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Bank Debt Regulations: Implications for Bank Capital and Bond Risk

Stig Helberg
Department of Economics, Norwegian University of Science and Technology

Snorre Lindset
Department of Economics, Norwegian University of Science and Technology

Department of Economics

Norwegian University of Science and Technology
N-7491 Trondheim, Norway
www.svt.ntnu.no/iso/wp/wp.htm

Bank Debt Regulations and Instruments: Implications for Bank Capital and Bond Risk

Stig Helberg
and
Snorre Lindset*

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Abstract

We study how optimal bank capital and bond risk are influenced by deposit insurance, implicit guarantees, depositor preference, asset encumbrance, and bail-in resolution frameworks. We find that these features of bank financing change the optimal amount of bank capital. The net effect on bond debt risk and valuation is small, while the effects on shareholder value and public sector liability value are significant. A gap between optimal capital and required capital represents a cost to shareholders and increases the risk of regulatory arbitrage. Based on a small sample of European banks, we find support for the central model predictions.

Keywords: Bank debt regulations, optimal bank capital, bond risk.

JEL Classification: G21, G28, G32.

*Both authors at Norwegian University of Science and Technology (NTNU), Department of Economics, Dragvoll, NO-7491 Trondheim, Norway. E-mail: stig.helberg@svt.ntnu.no and snorre.lindset@svt.ntnu.no. The authors would like to thank participants at faculty seminars at NTNU, Barcelona GSE Summer School 2013 including Robert DeYoung, and the national research school in business economics and administration NFB Conference 2013 including Siri Valseth for useful comments and discussions.

1 Introduction

We observe a range of regulatory reforms and proposals regarding bank *debt* financing following the financial crisis. These are reforms in addition to changes in the minimum capital requirements[1]. Bank debt regulations have several motivations, e.g., preventing bank runs, diversifying bank financing, and orderly resolution of banks. We study special features of bank debt in a unified framework, in order to evaluate the implications for bank capital and bond risk. To this end, we extend the structural model of default risk of Leland (1994) and compare six structural and regulatory banking regimes, representing recent trends in banking and bank regulation. Based on a small sample of banks, as well as earlier large sample studies, we find support for the model predictions.

We use our model predictions to comment on several important questions regarding bank regulations and bank financing. Why introducing depositor preference in Europe is smart. Why it is costly to introduce covered bonds in the US. Why introduction of bail-in regimes may lead to less bank capital. Why some of the regulations have counteracting effects. Why banks' creditors may be unaffected by both depositor preference and asset encumbrance. Why the banks' reaction to the regulations may create the next crisis.

Details are provided later, but our key findings are as follows:

- Bank debt financing patterns and debt regulations have a strong influence on optimal bank capital. The stable cross-sectional variation in capital structure documented by Gropp and Heider (2010) may reflect banks' debt structure and the regulatory environment.

- Debt regulatory reforms change the expected pay-off to bondholders in a bank failure. The changes have an immediate, first-order effect on bond debt risk. However, the subsequent changes in optimal bank capital counter the effect on bond debt risk; a second-order effect. Shareholders and the public sector are most influenced by the combined effects, not bondholders. This result is in contrast to the opinion that bank debt regulations have a material impact on bank bond debt risk, based on the first-order effect only, see e.g., the IMF Working Paper "Bank Debt in Europe: Are Funding Models Broken?", Le Leslé (2012).

- A gap between optimal capital and required capital represents a cost to the shareholders and strengthens the incentive to undertake regulatory arbitrage. The incentive reduces the reliability of the regulations and undermines the usefulness of formal capital requirements as a prudential policy tool. This relationship must not be forgotten in the ongoing

[1] In banking, the term *capital* has come to have the meaning of *equity*. We will use these terms interchangeably.

outcry for more bank capital, see e.g., Admati, DeMarzo, Hellwig, and Pfleider (2011) and Miles, Yang, and Marcheggiano (2012). Enhancing capital requirements, and at the same time adopting debt regulations that reduce the private optimal capital, is to gain some and lose some in terms of financial stability. Higher minimum capital requirements *force* banks to increase capital. In contrast, debt regulations like depositor preference, *motivate* banks to increase capital.

Our model is related to the market discipline literature, in which private sector agents - shareholders and debtholders - face costs that increase as banks take risk, and take action as a result of these costs.

Insured depositors are risk insensitive[2], and do not object to increased bank leverage. Insuring deposits to prevent bank runs has, thus, the unintended side effect of increasing financial risk among banks, and less capital increases bond debt risk.

Expectations of a public sector rescue of a distressed bank, an *implicit guarantee*, make senior bondholders less risk sensitive and less concerned of the bank's financial risk. As deposit insurance, implicit guarantees work as an accelerator on risk by reducing optimal capital.

We find two counteracting effects on bond debt risk from implicit guarantees. A bailout reduces the loss given default, but there is also a substantial increase in the risk of default from higher leverage. In the model's numerical base case, these effects cancel each other out leaving bond debt risk unchanged. More leverage increases firm value, and the implicit guarantee ends up as increased shareholder value. Too-big-to-fail is a subsidy of bank shareholders.

Depositor preference covers different legislative actions giving depositors a preferential claim on bank assets in a failure. Senior bondholders become more risk sensitive when they must take loss before depositors. The incentive to increase leverage, caused by deposit insurance and/or implicit guarantees, is weakened.

Due to the subordination of senior bonds, depositor preference is often seen as negative to bondholders and subsequently to bank financing[3]. The argument is incomplete, omitting the market influence on the bank's financial decisions. Depositor preference leaves, *ceteris paribus*, less assets to bondholders in a bankruptcy; a negative, first-order effect. But, depositor preference also lowers optimal leverage, reducing the risk to senior bonds;

[2] A *risk insensitive* bank creditor stands to lose little given a bank failure, whereas a *risk sensitive* bank creditor stands to lose a lot.

[3] See e.g. Schich and Kim (2012) in the OECD Journal: Financial Market Trend: "Depositor preference could however have adverse effects on banks' overall funding conditions. Non-deposit creditors might take actions to better protect themselves through collateralizing their claims and shortening the terms of maturity of them so as to be able to exit earlier. These creditors might also impose additional charges to compensate for the lower expected recovery in case of default."

a positive, counteracting, second-order effect. In the numerical base case, bond risk is unchanged, given that banks position themselves optimally.

Adopting depositor preference motivates banks to take on more capital, aligning private and social interests. The reduction in firm value from lower leverage is ultimately carried by the shareholders, and the shareholder loss is the gain of the deposit insurer.

Asset encumbrance is the pledging of assets to one group of bank creditors at the expense of another. Secured debt financing effectively subordinates depositors, but the risk insensitive depositors do not object to being subordinated. Less risk sensitive creditors, due to the collateral, work as an accelerator on risk and increases optimal leverage.

An example of asset encumbrance is banks issuing covered bonds secured by a defined part of their loan portfolio. The final outcome of switching from senior bonds to covered bonds is not necessarily less risky bonds. True, *ceteris paribus*, the loss given default decreases by subordinating depositors; a positive, first-order effect to bondholders. Increased leverage, however, represents a negative, second-order effect to bondholders. In the numerical base case, converting *all* senior bonds to covered bonds actually leaves bond debt risk unchanged. The loss given default is low, whereas the risk of default is high.

Optimal firm value increases when covered bonds subordinate depositors, representing a wealth transfer from the deposit insurer to shareholders. This subsidy is even larger under depositor preference, like in the US. Allowing US banks to use secured financing, like covered bonds, extensively will thus have especially high social costs. High deposit volume combined with secured financing, two factors commonly attributed to a stable banking system, give an extreme motivation to high leverage among banks. Further, banks with high asset volatility gain more from using secured financing than banks with low asset volatility.

Bail-in resolution regimes are designed to restructure the debt of a distressed bank by writing down senior debt and/or converting it to equity. The restructuring is done as a going concern and offers a credible, private resolution option. The intention is to remove the expectations of a public sector bailout[4].

Optimal leverage under a bail-in regime is dependent on the difference between the going concern value and the lost concern value. In the numerical base case, the going concern value is higher, in line with empirical evidence. Consequently, it is optimal to have more leverage under a bail-in regime than under a pari passu regime without implicit guarantees. Bond debt risk is somewhat increased by the bail-in framework, and the cost of the deposit insurance to the government is reduced. Shareholders gain from the going

[4]Governments will still have the legal authority to bail out distressed banks, so the existence of a bail-in framework does not eliminate the possibility of a bailout.

concern value being preserved.

The remainder of the paper is organized as follows. Section 2 offers a review of relevant literature. Section 3 describes six stylized structural and regulatory banking regimes. In section 4 we derive the economic set-up and valuation of claims. We study optimal bank capital and bond debt risk in section 5. In section 6 the model variables are tested on a small sample of banks, and on empirical findings in earlier large-sample studies of bank capital determinants. Finally, policy implications are outlined in section 7.

2 Literature

This paper contributes to the literature by providing a theoretical model based on market discipline to explain how banks' debt *structure* and debt *regulations* influence bank capital, when capital requirements are non-binding. Our model treats several empirical findings in a unified framework.

Traditionally, financials have been excluded from studies of capital structure and capital determinants because they are deemed "different" than other companies[5]. Flannery (1994), Myers and Rajan (1998), Diamond and Rajan (2000), and Allen, Carletti, and Marquez (2009) develop theories of optimal capital structure specifically to banks.

Recent empirical studies, however, suggest that there are considerable similarities between banks' and non-financial firms' capital structures, see e.g., Berger, DeYoung, Flannery, Lee, and Özde (2008) and Gropp and Heider (2010). Bank capital requirements are found to be non-binding, and there are large variations in banks' capital structure. Banks actively manage their capital ratios, and appear to have stable capital structures at levels that are specific to each individual bank.

Unlike other firms, financial institutions are governed by a combination of government and private forces. Flannery (2012) provides an interesting discussion of corporate finance and financial institutions. He argues that corporate finance theory applies equally well to financial firms, although modifications are required. Market discipline may work, especially for large banks with substantial financing in the bond market. See Flannery and Nikolova (2004) and Gropp (2004) for surveys of the market discipline literature.

These findings motivate us to use a standard corporate finance model and incorporate the idiosyncrasies of banking. Leland (1994) examines debt values and capital structure in a unified analytical framework. Leland's

[5]In a highly cited paper on capital structure, Rajan and Zingales (1995) say that "We eliminate financial firms such as banks and insurance companies from the sample because their leverage is strongly influenced by explicit (or implicit) investor insurance schemes such as deposit insurance. Furthermore, their debt-like liabilities are not strictly comparable to the debt issued by non-financial firms. Finally, regulations such as minimum capital requirements may directly affect capital structure."

contingent claim valuation approach includes an endogenous default barrier, and shows how firms optimally choose capital structure in order to maximize firm value. The Leland framework has been used previously analyzing banks, e.g., Harding, Liang, and Ross (2008) study the impact and interaction of deposit insurance, capital requirements, and tax benefits on a bank's choice of optimal capital structure, Koziol and Lawrenz (2009) study a bank subject to regulation, which tries to optimize its capital structure by readjusting the deposit volume over time. Both papers assume only one debt class; fully insured deposits. More complex debt structures have been used valuing bank contingent capital, e.g., Chen, Glasserman, Nouri, and Pelger (2013) and Hilscher and Raviv (2012). These papers do, however, not study implications for bank capital.

3 Structural and Regulatory Banking Regimes

We study strategic and regulatory changes within six stylized regimes. The regimes differ in which debt instruments the bank uses and/or what bank regulations are in force. The fundamental difference between the regimes is *how remaining assets in a bank failure are distributed among claimants.* Although, the regimes represent extreme examples, they illustrate how a particular development in banking affects optimal capital.

Regime I - No Deposits The bank has no deposits and borrowing is done entirely with senior bonds. Clearly, this debt structure is uncommon as long as the standard definition of a "bank" is a company that take deposits[6]. However, it forms a starting point. Without insured deposits, we are left with the original model with unprotected debt from Leland (1994).

Regime II - Pari Passu Traditionally, bank borrowing in most European countries is done with unsecured debt instruments that have equal priority in bankruptcy. Deposits, senior bonds, interbank borrowing etc. are all unsecured and rank pari passu[7]. The notable European exceptions are German and Danish banks that have a long history of secured, long term borrowing. Deposits are secured by a deposit insurance scheme, ultimately backed by the government.

In the model, the banks take insured deposits and issue senior bonds. In a bank failure the assets net of bankruptcy costs are distributed at a

[6]The Glass-Steagall Act prohibited any company or person from taking deposits if it was in the business of "issuing, underwriting, selling, or distributing" securities. Consequently, investment banks were not allowed to hold any deposits

[7]The Mozley and Whiteley's Law Dictionary defines *pari passu* as "On an equal footing or proportionately. A phrase used especially of the creditors of an insolvent estate who (with certain exceptions) are entitled to payment of their debts in shares proportioned to their respective claims."

pro rata basis among the depositors and the senior bondholders. If the insured depositors fall short of recovering their deposits, the insurer covers any shortcomings. The bank may hold deposits that are not insured, e.g., deposits that exceed the individual maximum amount insured. In the model, such deposits are priced as senior bonds.

Regime III - Implicit Guarantee The expectation that the sovereign will provide a bailout of bondholders works as an implicit guarantee for bank bond debt. This perceived guarantee also covers uninsured deposits. The guarantee is implicit because the state has not made any commitment to provide such support, but it is perceived by investors that they will do so based on experience. No fee is charged. The possibility of state intervention is typically explained by the bank being too-big-to-fail. See Schich and Kim (2012) and Noss and Sowerbutts (2012) for discussions on the value of implicit guarantees to banks.

We stick with the bank from the previous regime that borrows using insured deposits and senior bonds, but now we assume that senior bondholders with a given probability do not expect to incur losses at a default due to a state bailout. The investors' assessment of the likelihood of a bailout, conditional on default, influences the valuation of senior bonds.

Regime IV - Depositor Preference Depositor preference covers different legislative actions. Common is that they change the priority of depositors' claims on the assets of failed banks by making other senior claimants subordinate to depositors. In 1993 the US created a national depositor preference law. The rationale was a fear that the Federal Deposit Insurance Corporation (FDIC) could be exposed to large claims which would have to be covered with public funds, and instead shift these to private creditors. According to consultancy firm Clifford Chance, eleven of the G20 countries have an existing regime for preferring depositors (or the deposit protection scheme) in liquidation. The scope and operation of the preference differs considerably across jurisdictions.

Protection of depositors in liquidation has attracted increasing interest the last years. For example, the UK Independent Commission on Banking proposes amendments to the creditor hierarchy making some deposits rank senior to other unsecured claims. Similarly, the Financial Stability Board is considering if depositor preference should be adopted on a coordinated international basis.

To analyze depositor preference, we continue to study a bank that borrows using insured deposits and senior bonds. There are no implicit guarantees present. The assets net of bankruptcy costs in a bank failure are *first distributed to the insured depositors*. Any remaining assets are distributed to the senior bondholders. If the assets are not sufficient to cover the depositors in the first place, the insurer pays up to the depositors.

Regime V - Asset Encumbrance A trend in European banking is rising balance sheet encumbrance, the pledging or earmarking of assets to one group of creditors at the expense of another. When using collateralized financial instruments, the bank specifies assets that creditors or counterparties can possess if the bank defaults on its commitments. Short term secured borrowing, like repos, and long term secured borrowing, like covered bonds, make fewer assets left over for unsecured lenders. In addition, derivative and insurance claims may involve similar pledging. A bank's level of asset encumbrance changes over time, and is both a function of deliberate borrowing decisions as well as market price fluctuations resulting in collateral calls or margin calls [8].

The growth in asset encumbrance has two major explanations. First, covered bonds have become an important funding source, accounting for 40% of bank bond issuance in Europe in 2011. Outstanding senior unsecured bank debt has been reduced since 2011. Second, the use of secured borrowing in the liquidity assistance by the European Central Bank (ECB), for instance in the long-term refinancing operations (LTROs). Across a sample of major European banks, Fitch Ratings[9] estimates median encumbrance to be around 28% of bank assets. See e.g., Juks (2012) for more on the sources and growth of asset encumbrance.

To analyze asset encumbrance, we construct a regime where the bank is debt financed entirely with insured deposits and *covered bonds*. Covered bonds offer the investor a dual recourse, both to a defined part of the bank's loan portfolio (the cover pool) as well as a claim on the bank. If the issuer defaults on its outstanding covered bonds, the bondholders may take possession, and if necessary, sell the loans in the cover pool to cover their claims before other, unsecured lenders (like depositors) are repaid. The cover pool is larger than the principal amount of covered bonds outstanding. This overcollateralization secures covered bondholders when there is a fall in cover pool asset values.

If there is a depositor preference regulation in force, we assume that their preference will not include assets that are pledged to covered bondholders. Consequently, covered bondholders have a *de facto*, although not *de jure*, first priority on assets in a bank failure and the depositors will only receive what is left. As in the previous regimes, the deposit insurer covers any shortcomings to the depositors. There are no implicit guarantees present.

[8] The level of encumbrance is controlled by the bank, but is strongly influenced by regulatory actions, e.g., favored regulatory treatment of covered bonds under the Capital Requirements Directive and Solvency II, and under (proposed) depositor preference - and bail-in regimes.

[9] Fitch Ratings' Report: Major European Bank Balance-Sheet Encumbrance, 8 Aug 2012.

Regime VI - Bail-In Bail-in is a statutory power of a resolution authority. The intention is to restructure the liabilities of a distressed bank, by writing down its senior debt and/or converting it to equity. The aim is to have an alternative to government-funded rescues of banks, and reduce investors' expectations of a state bailout. The European Commission (EC) has proposed a bail-in regime, with additional options discussed in the Liikanen report[10]. While EC proposals consider all existing subordinated and senior unsecured debt as bail-in'able, the Liikanen proposals support the use of designated bail-in instruments.

Bail-in differs from private, contractual contingent capital instruments with write-off, like CoCo's. Public bail-in and private convertibles can, however, be seen as a complementary approach, with contingent capital as the first line of defense and bail-in kicking in to deal with the banks that remain distressed after the conversion of contingent capital[11]. We do not extend our model to include CoCo's. For more on CoCo's in a structural model of default risk, see e.g., Chen et al. (2013).

We study a bank that finances its activities with insured deposits and senior bonds. All outstanding senior bonds are bail-in'able. If the original equity is lost, the bank is *restructured*. The insured depositors carry their claim to the restructured bank, whereas the original senior bondholders are given the ownership of the bank. Thus, the senior bondholders have to both take a loss and convert their remaining claim to equity. By the resolution authority, the senior bondholders are given the right to choose the leverage of the restructured bank. This is done by swapping a part of their equity to restructured senior bonds. These restructured senior bonds are sold in the open market. We assume that the original senior bondholders will choose the leverage that maximizes firm value of the restructured bank. However, the optimal leverage may be impossible to obtain if there are not enough senior bonds outstanding to be bailed in. If so, the capital structure of the re-organized bank consists only of equity and insured deposits. The restructured senior bonds are not bail-in'able and they rank pari passu with insured deposits. The restructuring is done as a going concern.

Summary of Regimes The six regimes are summarized in table 1 by showing how the relevant debt instruments rank or are treated in a bank failure.

[10] "Report of the European Commission's High-level Expert Group on Bank Structural Reform" is a set of recommendations which were published in October 2012 by a group of experts chaired by Erkki Liikanen, governor of the Bank of Finland and ECB council member.

[11] For more on this relationship, see "From Bail-out to Bail-in: Mandatory Debt Restructuring of Systemic Financial Institutions", IMF Staff Discussion Note, 24 April 2012.

Table 1: Summary of banking regimes.

Regime	**Insured deposits**	**Senior bonds**	**Covered bonds**
I - No deposits			
II - Pari passu	*Equal priority*	*Equal priority*	
III - Implicit guarantee	*Equal priority*	*Equal priority* *Implicit guarantee*	
IV - Depositor preference	*1st priority*	*2nd priority*	
V - Asset encumbrance	*2nd priority* *(de facto)*		*1st priority* *(de facto)*
VI - Bail-in	*1st priority* *(de facto)*	*Conversion* *to equity*	

4 Economic Set-up and Basic Valuation

4.1 Firm Asset Value and Endogenous Default

We consider the balance sheet of a bank. The bank is financed by equity and various types of debt. Part of the debt is deposits from bank customers. A deposit insurance secures that the depositors do not lose money in case of bank failure. The value of the bank's assets (V) follows the diffusion process

$$dV_t = \mu V_t dt + \sigma V_t dB_t,$$

where μ and σ are constants and B is a standard Brownian motion. The process is consistent with most existing structural models, including models pricing a bank's claims. Large commercial banks' activities can be divided in two categories. The portfolio of loans and investment securities has little upside and significant downside. The banks' upside potential are given mainly by investment banking, loan origination, cash management, advisory services, and insurance and mutual fund sales. Large banks have increased their reliance on the latter category over the last decades. For example, Stiroh (2004) finds that non-interest income grew from 25% to 43% of total revenue at US commercial banks between 1984 and 2001. Similarly, Brunnermeier, Dong, and Palia (2012) find that the ten largest US bank holding companies raised their average fraction of non-interest revenue to total revenue from 18% in 1989 to 59% in 2007. The debt regulations we study are primarily aimed at too-big-to-fail institutions, i.e., generally large banks with an income distribution as described above. Consequently, we find the value process representative of the banks we study. The value process is less descriptive of more loan oriented financial institutions, like mortgage companies or smaller, regional banks.

As is common in the literature (see e.g., Leland (1994)), we assume that the debt is perpetual and coupons are paid continuously in time. The funds needed to pay for the stream of coupon payments come from new stock issues. Throughout the paper we consider three different types of debt; insured deposits, senior bonds, and covered bonds. The terms of the different debt instruments, i.e., the rate of interest to be paid and priority in case of bank failure are determined at the onset of our analysis, i.e., at time $t = 0$.

The value of a debt contract (F) in such an environment is (see e.g., Leland (1994))

$$F(V) = A_0 + A_1 V + A_2 V^{-X}, \tag{1}$$

where $X = 2r/\sigma^2$, r is the constant risk-free interest rate, and we have omitted the time variable t. The value at time t should be interpreted as $F(V_t)$. The constants A_i, $i = 0, 1, 2$, are constants to be determined.

Denote the time of bankruptcy by τ, $\tau = \inf\{t \geq 0 : V_t \leq V_B\}$. Thus, the bank defaults the first time the asset value $V = V_B$. We assume bankruptcy is triggered (endogenously) by the inability of the bank to raise sufficient equity capital to service its debt.

The basic assumption of the structural model is that there is a causal, economically motivated reason that bankruptcy occurs. The endogenous trigger is in contrast to a situation where bankruptcy is the result of an exogenous trigger like debt covenants, bank run, or regulatory intervention. The relevance of an endogenous or an exogenous trigger depends on what is the likely scenario when a bank approaches bankruptcy, either individually or as part of a systemic crisis. Admittedly, the anatomy of a bank crisis varies. We argue, though, that the inability to raise equity is the critical factor – the common denominator. Bond investors, depositors, and regulators are all part of the crisis narrative, provoking a financial distressed situation for the bank. However, access to the equity market will drastically reduce the motivation for their actions. During 2008 and 2009, governments did intervene, but their intervention was sparked by the banks' inability to raise equity.

In the model, the equity value of the bank is allowed to drift to zero before action has to be taken by the shareholders, i.e., the bank cannot raise new equity capital. Following the capital regulatory framework, banks are required to maintain a minimum capital ratio. If properly executed, bank shareholders will be forced by the regulator to increase equity (e.g., through elimination of dividends or issuance of equity) prior to asset value $V = V_B$. However, if the requirement had been fully binding, we would never have experienced banks going bankrupt. Sudden, material drops in asset value and/or asset valuation difficulties combined with lagged reporting may explain the presence of bank bankruptcies despite regulatory capital requirements. Consequently, we find the endogenous bankruptcy trigger to be relevant for banks as well.

4.2 Two Basic Securities

Let $\pi_1 = \pi_1(V)$ be the value of the first *basic security* that is constructed so that it pays 1 if $V = V_B$ and zero in all other states. The second basic security with value $\pi_2 = \pi_2(V)$ is constructed so that it pays a continuous coupon rate $C = 1$ as long as $V > V_B$ and becomes worthless the first time $V = V_B$. We will use these two basic securities to analyze the capital structure of a bank.

The value of the basic securities must satisfy (1). Consider the first basic security. As $V \to \infty$, $\pi_1 \to 0$, implying that both A_0 and A_1 equal 0. Because $\pi_1(V_B) = 1$, $A_2 = V_B^X$. We then have that

$$\pi_1(V) = \left(\frac{V}{V_B}\right)^{-X}.$$

As $V \to \infty$, $\pi_2 \to 1/r$. This fact implies that $A_1 = 0$ and that $A_0 = 1/r$. We also have that $\pi_2(V_B) = 0$, implying that $A_2 = -\frac{1}{r}V_B^X$. Thus,

$$\pi_2(V) = \frac{1}{r}(1 - \pi_1(V)).$$

4.3 Firm Value Components

The value of the bank's assets is the starting point when calculating the firm value.

The benefit for the owners of the bank of using debt financing is that the coupon payments can be deducted from taxable profits, reducing the overall tax burden. The cost of equity financing is not typically tax deductible. We assume that the bank has taxable profits that are at least as great as the deductible coupon payments. We let the tax rate be θ. Different types of debt may have different coupon rates. We let C_{dp}, C_{sb}, and C_{cb} be the coupon rates paid on the deposits, on the senior bonds, and on the covered bonds, respectively.

The value of the tax benefits (TB) follows from the value of the second basic security. With a *total* rate of coupon payments C_T, the rate of tax benefit is θC_T. This benefit is only received as long as the bank has not defaulted. Thus, it follows that the value of the tax benefit is proportional to the value of the second basic security (see e.g., Leland (1994))

$$TB(V) = \theta C_T \pi_2(V).$$

An additional particular benefit of deposits is that they are backed with an insurance. This fact makes financing by deposits cheaper than financing by non-insured debt. Let DI be the amount the insurer has to pay to the depositors in order for them to recover their deposits. The possible payment will constitute the only negative cashflow for the insurer and is payable at time τ, i.e., when $V = V_B$. The value of the payment (DIV) is proportional to the value of the first basic security,

$$DIV(V) = DI\pi_1(V).$$

The actual size of DI will in general depend on the parameters of the model and for this model in particular, the ratio of deposits to other debt financing and on what type of other financing the bank has used[12].

The bank pays a premium to the deposit insurer. The fee is calculated as a fraction φ of insured deposits (D). This cost may or may not be fairly priced, meaning it can be lower or higher than the value of the deposit insurance. The cost of the deposit insurance for the bank (DIC) is proportional to the value of the second basic security,

$$DIC(V) = \varphi D\pi_2(V).$$

The deposit insurance premium is tax deductible. Thus, in regimes with insured deposits, the value of tax benefits is given by $TB(V) = \theta(C_T + \varphi D)\pi_2(V)$.

A disadvantage of debt financing is that bank failure is a real possibility, imposing bankruptcy costs on the claim holders. We let the bankruptcy cost be proportional to the value of the assets. A bank failure gives bankruptcy costs $\alpha V_\tau = \alpha V_B$, $0 \leq \alpha \leq 1$, at the time of bankruptcy, leaving $(1-\alpha)V_B$ for distribution among the claimants. The value of the bankruptcy cost (BC) is proportional to the value of the first basic security and is given by

$$BC(V) = \alpha V_B \pi_1(V).$$

A bail-in is done as a going concern, but if so, we have restructuring costs instead. We assume that the fraction of value lost to restructuring costs is half of the fraction lost in a bankruptcy.

The presence of an implicit guarantee has a value to the firm. We study implicit guarantee in a pari passu-framework. If a bailout takes place, senior bondholders receive, from the sovereign, the debt face value (the initial amount the bank borrows from senior bondholders) minus bondholders' share of net remaining assets. Let p be the probability of a bailout given that $V = V_B$, and assume that the face value of senior bonds, as a fraction of the sum of senior bonds face value and insured deposits is a. The value of the implicit guarantee (IGV) is proportional to the value of the first basic security,

$$IGV(V) = \Big(D_{sb}(V_0) - a(1-\alpha)V_B\Big)\pi_1(V)p.$$

In a bail-in, the net remaining assets in a bankruptcy are substituted with the value of the restructured firm, v^*. The approach will always be

[12] Note that we can determine DI at time t=0.

value enhancing. We assume that the restructuring costs are given by $\frac{\alpha}{2}V_B$. The value of the bail-in procedure is proportional to the value of the first basic security and is given by

$$BIV(V) = \Big(v^* - (1 - \frac{\alpha}{2})V_B\Big)\pi_1(V).$$

We omit agency costs from our model. The idea that debt is advantageous to equity due to the disciplinary effect from having to pay a continuous coupon, has limited empirical evidence for banks. Potential explanations are explicit and implicit guarantees for deposits and senior bonds, and it is unclear whether the argument requires such high leverage as is common among banks.

In all six cases, the total value of the bank reflects four terms: the asset value, plus the tax benefit of debt, less the bankruptcy costs, and the value and cost of deposit insurance, i.e.,

$$v(V) = V + TB(V) - BC(V) + DIV(V) - DIC(V).$$

In Regime III - Implicit Guarantee we add $IGV(V)$. In Regime VI - Bail in we add $BIV(V)$.

4.4 Valuation of Claims

Deposits Because the deposit insurance covers any losses the depositors face in a bank failure, they are not exposed to credit risk and therefore earn the risk-free rate of return (r) on the deposits. As long as the bank has not defaulted, depositors receive the continuous rate of coupon payments rD, and the value is proportional to the value of the second basic security. At default, depositors recover their deposit D, with a value proportional to the value of the first basic security. Thus, the value of the deposits is

$$D_{dp}(V) = D$$

and is the same in all regimes with deposits.

Senior Bonds in Regime I - No Deposits The senior bond consists of two parts. The first part is the continuous rate of coupon payments C_{sb}, paid as long as the bank has not defaulted. The value of this part of the debt is proportional to the value of the second basic security. The second part is the value of the payment in case of bank failure. As bond debt is the only form of debt in this regime, the bondholders receive $(1-\alpha)V_B$ the first time $V = V_B$. The value of this part is proportional to the value of the first basic security. The value of the senior bonds in Regime I is given by

$$D^I_{sb}(V) = C_{sb}\pi_2(V) + (1-\alpha)V_B\pi_1(V).$$

Senior Bonds in Regime II - Pari Passu The face value of senior bonds, as a fraction of the sum of senior bonds' face value and insured deposits is a. Thus, in case of bank failure, a fraction a of the bank's assets goes to cover the senior bondholders' claims, while a fraction $(1-a)$ of the assets is distributed to the depositors.

The value of continuous rate of coupon payments is proportional to the value of the second basic security, while the value of the payment in case of bank failure, $a(1-\alpha)V_B$, is proportional to the value of the first basic security. The value of the senior bonds in Regime II is given by

$$D_{sb}^{II}(V) = C_{sb}\pi_2(V) + a(1-\alpha)V_B\pi_1(V).$$

Inserting for a and by letting $V = V_0$, we get an implicit expression for the initial value of the senior bonds:

$$D_{sb}^{II}(V) = C_{sb}\pi_2(V) + \frac{D_{sb}^{II}(V)}{D_{sb}^{II}(V) + D}(1-\alpha)V_B\pi_1(V).$$

Solving for $D_{sb}^{II}(V)$, the initial value of the senior debt is

$$D_{sb}^{II}(V) = \frac{-H + \sqrt{H^2 + 4J}}{2},$$

where $H = D - C_{sb}\pi_2(V) - (1-\alpha)V_B\pi_1(V)$ and $J = DC_{sb}\pi_2(V)$.

Senior Bonds in Regime III - Implicit Guarantee At default there are two possible outcomes. In a bailout, bondholders receive the face value of senior bonds. If no bailout, bondholders receive a fraction a of the bank's assets net of bankruptcy costs. The face value of senior bonds in relation to the sum of senior bonds and insured deposits, is still given by a. Let the bondholders' perceived probability of a state bailout at default be given by p. The value of the senior bonds in Regime III is

$$D_{sb}^{III}(V) = C_{sb}\pi_2(V) + (1-p)a(1-\alpha)V_B\pi_1(V) + pD_{sb}^{III}(V_0)\pi_1(V).$$

With $p = 1$ senior bonds are considered risk-free by investors. Inserting for $\pi_2(V) = \frac{1}{r}(1-\pi_1(V))$ in the expression above for $D_{sb}^{III}(V)$, we get $D_{sb}^{III}(V) = \frac{C_{sb}}{r}$. With $p = 0$ we are left with the identical valuation of senior bonds as in Regime II.

Senior Bonds in Regime IV - Depositor Preference In case of bank failure, senior bondholders receive what is left after the depositors have received their claims on the bank. The payment to debtholders, given default, is $K = \max((1-\alpha)V_B - D, 0)$. The value of K is proportional to the value of the first basic security, while the value of the stream of coupon payments (the rate C_{sb} paid until the time of default) is proportional to the value of the second basic security. The value of the senior debt is

$$D_{sb}^{IV}(V) = C_{sb}\pi_2(V) + K\pi_1(V).$$

Covered Bonds in Regime V - Asset Encumbrance Covered bondholders' claims are covered before anything is distributed to depositors. If the asset value at bankruptcy is less than the principal amount of the covered bonds, the depositors are covered by the insurer in full. The payment the bondholders receive at the default date is $M = \min(D_{cb}(V_0), (1-\alpha)V_B)$, where $D_{cb}(\cdot)$ is the value of the covered bonds. Whether $D_{cb}(V_0) \lesseqgtr (1-\alpha)V_B$, can be determined at time 0. The initial value of the covered bonds is therefore

$$D_{cb}(V) = \frac{C_{cb}\pi_2(V)}{1-\pi_1(V)}$$

or

$$D_{cb}(V) = C_{cb}\pi_2(V) + (1-\alpha)V_B\pi_1(V).$$

At any time $t < \tau$, the value of the covered bonds is

$$D_{cb}(V) = C_{cb}\pi_2(V) + M\pi_1(V).$$

Senior Bonds in Regime VI - Bail-In Figure 1 illustrates the bail-in-model.

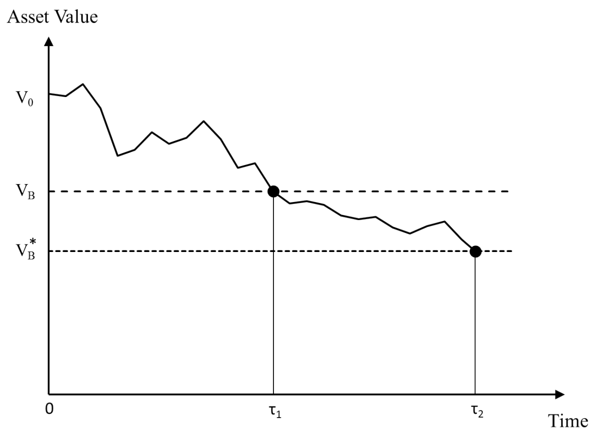

Figure 1: The bail-in model.

If $V = V_B$, the original equity is lost and the bank is *restructured* at time τ_1. Senior bondholders receive the value of the restructured bank, v^*, minus the depositors' claim.

The value of the continuous coupon C_{sb} is proportional to the value of the second basic security. The value of the payment in case of asset value falling below V_B is proportional to the value of the first basic security. The value of senior bonds in Regime VI is

$$D_{sb}^{VI}(V) = C_{sb}\pi_2(V) + (v^* - D)\pi_1(V).$$

Given the asset value at time τ_1 ($V_{\tau_1} = V_B$), we find the optimal coupon and bankruptcy level, C^*_{sb} and V^*_B, for the restructured bank. This calculation can be done at time 0, and it allows us to find v^*, conditional on V_B. Thus, for a given C_{sb}, we find the value of V_B that maximizes firm value at time 0 and simultaneously the value of the bail-in'able senior bonds D_{sb}. If the optimal equity of the restructured bank, E^*, is higher than the face value of the original senior bonds, $E^* \leq D_{sb}$, the capital structure of the restructured bank will consist of insured deposits and equity.

If the asset value later falls to V^*_B, shown at time τ_2 in figure 1, the bank is bankrupt.

The Claim on the Deposit Insurer Table 2 summarizes the claim on the deposit insurer, DI, after the remaining net assets have been distributed among the claimants.

Table 2: Claim on the deposit insurer.

Regime I - No Deposits	0
Regime II - Pari Passu	$D - (1-a)(1-\alpha)V_B$
Regime III - Implicit Guarantee	$D - (1-a)(1-\alpha)V_B$
Regime IV - Depositor Preference	$\max(D - (1-\alpha)V_B, 0)$
Regime V - Asset Encumbrance	$D - \max((1-\alpha)V_B - D_{cb}(V_0), 0)$
Regime VI - Bail-In	0 (at time τ_1)

In Regime VI - Bail-In the deposits insurance has no value to the bank at time τ_1. Bail-in will always take place at bankruptcy and depositors will have their claims covered. The deposit insurer will, however, have to pay if asset value falls to V^*_B and the restructured bank goes bankrupt. In that case the depositors will be short an amount $DI = D - (1-b)(1-\alpha)V^*_B$, where b is the face value of the restructured senior bonds as a fraction of the sum of restructured senior bonds face value and insured deposits. The value of that payment is given by $DI\left(\frac{V}{V^*_B}\right)^{-X}$ and is included when calculating firm value of the restructured bank.

5 Private Optimal Bank Capital

5.1 Optimization

Subtracting the debt value from total firm value gives the equity value,

$$E(V) = v(V) - D_{dp}(V) - D_{sb}(V).$$

In Regime V - Asset Encumbrance, $D_{sb}(V)$ is substituted with $D_{cb}(V)$.

We consider the bank's volume of insured deposits as exogenous. Over time a bank's deposit volume may vary, both in absolute and relative terms, but it is “sticky” in the sense that changes are low and slow. Insured deposits are primarily retail deposits, i.e., many, but small deposits. These are stable and unlikely to be withdrawn rapidly. The characteristics are in contrast to wholesale borrowing where large volumes may be borrowed during a short time period. Changes in insured deposits will be more gradual. Consequently, wholesale borrowing, like senior and covered bonds, is the marginal financing source and is used to obtain the desired leverage. The model can be extended with an endogenous deposit volume by introducing a supply-demand curve for deposits depending on interest rates.

For a given bond coupon level, C_{sb} or C_{cb}, the bank chooses the bankruptcy value, V_B, that maximize equity value. For all $V > V_B$, the equity value is non-negative. A non-negative equity is the condition for being able to raise equity from shareholders. Optimal capital is given by the coupon that maximizes firm value.

5.2 Base Case Parameters: Numerical Values and Discussion

We use a numerical base case to analyze the bank's capital structure decision under the six regimes. The base case intends to represent the present conditions for a typical, major commercial bank in an advanced economy. Table 3 summarizes the parameter values. We perform sensitivity analysis around these values.

Table 3: Parameter values in base case.

Risk-free rate	r	0.03
Asset volatility	σ	0.08
Bankruptcy costs	α	0.2
Tax rate	θ	0.28
Deposit insurance premium	φ	0.0015
Deposits	D	35
Inititial asset value	V_0	100

Risk-Free Rate (r) We assume deterministic risk-free interest rates. In the absence of arbitrage, this assumption implies a flat term structure of interest rates. In line with the current US and German 30 year government bond rate, we set the risk-free interest rate at 3%.

Asset Volatility (σ) Crosbie and Bohn (2003) use contingent claims analysis to calculate implied asset volatilities for several industries and asset sizes. They find that the banking industry has lower asset volatility than other industries. Bank asset volatility at end 2003 are 5-6% for small banks and somewhat lower for larger banks. In literature, Koziol and Lawrenz

(2009) use 5% asset volatility, whereas Chen et al. (2013) use a total volatility of 20.6% combining diffusion (8%) and jumps. In our base case, we set the asset volatility parameter to 8%.

Bankruptcy Costs (α) Default can lead to restructuring in or outside of bankruptcy proceedings, or to liquidation. While default need not lead to bankruptcy, we refer to the costs of restructuring or liquidation as "bankruptcy costs". In the model, this cost is defined as a fraction α of the asset value at default (V_B). We use bankruptcy costs of 20% in the base case.

James (1991) examines the losses realized in 412 US bank failures during 1985 to 1988. Direct costs of resolution, i.e., administration and legal expenses associated with the failures, are on average 10% of the assets of the failed bank. He also measures the loss as the difference between the book value of a bank's assets at the time of its closure and the value of the assets in the receivership of the deposit insurer or the value of the assets to an acquirer. By this measure, the losses are on average 30% of the failed banks' assets. This figure includes expenses incurred in the liquidation and sale of assets, losses associated with forced liquidation, including lost charter value, i.e., the value of the right to continue to operate, and past unrealized losses, i.e., losses on assets that occur prior to the bank's failure, but that are not reported on the banks' balance sheet at the time of the failure. The latter is found to contribute significantly to the losses, but is not bankruptcy costs as defined in the model. Past realized losses, as defined by James (1991), arise because bank assets are not booked at market value, due to either accounting principles or uncertainty surrounding market prices. The model, however, assumes that market prices are observable at all times.

Tax Rate (θ) We use a tax rate of 28%, which is the average corporate tax rate in a relevant sample of countries[13] according to the KPMG corporate tax rates table[14].

Deposit Insurance Premium (φ) We use a flat, annual rate of 0.15% of insured deposits in the base case. Demirgüç-Kunt, Karacaovali, and Laeven (2005) present cross-country deposit insurance premium information. For the majority of the relevant countries, the premium is a fraction of insured deposits. The base case rate is close to the observed average.

According to Demirgüç-Kunt et al. (2005), some countries have "risk-adjusted premiums". For example, in the US, the FDIC sets premiums

[13]The sample of countries includes US, Canada, Western European countries, Japan, Australia, New Zealand, and South Africa.

[14]http://www.kpmg.com/global/en/services/tax/tax-tools-and-resources/pages/corporate-tax-rates-table.aspx

based on bank characteristics, but it is unclear how this has affected banks' capital decisions[15].

Deposits (D) Depending on national regulations, not all deposits are covered by a deposit insurance. Unfortunately, disclosure is poor regarding volume of *insured* deposits. The World Bank's 2011-12 Bank Regulation and Supervision Survey (BRSS)[16], however, includes figures both on deposit coverage in per cent of assets and on deposit insurance coverage. The product of these being the ratio of insured deposits to assets. The average ratio for banks in the relevant sample of countries is 35%. Insured deposits finance a smaller proportion of bank assets in Europe than in North America and Asia. We use an initial deposit volume $D = 35$, compared to an initial asset value $V_0 = 100$.

5.3 Model Capital versus Basel Capital

There is a distinction between the definitions of assets, equity/capital, and leverage used in our model and those used in the regulatory capital framework. While the model is based on total assets, the current Basel Committee's regulatory solvency measures are all defined in terms of risk-weighted assets (RWA). Different classes of assets have different risk weights assigned to them. The risk weights are either set by the regulator (the standardized approach) or based on internal ratings, after supervisory validation (the IRB approach). On average, risk weighted asset values are materially lower than total asset values. At end 2010, RWA in relation to total assets for European, Asian, and North American banks were 36, 51, and 58%, respectively. Consequently, reported capital ratios are on average twice as high as equity in relation to total assets.

The regulatory framework distinguishes between Tier 1 capital and Tier 2 capital, with several types of financial instruments being eligible for the different categories[17]. While shareholders' investments have been diluted or even wiped out during bank failures over the past years, there are examples

[15]See e.g., Acharya, Santos, and Yorulmazer (2010b): "This short discussion confirms our earlier assertion that deposit insurance premiums have either been risk-insensitive or relied only on individual bank failure risk and never on systemic risk. Furthermore, even when premiums have been risk-sensitive, the focus has been on maintaining reserves at an "appropriate" level. For example, when the deposit insurance fund's reserves become sufficiently high relative to the size of insured deposits, the FDIC in effect returns premiums to banks. This type of approach to premiums is divorced from incentive properties"

[16]This is the fourth iteration of the survey and provides information on bank regulation and supervision for 143 jurisdictions and includes close to 300 questions. The survey is presented and examined in Ĉihák, Demirgüç-Kunt, Peria, and Mohseni-Cheraghlou (2012).

[17]Tier 1 capital = Common equity + preferred noncumulative stock + minority interest in consolidated subsidiaries. Tier 2 capital = Tier 1 capital + allowances for loan losses + perpetual preferred stock + subordinated debt + various hybrid capital instruments.

of subordinated bondholders being exempt. Still, subordinated debt is part of Tier 2 capital[18]. The model has one class of equity, which can be seen as truly loss-absorbing capital and is best compared to Tier 1 capital.

Growing concerns on the reliability both on the numerator and the denominator in the regulatory capital ratios has led Basel III to propose a complementary measure, a non-risk weighted leverage ratio[19]. The specific definition and enforcement of the leverage ratio under Basel III is pending, but so far it has been proposed at 3%. The capital ratio in the model is best compared to this leverage ratio.

5.4 Regimes and Optimal Capital Structure

Table 4 summarizes optimal capital structure for banks in Regime I to VI with the base case parameters, showing total firm value in its components and key figures.

Table 4: Optimal positioning under different regimes.

		Regime I No Deposits	Regime II Pari Passu	Regime III Implicit Guarantee	Regime IV Depositor Preference	Regime V Asset Encumbrance	Regime VI Bail-In
Asset value	V	100.0	100.0	100.0	100.0	100.0	100.0
Tax benefit	TB	30.1	30.3	30.1	30.1	29.4	29.7
Bankruptcy costs	BC	1.0	1.5	2.0	1.0	3.0	1.4
Deposit insurance	DIV		1.5	2.1	0.0	6.3	0.0
Insurance premium	DIC		1.6	1.5	1.6	1.4	1.5
Implicit guarantee	IGV			1.2			
Bail-in	BIV						3.5
Total firm value	v	129.1	128.7	129.8	127.5	131.3	130.4
Deposits	$D_{deposits}$		35.0	35.0	35.0	35.0	35.0
Bond debt	D_{bonds}	111.4	79.2	82.6	75.0	86.9	85.2
Equity	E	17.7	14.6	12.2	17.4	9.4	10.2
Leverage (per cent)	L	86.3	88.7	90.6	86.3	92.9	92.2
Credit spread (bp)	$R-r$	10	15	15	15	15	17
Bankruptcy value	V_B	74.8	77.9	80.3	75.1	83.3	82.5

The side effect of insured deposits Regime I follows Leland (1994) when analyzing unprotected debt. By introducing insured deposits, we move to Regime II - Pari Passu. Figure 2 shows firm value as a function of leverage for the two regimes. Leverage (L) is defined as total debt value in relation to firm value (D/v). When insured deposits are a part of the debt structure, the optimal leverage is pushed upwards from 86.3% to 88.7%. The risk-insensitive pricing of the deposit insurance gives an incentive to take on more financial risk. Neither the insured depositors nor the insurer demand to be compensated for higher financial risk. The presence of bankruptcy costs

[18]Schich and Kim (2012) provide a summary of losses for different types of financial instruments in selected cases of bank distress.

[19]More correctly, a non-risk weighed capital ratio or an inverse leverage ratio.

prevents the bank from taking on arbitrarily large amounts of debt. The 2.4 percentage points increase in leverage corresponds to a 4.8 percentage points decrease in the optimal capital ratio if we assume RWA at 50% of total assets.

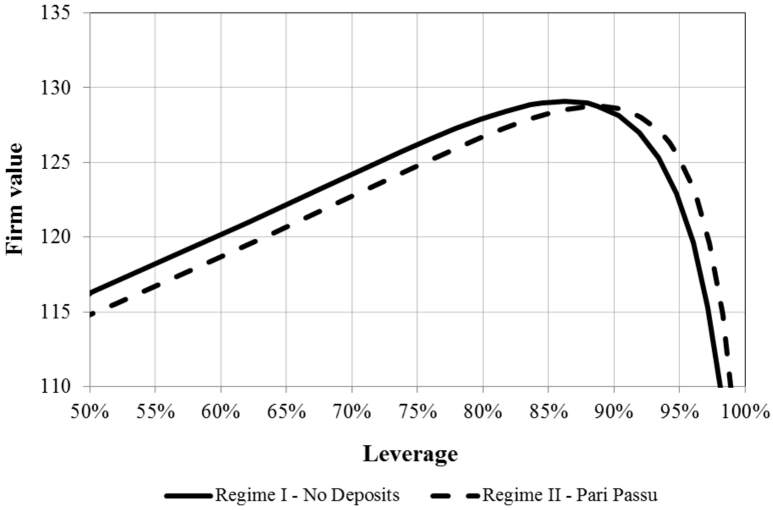

Figure 2: Firm value of a bank with insured deposits.

The cost of the deposit insurance premium is independent of leverage. For low leverage the value of the deposit insurance approaches zero, resulting in a lower firm value under the pari passu regime. This relationship changes gradually, and at a high leverage the value of the deposit insurance is higher than the cost. The total firm value at optimal leverage is not materially different in the respective regimes. The deposit insurance is thus close to fairly[20] priced in the numerical base case, and does not represent a transfer of value from the government to the private bank.

What If Investors Assume There Are Implicit Guarantees? We assume that bondholders expect a public sector bailout conditional on default with a 25% probability. Figure 3 shows firm value for different leverage compared to Regime II - Pari Passu.

In addition to depositors having an insurance against losses, now bondholders have a possible insurance as well. Less risk sensitive bondholders allow optimal leverage to be increased from 88.7% in Regime II to 90.6% in Regime III.

More leverage increases the tax benefit of debt and the value of the deposit insurance. The bank is not charged for the implicit guarantee and

[20]We define *fair* as the premium where the cost of the insurance equals the value of the insurance to the bank.

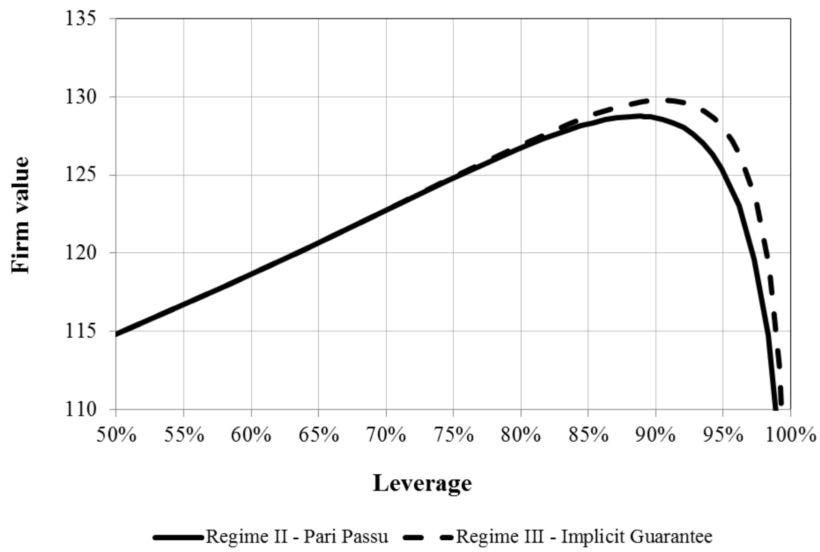

Figure 3: Firm value of a bank when there is a possibility of a state bailout.

the deposit insurance premium is not dependent on leverage. Further, bankruptcy costs are lower compared to Regime II because they are covered by the government in case of a bailout. The "probability" of a bailout actually occurring is

$$\left(\frac{V}{V_B}\right)^{-X} p.$$

A 25% probability of bailout increase optimal firm value from 128.7 to 129.8 in the numerical base case. The increase is 0.9%. However, as the asset value is given and not controlled by the bank, the increase is 3.9% measured against firm value in excess of asset value.

Introducing Depositor Preference Figure 4 shows firm value dependent on leverage for Regime II, IV, and V.

Adopting depositor preference (moving from Regime II to IV), shifts optimal leverage downwards. If depositors are served first in case of bankruptcy, the burden on the insurer reduces drastically. In fact, in the numerical base case it is optimal for the bank to choose a bankruptcy value where depositors always are covered by the remaining assets in the bank. Thus, with base case parameter values, deposit insurance has no value. Consequently, the deposit insurance represents no motivation to take on more leverage.

Optimal leverage at 86.3% is identical to Regime I - No Deposits. Thus, in the numerical base case, depositor preference cancels out the risk incentives brought about by the deposit insurance.

Due to the deposit insurance no longer having any value to the bank,

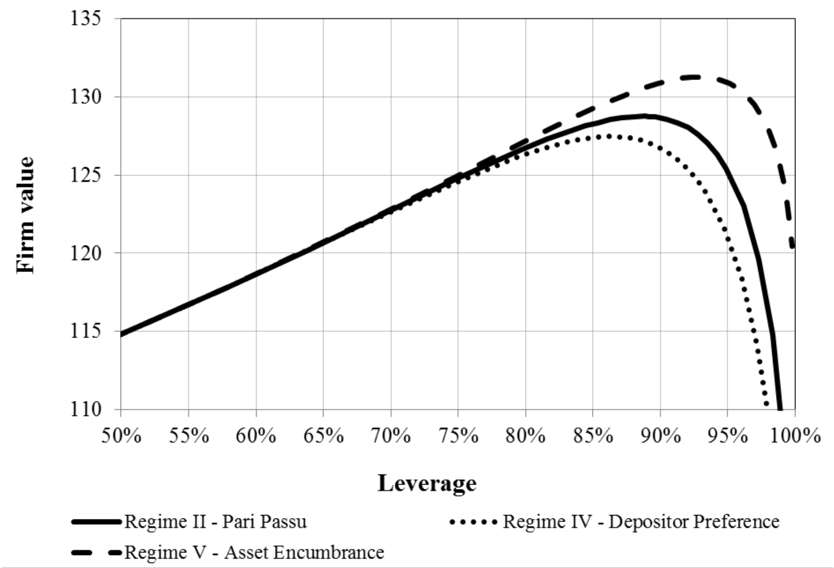

Figure 4: Firm value under depositor preference and asset encumbrance.

firm value is lower under depositor preference than under pari passu.

Replacing Senior Bonds with Covered Bonds Introducing covered bonds (moving from Regime II to Regime IV) has a material impact on optimal capital. Covered bonds effectively subordinate depositors, thereby increasing the value of the deposit insurance to the bank. By putting a higher burden on the insurer, it is optimal for the bank to raise the leverage substantially. In Regime V - Asset Encumbrance the optimal leverage is 92.9%, a 4.2 percentage point increase in leverage from Regime II Pari Passu.

We assume that depositors have a preferential claim on the cover pool assets even under depositor preference. If the asset encumbrance takes place under depositor preference, the increase in optimal leverage is even larger, at 6.6 percentage point.

Higher leverage increases bankruptcy costs. For the bank, this cost is more than compensated for by the increased value of deposit insurance. The optimal base case leverage is at a level where covered bondholders claim all net remaining assets. The deposit insurer must cover all deposits in a bank failure. Compared to the pari passu regime, the value of the deposit insurance to the bank is more than four times as high when assets are encumbered, representing a large transfer of value from the public sector to the shareholders.

The increase in value from replacing senior bonds with covered bonds is 9.1% measured against firm value in excess of asset value.

Going from Bail-Out to Bail-In The model's bail-in system is designed so that losses are pushed to the bondholders without the entire bank having to be liquidated. Senior bondholders now receive the value of the restructured bank minus depositors' claim. The immediate benefits to bondholders are twofold. First, the restructuring costs are lower than the bankruptcy costs. Second, the restructured bank has tax benefits of debt and deposit insurance value, as any going concern bank, in addition to the net asset value.

In the numerical base case, a higher pay-off to bondholders than in a pari passu regime makes it optimal to increase leverage, see figure 5. Optimal leverage is even higher than in the implicit guarantee regime.

Depositors are secured in the bail-in framework. Their claim will always be carried over to the restructured bank. Thus, the value of the deposit insurance to the bank is not from any payment at time τ_1, but instead indirectly from the deposit insurance's influence on firm value of the restructured bank.

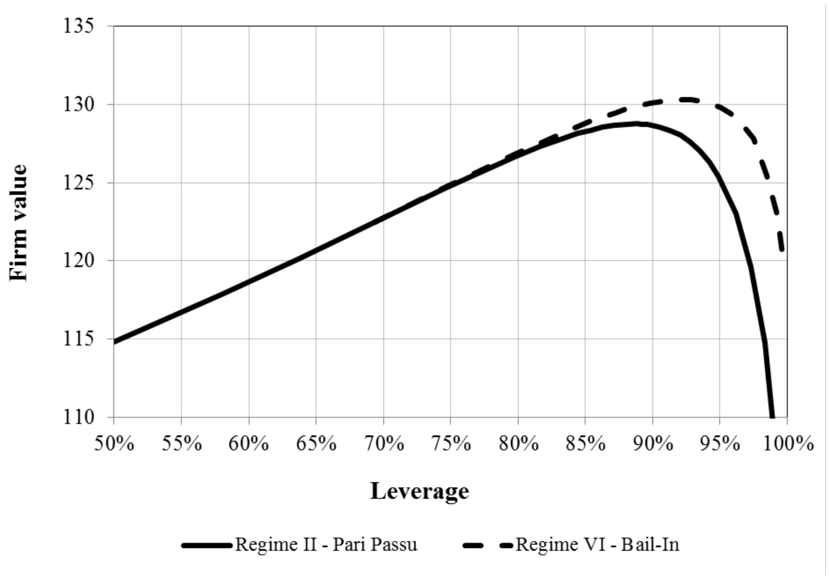

Figure 5: Firm value under a bail-in resolution framework.

5.5 Sensitivity of Leverage to Parameter Values

Table 5 summarizes the effect on optimal leverage and the corresponding firm value, for alternative parameter values. We change one parameter at a time. We double the parameter values compared to the base case, except for the tax rate which is increased ten percentage points.

Table 5: Optimal leverage and firm value under alternative parameter values.

		Regime I No Deposits		Regime II Pari Passu		Regime III Implicit Guarantee	
	New value	Leverage	Firm value	Leverage	Firm value	Leverage	Firm value
Base case		86.3	129.1	88.7	128.7	90.6	129.8
Risk-free rate	0.06	90.8	132.5	91.9	132.3	93.0	132.8
Asset volatility	0.16	74.9	120.4	82.1	124.0	86.6	127.4
Bankruptcy costs	0.4	84.4	128.3	86.9	127.9	88.7	128.8
Tax rate	0.38	88.6	146.5	90.3	146.4	91.8	148.0
Dep. ins. premium	0.003			88.8	127.1	90.7	128.2
Deposits	70			91.8	129.2	93.4	130.2
Bailout prob.	0.50					93.0	131.4

		Regime IV Depositor Preference		Regime V Asset Encumbrance		Regime VI Bail-In	
	New value	Leverage	Firm value	Leverage	Firm value	Leverage	Firm value
Base case		86.3	127.5	92.9	131.3	92.2	130.4
Risk-free rate	0.06	90.8	131.6	94.3	133.6	93.4	133.4
Asset volatility	0.16	75.3	119.0	89.9	130.1	88.9	125.4
Bankruptcy costs	0.4	84.4	126.6	89.0	129.1	89.4	128.9
Tax rate	0.38	88.6	144.8	92.3	148.4	94.4	149.7
Dep. ins. premium	0.003	86.4	125.8	93.1	129.8	92.2	128.6
Deposits	70	86.8	126.5	100.0	150.0	92.9	129.1

Asset Volatility With the deposit insurer picking up parts of the costs from a failure, or the possibility of an outright bailout, it is tempting for the bank to take on more risk. Haldane (2011) has described bankers as "volatility junkies". Our discussion so far has been on financial risk, but risk can also be in the form of operational risk. Higher asset volatility reduces optimal leverage, but there are material differences depending on regime[21].

Higher asset volatility increases the probability of asset value falling to a given bankruptcy value and thereby increasing the bankruptcy costs. *Ceteris paribus*, optimal leverage decreases, thereby reducing the tax benefit from debt. The deleveraging effect is countered by the increased value of the deposit insurance, except under depositor preference, where the deposit insurance still has no value. Thus, depositor preference is the regime where leverage is reduced the most. If we change the asset volatility parameter from the base case value of 8%, to 16%, optimal leverage is reduced by 11.0 percentage points to 75.3%. We find that depositor preference has strongest influence on the capital of high-risk banks.

For covered bondholders, high asset volatility is not of similar concern. First loss is taken by shareholders and second loss is taken by insured depositors. This priority ranking results in only a minor reaction from creditors to high volatility. Optimal leverage is down 3.0 percentage points to 89.9%. Bankruptcy costs increase and tax benefits decrease, but the effect on total

[21]We investigate the effects of an *ex ante* higher asset volatility, not the effects of *asset substitution*, i.e., changing the asset volatility *after* having issued debt.

firm value is small due to a strong increase in the value of the deposit insurance. A 2.4 times increase in the value of the deposit insurance, compared to the base case, brings the value to 15.1 and the corresponding cost of the deposit insurance is 1.0. We find that banks with high asset volatility gain more from using secured financing than banks with low asset volatility.

Deposits Under asset encumbrance, covered bonds can either be risk-free or risky. If the bankruptcy level is set sufficiently high, covered bondholders know with certainty that net remaining assets cover their claims in a failure, consequently, the bonds are risk-free. A lower bankruptcy level makes bonds risky.

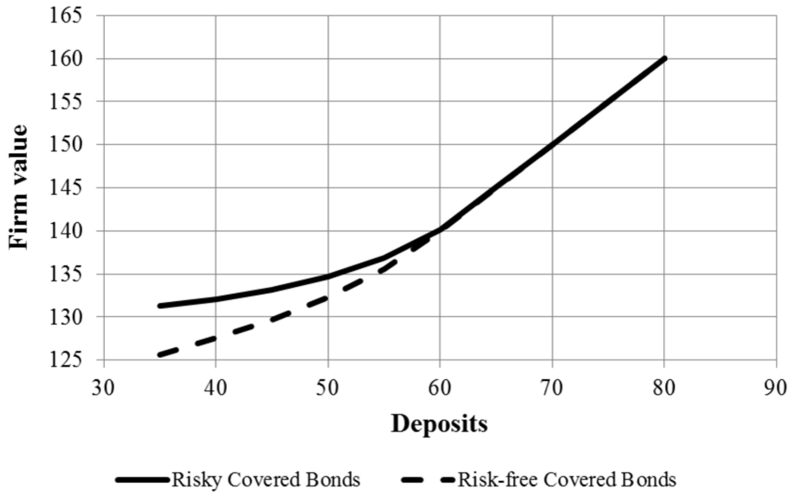

Figure 6: Optimal firm value under asset encumbrance for different deposit volumes.

Figure 6 shows optimal firm value under asset encumbrance for different deposit volumes. The solid line represents the situation where covered bonds are risky. The dotted line shows optimal firm value under the condition that covered bonds are risk-free ($V_B(1-\alpha) > D_{cb}(V_0)$). For low levels of deposits it is optimal to have risky bonds. When the deposit volume exceeds a certain level, the optimal positioning is having risk-free bonds. Then, both of the bank's creditors, the bondholders and the depositors, face no risk of losing money, and it is optimal for the bank to have the highest possible leverage. With no minimum capital requirements, optimal leverage is 100%. If so, the bankruptcy level is equal to the initial asset value. Firm value equals asset value, minus bankruptcy costs, plus the value of the deposit insurance. The latter is identical to the deposit volume because there are no assets left to the depositors in a failure and the insurer have to cover the full amount.

We find that a high deposit volume combined with secured financing, two factors commonly attributed to a stable banking system, are an extreme motivation to high leverage among banks.

5.6 Bond Debt Risk

Debt regulations change the expected pay-off to bondholders in a bankruptcy, thereby influencing bond debt risk (the first-order effect). Further, debt regulations alter optimal capital. More or less capital represents a second-order effect on bond debt risk. The first and second-order effects work in opposite directions. To study the combined effect, we split bond debt risk in two; loss given default and risk of default.

Loss given default is dependent on the bankruptcy value, bankruptcy costs, and the order of priority when distributing the remaining assets. Figure 7 shows the loss given default to bondholders for optimally positioned banks under the six regimes.

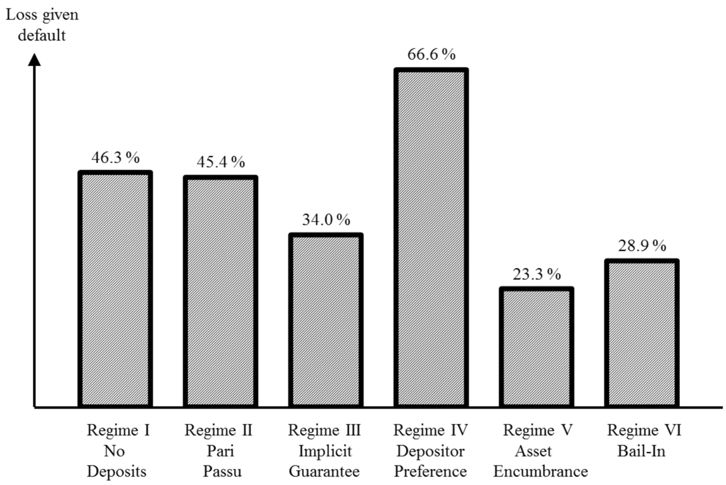

Figure 7: Loss given default on bond debt.

Compared to the pari passu regime, loss given default decreases due to government bailout (Regime III), collateral (Regime V), and the value of bail-in (Regime VI). In these three regimes, the bankruptcy value is higher than in the pari passu regime. A higher bankruptcy value means banks' assets fall less in value before bankruptcy is declared, further reducing loss given default.

Depositor preference, on the other hand, materially increases bondholders' loss given default. Bondholders rank after depositors in a failure, reducing the prospects of having their claims covered. In addition, a lower bankruptcy value means banks' assets fall more in value before bankruptcy is declared.

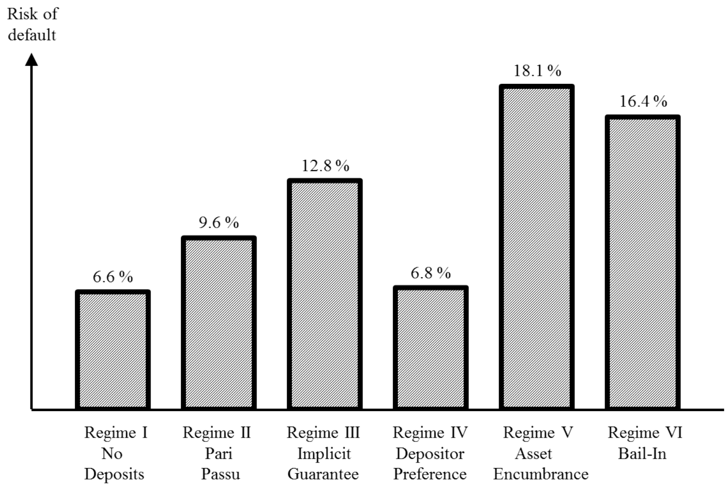

Figure 8: Risk of default on bond debt.

The first basic security has the interpretation of the present value of 1 dollar contingent on future bankruptcy, i.e. V falling to V_B. Thus, $\pi_1(V) = \left(\frac{V}{V_B}\right)^{-X}$, can be seen as a measure of the default risk. Figure 8 shows the numerical value of this measure for optimally positioned banks under the six regimes.

The *risk of default* is dependent on leverage. With implicit guarantees, asset encumbrance, and bail-in, it is optimal with more leverage compared to the pari passu regime. Consequently, the risk of default increases under these three regimes. Depositor preference reduces the risk of default compared to the pari passu-regime. In contrast, letting banks position themselves optimally in an asset encumbrance regime increases the risk of default 2.7 times compared to the depositor preference regime.

Credit spreads are a function of the risk of default and the loss given default. The credit spread represents the compensation required by the bond investor to take on the risk of investing in the bond, a measure of bond debt risk. From table 4 we find that credit spreads do not differ much between the regimes. Bond debt risk is stable between the regimes. We find that loss given default and risk of default work in opposite directions.

The result is contrary to the view that debt regulations have material impact on bond risk. Such a view is based on first-order effects from changes in the expected pay-off to bondholders. Our numerical examples show that there is an important counteracting, second-order effect to bond risk from changes in optimal leverage caused by the respective debt regulations.

We have shown that too-big-to-fail is a subsidy of bank shareholders, not of bondholders, and that the cost of depositor preference is carried by shareholders, not by bondholders. We have also shown that asset encumbrance represents a transfer of value from the public sector to shareholders not to bondholders.

6 Testing the Model on Bank Data

6.1 Determinants of Bank Capital

The exogenous capital requirement is generally set independent of the variables used in our model[22]. Thus, if the regulatory capital requirement is binding, real-world capital ratios will be independent of the model's private optimal capital.

However, the empirical work of Berger et al. (2008) document that the largest US banks desire to hold capital far in excess of even the most stringent regulatory requirements. They study all publicly traded US bank holding companies in the period 1992 to 2006, i.e., around 300 banks per year on average. The evidence suggest that banks actively manage their capital ratios, set target levels substantially above requirements, and make rapid adjustments towards their targets. These findings are supported by Gropp and Heider (2010) who suggest that capital regulation and buffers may only be of second-order importance in determining the capital structure of most banks. They study the 100 largest banks in the US and the 100 largest banks in 15 countries of the EU over the period 1991 to 2004. Regulatory intervention may be non-binding, and the observed capital levels do not appear to be explained by buffers that banks hold to insure against falling below the minimum level.

Table 6 summarizes our model variables and predicted correlation with bank capital. Real-world banks have debt structures that include both insured deposits, senior bonds, and covered bonds, as well as other debt instruments. Banks have partial asset encumbrance and some operate under depositor preference. No bank is fully described by one of the six regimes. *General variables* are common for all six regimes, whereas *regime variables* are variables used in the individual regimes.

6.2 Empirical Evidence

Public information on insured deposits and asset encumbrance is poor. For most banks, financial statements do not distinguish between deposits that are covered by an insurance and deposits not covered. Data at country

[22]The minimum capital requirements are based on credit risk, operational risk, and market risk. Pillar 2 of the Basel II framework allows supervisory authorities to deal with all other risks. For instance, this may include the level of asset encumbrance. There is, however, no disclosure of how such pillar 2 assessments affect the required capital level in excess of the minimum level.

Table 6: Variable overview and predicted correlation with the capital ratio.

		Data level	Predicted correlation	Data available
General variables				
Asset volatility	σ	Bank	$+$	Yes
Bankruptcy costs	α	Country	$+$	Yes
Tax rate	θ	Country	$-$	Yes
Risk-free rate	r	Country	$-$	Yes
Insured deposits	D	Bank	$-$	No
Deposit insurance premium	φ	Country	$+$	Yes[a]
Regime variables				
Implicit guarantees	p	Bank	$-$	No
Depositor preference		Country	$+$	Yes[b]
Asset encumbrance	$STsec/LTsec$	Bank	$-$	Yes
Bail-in		Country	$-$	Yes[b]

a Not included.

b No variation in sample.

level are available, but not at individual bank level. Moreover, publicly available data on variables disclosed by individual banks are not comparable due to different accounting standards and disclosure requirements across jurisdictions. For instance, the level of *asset encumbrance* is not reported by banks in a uniform manner.

Further, the value of the *implicit guarantee* for banks' debt is difficult to measure. Attempts have been made to use the differential between the stand-alone credit rating of a bank and the corresponding all-in credit rating, the latter including external support like assumed government and central bank support. Likewise, attempts have been made to develop market based measures from observed credit spreads. Size has also been used as a proxy of too-big-to-fail when studying large samples.

Depositor preference in some form is baked into legislation in a number of European countries, including Germany and the UK. However, these are indirect versions compared to the US system where the FDIC takes over the claims of insured depositors and cover these before any other claimants. No country has introduced a full-fledged *bail-in framework*.

The Morgan Stanley Research paper, "European Banks: Depositor Preference Is the Real Threat - Not Encumbrance" (Street, Ineke, and McGrath (2012)), looks at the make-up of banks' liability structure. The sample consists of the main UK and French banks, three Scandinavians and a representative bank in Germany, Spain, and Italy. The Morgan Stanley report delivers high quality data where variables have similar content across banks. Short-term secured debt includes repo market financing (including the ECB LTROs). This definition may overestimate the volume of secured financing, as in reality an amount of netting of repos could take place. It is unclear to what extent netting takes place for each individual bank, and in a distressed scenario, it is unclear what chance a bank has to unwind its repos and to what extent any netting could take place ahead of a decision to bail-in.

Table 7: Parameter values for the 13 banks in the sample.

Bank	Country	$Tier1$	α	θ	r	σ	$STsec$	$LTsec$
Lloyds	UK	5.2	6	26	2.49	3.4	9.8	8.6
RBS	UK	5.1	6	26	2.49	3.2	19.8	2.6
Barclays	UK	4.3	6	26	2.49	2.7	27.4	2.0
HSBC	UK	5.2	6	26	2.49	1.5	18.4	0.1
BNP	France	4.7	9	33	2.45	3.4	24.8	3.9
Agricole	France	2.9	9	33	2.45	1.8	15.9	2.6
SocGen	France	4.0	9	33	2.45	3.3	27.2	3.4
Nordea	Sweden	4.2	9	26	2.34	1.6	10.3	15.6
DNB	Norway	5.2	1	28	3.54	2.2	0.0	19.8
Danske	Denmark	4.3	4	25	2.25	2.0	17.3	27.4
Cmzbank	Germany	4.6	8	29.5	2.45	3.4	14.0	15.5
BBVA	Spain	6.3	11	30	2.45	3.1	15.7	8.2
Intesa	Italy	7.3	22	31.4	2.45	6.7	14.1	3.7
Average		*4.9*	*8.2*	*28.8*	*2.52*	*3.0*	*16.5*	*8.7*

$Tier1$: Adjusted core tier 1 capital at year-end 2011 as reported by Morgan Stanley. Measured as % of group funding. The methodology for adjusting the public figures is described in the report.
α: Cost of bankruptcy proceedings as % of the value of the debtor's estate, as estimated by the World Bank's Doing Business Project (http://www.doingbusiness.org). The figure includes court fees and government levies; fees of insolvency administrators, auctioneers, assessors, and lawyers; and all other fees and costs.
θ: From the KPMG corporate tax rate table.
r: 10 year interest rate swap rate at year-end 2011.
σ: Based on daily observations of the banks' stock price during 2011. Calculated using the Merton model.
$STsec$ and $LTsec$: As reported by Morgan Stanley. Measured as % of group funding. The methodology is described in the report.

Table 7 summarizes variable values for the scenario with gross repos. Indeed, it is difficult to undertake a formal econometric analysis of our model predictions on this small sample. In table 8 we present correlation coefficients to indicate the relevance of the model variables. We perform two calculations based on *gross* repo figures without netting of reverse repos, and *net* repo figures. All coefficients have the predicted sign, except interest rates in both scenarios[23]. The statistics indicate that our model is relevant to bank capital.

[23]Swap-rates are linked to currencies, meaning the euro risk-free rate applies to all banks in the euro area. Government bond rates are an alternative that designate an interest rate to each country. However, government bond rates around 2011 were substantially influenced by sovereign default risk.

Table 8: Correlation between bank capital and model variables.

		Repo and short-sales gross	Repo and short-sales net
Asset volatility	σ	0.69	0.71
Cost of estate	α	0.53	0.52
Tax rate	θ	-0.07	-0.05
Swap rate	r	0.14	0.03
Short-term secured	$STsec$	-0.25	-0.55
Long-term secured	$LTsec$	-0.09	-0.21

Table 9 summarizes the empirical evidence of Berger et al. (2008) and Gropp and Heider (2010) based on large samples of banks. The signs show the statistical significant relationships between variables and capital[24].

Two variables are tested in both studies. *Asset size* is negatively related to capital. As mentioned, size can be seen as a measure of implicit guarantees, because large banks are considered too-big-to-fail. If so, this finding supports our model's negative relationship between implicit guarantees and bank capital. The empirical findings on the *market-to-book ratio* are ambiguous. Our model has no attention on book values, and the market-to-book ratio is, thus, not part of our model.

Gropp and Heider find that more *collateral* decreases capital. Collateral is defined as liquid securities that can be used as collateral when borrowing from central banks. This definition is related to secured financing in our model, and thus support the model's negative relationship between asset encumbrance and capital. *Asset volatility* is found to be positively related to capital, also in line with our model predictions.

Profits and *dividends* are not part of our model. The described empirical findings are in line with the pecking order theories of debt, showing that our model could be extended to factor in capital adjustment costs. We return to the empirical findings on *retail deposits* below.

6.3 Puzzles

Gropp and Heider find that unobserved time-invariant fixed effects are important in explaining capital structure. The stability of capital structures over time implies that the factors driving the cross-sectional variation in capital ratios are stable over long horizons as well. Our model suggest that observed differences in capital structure might stem from banks' debt structure and debt regulations, both factors known to be quite stable over time.

[24]The two studies evaluate a very similar question, but the analyses differ in several aspects. Gropp and Heider investigate determinants of *market-valued* capital ratios, while Berger et al. study *regulatory* capital ratios.

Table 9: Relationship between bank characteristics and bank capital in earlier studies.

	Berger et al. (2008) Table 5 (Panel B)	Gropp and Heider (2010) Table VII
Asset size	−	−
Market-to-book ratio	−	+
Retail deposits	+	
Earnings volatility	No evidence	
Acquisition plans	No evidence	
Collateral		−
Asset volatility		+
Profits		+
Dividends		+

Further empirical investigation requires more extensive individual bank data and is outside the scope of this article.

Berger et al. find a negative and significant relationship between retail deposits and leverage. According to the authors, this finding support the hypothesis that more retail deposits increase the banks' charter value, inducing the bank to hold more equity as protection. Gropp and Heider do not find a significant effect of deposit insurance on the capital structure. Both findings are in opposition to our model's prediction that more deposits *ceteris paribus* increase leverage as banks seek to maximize the subsidy from deposit insurance. One possible explanation to the empirical findings can be our model's prediction that depositor preference cancel out the effect on bank capital from deposit insurance. All of the banks in the Berger et al. study and half of the Gropp and Heider-sample are US banks operating under depositor preference. The empirical findings can also be a victim of the data issues regarding insured deposits at individual bank level described above.

6.4 Credit Spreads

Credit spreads in the numerical base case are low compared to the present spreads in the bond markets for major US and German commercial banks. Two comments can be made to this observation.

First, the model assumption is that debt has infinite life. This assumption complicates comparisons to actual bond spreads with different finite maturities. Leland and Toft (1996) extend the model from Leland (1994) with a debt maturity structure. They find that with high leverage, the term structure of credit spreads decreases from a peak for very short maturities, but with a "humped" shape because short dated debt becomes close to risk-free. It is therefore not surprising that the model predicts lower credit spreads than actual finite debt with 3 to 5 years maturity.

Second, credit risk is only one of the factors behind observed spreads between risky and risk-free bonds. The model spread may be interpreted as the part of the observed spread attributable to credit risk. Other factors may include illiquidity, call and conversion features, and asymmetric tax treatment. See e.g., Huang and Huang (2012) for more.

7 Policy Implications

Non-binding capital regulations imply that variations in optimal capital have a direct impact on financial stability. *Ceteris paribus*, poorly capitalized banks reduce financial system stability.

It is broadly recognized that the social optimal capital for banks is higher than the private optimal capital. The reason for this is twofold. First, as predicted by our model, deposit insurance and implicit guarantees drive optimal capital downwards. Second, and not discussed in this article, high bank leverage imposes negative externalities from an increase in systemic risk in the financial markets, see e.g., Acharya, Pedersen, Philippon, and Richardson (2010a).

These factors justify regulation. In literature we often find that materially higher capital requirements is the straightforward solution to the social non-optimal leverage among banks, see e.g., Admati et al. (2011) and Miles et al. (2012).

The Basel III framework demands substantially more bank capital. Then why should we care about private optimal capital, if the forthcoming capital requirement is set higher?

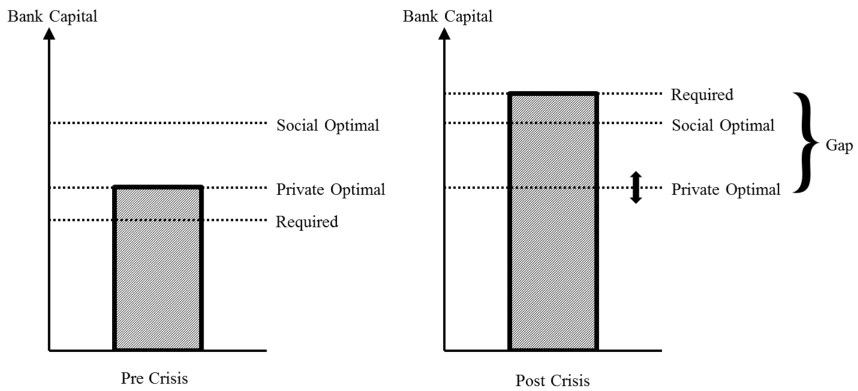

Figure 9: Bank capital before and after the financial crisis.

The left panel of figure 9 describes bank capital status prior to the financial crisis. Private optimal and required capital were by far lower than the social optimal. Whether the required level was below or above the private optimal is open for discussion. Regulatory reforms following the financial crisis have pushed the required capital upwards, and the current situation is illustrated by the right panel of figure 9. Whether the future required level will be below or above the social optimal level is an open question. This is an ongoing debate that we do not weigh in on. Our attention is on private optimal capital and its drivers.

If we impose an exogenous capital requirement on banks, there will be a gap between what the bank is required to do and what the bank voluntarily would choose to do. The difference between optimal firm value and firm value when complying with the capital requirement represents a cost to the shareholders. Our model shows that the cost may be material, and opens for regulatory arbitrage. Thus, private optimal capital is still relevant and important.

Higher private optimal capital will enhance the effectiveness of increased requirements. Debt regulations are important in this aspect. Depositor preference, limitations of asset encumbrance, bail-in of bond debt, and disclosure help to align private and social interest. We stress that our analysis is partial, having attention only on the implications for bank capital.

The Case for Depositor Preference Depositor preference dampens banks' incentive to take on excessive leverage. It makes senior bonds more responsive to financial risk, and subsequently it becomes optimal for banks to have more capital. The traditional view has been that senior bonds must be a more equal partner in burden sharing, but as we have shown, the ultimate effect of depositor preference is reduced value to shareholders.

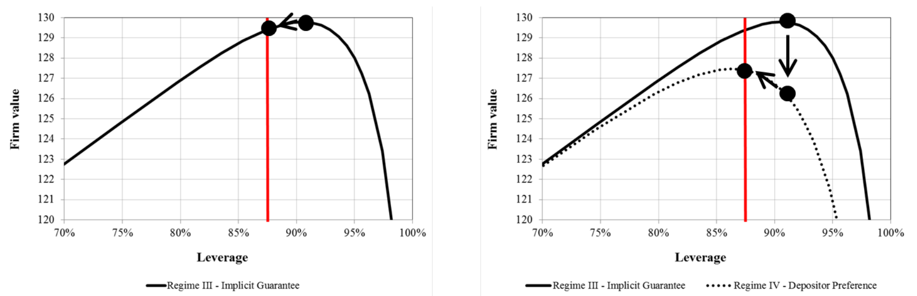

Figure 10: Depositor preference motivates banks to have more capital.

The left panel of figure 10 shows the introduction of a binding capital requirement given by the vertical line. The bank must increase its capital to comply with the requirement, and the firm value falls. There is an incentive to regulatory arbitrage. The right panel of figure 10 shows a similar increase in the capital requirement, but this time accompanied by the introduction of depositor preference. The latter leads to an immediate reduction in firm value, and a subsequent increase in private optimal capital. The bank is motivated to increase capital, and the incentive to regulatory arbitrage is eliminated.

The Case for Limits on Asset Encumbrance As shown by figure 4, asset encumbrance increases financial instability from lower optimal capital, and transfers value from the deposit insurer to the shareholders. High deposit volumes and an unlimited use of secured financing give a strong motivation for high bank leverage. Asset encumbrance is especially costly to the public sector in countries with depositor preference, like the US.

In addition, crowding out unsecured debt may result in too few debt instruments to establish a functional bail-in resolution regime as long as covered bonds are not intended to be bail-in'able. See Juks (2012) for a discussion on hard versus soft limits on asset encumbrance.

The Case for Bail-In A bail-in resolution system intends to remove the incentive to take on more leverage from the expectation of a public bailout. In our numerical base case, though, the bail-in leverage is even higher than in the bailout regime. We argue that this is still a "healthier" situation than a lower leverage based on implicit guarantees. With a bail-in, depositors' interests in a bank failure are taken care of without any payments from the deposit insurer. Moreover, in a bank failure a public rescue operation is not required.

The Case for Disclosure The driver for change in the optimal capital structure is investors' reaction to changes in debt structure or regulations. When investors change their valuation of bank bonds, the shareholders are better off by adjusting the bank's capital structure. Consequently, investors need insight into the type, amount, and ranking of debt instruments in case of bankruptcy and their ranking relative to other creditors. This includes consistent information on asset encumbrance and banks' financing strategies. Today, it is close to impossible to find information on for example insured deposits and asset encumbrance at the individual bank level. Due to lack of transparency, bond debt is not able to fulfill its role as a signaling mechanism.

Disclosure would also provide insight into the determinants of bank capital and better understanding of bank behaviour. Such insight facilitates more efficient and targeted regulations.

The construction of Basel III has been intensely debated. A much used argument, primarily from the banking industry, has been the necessity of creating a "level playing field". But what is a level playing field? In the debate it looks to mean similar required capital ratios for all banks, regardless of jurisdiction. Our analysis shows that deposit insurance, implicit guarantees, depositor preference, asset encumbrance, and bail-in frameworks have material effects on optimal bank capital and bank firm value. Thus, a level playing field is a much wider concept than identical capital requirements. We have presented a unified framework where the combined effect of several, possibly uncoordinated, regulatory initiatives can be studied.

Bondholders require compensation for lower expected recovery, for example due to expectations of depositor preference and reduced value of implicit guarantees. This development is *not* a threat to bank financing models, but rather an indication of market discipline working. The transition to steady state may prove challenging, but it is vital to align private and social interests.

We do not disagree with the call for more bank capital. However, as long as there is a gap between the private optimal capital and regulatory capital, it leaves the banks with incentives to regulatory arbitrage. We stress that we do not see this as an argument to remove capital requirements. On the contrary, we see this as a motivation to improve the capital regulations by making them harder to manipulate. Effective capital regulation and enforcement are essential to achieve a robust financial system.

Until such improvements materialize, we must accept that direct equity regulation comes with the material challenge of being arbitraged. Hence, the financial system will remain fundamentally unstable if private optimal bank capital is substantially lower than the required level. Enhancing capital requirements, and at the same time introducing debt regulations that reduces the private optimal capital, is to gain some and lose some in terms of financial stability.

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