Debt Overhang and Capital Regulation

Anat R. Admati
Peter M. DeMarzo
Martin F. Hellwig
Paul Pfleiderer[*]

March 23, 2012

[*]Admati, DeMarzo and Pfleiderer are from the Graduate School of Business, Stanford University; Hellwig is from the Max Planck Institute for Research on Collective Goods, Bonn. We are grateful to Mary Barth, Rebel Cole, Hamid Mehran, Steve Ross, Chester Spatt, and Jeff Zwiebel for useful discussions and comments.

Contact information:
admati@stanford.edu; demarzo_peter@gsb.stanford.edu; hellwig@coll.mpg.de; pfleider@stanford.edu.

Debt Overhang and Capital Regulation

Anat R. Admati, Peter M. DeMarzo, Martin F. Hellwig, and Paul Pfleiderer

Abstract

We analyze shareholders' incentives to change the leverage of a firm that has already borrowed substantially. As a result of debt overhang, shareholders have incentives to resist reductions in leverage that make the remaining debt safer. This resistance is present even without any government subsidies of debt, but it is exacerbated by such subsidies.

Our analysis is relevant to the debate on bank capital regulation, and complements Admati et al. (2010). In that paper we argued that subsidies that favor debt over equity are the key reason that banks funding costs would be lower if they "economize" on equity. Subsidies come from public funds, and reducing them does not represent a *social* cost. It is thus irrelevant for assessing regulation. Other arguments made to support claims that "equity is expensive" are flawed.

Like reduction in subsidies, the effects of leverage reduction on bank managers or shareholders do not represent a social cost. In fact, we show that debt overhang creates inefficiency, since shareholders would resist recapitalization even when this would increase the combined value of the firm to shareholders and creditors. Moreover, debt overhang creates an "addiction" to leverage through a ratchet effect. In the presence of government guarantees, the inefficiencies of excessive leverage are not fully reflected in banks' borrowing costs.

Since banks' high leverage is a source of systemic risks and imposes costs on the public, resistance to leverage reduction leads to *social* inefficiencies. The main beneficiaries from high leverage may be bank managers. The majority of the banks' shareholders, who hold diversified portfolios and who are part of the public, are likely to be net losers. Our analysis highlights the critical importance of effective capital regulation and high equity requirements, especially for large and "systemic" financial institutions.

We analyze shareholders' preferences when choosing among various ways leverage can be reduced. We show that, with homogeneous assets, if the firm's security and asset trades have zero NPV, and the firm has a single class of debt outstanding, then shareholders find it equally undesirable to deleverage through asset sales, pure recapitalization, or asset expansion with new equity. When these conditions are not met, shareholders can have strong preferences for one approach over another. For example, if the firm can buy back junior debt, asset sales are the preferred way to reduce leverage. This preference for asset sales, or "deleveraging," can persist even if such sales are inefficient and reduce the total value of the firm.

Keywords: capital regulation, financial institutions, capital structure, "too big to fail," systemic risk, bank equity, debt overhang, underinvestment, recapitalization, deleveraging, bankruptcy costs, Basel.

JEL classifications: G21, G28, G32, G38, H81, K23.

1. Introduction

After the financial crisis of 2007-2009, regulators have sought to increase capital requirements for banks, so that a greater share of their investments would be funded by equity. The advantage of equity funding is that with more equity funding banks can absorb more losses without becoming distressed, defaulting on their debt, requiring resolution or government support, or causing a financial crisis.[1] Bankers have strongly resisted increased capital requirements because, they claim, "equity is expensive."

In Admati et al. (2010), we reviewed this discussion and found that, in the context that is relevant to regulation, where the issue is *the cost to the economy* of more equity funding for banks, the arguments put forward supporting the view that equity is "expensive" are invalid. Some of the arguments rest on confusions about the way debt and equity are priced in financial markets.[2] Other arguments involve confusing the bank's private costs of funding, which are distorted by government subsidies to debt, with the true economic costs. Meanwhile, the high leverage of large financial institutions imposes significant negative externalities by increasing the fragility of the financial system.[3]

In this paper we show that *debt overhang* provides another reason why the *shareholders* (or managers) of a distressed bank, or indeed any firm, would find it "expensive" to issue new equity and to reduce leverage. A reduction of leverage generally has the effect of reducing the likelihood of default. This benefits existing debt holders (or anyone providing guarantees to the debt, such as the government), by making the debt safer. Unless debt holders can be made to pay for this benefit, shareholders would lose from a debt buyback.

Shareholders resist reduction in leverage even if such a reduction would not change, *or might even increase*, the total value of the firm. *This effect does not depend on the presence of third-party subsidies to debt.* Rather, it fundamentally involves conflicts of interests between

[1] See, e.g., Basel Committee on Banking Supervision (2009).
[2] In many discussions, there is even confusion about what is meant by "capital" and the fact that it refers to funding only and does not require the bank to "hold" or "set aside" any cash or otherwise restrict its investment as reserve and liquidity requirements do
[3] In Admati et al (2010) we also take up models involving incentive and information effects and argue that the available models in this vein are inadequate for guiding policy.

incumbent shareholders and debt holders (and possibly taxpayers), regarding reductions in leverage. Reducing leverage is costly to shareholders since it transfers value from them to debt holders and/or taxpayers. This transfer is a key reason for the share price decline (or "dilution") that shareholders may experience from leverage reduction. [4]

Moreover, debt overhang can create an "addiction" to leverage on the part of shareholders. Once debt is in place, shareholders would not voluntarily reduce leverage even when it benefits the firm. By contrast, they will want to *increase* leverage if existing covenants permit it. Since a commitment to reduce leverage in certain situations is difficult to make, this creates an agency cost of debt.[5] In the absence of government guarantees, this agency cost would be reflected in the cost of debt finance. If debt benefits from underpriced implicit or explicit government guarantees, the full effects of the agency problem would not be reflected in the cost of debt.

The distress or default of the firm may have external effects on third parties. In that case the resistance of shareholders to leverage reduction that would reduce the external damage would impose an additional *social cost*. For example, when banks are distressed or insolvent, this often has adverse consequences for the financial system and possibly for the broader economy. In that case imposing higher equity requirements is *not costly* when viewed from the perspective of the economy, and could in fact be *highly beneficial*. (See Section 2 in Admati *et al* (2010) for a discussion of the benefit.)

We study the reaction of firms to regulation requiring that they lower their leverage. This issue is highly relevant for banks that must reduce leverage to meet capital requirements. Suppose the regulation mandates that the proportion of total assets funded with equity meets or

[4] In the context of equity issuance, the word "dilution" is often used in a flawed way. Dilution of incumbent shareholders is *not* due to the fact that their share of the overall pie is reduced. Incumbent shareholders would not lose any value if the funds raised were used to provide a sufficient increase in the value of the firm's assets. For example, equity issuance to raise money for highly productive investment can lead to price increase and gains by incumbent shareholders even though they increase the number of shares. In contrast, if shares are sold to an executive who exercises a previously-issued option received as compensation, incumbent shareholders are diluted because, in exercising the "in the money" option, the executive obviously pays less than the (post-exercise) value of the shares.

[5] An example of this is the "maturity rat race," described in Brunnermeier and Oehmke (2012); see also Bizer and DeMarzo (1992).

exceeds some minimum level.[6] There are several ways to respond to a requirement that the ratio of equity to assets be increased. A pure recapitalization involves buying (or paying) back debt using new equity funding, without any change in assets. Alternatively, the ratio of equity to assets can be increased by selling assets and using the proceeds to buy back debt, a process often referred to as "deleveraging." Finally, the firm may increase the equity to asset ratio by issuing new equity and acquiring new assets.

We obtain a striking "irrelevance" result: *If there is one class of debt outstanding and asset sales or purchases do not, by themselves, generate value, then shareholders are indifferent between asset sales, pure recapitalization and asset expansion. All are equally undesirable from the perspective of shareholders.*[7]

Irrelevance does not hold if asset prices are such that either asset sales or asset purchases create value. In this case, an asset price below the zero-NPV level influences preferences in the direction of asset purchases since purchases are positive-NPV investments, while a price above the zero-NPV level pushes in the direction of asset sales.

Importantly, however, we show that these preferences may change when there are multiple classes of debt. In the absence of covenants to the contrary, the shareholders will choose to buy back the most junior debt before repurchasing debt with higher priority. In this case, if assets are priced so that asset sales or purchases do not, by themselves create value, shareholders have a strict preference for reducing leverage by selling assets and buying back the most junior debt. Expanding assets through new equity issuance is seen as the worst alternative. Moreover, this ranking may hold even when selling assets is inefficient (i.e., has negative NPV).

The effects that we consider here differ from those discussed Admati et al. (2010). In Admati et al. (2010), the focus was on the impact of leverage on the total funding costs of the firm (or bank), and thus on its *overall value*.[8] Here, by contrast, we consider the situation where debt is already in place, and analyze the incentives of *incumbent shareholders* (and bank

[6] The requirements specified in Basel II and Basel III are based on the ratio of equity to risk-weighted assets, rather than the ratio equity to total assets, the so called "leverage ratio." This colors the reaction of banks to increased capital requirements. We discuss this issue in the concluding remarks.

[7] The irrelevance also holds if there is a single class of debt outstanding but a covenant requires new debt to be junior to incumbent debt, except that shareholders would be averse to any level of asset expansion that would require that additional debt be issued.

[8] This is effectively the *ex ante* perspective, before any securities have been issued.

managers) in responding to increased equity requirements. We show that these incentives lead to additional distortions, and potentially increase the value of capital regulations.

Our analysis combines the insights on debt overhang presented in the foundational work in Myers (1977) with insights on market-based solutions to the sovereign debt crisis of the 1980s found in Frenkel et al. (1989) and Bulow and Rogoff (1990). The literature on market-based solutions to sovereign debt crises showed that if debt is repurchased in the open market, the buyback must convey a benefit to debt holders. The price of debt must be higher than it would be without the buyback, because it must reflect the beneficial effects of the debt reduction on the debtor's default probability. Unless a debt holder believes that his decision can affect the overall outcome, he will decide whether to hold on to the debt securities or sell depending on which alternative provides the better return prospects. For a debt holder to be willing to sell, therefore, the price must already reflect the fact that, if the debtor has less debt, default is less likely.

The first formal analysis of debt overhang is found in Myers (1977). He showed that debt overhang can lead to underinvestment, since the shareholders of a leveraged firm may refuse to fund a new project even though its net present value is positive.[9] In the main analysis of Myers (1977), the argument establishing underinvestment relied critically on the assumption that the new investment must be funded with equity[10] For a firm with outstanding debt, pure equity funding reduces leverage. In this context, therefore, Myers (1977) involves an interaction between investment and funding considerations. The current paper disentangles the effects of changes in leverage from those on investment, showing that aversion to reducing leverage is the key to Myers (1977). The irrelevance result mentioned above shows that the effect of debt overhang on investment appears somewhat coincidental.

In our model, the firm's default probability varies with leverage, but is independent of the scale of the firm. If there is only one class of debt, therefore, in the absence of any frictions, the market price of debt is also independent of the scale of the firm. Additional investments that are undertaken without changing leverage change the scale of the firm but do not change the market price of the firm's debt. Therefore these investments have no effect on the value of the debt held

[9] Debt overhang is also a key issue in the literature on sovereign debt in the 1980s; see for example the essays in Frenkel et al. (1989).

[10] Myers (1977) noted that if the new project could be funded by debt, the resulting dilution of incumbent debt holders' position would counter the effect he was demonstrating.

by incumbent debt holders. It follows that with fixed leverage, shareholders' attitudes to these investments depend only on whether the NPV of the investments, and there is no debt overhang effect. If the NPV of buying and selling assets is zero, shareholders are indifferent about the scale of the firm.

If there are different classes of debt, shareholders' attitudes to changes in firm scale depend on how it can fund the investments. If new investments or asset sales involve a change in capital structure, and if buying or selling assets has zero-NPV, shareholders' preferences will be related to how the claims of different classes of incumbent debt holders would be affected by the change in scale. For example, if the firm must reduce leverage and is given a choice of scale, it will choose to sell assets and buy back the most junior debt.

The paper is organized as follows. Section 2 presents the basic model. Section 3 analyzes pure recapitalization as viewed from the private considerations of shareholders and the impact on the value of the firm. In Section 4 we consider alternative ways for a firm to reduce leverage other than pure recapitalization. These include asset sales (so-called "deleveraging"), and asset expansion through new equity. Section 5 offers a non-technical discussion of our results and discusses their implications for capital regulation, including the impact of asset sales, debt overhand and lending, heterogeneous assets and risk weights.

2. The Basic Model

We consider a firm that has made an investment in risky assets and has funded itself with debt. For our basic argument, we make the following assumptions:

Firm Investment: The firm has made a real investment A in the past ("date 0"). Investment returns are realized at date 2 and are given by a random variable $\tilde{x}A$.

Firm Liabilities: We assume that the firm is funded by equity and a total debt claim of D against the firm that is due at date 2, the date at which the asset return of $\tilde{x}A$ is realized. If $\tilde{x}A \geq D$, debt claims are honored in full.

We consider three "frictions" that affect the payouts of the firm's securities at date 2. These are taxes, bankruptcy costs, and third party (government) subsidies.

Taxes: We assume that a tax may be applied to those returns earned on the firm's assets that exceed what is paid to the debt holders. The tax is given by $t(\tilde{x}, A, D) \in [0, \tilde{x}A - D]$ when $\tilde{x}A > D$. We assume that no tax is paid when $\tilde{x}A \leq D$.

Subsidies: If $\tilde{x}A < D$, the firm is unable to fulfill its obligation to debt holders and must default unless it receives a subsidy from the government or some other third party. Such a subsidy might be given to avoid negative repercussions of a default on others. We denote the amount of any subsidy by $s(\tilde{x}A, D)$. We assume that subsides are only paid, if they are paid at all, when $\tilde{x}A < D$.

Bankruptcy costs: In the event of default, there may also be a bankruptcy cost $b(\tilde{x}A, D, s(\tilde{x}A, D))$. The dependence of this cost on the subsidy $s(\tilde{x}A, D)$ reflects the notion that the subsidy may eliminate bankruptcy altogether or at least reduce its costs.

A key variable in much that will follow is the *net default cost.*

Net default cost: This is defined to be the difference between the bankruptcy cost and the third party (government) subsidy. Letting $n(\tilde{x}A, D)$ be net default cost, we have $n(\tilde{x}A, D) = b(\tilde{x}A, D, s(\tilde{x}A, D)) - s(\tilde{x}A, D)$. Note that if the subsidy exceeds the bankruptcy cost, the net default cost will be *negative*, which means that when $\tilde{x}A < D$, the firm's debt holders will receive *more* than $\tilde{x}A$. We assume that $\tilde{x}A - n(\tilde{x}A, D) \in [0, D]$ if $\tilde{x}A < D$ and $n(\tilde{x}A, D) = 0$ if $\tilde{x}A \geq D$. At best, government subsidies bring the available funds up to the amount that is needed to avoid default. In the event that $\tilde{x}A > D$, there are no subsidies and no bankruptcy costs.

Given these assumptions, the payoffs on the firm's debt and its equity are those given in the following table:

	If $\tilde{x}A < D$	If $\tilde{x}A \geq D$
Payoff to Shareholders	0	$\tilde{x}A - t(\tilde{x}, A, D) - D$
Payoff to Debt Holders	$\tilde{x}A - n(\tilde{x}A, D)$	D

Pricing at Date 1: The prices of securities at date 1 are determined by taking expectations of the payoffs on the securities. These expectations are defined with respect to the distribution function F of the return on the firms' asset, $\tilde{x}$. The distribution function F has full support on $[0, \infty)$.[11]

Given our assumptions about payouts and pricing, it follows that at date 1 the values of the firm's debt and its equity are:

$$\begin{aligned} \text{Total value of debt} &= V^D(D, A) \\ &= \int_{D/A}^{\infty} D \, \mathrm{d}F(x) + \int_{0}^{D/A} \left(xA - n(\tilde{x}A, D) \right) \mathrm{d}F(x) \end{aligned} \tag{1}$$

and

$$\text{Value of equity} = V^E(D, A) = \int_{D/A}^{\infty} \left(xA - t(x, A, D) - D \right) \mathrm{d}F(x). \tag{2}$$

[11] If investors have homogeneous beliefs and are risk neutral, F can be simply viewed as the actual ("physical") probability distribution of returns. More generally, even if investors have heterogeneous beliefs and are risk averse, the existence of a distribution F such that market prices of assets are equal to expected returns under F is still implied by no arbitrage (a necessary condition for equilibrium). Throughout our analysis we assume that the distribution F is independent of the firm's choices, e.g., the level of its debt. This is akin to the assumption of price-taking in the theory of competitive equilibrium. The idea is that the firm is unable to alter the allocation and the pricing of risks in the economy. In the terminology of Grossman and Stiglitz (1980), we assume *competitivity* and *spanning*. For a discussion of the underlying issues, see also the survey article of Baron (1979).

3. Debt Overhang and Recapitalization

In this section, we assume that the real investments of the firm, which were made in date 0, are fixed and will not be changed. We examine the effects of reducing the firms' leverage through a pure recapitalization that involves the firm issuing new equity and buying back some of its debt. We assume that the debt must be bought back at the prevailing market price. Because debt holders are free to choose between selling the debt securities and keeping them, the market price must be such that, at the margin, debt holders are indifferent. We assume that new equity will be issued at the market price.

In Section 4.1 we show that existing shareholders are made worse off by such a recapitalization and thus would not voluntarily choose to engage in it. In Section 4.2 we show that this may be inefficient because shareholders remain resistant to a recapitalization even if it increases the total value of the firm. This is an agency cost of having debt and it reduces the *ex ante* value of the firm. Interestingly, the dynamics of capital structure choices work to ratchet leverage up but not down once it is in place, which leads to what might be called an "addiction" to leverage. Thus, once debt is in place, leverage will not decrease when it is up to shareholders to make subsequent capital structure decisions and they are free to make them to suit their preferences. There is a fundamental asymmetry between changes that reduce or increase leverage. While shareholders often find it in their interest to *increase* leverage when permitted to do so, they will generally not choose to *decrease* the leverage, since this transfers wealth to incumbent debt holders.

3.1 The Impact of Recapitalization on Shareholders

We begin by assuming that the firm has issued at time 0 a single class of debt with face value D. Equation (1) above implies that the current market price of debt per unit of nominal face value is equal to:

$$\begin{aligned} q(D,A) &= \frac{V^D(D,A)}{D} \\ &= \int_{D/A}^{\infty} \mathrm{d}F(x) + \int_{0}^{D/A} \frac{xA - n(\tilde{x}A, D)}{D}\, \mathrm{d}F(x). \end{aligned} \tag{3}$$

Suppose that, at date 1, the firm considers buying back debt with a nominal claim equal to Δ. If the firm wants to buy back debt in the open market, it cannot do so at the price given in (3). The repurchase price must be such that debt holders are at the margin indifferent between selling debt and holding on to it. Per unit of nominal claims, the debt holders who hold on get 1 if $\tilde{x}A \geq D - \Delta$ and $\left(\tilde{x}A - n(\tilde{x}A, D)\right)/\left(D - \Delta\right)$ if $\tilde{x}A < D - \Delta$. The buyback price of the debt must therefore be equal to the market price $q\left(D - \Delta, A\right)$ that prevails at the post-buyback debt level. [12]

We assume that incumbent shareholders assess such a buyback only on the basis of what it does to their wealth.[13] This assessment depends only on whether the difference between the market value of the firm's equity with and without the buyback, $V^E\left(D - \Delta\right) - V^E\left(D\right)$, exceeds the cost $q\left(D - \Delta, A\right) \times \Delta$. The following proposition shows that the answer to this question is unambiguously negative.

Proposition 1 (Shareholder resistance to Recapitalization): *Equity holders are strictly worse off issuing securities to recapitalize the firm and reduce its outstanding debt. The loss to equity holders is mitigated by bankruptcy costs, and increased by the presence of subsidies.*

Proof: From (1), we have:

$$\begin{aligned} V^E\left(D - \Delta, A\right) - V^E\left(D, A\right) &= \int_{(D-\Delta)/A}^{D/A} \left(xA - D\right) \mathrm{d}F\left(x\right) + \Delta \times \left(1 - F\left(\frac{D - \Delta}{A}\right)\right) \\ &\quad - \int_{(D-\Delta)/A}^{\infty} t\left(x, A, D - \Delta\right) \mathrm{d}F\left(x\right) + \int_{D/A}^{\infty} t\left(x, A, D\right) \mathrm{d}F\left(x\right) \\ &< \Delta \times \left(1 - F\left(\frac{D - \Delta}{A}\right)\right) \\ &\leq \Delta \times q^D(D - \Delta, A). \end{aligned} \tag{4}$$

[12] For extensive discussions of this point, see Frenkel et al. (1989) and Bulow and Rogoff (1990).

[13] Here, too, we implicitly assume *competitivity* and *spanning*. Spanning guarantees that the set of state-contingent portfolio return patterns available to investors does not depend on *D*. Together with competitiveness, this ensures that the firm's actions raise an investor's expected payoff if and only if they raise his wealth.

The first, strict inequality holds because our assumption that F has full support implies $\int_{(D-\Delta)/A}^{D/A}(xA-D)\,\mathrm{d}F(x)<0$ and because taxes are non-increasing in D. The second inequality holds because, by (3), the final price of the debt, $q(D-\Delta,A)$, cannot be lower than the probability that the firm does not default.

Thus, the increase in the total value of equity from a recapitalization, $V^E(D-\Delta,A)-V^E(D,A)$, is more than offset by the cost $\Delta\times q(D-\Delta,A)$ of the debt repurchase. The loss to shareholders is magnified by taxes, which are explicitly in (4). The loss is decreasing in expected net default costs, $\int_0^{(D-\Delta)/A} n(xA,D-\Delta)\,\mathrm{d}F(x)$, which are implicitly in (4), through the difference between $q^D(D-\Delta,A)$ and the probability the firm does not default, i.e., $1-F\left((D-\Delta)/A\right)$, which accounts for the last inequality. ■

When there is a positive probability that the firm may default, debt trades at a discount relative to its face value. Nevertheless, a buyback cannot be beneficial to shareholders. From the shareholders' perspective, the benefits of the buyback are due to debt service being lower when the firm does not default. Therefore, they are willing to pay at most $\Delta\times\left(1-F\left((D-\Delta)/A\right)\right)$ for the buyback. Indeed, given their option to default when returns are between $D-\Delta$ and D, the shareholders are not even willing to pay $\Delta\times\left(1-F\left((D-\Delta)/A\right)\right)$. By the same consideration, however, as shown in the proof of the proposition, debt holders want at least the amount $\Delta\times\left(1-F\left((D-\Delta)/A\right)\right)$.

If the recapitalization makes expected tax payments go up, the conclusion of the proposition remains true even if the distribution F does not have full support and the option to default when returns are between $D-\Delta$ and D plays no role. This is also true if the debt holders expect to recover some positive amount in default, creating a wedge between the buyback price $q^D(D-\Delta,A)$ and the price shareholders are willing to pay.

So far we have assumed that the firm has only a single class of debt outstanding. Note that if the firm has several classes of debt outstanding, any buy back will involve the cheapest classes, which will be the most junior classes of debt. The buyback price of these junior classes

must be at least $\left(1-F\left(\left(D-\Delta\right)/A\right)\right)$ and will not exceed $q(D-\Delta, A)$. Since $\left(1-F\left(\left(D-\Delta\right)/A\right)\right)$ is the lower bound on the buyback price, the proof of Proposition 1 therefore establishes that a debt repurchase is unattractive to shareholders even if the firm is able to repurchase the least expensive debt claims when multiple claims exits. This gives us the following important generalization:

Proposition 2 (Shareholder Resistance to *any* debt buybacks): *Equity holders are strictly worse off issuing securities to recapitalize the firm by repurchasing any class of outstanding debt.*

3.2 Debt Overhang and Firm Value Maximization

Proposition 1 refers to the preferences of equity holders. When default is costly to the firm, the interests of equity holders can be in conflict with maximization of total firm value. For example, if taxes and subsidies are zero while bankruptcy costs are not, then a recapitalization and buyback of risky debt raises the combined wealth of shareholders and debt holders jointly. Yet, shareholders consider such a move harmful to their interests.

Thus, *debt overhang can give rise to a situation in which shareholders and debt holders jointly would benefit from a recapitalization and debt buyback, but shareholders would not find it in their interest to recapitalize*. The benefits from the debt buyback are due to the reduction of bankruptcy costs. However, when debt is already outstanding, the benefits of a debt buyback (and more) accrue to debt holders. Shareholders are unable to appropriate enough of these benefits and therefore resist such a buyback.

Matters would be different if there were collective bargaining about the price of debt in the buyback, as would be the case if debt contracts had collective action clauses and the firm's management, acting on behalf of shareholders, could negotiate a buyback agreement with debt holder representatives. In such a negotiation, with the no-buyback outcome as a default option, debt holders would end up sharing their gains from the buyback with the shareholders. This is not possible when debt is bought back through the market, and every debt holder decides on his own whether to hold on or to sell.

The difference between a buyback through collective bargaining and a buyback through the market is due to the fact that the buyback through the market itself raises the market price. For debt holders to agree to a buyback Δ in collective bargaining, the compensation they receive must be equal to the difference between the value of outstanding debt without and with the debt buyback:

$$V^D(D,A) - V^D(D-\Delta,A) = q^D(D,A)\times D - q^D(D-\Delta,A)\times(D-\Delta). \tag{5}$$

A rearrangement of terms yields:

$$V^D(D,A) - V^D(D-\Delta,A) = \Delta\times q^D(D-\Delta,A) - \left(q^D(D-\Delta,A) - q^D(D,A)\right)\times D. \tag{6}$$

The cost $\Delta\times q^D\left(D-\Delta,A\right)$ of a debt buyback in the market exceeds the compensation that debt holders require in collective bargaining by $\left(q^D(D-\Delta,A) - q^D(D,A)\right)\times D$. The following proposition shows that, if net default costs are increasing in the amount of debt outstanding, this amount is unambiguously positive.

Proposition 3 (Increased Debt Value Post Recapitalization): *If expected net default costs are non-decreasing in the amount of debt outstanding, then the price of debt rises after a recapitalization, i.e.,* $q^D\left(D-\Delta,A\right) > q^D\left(D,A\right)$.

Proof: From (3), plus the fact that $F(D/A) > F\left((D-\Delta)/A\right)$ and $n(xA,D) \geq n(xA,D-\Delta)$, we obtain:

$$\begin{aligned} q^D\left(D,A\right) &= \int_{D/A}^{\infty} \mathrm{d}F\left(x\right) + \int_{(D-\Delta)/A}^{D/A} \frac{xA - n(xA,D)}{D}\,\mathrm{d}F\left(x\right) + \int_{0}^{(D-\Delta)/A} \frac{xA - n(xA,D)}{D}\,\mathrm{d}F\left(x\right) \\ &< \int_{(D-\Delta)/A}^{\infty} \mathrm{d}F\left(x\right) + \int_{0}^{(D-\Delta)/A} \frac{xA - n\left(xA,D-\Delta\right)}{D-\Delta}\,\mathrm{d}F\left(x\right) \qquad (7) \\ &= q^D\left(D-\Delta,D\right). \end{aligned}$$

This proves the result. ■

As a rule, a debt buyback raises the market price of debt. Return prospects per unit of debt improve, either because the default probability goes down or because, in the event of default the available asset value, net of bankruptcy costs, is split between fewer claimants. The market price of the debt must therefore increase. An exception to this rule occurs only if the buyback has no effect on the default probability and, in the event of default, debt holders do not get anything.

The benefits of a buyback to debt holders were very much in evidence in the buyback of Bolivian sovereign debt in 1988. Because Bolivian debt had been trading at 6 cents on the dollar, there was a notion that the international community should buy this debt in the market and forgive it in order to provide Bolivia with effective debt relief. Some $34 million were spent to buy back and forgive debt securities with a nominal value of 308 million dollars. The market price of Bolivian debt after the buyback was 11 cents on the dollar, the market value of total debt outstanding $39.8 million, as opposed to $40.2 million before the buyback. As a group, debt holders saw their wealth go up by over $33 million. The fact that the aggregate market value of outstanding debt was almost the same after the buyback as it had been before indicates that there was practically no change in the amount that debt holders expected to extract from Bolivia.[14]

Proposition 3 raises potential concerns about the practice of using mark-to-market accounting for a firm's liabilities. The problem is that the market price is not independent of the firm's actions, especially actions related to changes in capital structure. If investors believe that the firm will not be buying back debt, the market price of the firm's debt securities will be $q(D, A)$, but the firm cannot use this mark-to-market price as a proper representation of all its opportunities, since it will not be the price at which it will be able to buy back its debt. As a monopsonist or a monopolist in the markets for its own securities, the firm should not take the prices of its securities as given and independent of its own actions.

3.3. Leverage "Addiction" as an *Ex Ante* Cost of Leverage

[14] For a detailed analysis of this episode, see Bulow and Rogoff (1990). In contrast, to the Bolivian buyback, the Brady plan for Mexico two years later relied on collective bargaining rather than a debt buyback through the market. It seems that in these negotiations, the private creditors were prevented from obtaining any windfalls from the international intervention in favor of Mexico; see van Wijnbergen (1991).

We have shown that debt overhang means that shareholders will not voluntarily recapitalize, even if a recapitalization increases firm value. This leads to the question why equity holders would take on debt levels that might lead to the problems created by debt overhang. What level of debt *D* will shareholders choose initially and what does the debt overhang mean for the dynamics of leverage?

We first observe that, by the logic of Modigliani and Miller (1958), the capital structure choice is only relevant to the *ex ante* value of the firm to the extent that it affects the impact of "frictions" that affect returns. These frictions include the taxes, bankruptcy costs and bailout subsidies we have considered above, as well as agency costs associated with different ways of funding. If expected net subsidies are increasing in the initial choice of leverage, then firm value is increasing with leverage, and there will incentives to increase leverage to very high levels. In that setting, capital requirements that restrict leverage will be binding for the firm. If expected net subsidies do not uniformly increase with leverage, the firm would choose the capital structure that maximizes firm value. As is well understood, this maximization would involve a tradeoff between concerns about bankruptcy and distress costs and concerns about taxes and other subsidies of debt.[15]

Once the debt is in place, shareholders generally have incentives to dilute the value of existing debt by issuing debt of equal or higher seniority, including for example debt of shorter maturity. This is one of the conflicts of interest between equity and existing debt. This phenomenon, and the resulting "maturity rat race" that it induces (see Bizer and DeMarzo (1992) and Brunnermeier and Oehmke (2012)) occurs when shareholders cannot commit ex ante to avoid increasing leverage in this way, and might be alleviated by debt covenants.

From an ex ante perspective, debt holders who understand that they can be diluted by shareholder actions can respond in two ways: they can insist on debt covenants aimed at preventing the dilution (e.g., requirements that future debt issuance be junior to existing debt) and they can factor in the potential for dilution into the price they are willing to pay for the firms' debt.

Our results in the previous subsections suggest additional observations about the dynamics of debt and the agency costs associated with high leverage. Specifically, suppose that

[15] See, for example, Berk and DeMarzo, *Corporate Finance*, pp. 520-522.

after the initial choice of capital structure, circumstances change so that the capital structure that maximizes the total value of the firm (taking into account all frictions) involves higher leverage, i.e., additional borrowing. In that case, if covenants did not prevent such a change, shareholders would certainly choose to increase leverage. The debt holders are likely to lose because the default probability will be higher, even though the value of the total firm is increased.

However, because of the debt overhang effect, shareholders respond differently if instead of an increase in leverage, changes in the optimal capital structure for the firm involve a *reduction in* leverage. In that case shareholders will resist the change. There is typically little that debt holders can do to force a recapitalization plan that reduces leverage. It is therefore possible that debt holders would lose and the total value of the firm would decline because of the resistance of shareholders to recapitalization.

This asymmetry has implications for the *ex ante* choice of debt and the value of a commitment to recapitalize. Specifically, if the effect of debt overhang that leads to shareholders being resistant to beneficial recapitalizations is reflected in the pricing of the initial debt, then the initial debt becomes more expensive. Put another way and applied in the context of bank capital regulation, the total value of banks, *net of the value of bailout subsidies,* can be increased when regulators force banks to recapitalize because, in effect, the regulators can create a commitment technology that allows banks to overcome the debt overhang agency problem that would otherwise prevent beneficial recapitalizations. In other words, assuming there are no bailout subsidies but there are bankruptcy costs (that are incurred by the firm), regulators who force the firm to recapitalize might enhance its ex ante value by allowing it to raise debt at a lower price than it could absent a way to commit to such recapitalizations.

3.4. Externalities and the Social Cost of Excessive Leverage

Whereas the preceding discussion had focused on the joint interests of shareholders and debt holders, we now turn to a more general welfare analysis. Thus far, we have only focused on the net cost of default to the firm itself. The event of default may also impose real costs or benefits on parties other than the firm's investors. For example, the firm's partners may need to write off relationship-specific investments, or "contagion" effects may cause other firms to enter

financial distress and incur corresponding costs.[16] On the other hand, some parties may stand to benefit if the firm defaults (e.g., lawyers may earn rents from legal fees).[17] We denote by $e(xA, D, s)$ the expected net third-party external costs associated with bankruptcy, where we assume $e(xA, D, s) = 0$ if there is no default. The total expected real welfare costs associated with bankruptcy are therefore $b(xA, D, s) + e(xA, D, s)$.[18]

Any subsidies $s(xA, D)$ are a transfer from the government and have no "direct" welfare implications, but since they lead to a number of potential distortions, they can have very significant indirect welfare implications. As discussed in Admati et al. (2010), subsidies can lead to inefficient investment, excessive risk taking, and other distortions. In addition, the taxes that serve to finance these subsidies may have significant distortionary effects. For simplicity, we assume that the costs of all these distortions are proportional to the amount of the transfer. The cost of the transfer is therefore given as $(1+\lambda)s(xA, D)$, which exceeds the benefit $s(xA, D)$ to the firm.

Suppose the government determines the bailout subsidy s with a view to maximizing welfare by reducing or eliminating the social costs associated with default. Then we can think of $s(xA, D)$ as the subsidy level that minimizes the total social cost:

$$s(xA, D) = \arg\min_s \left[\lambda s + b(xA, D, s) + e(xA, D, s)\right]. \tag{8}$$

Given the government's intervention rule, the overall expected surplus from the firm is given as:

$$w(A, D) = \int \left(xA - c(xA, D)\right) \mathrm{d}F(x), \tag{9}$$

where $c(xA, D) = \min_s \left[\lambda s + b(xA, D, s) + e(xA, D, s)\right]$. The following result is immediate:

[16] The former is particularly important when the defaulting firm is a bank whose loan clients may not immediately find another lender with as much information about them and as much confidence in them.

[17] In a multi-period setting, one might also think of other firms gaining from the disappearance of the firm as a competitor.

[18] As an example, consider legal fees of bankruptcy. Total legal fees would be included in $b(A, D, s)$. However, a portion of those legal fees might represent excess rents above and beyond the opportunity cost of the labor input. These rents would appear as a benefit in $e(A, D, s)$. Thus, $b(A, D, s) + e(A, D, s)$ would just measure the dead weight cost of the labor input. The excess rents, which are a transfer, would cancel out.

Proposition 4 (Social Cost of Resistance to Recapitalization): *If expected default costs and expected third-party costs are increasing in the amount of debt outstanding, then a recapitalization and debt buyback raises the overall expected surplus from the firm.*

Proof: Note that

$$w(A, D-\Delta) - w(A, D) = \int \left(c\left(xA, D\right) - c\left(xA, D-\Delta\right)\right) \mathrm{d}F\left(x\right), \tag{10}$$

and by the envelope theorem, $c(xA, D)$ is increasing in D. ■

A comparison of Propositions 2 and 4 highlights the difference between the private perspective of the firms' shareholders and debt holders and the overall welfare perspective. In Proposition 2, we required that bankruptcy costs outweigh subsidies. The conclusion of Proposition 2 is reversed, i.e., a recapitalization and debt buyback *lowers* the combined wealth of shareholders and debt holders, if the bailout subsidies from the government exceed bankruptcy costs, e.g., if $s(xA, D) = D - xA$, so that default is avoided altogether. In this case, shareholders and debt holders together would refuse a recapitalization, even in collective bargaining, and even if it were socially efficient.

To appreciate the externality, it is useful to rewrite the expected surplus from the firm as:

$$V^F(D, A) - \int \left((1+\lambda) s(xA, D) + e(xA, D, s(xA, D)) - t(x, A, D) \right) \mathrm{d}F(x). \tag{11}$$

The overall surplus from the firm is equal to the difference between its contribution to wealth of shareholders and debt holders and the costs of default that are imposed on the government and on third parties net of taxes paid. This latter externality accounts for any difference between the results of collective bargaining of shareholders and debt holders and the results of welfare maximization. In the absence of collective bargaining, of course, as shown in Proposition 1, even the benefits of recapitalization for shareholders and debt holders jointly would not be realized.

4. Alternative Ways to Reduce Leverage

Up to this point, we have restricted our attention to the costs and benefits of adjusting leverage by a pure recapitalization in which the firm issues equity and uses the proceeds to

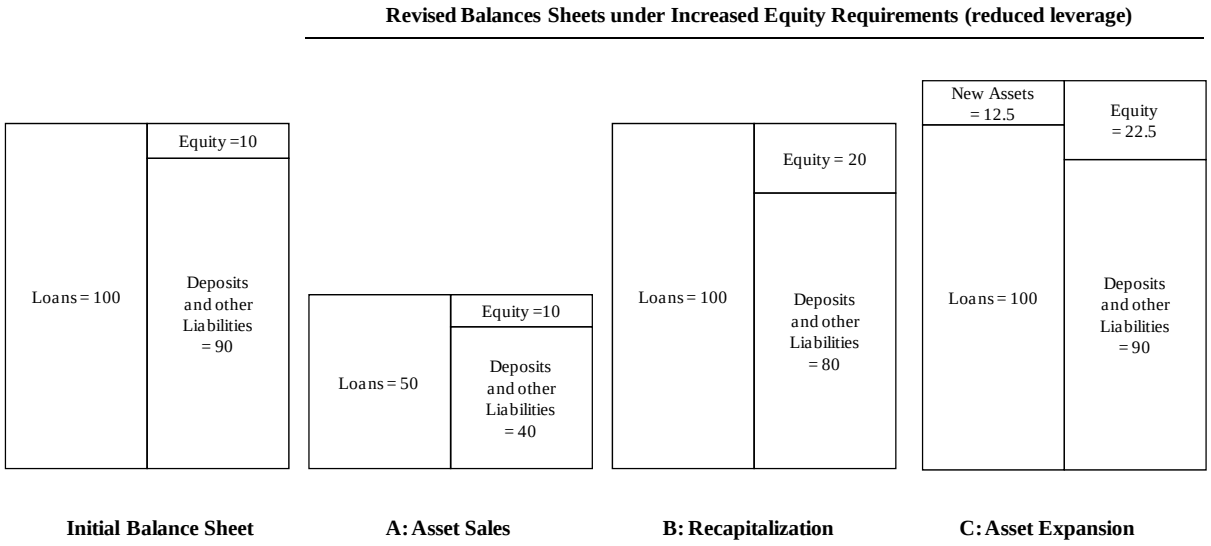
repurchase outstanding debt. In such a transaction, the scale of the firm and the assets on its balance sheet are unchanged.

However, a pure recapitalization is not the only method available to reduce leverage. Leverage can also be changed through adjustments to the scale of the firm's assets. For example, consider the following alternative transactions:

- **Asset Sales** (so-called "deleveraging"): The firm sells assets and uses the proceeds to repurchase debt, thus lowering leverage without issuing new equity.
- **Asset Expansion:** The firm issues equity and uses the proceeds to buy additional assets, thus lowering leverage without repurchasing debt.[19]

In Figure 1 we illustrate how leverage can be reduced using each of the three responses. We assume that the ratio of debt to assets must be reduced from 90% to 80%. As the figure shows this can be accomplished by selling half of the firm's assets (asset sales), issuing equity equal to 10% of the firm's assets and using the proceeds to buy back debt (recapitalization), or issuing equity equal to 12.5% of the firm's assets and using the proceeds to invest in new assets (asset expansion).

Figure 1: Alternative Responses to Increased Equity Requirements



[19] Asset expansion was the subject of the original analysis of debt overhang in Myers (1977). Myers shows that because existing debt holders capture some of the benefit of the new investment via reduced credit risk, shareholders may refuse to undertake a new positive NPV investment project.

In Admati et al. (2010) we observed that increased capital requirements do not force banks to reduce bank lending because they do not require that banks shrink. Increased capital requirements can be met either through recapitalization (B) or asset expansion (C), which either leave the size of the bank unchanged or increase it. The analysis below complements Admati et al (2010) by examining *the incentives of shareholders* in choosing one course of action over the others. Understanding the incentives of shareholders is important in assessing the effects of imposing minimum capital (equity) requirements for firms, and in particular determining whether capital requirements will induce banks to deleverage via asset sales.

4.1 Asset Sales and Expansions

The different approaches to reducing leverage involve different asset levels. Let D_0 be the current face value of debt and A_0 be the level of assets for the firm, so that $\delta_0 = D_0 / A_0$ is its current debt-asset ratio. Suppose that firm is required to reduce its debt-asset ratio to $\delta_1 < \delta_0$. If the firm can choose any combination of debt and assets (D_1, A_1) satisfying this debt-asset ratio – i.e., such that $D_1 = \delta_1 A_1$ – which combination will shareholders prefer?

If $A_1 \neq A_0$, then assets will be either sold or purchased as part of the recapitalization. We assume that the assets are perfectly homogeneous, so that each unit of the assets today will generate a payoff of $\tilde{x}$ in the future. (We comment on the more general case in the concluding remarks.) We also assume that the frictions we have considered (taxes, bankruptcy costs and subsidies) are homogenous with firm size. Letting $\delta = D / A,$ we assume that for all (A, D), we have

$$t(x, A, D) = t(x, 1, \delta) A \quad \text{and} \quad n(xA, D) = n(x, \delta) A. \tag{12}$$

Using the expressions for the value of debt and equity in Section 3, we see with homogenous assets and homogeneous frictions, the total enterprise value of the firm (equity plus debt) is proportional to its asset holdings and is given by:

$$
\begin{aligned}
V(A,D) &= \int_{\delta}^{\infty} xA - t\left(x,A,D\right)\mathrm{d}F\left(x\right) + \int_{0}^{\delta} xA - n(xA,D)\ \mathrm{d}F\left(x\right) \\
&= \left[\int_{0}^{\infty} x\,\mathrm{d}F\left(x\right) - \int_{\delta}^{\infty} t\left(x,1,\delta\right)\mathrm{d}F\left(x\right) - \int_{0}^{\delta} n(x,\delta)\ \mathrm{d}F\left(x\right)\right]A \\
&\equiv \nu(\delta)A
\end{aligned}
\tag{13}
$$

The homogeneity of the firm's assets also implies that the average price of the firm's debt, which we denote by $q\left(\delta\right)$, depends only on the leverage ratio $\delta = D/A$:

$$
\begin{aligned}
q\left(\delta\right) &= q\left(\frac{D}{A}\right) \\
&= \frac{V^{D}(D,A)}{D} = \int_{D/A}^{\infty} \mathrm{d}F\left(x\right) + \int_{0}^{D/A} \frac{xA - n(xA,D)}{D}\ \mathrm{d}F\left(x\right) \\
&= \int_{\delta}^{\infty} \mathrm{d}F\left(x\right) + \frac{1}{\delta}\int_{0}^{\delta} x - n(x,\delta)\mathrm{d}F\left(x\right)
\end{aligned}
\tag{14}
$$

Recall from Section 4 that if the firm has a single class of debt outstanding, it will be forced to pay the price $q\left(\delta_1\right)$ to repurchase its outstanding debt in the market (as this price is the value of the debt to a bondholder who refuses to tender). Thus, to reduce its debt level to $D_1 \le D_0$, the firm must spend $q\left(\delta_1\right)\times\left(D_0 - D_1\right)$ on debt repurchases.

Assume that the price at which the firm will be able to buy or sell assets is p. It follows that to move from an initial balance sheet (D_0, A_0) to the new balance sheet (D_1, A_1) with $D_1 \le D_0$, the amount of equity the firm must issue is:

$$
\text{New Equity Issued } = N = p\times\left(A_1 - A_0\right) + q\left(\delta_1\right)\times\left(D_0 - D_1\right) \tag{15}
$$

On the other hand, the total change in the firm's equity value from the transaction is given by:

$$
\text{Change in Total Equity Value } = \Delta V^{E} = V^{E}(D_1,A_1) - V^{E}(D_0,A_0) \tag{16}
$$

We can therefore determine the effect of the leverage change on existing shareholders by subtracting (15) from (16); specifically, the gain or loss for new shareholders is given by $\Delta V^E - N$.

We are now in a position to evaluate the effect on existing shareholders from alternative methods of reducing leverage. Recall that in a pure recapitalization, there is no change to the firm's assets $(A_1 = A_0)$. With pure asset sales, all reductions in debt are financed by asset sales, so that $N = 0$. In a pure asset expansion, no debt is repurchased so that $D_1 = D_0$.

We can now ask whether shareholder losses differ across these or other intermediate scenarios. As one would expect, the answer depends, among other things, on the relation between the price of the assets and their expected rates of return. Recall from (13) that

$$v(\delta_1) = \int_0^{\infty} x \, \mathrm{d}F(x) - \int_{\delta_1}^{\infty} t(x, 1, \delta_1) \, \mathrm{d}F(x) - \int_0^{\delta_1} n(x, \delta_1) \, \mathrm{d}F(x), \tag{17}$$

is the expected payoff of the assets net of taxes and of (net) default costs. If $p = v(\delta_1)$ then the Net Present Value (NPV) of asset sales and purchases is zero. If $p < v(\delta_1)$ then the NPV of asset purchases is positive, and if $p > v(\delta_1)$ then the NPV of asset sales is positive.

Proposition 5 (An Irrelevance Result): *If $p = v(\delta_1)$ and if there is only one class of debt, then shareholders find pure recapitalization, asset sales, and asset expansion equally undesirable. Specifically, starting from the initial position (D_0, A_0), shareholder losses are equal to $\left(q(\delta_1) - q(\delta_0)\right) \times D_0 + \left(v(\delta_0) - v(\delta_1)\right) A_0$ for all (D_1, A_1) with $D_1 = \delta_1 A_1 \le D_0$.*

Proof: After the change, the total value of equity will be:

$$V^E(A_1, D_1) = v(\delta_1) A_1 - q(\delta_1) D_1. \tag{18}$$

Therefore,

$$\Delta V^E = \left(v(\delta_1) A_1 - q(\delta_1) D_1\right) - \left(v(\delta_0) A_0 - q(\delta_0) D_0\right). \tag{19}$$

Thus, the total change in value for existing shareholders is

$$\begin{aligned}\Delta V^E - N &= \left(\nu(\delta_1)A_1 - q(\delta_1)D_1\right) - \left(\nu(\delta_0)A_0 - q(\delta_0)D_0\right) \\ &\quad - p(A_1 - A_0) - q(\delta_1)(D_0 - D_1) \\ &= \left(\nu(\delta_1) - p\right)A_1 - \left(q(\delta_1) - q(\delta_0)\right)D_0 - \left(\nu(\delta_0) - p\right)A_0 \\ &= -\left(q(\delta_1) - q(\delta_0)\right)D_0 - \left(\nu(\delta_0) - \nu(\delta_1)\right)A_0.\end{aligned} \tag{20}$$

Since this does not depend on either A_1 or D_1, it is the same for all changes that lead to a given reduction in the leverage ratio, proving the result.■

While perhaps surprising, the intuition for this result is straightforward. If asset and security sales or purchases have zero NPV, they cannot change the total value of the firm. Because debt holders gain from the decline in leverage, the shareholders must lose an equal amount. The gain for debt holders is determined by the change in the average price of the debt, which depends only on the change in the firm's leverage ratio. All of this is captured in the first term in the last line of (20). The second term represents losses on the value of existing assets due to changes in tax benefits, bankruptcy costs or subsidies resulting from the reduction in leverage

Now assume that $p = \nu(\delta_1) + \theta.$ If $\theta > 0$, the market price for assets exceeds the value of those assets if they are held by the firm. If $\theta < 0$, then the firm can generate value by purchasing assets at the market price and holding them. The change in shareholder value becomes:

$$\Delta V^E - N = -\left(q(\delta_1) - q(\delta_0)\right)D_0 - \left(\nu(\delta_0) - \nu(\delta_1)\right)A_0 - \theta(A_1 - A_0), \tag{21}$$

which clearly is not independent of A_1. The third term shows that shareholders capture the NPV given by θ on asset sales and the NPV given by $-\theta$ on asset purchases. If $\theta < 0$, the firm will want to expand and if $\theta > 0$, the shareholders will prefer that the firm reduce its leverage through asset sales.

In this analysis, we have taken the asset price as given because the individual firm or bank is assumed to be a price taker. However, in the context of bank capital requirements, the change concerns all banks. Even though the individual bank takes the market price of assets as given, the equilibrium market price must react to the change in aggregate behavior that is induced by the change in regulatory requirements.

Suppose the initial capital requirements correspond to the debt-asset ratio δ_0 and the initial equilibrium asset price was equal to $p_0 = \nu(\delta_0)$, the price at which banks with the debt-asset ratio δ_0 would just be indifferent about their asset holdings. Now suppose capital requirements are tightened, so that leverage must fall to δ_1, and that, because of a reduction in tax benefits and subsidies net of bankruptcy costs, we have $\nu(\delta_1) < \nu(\delta_0)$. Then, at the price $p_0 = \nu(\delta_0)$, all banks want to respond to the new requirement by selling assets to buy back debt. Unless there are third parties wanting to hold assets at this price, the asset price $p_0 = \nu(\delta_0)$ will no longer clear the market. The new equilibrium price of the asset must be lower. Indeed, if there are no third parties wanting to hold the assets, the new equilibrium price will be $p_1 = \nu(\delta_1)$.

In this discussion, we have assumed that the leverage regulation involves a debt-asset ratio D/A, which is fixed without regard to prices. In practice, capital regulation relies on values, imposing a lower bound on a ratio such as $q(\delta_1)D/p_1A$. If δ_1 has to be equal to $q(\delta_1)D/p_1A$, then, because $q(\delta_1) > q(\delta_0)$ and $p_1 < p_0 = \nu(\delta_0)$, the deleveraging effect is rather larger than it would be if δ_1 had to be equal to D/A. With a leverage ratio fixed in terms of values, rather than quantities, the effect of deleveraging is exacerbated.

4.2 The Case of Multiple Classes of Existing Debt

In this section we consider shareholder preferences in responding to a requirement that leverage be reduced when not all debt has the same priority. We continue to assume that the assets returns and the frictions are perfectly homogenous with firm size, but we now assume that the firm has multiple classes of *existing* debt with different levels of priority. In this case, if $D_1 < D_0$, it is optimal for the firm to repurchase the most junior debt first, as it will be the least expensive. For simplicity, we will assume that all of the debt that is repurchased is junior to the debt that remains after the transaction. Because a junior debt holder who does not tender will not be paid until after the remaining debt D_1 is fully repaid, the junior debt can be repurchased at the price

$$
\begin{aligned}
q^J(\delta) &= \int_{\delta}^{\infty} \mathrm{d}F(x) \\
&< \int_{\delta}^{\infty} \mathrm{d}F(x) + \frac{1}{\delta}\int_{0}^{\delta} x - n(x,\delta)\mathrm{d}F(x) \;= q(\delta).
\end{aligned}
\tag{22}
$$

The fact that junior debt is cheaper to repurchase breaks our earlier indifference result that held when $p = \nu(\delta_1)$. Now, shareholders will be better off the more (junior) debt that is repurchased. In particular, we have the following important result:

Proposition 6 (Multiple Classes of Existing Debt): *Assume* $p = \nu(\delta_1)$. *Then*

i. If the firm can repurchase junior debt, shareholders find asset sales preferable to a pure recapitalization, which in turn is preferable to an asset expansion.

ii. In the case of asset expansion, the ability to purchase junior debt makes no difference.

iii. In the case of a pure recapitalization the shareholders lose less with the ability to repurchase junior debt than they lose when there is only one debt class, but they still lose.

iv. In the case of asset sales, shareholders may gain if the reduction in leverage is sufficiently small.

Proof: As before we have $\Delta V^E = \left(\nu(\delta_1)A_1 - q(\delta_1)D_1\right) - \left(\nu(\delta_0)A_0 - q(\delta_0)D_0\right)$, but given the lower cost $q^J(\delta_1)$ of repurchasing the junior debt, the total change in value for existing shareholders is:

$$
\begin{aligned}
\Delta V^E - N &= \left(\nu(\delta_1)A_1 - q(\delta_1)D_1\right) - \left(\nu(\delta_0)A_0 - q(\delta_0)D_0\right) \\
&\quad - p\left(A_1 - A_0\right) - q^J(\delta_1)\left(D_0 - D_1\right) \\
&= \left(\nu(\delta_1) - p\right)A_1 - \left(\nu(\delta_0) - p\right)A_0 - \left(q(\delta_1) - q(\delta_0)\right)D_0 \\
&\quad + \left(q(\delta_1) - q^J(\delta_1)\right)(D_0 - D_1) \\
&= -\left(q(\delta_1) - q(\delta_0)\right)D_0 - \left(\nu(\delta_0) - \nu(\delta_1)\right)A_0 + \left(q(\delta_1) - q^J(\delta_1)\right)\left(D_0 - D_1\right)
\end{aligned}
\tag{23}
$$

Since $q(\delta_1) > q^J(\delta_1)$, the shareholders' loss is lower the more junior debt that is repurchased, i.e., the greater is $\left(D_0 - D_1\right)$. Since for a pure asset expansion we have $D_0 = D_1$, the shareholder

loss is identical to that in the case of a single debt class. For a pure recapitalization, $(D_0 - D_1) > 0,$ and for the case of asset sales $(D_0 - D_1)$ is even larger. This establishes that with the ability to repurchase junior debt shareholders prefer asset sales over recapitalization and recapitalization over expansion. From Proposition 2 we know that shareholders lose in a pure recapitalization even if they are able to repurchase junior debt. To show that shareholders may gain with asset sales if they can repurchase junior debt, we consider the case in which there are no frictions. Since in a pure asset sale the proceeds from the sale are used solely to repurchase junior debt, we know that $N = 0$. This means that

$$p \times (A_0 - A_1) = q^J(\delta_1)(D_0 - D_1) = q^J(\delta_1)(\delta_0 A_0 - \delta_1 A_1) \tag{24}$$

or

$$A_1 = \frac{p - \delta_0 q^J(\delta_1)}{p - \delta_1 q^J(\delta_1)} A_0. \tag{25}$$

From (23) and assuming no frictions we can derive the following:

$$\Delta V^E - N = -A_0 \int_{\delta_1}^{\delta_0} (\delta_0 - x)\, dF(x) + (A_0 - A_1) \int_0^{\delta_1} x dF(x). \tag{26}$$

Substituting the expression for A_1 in (25) into (26), we find the shareholders will gain in a pure asset sale $(\Delta V^E - N > 0)$ if and only if

$$\begin{aligned} \frac{q^J(\delta_1)}{p - \delta_1 q^J(\delta_1)} \int_0^{\delta_1} x dF(x) &= \frac{q^J(\delta_1)}{\nu(\delta_1) - \delta_1 q^J(\delta_1)} \int_0^{\delta_1} x dF(x) \\ &> \frac{1}{\delta_0 - \delta_1} \int_{\delta_1}^{\delta_0} (\delta_0 - x)\, dF(x), \end{aligned} \tag{27}$$

which, since $\nu(\delta) > \delta q^J(\delta)$, holds for δ_1 sufficiently close to δ_0.■

This also may explain why shareholders would choose to engage in asset sales or "deleveraging" (as opposed to recapitalization or asset expansion) if a decrease in leverage is imposed by regulation and there are no covenants protecting senior debt holders. In this case, if the proceeds of a sale of assets are used to buy back junior debt and perhaps make payouts to

equity, the senior debt holders lose to the benefit of the shareholders. Shareholders therefore prefer this over a pure recapitalization or asset expansion.

Note that in our analysis of asset expansion we have assumed that $A_1 = D_0 / \delta_1$ so that $D_1 = \delta_1 A_1 = D_0$. Increasing assets further would necessitate issuing new debt in order to achieve the target leverage ratio δ_1. If this new debt could be issued at an equal priority to the firm's existing debt (so that it would command the same average price), asset expansion with $A_1 > D_0 / \delta_1$ will be no more costly than it is with $A_1 = D_0 / \delta_1$. In many cases, however, any new debt would be required to be junior to the existing debt. In this case, it would command a lower price, and additional asset purchases beyond $D_0 \times (1/\delta_1 - 1/\delta_0)$ would impose further losses on shareholders. In other words, we have the following straightforward extension of Myers (1977) debt overhang result:

Proposition 7 (Asset Expansion with Additional Debt): *Assume* $p = v(\delta_1)$. *If* $D_1 = \delta_1 A_1 > D_0$ *then:*

i. *shareholders are indifferent to any choice of* A_1 *if the new debt is of equal seniority to existing debt;*
ii. *if new debt must be junior to existing debt, then shareholders are worse off choosing* $A_1 > D_0 / \delta_1$*; and*
iii. *if new debt can be senior to existing debt, then choosing* $A_1 > D_0 / \delta_1$ *makes shareholders better off.*

Proof: By the same logic as the prior result, if q_1^E is the post transaction price of the firm's existing debt, then shareholder losses are given by $\left(q_1^E - q(\delta_0)\right) \times D_0$. If new debt is equal priority to existing debt, then $q_1^E = q(\delta_1)$ for any level of A_1 and $D_1 = \delta_1 A_1$. But if new debt is junior to existing debt and $A_1 > D_0 / \delta_1$, then $q_1^E = q\left(\frac{D_0}{A_1}\right) > q(\delta_1)$ and this is increasing in A_1 Alternatively, if new debt is senior to existing debt, q_1^E will be less than $q(\delta_1)$. ■

This result extends Proposition 5 by showing that that irrelevance to scale continues to hold if new debt is of equal seniority to existing debt. Shareholders would not choose to expand if any of the new debt issued must be junior to existing debt. An interesting case is one where the new debt can be senior to existing debt. This case might be relevant for banks, which rely on significant amounts of short term debt. Short term debt is effectively senior to the bank's long-term debt. Proposition 7 suggests that shareholder losses are *decreasing* in the scale of the firm in this case. This suggests that if new debt can be senior, shareholders might prefer asset expansion beyond even the level of balance sheet C in Figure 1.

In the above discussion, we have taken the asset price as given. As in the analysis of Section 4.1, this is appropriate if we consider the reaction of a single bank to a requirement that leverage be reduced, but may be inappropriate if many banks are responding to such a requirement at the same time. In the latter case, again, some price change is to be expected. A precise prediction about the new equilibrium price is difficult to make, because the different banks' reactions can be quite different depending on their debt structures.

5. Concluding Remarks

We have analyzed the incentives of shareholders in a firm that has debt in place and must reduce its leverage. We have shown that, because of a debt overhang effect, shareholders generally resist reductions in leverage, as such reductions transfer value to creditors (or others) by making the debt safer. In this section we summarize our results and discuss their policy implications.

Summary of Results

Our analysis has shown that, once debt is in place, shareholders (and managers working on their behalf) will find recapitalizations that involve issuing new equity and using the proceeds to buy back debt costly; they will resist recapitalizations even when the combined value of debt and equity would increase. However, in many cases shareholders will want to *increase* leverage when not constrained by covenants and regulations. This asymmetry in shareholder preferences gives rise to a ratchet effect in which leverage tends to increase and is "addictive." Since this dynamic can lead to inefficient outcomes, except for the possible effect of subsidies, shareholders would benefit if they had the ability to commit in advance to recapitalizations that would in the future increase firm value.

Debt overhang also has additional *social* costs when distress or insolvency have negative external effects on third parties. This means that there would be additional *social* benefits to a reduction in leverage.

In addition to pure recapitalization, we consider two other ways by which leverage can be reduced. One approach contracts the firm through asset sales whose proceeds are used to buy back debt. Another expands the firm by issuing new equity and using the proceeds to buy additional assets. In both of these alternative approaches the scale of the firm is changed. We show that if there is one class of debt and if asset and security are properly priced such that the net present value of asset sales or expansion is zero, shareholders find asset sales, pure recapitalization, and asset expansion equally undesirable. However, there are conditions under which shareholders will have strict preferences for one approach over the others. For example, if there are multiple classes of debt and reduced leverage can be achieved by buying junior debt, then asset sales will generally be considered preferable even when scale reductions do not by themselves generate value. In this constellation, repurchases of junior debt that are financed by asset sales imply a wealth transfer from senior debt holders to shareholders. This preference for asset sales, or "deleveraging," can persist even if such sales are inefficient and reduce the total value of the firm.

Debt Overhang vs. Asymmetric Information

The literature on attitudes towards equity issuance has been primarily influenced by the analysis of Myers and Majluf (1984), which considers a firm's choice of funding when there is asymmetric information between managers and investors about the firm's prospects. With asymmetric information, firms with good return prospects may refrain from issuing new shares to raise funds for investments because management expects the market to price the new shares according to its expectations of some average prospects. Management, acting on behalf of incumbent shareholders, would resist the implied loss or "dilution" to incumbent shareholders that would result from equity issuance. Because markets take this adverse-selection into account, the pricing of new shares would be all the more unfavorable. Asymmetric information concerns,

if present, would tend to increase shareholders' resistance to leverage reductions that involve the issuance of new equity.[20]

There are several reasons to doubt that the adverse selection effect is of first-order importance. First, adverse selection costs do not apply if equity is built through retained earnings or rights offerings. Second, the adverse-selection argument presumes that managers of the firm in question have discretion with respect to equity issuance. Capital regulation that reduces this discretion would limit the scope for adverse selection and lower any costs. Finally, if equity issuance is mandated by regulators, the dilution costs for incumbent shareholders in banks with above-average prospects should be matched by the gains to shareholders of banks with below-average prospects. In this case the effect of equity issuance on shareholders will be heterogeneous across the industry.[21]

While the effect of asymmetric information creates different incentives across banks depending on their perceived prospects, the effect of debt overhang discussed in this paper results in a *uniform* resistance by *all* bank managers to equity issuance that reduces leverage. This opposition is reinforced by the loss of subsidies that might accompany leverage reductions, and by managerial compensation that creates a focus on return on equity (ROE).

The banking industry and some in the legal community question the appropriateness of regulatory intervention infringing the autonomy of corporate decision making. References to the effect of equity issuance with asymmetric information as in Myers and Majluf (1984) are put forward with the undertone that it would be "unfair" to force incumbent shareholders to issue new equity if this leads to the dilution of equity in banks with above-average return prospects when the quality of these prospects is not reflected in share prices.

In discussing any issue of "fairness" it must be remembered that when leverage is high, debt overhang problems of the sort we have discussed in this paper, and other agency problems associated with debt, can be severe. These problems arise from conflicts of interests, which in the case of banks involve the public interest. As a result, there will be winners and losers whatever action regulators take (or do not take). Since regulators are charged with promoting the public

[20] For applications of the Myers-Majluf argument to the debate about capital requirements for banks, see Kashyap, Hansen, and Stein (2010) and Bolton and Freixas (2006).

[21] Of course, managers always have incentives to claim that their shares are underpriced, and not overpriced., no matter what their information actually is.

good, they must take into account all parties. Fairness considerations should not be focused on the narrow perspective of undiversified bank shareholders and their managers.

In nonfinancial firms, which are not generally supported by the government safety net, creditors protect themselves through covenants that give them legal rights, and through the legal system. When the government safety net is present, creditors no longer have strong incentives to protect themselves in this way, since many of the risks have been transferred to the government and its taxpayers. This means that regulators have the responsibility of ensuring that the taxpayers and the public are protected and fairly treated.

To the extent that capital requirements apply to the banking industry as a whole, or even to just "systemically important" financial institutions, shareholders with diversified portfolios are in fact likely to be helped rather than harmed by high equity requirements, because the risks imposed by the large banks on the system and the economy affect their other holdings and affect them as taxpayers. The main beneficiaries from resisting industry-wide reductions in leverage would seem to be bank managers.

Heterogeneous Assets and Risk Weights

Our analysis of shareholders' response to requirements to reduce leverage was based on a model where assets are homogeneous. In that case, asset sales and purchases only change the scale of the firm, but not the risk of the debt for any given level of leverage. If assets are heterogeneous, and particularly if they differ in their contribution to the overall risk of the assets, shareholders will generally have preferences with respect to which assets to sell or purchase. If a firm deleverages through asset sales, shareholders prefer to sell relatively safe assets, while they would prefer to purchase relatively risky assets if the firm expands. This is a manifestation of the classic "risk shifting" problem that arises with high leverage, where shareholders have incentives to increase risk to benefit themselves at the expense of debt holders or of taxpayers bailing the debt out. Capital regulation under Basel II and Basel III attempts to address this problem by assigning risk weights to assets. In practice, however, this approach is very problematic. For example, the regulation often stipulates inappropriate risk weights, e.g., a zero risk weight for government debt or to highly rated securities even when they clearly carry some potentially significant risk. Other problems are due to the fact that the implementation of the risk weighting system relies on the banks' own internal risk models and is therefore highly manipulable. In

response to recent increases in capital requirements, banks were reported to engage in so-called "risk-weight optimization" or use creative accounting to appear better capitalized without actually reducing the risk they impose on the system.[22]

Debt Overhang and Asset Sales

As we have shown, there are a number of circumstances under which banks would choose to reduce leverage by selling assets and "shrinking," something we have recently observed some European banks doing. In addition to the considerations raised above, asset sales might also be the fastest way for banks to reduce leverage. As we saw in the financial crisis, simultaneous attempts to sell assets in a crisis situation can have a destabilizing effect. *The destabilizing effects of simultaneous deleveraging by asset sales would be greatly reduced if banks were much better capitalized*, because the required level of sales is much reduced when the initial leverage is much lower. (In other words, "deleveraging multiples" are much lower.) This is yet another benefit of higher equity requirements.

Onaran, (2011) argues that a number of banks in Europe and in the US are currently insolvent. Insolvent banks would find it difficult, and possibly impossible, to raise new equity from investors, and they may therefore have to resort to asset sales in order to appear sufficiently capitalized. *It is critically important for regulators to recognize hidden insolvencies and intervene in such cases*. As seen, for example, in the Savings and Loans crisis in the US in the 1980s, insolvent banks are subject to many distortions and might inflict additional costs on taxpayers.

Asset sales, and the accompanying shrinkage of bank balance sheets, can be socially beneficial. For example, subsidies associated with high leverage, and the resulting subsidized funding, can lead banks to become overly large and complex and encourage them to hold assets that would be uneconomical for them to hold absent the subsidies. If subsidies are reduced with leverage reduction, the allocation of assets in the economy might become more efficient as banks sell assets. An added benefit is that this would make banks smaller and less complex to manage,

[22] See, for example, "Banks turn to financial alchemy in search for capital," by Tom Braithwaite, *Financial Times*, October 24, 2011. Jamie Dimon, CEO of JP Morgan Chase is quoted in this story as saying that he intends to "manage the hell out of Risk Weighted Assets" to meet higher capital levels.) For a more detailed discussion of the problems associated with risk weights, see Hellwig (2010).

regulate and unwind.[23] If asset sales are considered undesirable, regulators should avoid giving banks full discretion as to how to reduce their leverage.

Debt Overhang and Bank Lending

Much of the policy debate and the literature on the effects of bank capital requirements on banks' activities have been focused on bank lending.[24] A key concern is that banks might choose not to make new loans that would support the economy. Our discussion of banks' choice to how to reduce leverage focused on asset sales. Such sales require markets in the assets. Asset sales are therefore likely to focus on marketable assets, not loans that have already been made, which the bank might have an advantage continuing to monitor. Not renewing loans, however, would be equivalent to the asset sales we discussed.

Banks' willingness to make new loans (and renew existing loans) would be affected by debt overhang in a manner consistent with the original Myers (1977) analysis of how debt overhang can lead to underinvestment. As noted in Admati et al. (2010), this is key to understanding the credit freeze in the financial crisis. Importantly, the problems due to debt overhang are more significant the higher is the leverage of the bank. If banks have significantly less leverage on an ongoing basis, lending contraction due to debt overhang would be less of a concern. The alleviation of debt overhang, and the better lending decisions that would follow, are indeed among the important benefits of higher capital requirements.

In the transition to better capitalizations, if policy makers are concerned with a reduction in lending, it again becomes key to reduce the discretion banks have to adjust their leverage. Rather than direct them to achieve a particular *ratio,* regulators should focus on reducing payouts that deplete equity, and possibly mandate specific amounts of new equity for banks to issue. Directing banks in this way would lead banks to have sufficient funds with which to make worthy loans, and prevent inefficient contraction.

The impact of capital requirements on new lending can be distorted by the use of risk weights that bias banks' decisions away from traditional lending. For example, bank managers compensated on the basis of ROE have strong incentives to bias their investments away from

[23] A concern often raised in this context is that the assets sold would be held by entities in the so-called "shadow banking system." This only highlights the importance of effective enforcement, something essential for any regulation to achieve its objective.

[24] See, for example, Bernanke and Lown (1991), Blum and Hellwig (1995).

lending and towards risky investments such as sovereign debt that have low regulatory risk weights but have a higher yield to compensate for their actual risk.

The Strong Case for Much Higher Bank Equity Requirements

Our analysis complements Admati et al. (2010) in highlighting the need to distinguish between social costs and private costs in determining appropriate public policy and regulation. As argued in Admati et al (2010), there are significant social benefits to high equity requirements. The current paper shows that debt overhang, a condition created by high leverage, can lead to additional distortions by generating resistance on the part of managers (and shareholders with concentrated holdings) to reductions in leverage, even when such reductions can increase the total value of the bank (absent subsidies), and bring about benefits to the public.

The resistance of bankers to higher capital requirements is easily explained by the debt overhang effect discussed in this paper, the lost subsidies associated with debt, and flawed, ROE-based compensation structures that give bankers direct incentives to prefer high leverage. Importantly, *none of these factors relate to any social costs*.

The analysis in this paper reinforces the conclusions of our previous paper that equity requirements significantly higher than those currently considered would provide large social benefits at little if any social cost. The studies that have been put forth to support the specific Basel III "numbers" are flawed. For example, by treating the required return on equity as fixed, or neglecting the inefficiencies, distortions and externalities that high leverage generates, the studies over-estimate the cost of equity requirements and ignore some of their benefits. [25]

At this point, even the Basel III proposals are not fully implemented anywhere. As noted in Miles et al (2011), there is a large asymmetry between capital ratios being too low, which exposes the economy to great risks, and having "too much" capital. Starting from the proposed Basel III numbers, namely 4.5%-7% "Tier 1 capital" relative to risk-weighted assets, and a minimum of 3% capital relative to *total* assets, there are significant social benefits, and essentially no social costs, as one moves toward higher equity ratios, particularly if regulators manage the transition in the public interest. For example, regulators should make sure banks

[25] For further discussion of this, see Admati et al. (2010) and Admati and Hellwig (2011).

build their equity capital through earnings retention, avoid cash payouts that deplete equity, and possibly issue new equity (such as through rights offering).

Conflicts of interests similar to those analyzed here give incentives to bank managers to make large cash payouts such as dividends and share buybacks that maintain high leverage and harm creditors and the public. Cash paid to shareholders or managers is no longer available to pay creditors. European countries whose banks are clearly in distress should have banned such payouts long ago. Similarly, recent decisions by the Federal Reserve to allow most large US banks to increase their payouts before even reaching Basel III levels were misguided. Some of these banks face significant risks and would impose large costs on the economy if they became distressed. By contrast, a useful approach was recently used by the Bank of England's Financial Stability Committee, which pressed UK banks to issue new equity in order to pay bonuses to executive, rather than using cash.[26]

To summarize, from the public's perspective, high equity requirements for banks bring about large benefits at essentially no relevant social cost. Banks funded with much more equity would be able to serve the economy better, without subjecting it to excessive risks and costs. From the public's perspective, much more equity for banks is a cost-effective way to increase the health and stability of the financial system and remove significant distortions. It should be a critical part of any financial reform.

[26] See "UK banks to issue new equity for bonuses," by Patrick Jenkins, Financial Times, March 4, 2012.

References

1) Admati, Anat R., Peter M., DeMarzo, Martin F. Hellwig and Paul Pfleiderer (2010), "Fallacies, Irrelevant Facts, and Myths in the Discussion of Capital Regulation: Why Bank Equity is Not Expensive," Rock Center for Corporate Governance at Stanford University Working Paper No. 86, Stanford Graduate School of Business Research Paper No. 2065, Max Planck Institute for Research on Collective Goods Preprint 2010/42. Available at http://www.gsb.stanford.edu/news/research/admati.etal.html (last revised March 2011)

2) Admati, Anat R., and Martin F. Hellwig (2011), "Good Banking Regulation Needs Clear Focus, Sensible Tools, and Political Will," Available at http://www.gsb.stanford.edu/news/packages/PDF/AdmatiHellwigGoodReg021412.pdf

3) Baron, David (1979) "Investment Policy, Optimality, and the Mean-Variance Model," *Journal of Finance*, Vol. 34, 207-232.

4) Basel Committee on Banking Supervision (2009), "Strengthening the Resilience of the Financial Sector," Consultative Document 164, Bank for International Settlements, December 2009, http://www.bis.org/publ/bcbs164.pdf

5) Basel Committee on Banking Supervision, (2010), "Calibrating regulatory minimum capital requirements and capital buffers: a top-down approach," Discussion Paper 180, http://www.bis.org/publ/bcbs180.pdf.

6) Berk, Jonathan and Peter DeMarzo (2011), *Corporate Finance*, Second Edition, Prentice Hall.

7) Bernanke, Ben S., and Cara S. Lown (1991), "The Credit Crunch", Brookings Papers on Economic Activity, 2, 205-247.

8) Bizer, and Peter M. DeMarzo (1992), "Sequential Banking," *Journal of Political Economy* 100, 41-61.

9) Blum, Jürg M., and Martin F. Hellwig (1995), "The Macroeconomic Implications of Capital Adequacy Requirements for Banks", *European Economic Review* 39, 739 – 749.

10) Bolton, Patrick and Xavier Freixas (2006), "Corporate Finance and the Monetary Transmission Mechanism," *Review of Financial Studies*, 19, 829-870.

11) Brunnermeier, M., and M. Oehmke (2012), "The Maturity Rat Race," *Journal of Finance*, Forthcoming.

12) Bulow, Jeremy and Kenneth Rogoff (1990), "Cleaning up Third-World Debt Without Getting Taken to the Cleaners," *Journal of Economic Perspectives* 4, 31-42.

13) Frenkel, Jacob A., Michael P. Dooley, and Peter Wickham (eds.) (1989), *Analytical Issues in Debt*, International Monetary Fund.

14) Grossman, Sanford J., and Joseph E. Stiglitz (1980), "Stockholder Unanimity in Making Production and Financial Decisions," *Quarterly Journal of Economics*, May1980, Vol. 94, 543-566.

15) Hellwig, Martin F. (2010), "Capital Regulation: Business as Usual?" Working paper, available at http://www.coll.mpg.de/pdf_dat/2010_31online.pdf

16) Kashyap, Anil, K., Jeremy C. Stein, and Samuel Hanson (2010), "An Analysis of the Impact of "Substantially Heightened" Capital Requirements on Large Financial Institutions," Working Paper, University of Chicago and Harvard University.

17) Miles, David, Jing Yang and Gilberto Marcheggiano (2011), "Optimal Bank Capital," Bank of England Discussion Paper.

18) Modigliani, Franco, and Merton H. Miller (1958), "The Cost of Capital, Corporation Finance, and the Theory of Investment," *American Economic Review* 48, 261-297.

19) Myers, Stewart C. (1977), "Determinants of Corporate Borrowing," *Journal of Financial Economics* 5, 147-175.

20) Myers, Stewart C. and Nicholas S. Majluf (1984), "Corporate Financing and Investment Decisions when Firms Have Information that Investors Do Not Have," *Journal of Financial Economics* 13, 187-222.

21) Onaran, Yalman, (2011), *Zombie Banks*, Bloomberg Press.

22) Van Wijnbergen, Sweder (1991), Mexico and the Brady Plan (with comments by Mervyn King and Richard Portes), *Economic Policy* 12, April 1991, 13 – 56.