$$\frac{(R-1-r_0)(\theta-\theta_{\min})}{R-1-r_0+\theta-\theta_{\min}} < \frac{(1-\theta_{\min})(R-1)}{R-1+1-\theta_{\min}}. \tag{43}$$

Rearranging terms, we obtain:

$$(R-\theta_{\min})[(1-\theta)(R-1)+r_0(\theta-\theta_{\min})] > (1-\theta_{\min})(R-1)(1-\theta+r_0),$$

or equivalently

$$(1-\theta)[(R-1)^2-r_0(R-\theta_{\min})] > -r_0(1-\theta_{\min})^2. \tag{44}$$

If $(R-1)^2-r_0(R-\theta_{\min}) > 0$, the inequality holds for any $\theta < 1$ (the left-hand side is positive, whereas the right-hand side is negative). If $(R-1)^2-r_0(R-\theta_{\min}) < 0$, it holds for:

$$\theta > 1 - \frac{r_0(1-\theta_{\min})^2}{r_0(R-\theta_{\min})-(R-1)^2}.$$

The inequality above is binding if the right-hand side is larger than $\theta_{\min}$:

$$(1-\theta_{\min})r_0 < r_0(R-\theta_{\min})-(R-1)^2,$$

implying $R-1-r_0<0$ which is not feasible. Thus, inequality (44) holds, and $b^{\theta}_{\max} < b_{\max}$.

A.3 Derivation of r_0 (equation (25))

First, we derive r_0. Using (21), the break-even condition (24) is:

$$p(1+r_0)+(1-p)\left[R-\frac{p\theta(R-1-r_0)-b\theta}{b-(1-p)(\theta-\theta_{\min})}\right]=1.$$

Rearranging the items, we get r_0 as in (25).

Next, we show that $R-1-r_0 \geq 0$. Substituting r_0 from (25), the inequality becomes:

$$\frac{1-p}{p}\cdot\frac{(R-1)[\theta-(1-p)\theta_{\min}-b]-b\theta}{(1-p)\theta_{\min}+b} \leq R-1,$$

implying that:

$$\theta \leq \frac{(R-1)[b+(1-p)\theta_{\min}]}{(1-p)(R-1-b)}. \tag{45}$$

This constraint on θ is binding if it is lower than 1, or equivalently:

$$(R-1)[b-(1-p)(1-\theta_{\min})] > -b(1-p),$$

yielding:

$$b < (1-p)(1-\theta_{\min}).$$

Substituting $\theta_{\min}$ from (22), we obtain $b < p\alpha$, which contradicts (5). Thus, (45) is not binding, implying $R-1-r_0 > 0$.

A.4 Proof of Proposition 2

To show the effect of R on risk incentives, we consider $\frac{\partial b^{\theta}_{\max}}{\partial R}$:

$$\begin{aligned}
\frac{\partial b^{\theta}_{\max}}{\partial R} &= \frac{\left(1-\frac{\partial r_0}{\partial R}\right)(\theta-\theta_{\min})(R-1-r_0+\theta-\theta_{\min}) - \left(1-\frac{\partial r_0}{\partial R}\right)(R-1-r_0)(\theta-\theta_{\min})}{(R-1-r_0+\theta-\theta_{\min})^2} \\
&= \frac{\left(1-\frac{\partial r_0}{\partial R}\right)(\theta-\theta_{\min})^2}{(R-1-r_0+\theta-\theta_{\min})^2},
\end{aligned} \tag{46}$$

where $\frac{\partial r_0}{\partial R}$ is given in (27). Note that $\frac{\partial r_0}{\partial R} > 0$, since $\theta > (1-p)\theta_{\min} + b$ from $r_0 \geq 0$.

Next, we sign $\frac{\partial b^{\theta}_{\max}}{\partial R}$. First item in the nominator $(1-\frac{\partial r_0}{\partial R})$ is positive if:

$$(1-p)[\theta-(1-p)\theta_{\min}-b] < p[(1-p)\theta_{\min}+b],$$

which is equivalent to:

$$b > p\alpha - (1-p)(1-\theta).$$

Note that $p\alpha-(1-p)(1-\theta)$ is lower than $p\alpha$, implying that for any $b > p\alpha$, $1-\frac{\partial r_0}{\partial R} > 0$. Thus, $\frac{\partial b^{\theta}_{\max}}{\partial R} > 0$.

Finally, $\frac{\partial X^{\theta}_{\max}}{\partial R}$ from (28) is positive since $1-\frac{\partial r_0}{\partial R} > 0$ and $b > (1-p)(\theta-\theta_{\min})$.

A.5 Proof of Proposition 3

First, we show that $X^{\theta}_{\max}$ increases with θ. Using (25), (30), and (32), $\frac{\partial X^{\theta}_{\max}}{\partial \theta} > 0$ if:

$$-\frac{(1-p)(R-1-b)}{p[(1-p)\theta_{\min}+b]} \cdot [b-(1-p)(\theta-\theta_{\min})] + (1-p)(R-1) - \theta \cdot \frac{(1-p)^2(R-1-b))}{p[(1-p)\theta_{\min}+b]} + \frac{(1-p)^2(R-1)[(1-p)\theta_{\min}+b]}{p[(1-p)\theta_{\min}+b]} > 0,$$

where the expressions with θ cancel out yielding:

$$R-1+\frac{[(1-p)\theta_{\min}+b][(1-p)(R-1)-(R-1-b)]}{p[(1-p)\theta_{\min}+b]} > 0.$$

Rearranging items, we obtain $b > 0$. Thus, $X^{\theta}_{\max}$ increases with θ.

Next, we show that $\frac{\partial b^{\theta}_{\max}}{\partial \theta} > 0$. From above, $\frac{\partial X^{\theta}_{\max}}{\partial \theta} > 0$. Note also that from (20),

$$\frac{\partial X^{\theta}_{\min}}{\partial \theta} = \frac{-\frac{\partial r_0}{\partial \theta}(\theta-\theta_{\min})-(R-1-r_0)}{(\theta-\theta_{\min})^2} < 0, \tag{47}$$

implying that $\frac{\partial b^{\theta}_{\max}}{\partial \theta} > 0$ as long as $\frac{\partial X^{\theta}_{\min}}{\partial b} > 0$ and $\frac{\partial X^{\theta}_{\max}}{\partial b} < 0$.

Indeed

$$\frac{\partial X^{\theta}_{\min}}{\partial b} = -\frac{\partial r_0/\partial b}{\theta-\theta_{\min}} > 0,$$

where

$$\frac{\partial r_0}{\partial b} = -\frac{1-p}{p} \cdot \frac{\theta[R-1+(1-p)\theta_{\min}]}{[(1-p)\theta_{\min}+b]^2} < 0. \tag{48}$$

And also from (21), (25), and (48),

$$\begin{aligned}\frac{\partial X^{\theta}_{\max}}{\partial b} &= \frac{(1-p)(\theta-\theta_{\min})-p(R-1-r_0)}{[b-(1-p)(\theta-\theta_{\min})]^2} + \frac{(1-p)\theta[R-1+(1-p)\theta_{\min}]}{[b-(1-p)(\theta-\theta_{\min})][(1-p)\theta_{\min}+b]^2} \\ &= -\frac{(1-p)\theta_{\min}[1-(1-p)\theta]+(R-1)[b-(1-p)(\theta-\theta_{\min})]}{[(1-p)\theta_{\min}+b]^2} < 0. \end{aligned} \tag{49}$$

As a result, $b^{\theta}_{\max}$ increases with θ, and so do risk incentives.

A.6 Proof of Proposition 4

The presence of market-based activities increases effort, i.e. $e_1 > e_0$, if:

$$\frac{p(R-1+\alpha X_{\max})}{c} > \frac{R-1}{c},$$

yielding:

$$X_{\max} > \frac{(1-p)(R-1)}{p\alpha}.$$

Next, we verify if indeed $X_{\max}$ is above this threshold:

$$X_{\max} = \frac{p(R-1)-b}{b-p\alpha} > \frac{(1-p)(R-1)}{p\alpha},$$

implying:

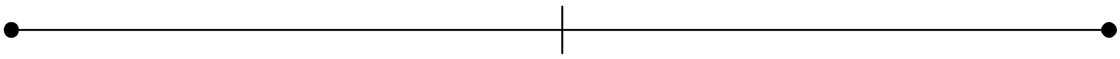
$$b < \frac{p\alpha(R-1)}{(1-p)(R-1)+p\alpha} = b_{\max}.$$

Thus, if $b < b_{\max}$, bank increases effort in the presence of market-based investments.

Also note, that there is an interior solution for effort $e_1 < 1$ if:

$$c > pb(R-1-\alpha).$$

Figure 1. The timeline.



Date 0

- A bank has no initial capital;
- A bank attracts funds at the interest rate r_0 to invest in the *core* project of size *1*.

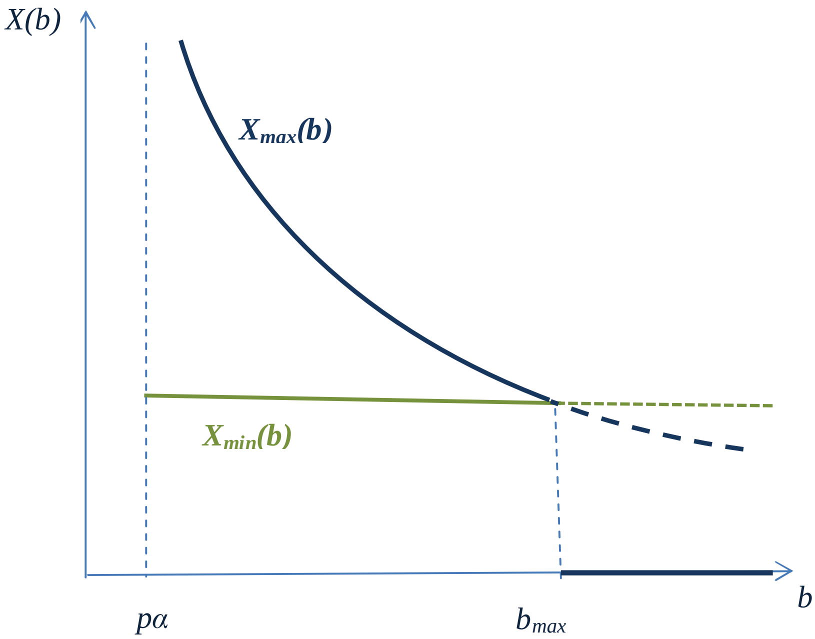
Date 1

- A bank chooses whether to invest in the *risky* asset of size *X* and attracts additional funds at the interest rate r_1;
- A bank chooses whether to convert the assets into private benefits.

Date 2

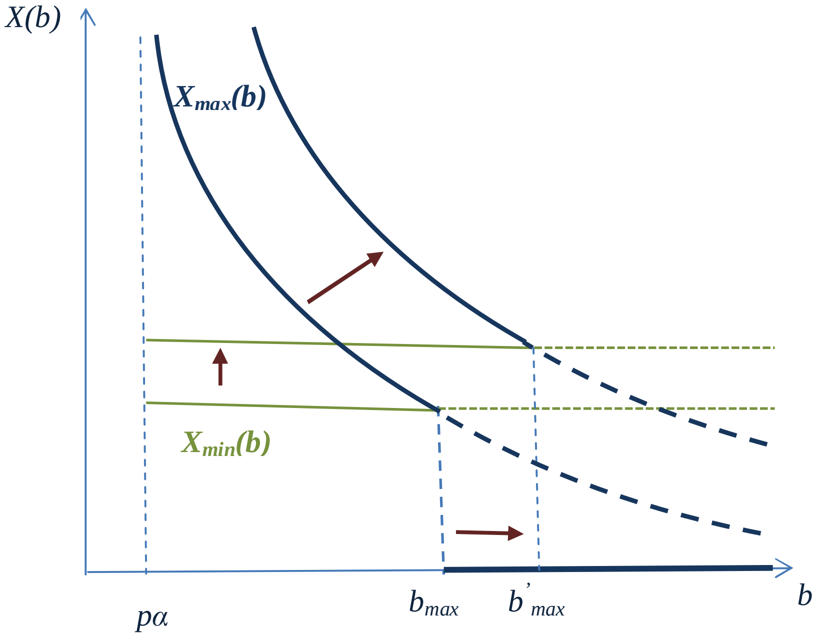
- Projects returns are realized and returns are distributed.

Figure 2. The scale of risky investment as a function of private benefits *b*.



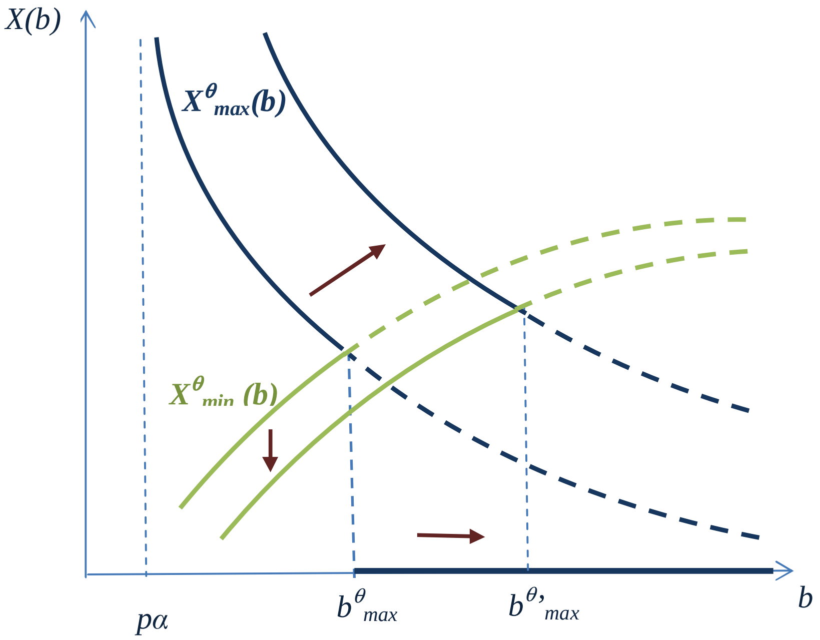
The figure shows that the bank's ability to borrow (as captured by X_{max}) increases in better institutional environment (lower b). For $b<b_{max}$, bank undertakes the risky investment at a scale X_{max}, whereas for $b \geq b_{max}$, bank invests only in the core project.

Figure 3. Risk incentives: comparative statics with respect to the franchise value *R*.



The figure shows that as franchise value R increases, the willingness to take risk of a given size decreases (as captured by higher X_{min}), while the ability to borrow increases (as captured by higher X_{max}). However, the ability to borrow increases more. As a result, higher franchise value R increases risk incentives (as captured by higher b_{max}), making more likely that $X_{min} < X_{max}$.

Figure 4. Risk incentives: comparative statics with respect to the debt seniority θ.



The figure shows that as debt seniority θ increases, both the willingness to take risk of a given size (as captured by lower X^{θ}_{min}), and the ability to borrow (as captured by higher X^{θ}_{max}) increase. As a result, higher debt seniority θ increases risk incentives (as captured by higher b^{θ}_{max}), making more likely that $X^{\theta}_{min} < X^{\theta}_{max}$.

Figure 5. Effort in the core project: The timeline.

Date 0

- A bank has no initial capital;
- A bank attracts funds at zero interest rate to invest in the *core* project of size *1*;
- A bank exerts effort *e* to increase the probability of success of the *core* project.

Date 1

- The value of core project is observed (*R* or *0*);
- A bank chooses whether to invest in the *risky* asset of size *X* and attracts additional funds at zero interest rate;
- A bank chooses whether to convert the assets into private benefits.

Date 2

- Projects returns are realized and returns are distributed.

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