The Leverage Ratchet Effect

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Abstract

We show that conflicts of interest with creditors lead shareholders to resist all forms of leverage reduction, even when reducing leverage would increase firm value. By contrast shareholders will generally favor increase in leverage, even if it destroys firm value. This leverage “ratchet effect” is present even under the perfect market conditions, but is exacerbated by standard frictions. Unlike theories based on asymmetric information, the leverage ratchet effect explains shareholders' resistance to earning retentions and rights offerings as ways to reduce leverage.

When forced to reduce leverage, by creditors or by regulation, firms can buy back debt using proceeds obtained either by selling assets or from issuing new equity. It can also purchase new assets funded by new equity. We present conditions under which shareholders are indifferent among these alternatives, considering all equally undesirable. We then analyze how various frictions affect shareholders’ choice among leverage-reduction methods.

Our results are particularly relevant to banking, where the ratchet effect is especially strong and not fully addressed by debt covenants. We highlight why effective capital regulation is important for constraining inefficiently excessive bank borrowing and offer insights to banks’ response to requirements specified in the form of leverage ratios.

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1. Introduction

Firms are often reluctant to issue new shares. For example, a firm experiencing financial distress can, as long as it is still solvent, reduce the costs of the distress by issuing new shares, but this is rarely seen. Banks and other financial institutions, which are sometimes required to reduce their leverage, either by market pressures or by regulation, appear more inclined to deleverage by selling assets even if this means that the assets are sold at “firesale” prices. Banks are among the most highly leveraged in the economy and seem particularly resistant to issuing new shares. They also actively resist rules that require retentions of earnings.

The resistance of shareholders and managers to issuing new shares is often explained by dilution costs induced by asymmetric information along the lines of Myers and Majluf (1984). The Myers-Majluf argument, however, is limited to new common share issues. It does not apply to new share issues that take the form of rights offerings, nor can it explain the resistance to earnings retentions. None of these involve shareholder losses from undervaluation in the market. Further, when leverage reductions are imposed by regulation, adverse selection becomes irrelevant. Any “dilution costs” for the shareholders of firms with above-average return prospects would be matched by benefits for the shareholders of firms with below-average return prospects.

In this paper we explain why the resistance of shareholders — and managers acting on their behalf — to reducing leverage is pervasive and applies to all forms of leverage reduction, not just those involving the issuance of new shares. Key to this resistance is a fundamental conflict of interest between shareholders and debt holders related to the debt overhang phenomenon introduced in Myers (1977). While Myers (1977) studied leverage-induced distortions in investment, we focus on the distortions created by high existing leverage on future leverage choices.

We refer to the resulting force as the leverage ratchet effect: once they are highly indebted, firms will avoid value-improving leverage reductions and may be induced to increase leverage even when it reduces total firm value. Moreover, we show that when such firms are forced to reduce leverage, either by covenants or regulations, they will often choose to do so in inefficient ways, such as liquidating assets (possibly even at fire sale prices) rather than simply recapitalizing (for example by retaining earnings or a rights offering). The behavior of heavily indebted firms such as banks, which often make payouts to shareholders and avoid all forms of leverage reduction, including rights offerings, is consistent with our analysis and inconsistent with theories relying only on asymmetric information.

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1 See for example Bolton and Freixas (2006) and Kashyap, Stein, and Hansen (2010).
2 Indeed, Myers and Majluf (1984) emphasize that, with the information asymmetries they consider, raising funds by retaining earnings should be preferred to new borrowing.
3 In other words, removing discretion also mitigates any negative signal associated with recapitalizations (see Admati et al (2013, Section 6) and Kashyap, Hansen and Stein (2011, p. 10)). Of course, managers might want to protest increased equity requirements in an attempt to show that their firm is undervalued in the market. However, relative to the average prices, some firms are actually overvalued by investors, and their informed managers may well know it.
The leverage ratchet effect suggests that, absent strict covenants to the contrary, firms will tend to increase leverage when changes to the tax code make borrowing more attractive, but will resist decreasing their leverage when the tax advantage of debt over equity is reduced. The effect means that leverage begets more leverage and can become “addictive.” The effect exacerbates, and is in turn exacerbated by, the other inefficiencies that are often attributed to high leverage, namely underinvestment and excessive risk taking (so-called asset substitution).

Because the leverage ratchet effect induces inefficiencies, exploring its workings is critical for understanding capital structure dynamics and for designing and implementing effective regulation of leverage when such regulation is desired. We consider different ways a firm can reduce leverage including (1) selling assets and using the proceeds to reduce debt levels (asset reduction or “deleveraging”), (2) issuing new equity to buy back debt (pure recapitalization), and (3) issuing new equity to increase assets backing liabilities (asset expansion). We present an important neutrality result that gives conditions under which shareholders are indifferent between these modes of leverage reduction. Specifically, we show that if there is one class of debt outstanding, if assets are homogeneous, and if sales or purchases of assets do not, by themselves, generate value for shareholders, then shareholders are indifferent among all ways leverage can be reduced; they consider them all equally undesirable and will resist each and every one of them.

We then examine a number of factors that influence shareholders’ choices of how to reduce leverage when the conditions of this equivalence result do not hold. For example, we show that when there are multiple classes of debt and in the absence of covenants to the contrary, shareholders will buy back the most junior debt before repurchasing debt with higher priority. When shareholders have the ability to buy back junior debt in this way, they will tend to prefer deleveraging through asset sales over the other two approaches. The reason is that asset sales funding a buyback of junior debt is a mechanism that imposes some of the cost of the deleveraging on the remaining senior debt holders whose expected returns are reduced when there are fewer assets and less junior debt to bear losses before they do.

The shareholders’ preferred choice of leverage reduction can depend in fairly complicated ways on the structure of the firm’s liabilities, the restrictions imposed by covenants, transactions costs and the effects of asymmetric information. However, the underlying principle is always the same: When called upon to reduce the firm’s leverage, shareholders always prefer to use the form of deleveraging that transfers the least amount of value to the other incumbent investors. Although shareholders often have a preference ordering over how leverage is reduced if it must be reduced, the key point is that they will generally resist any reduction in leverage no matter how it is effected and will prefer to raise any needed funds through borrowing, which increases the firm’s leverage.

In our analysis, as in Myers (1977), shareholders resist leverage reductions because they are unable to prevent creditors from appropriating benefits that are created at shareholder

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4 Some empirical results suggesting that this ratchet effect may be operative with respect to tax code changes are found in Heider and Ljungqvist (2012).
expense. However, in contrast to the Myers (1977) underinvestment problem, which only occurs when the net present value of the project is not large enough for the shareholders’ share of the benefits to cover its cost, shareholders’ resistance to leverage reductions can persist no matter how much leverage reduction would increase the total value of the firm. This resistance arises because shareholders generally do not capture the benefits of reduced leverage such as reduced bankruptcy costs.

We assume that creditors are small and dispersed so that conflicts of interest cannot be dealt with by collective bargaining. This means that reductions of leverage cannot be achieved through a renegotiation of outstanding contracts and any reduction in debt levels must be carried out through debt buybacks in the open market. In such a buyback, each creditor can choose whether to sell his claims back to the firm or hold on to them. The price at which debt is repurchased must therefore reflect the value that can be obtained by retaining a marginal amount of debt. If the leverage reduction reduces the borrower’s probability of default, the debt’s value will be raised by the buyback, which means that the price at which debt is repurchased is higher than the price that the debt would have if there were no buyback. Creditors are unambiguously better off.

This benefit to creditors is the key to understanding the resistance of shareholders to leverage reductions. This resistance does not depend on frictions created by government policies and is present even under the “no frictions” assumptions of Modigliani and Miller (1958). Under those assumptions, the total value of a firm is independent of its capital structure, and this means that the owners of an all-equity firm are indifferent among all changes that might be made in the firm’s capital structure. However, once the firm is indebted, its shareholders have a strict preference against any change in capital structure that makes creditors better off. If we introduce any “frictions” that provide a cost advantage to debt, e.g., a favorable tax treatment for debt over equity, shareholders of a levered firm will also have a strict preference for adding debt and reducing equity.

In many theoretical and empirical studies of capital structure, the standard assumption is that firms act to maximize their total value when making capital structure decisions. While conflicts of interests of between shareholders and creditors are widely recognized, most of the agency costs of debt have been based on asset substitution incentives and on losses stemming from underinvestment due to debt overhang as discussed in the Myers (1977). Less attention has been directed to the agency costs related to leverage choices once debt is in place.

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5 Such effects are well known from the literature concerning market-based solutions to the sovereign debt crisis of the 1980s. See, for example, the contributions in Frenkel et al. (1989) and Bulow and Rogoff (1990). The theory developed in that literature was confirmed in the Bolivian debt buyback of 1988 and more recently in the Greek debt buyback of 2012. By contrast, van Wijnbergen (1991) showed that, in the 1990 buyback of Mexican debt under the Brady plan, which involved collective bargaining, creditors were forced to agree to terms under which they neither gained nor lost from the buyback. The importance of the difference between collective bargaining and unilateral actions of the debtor is also stressed by Strebulaev and Whited (2012). However, they do not consider buybacks in markets, but study callable debt, where the call option requires a repayment of the amount that was originally borrowed, plus a premium.
In the literature on dynamic capital structure, it is common to explore shareholders’ decisions with respect to payouts and default without allowing changes in the capital structure (prior to default). Papers that allow adjustments in capital structure often assume that it is prohibitively costly to reduce leverage in distress, or that debt can only be recalled at par or at a premium. By contrast, our analysis assumes that debt must be bought back in the market at competitive prices. In addition, we allow funds to be raised either by selling assets or by issuing equity through common share or rights offerings. Unlike much of the literature, our key results do not depend on any assumptions about exogenous transactions costs.

Our paper is related to a number of papers that have looked at various ways that changes in a firm’s capital structure and its outstanding liabilities can affect the value of the firm’s creditors and shareholders. Dangl and Zechner (2007) analyze the dynamics of leverage and the choice between long- and short-term debt. They observe that with long-term debt shareholders do not have the incentives to reduce leverage when the firm has poor performance. Short-term debt requires the firm pay off all its debt frequently (at par) and effectively causes the firm to start afresh with new tradeoffs a-la Modigliani and Miller each time this debt matures. The frequent issuance of short-term debt entails higher transactions costs, which must be traded off against any benefits created. An important assumption in Dangl and Zechner (2007) is that there are covenants in place that prohibit the issuance of any new debt that would increase the total face value of debt outstanding. This assumption rules out the ratchet effect that we explore in this paper.

Another closely related paper is Brunnermeier and Oehmke (2013), which shows that shareholder incentives potentially lead to a “maturity rat race,” since under certain informational conditions shortening the maturity structure of a firm’s liabilities dilutes the firm’s longer-term creditors. The key assumption in Brunnermeier and Oehmke (2013) is that, although the firm can commit to a total amount of debt, it cannot commit to a particular maturity structure of that debt. They observe that this inability to commit is especially applicable to financial institutions with frequent funding needs and opaque balance sheets. Our paper is similar to Brunnermeier and Oehmke (2013) in that we assume that it is impossible or too costly for the firm to make binding commitments about all the details of the firm’s capital structure, but instead of focusing on the maturity structure of a fixed amount of debt, we focus on the firm’s leverage choices when covenants do not completely restrict firm leverage.

Finally, Bizer and DeMarzo (1992) demonstrate that in the presence of agency costs of debt, lack of commitment leads borrowers to choose excessive leverage. Their setting is focused on the case of a risk averse borrower or sovereign, rather than a firm, but the desire to increase leverage once existing leverage is in place mirrors our finding regarding resistance to leverage reductions.

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Some papers make the assumption that new debt can be issued pari passu with existing debt, which can help overcome the underinvestment problem identified in Myers (1977). Unless existing creditors benefit from additional investments, issuing such debt can reduce the value of existing debt and violate the creditors’ seniority. In the spirit of Myers (1977), we assume for most of our analysis that violating the seniority of existing creditors is not possible.
Leverage ratchet effects are particularly strong for highly levered firms, such as banks. They are therefore critical to understanding the capital structure dynamics of financial institutions that obtain most of their funding from debt. If their debts are explicitly or implicitly guaranteed, banks’ creditors have fewer incentives to put in place debt covenants that might mitigate the leverage ratchet. Leverage choices can therefore become extremely inefficient, especially since banks have many ways to issue debt that is effectively more senior to prior claims (e.g., because it has shorter maturity or is backed by collateral). Moreover, banks’ distress or default can have significant negative external effects. Since the market fails to correct the social inefficiency, effective regulation is essential to correct the resulting distortions.

In an earlier paper (Admati et al. 2013) we considered banks’ total funding costs and argued that banks will choose socially inefficient levels of leverage. The funding benefits that a bank derives from high leverage are due to debt subsidies (e.g. taxes and government guarantees) and these come at taxpayers’ expense. The social benefits of high leverage are at best very small, while the social costs borne by third parties are large as witnessed in the financial crisis of 2008. In this paper we show that high leverage is likely to be privately costly when viewed from the limited perspective bank’s investors (i.e., the bank’s shareholders and the bank’s creditors) in addition to socially costly. This is because leverage ratchet effects, which are particularly pronounced for banks, drive banks to increase leverage to levels that are potentially inefficient even for their own investors. The results of this paper therefore strengthen our conclusion that, in the context of banking, effective capital regulation is essential. In addition to reducing third-party damage from systemic risk associated with bank failures, such regulation can also mitigate the leverage ratchet effect, providing a substitute for ineffective ex ante covenants. Our analysis of shareholder preferences over various modes of leverage reduction also throws light on how banks react to such regulation.

The paper is organized as follows. Section 2 presents the basic model. Section 3 analyzes pure recapitalization as viewed from shareholders’ perspective and derives the key ratchet effect of leverage. In Section 4 we consider alternative ways for a firm to reduce leverage other than pure recapitalization. Section 5 discusses the application of our analysis to banking and the role of capital regulation. Section 6 provides concluding remarks.

2. The Basic Model

We consider a firm that has made an investment in risky assets and has funded itself with debt. To explain our results in the simplest possible terms, we begin with a simple and standard “tradeoff” model of capital structure, which we will generalize later as we examine additional frictions. 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 $\bar{x}A$. 
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 \( \bar{x}A \) is realized. If \( \bar{x}A \geq D \), debt claims are honored in full.

We begin by considering 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 benefits are determined by the firm’s total debt outstanding and are given by

\[
t(\bar{x}, A, D) \in [0, \bar{x}A - D] \quad \text{when } \bar{x}A > D.
\]

We assume that no tax is paid when \( \bar{x}A \leq D \). Finally, we assume that the total tax liability is weakly decreasing in \( D \), i.e. \( t_D(\bar{x}, A, D) \leq 0 \).\(^7\)

Net default costs: If \( \bar{x}A < D \), 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. Let \( n(\bar{x}A, D) \) be the net default costs for the firm, which is the difference between the bankruptcy cost and any third party subsidy. In the event that \( \bar{x}A > D \), there are no subsidies and no bankruptcy costs and thus \( n(\bar{x}A, D) = 0 \). If \( \bar{x}A < D \), we assume that \( \bar{x}A - n(\bar{x}A, D) \in [0, D] \).

Note that the net default costs could be negative if the subsidy exceeds the bankruptcy cost – which means that the firm’s debt holders will receive more than \( \bar{x}A \) – but we assume that, at best, subsidies bring the available funds up to the amount that is needed to avoid default.

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

<table>
<thead>
<tr>
<th></th>
<th>If ( \bar{x}A &lt; D )</th>
<th>If ( \bar{x}A \geq D )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payoff to Shareholders</td>
<td>0</td>
<td>( \bar{x}A - t(\bar{x}, A, D) - D )</td>
</tr>
<tr>
<td>Payoff to Debt Holders</td>
<td>( \bar{x}A - n(\bar{x}A, D) )</td>
<td>( D )</td>
</tr>
</tbody>
</table>

\(^7\) Note that there may be other effects of leverage on equity holders that can be included in the function \( t \). For example, if debt plays a “disciplining role” as in Jensen (1986) or we can think of \( t \) as capturing any losses resulting from a lack of discipline. Alternatively, there may be ex ante costs to equity associated with leverage, such as increased wages as in Berk, Stanton, and Zechner (2010). The key assumption is that on the margin, tax shields and disciplining benefits, net of any costs, are weakly increasing in \( D \).
**Pricing at Date 1:** All securities are traded in perfect Walrasian markets. The prices of securities at date 1 are equal to the expectations of their payoffs with respect to the *risk-neutral* distribution function $F$ of the return on the firms’ asset, $\tilde{x}$. The distribution function $F$ has full support on $[0, \infty)$. We assume that the firm takes $F$ as given and independent of its leverage choice.\(^8\)

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

\[
\text{Total value of debt } = V^D(D, A) = \int_{D/A}^{\infty} D \, dF(x) + \int_0^{D/A} (xA - n(\tilde{x}A, D)) \, dF(x)
\]

and

\[
\text{Value of equity } = V^E(D, A) = \int_{D/A}^{\infty} (xA - t(x, A, D) - D) \, dF(x).
\]

3. **Debt Overhang, Recapitalization and the Leverage Ratchet Effect**

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 also assume that new equity will be issued at the market price, reflecting the post-recapitalization value of a share.\(^9\)

In Section 3.1 we show that incumbent shareholders are made worse off by a recapitalization that reduces leverage, and thus they would not voluntarily choose to engage in it. While it is perhaps not surprising that debt overhang can make shareholders averse to a recapitalization, we show that this aversion is actually more powerful than the underinvestment effect that was identified by Myers (1977). Shareholder resistance to leverage reduction is *universal*: shareholders will resist repurchasing risky debt no matter how small the leverage of

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8 The existence of such a distribution (or pricing kernel) $F$ follows from the absence of arbitrage opportunities. We assume the firm acts as a price-taker with respect to this pricing kernel. Thus, as is standard in the corporate finance literature, we are ignoring any general equilibrium consequences of the individual firm’s security choices on the equilibrium pricing kernel. Finally note that we can without loss of generality normalize the risk-free interest rate to zero or alternatively interpret the prices as future values.

9 Of course, the issuance and buyback prices may also be affected by transactions costs and asymmetric information, which we consider in Section 4.
the firm may actually be, and no matter how large the benefit may be in terms of reduced default costs.

In Section 3.2, we generalize our model to allow for additional shareholder-debt holder conflicts involving the possibility of asset substitution (risk-shifting) and future underinvestment. These conflicts raise the potential benefits to the firm from reducing leverage. Nonetheless, we show that no matter how large the agency costs from these conflicts are, and how over-leveraged the firm currently is, shareholders will still resist any attempt to recapitalize the firm in order to reduce these costs. Indeed, if the leverage reduction reduces future incentives for asset substitution and underinvestment, shareholders’ resistance is to reducing leverage is actually stronger, which means that what we will call the leverage ratchet effect is exacerbated.

Whereas the existence of risky debt induces shareholder resistance to reducing leverage, there is no analogous resistance to increasing leverage. The dynamics of the firm’s capital structure therefore involve a leverage ratchet: Once debt is in place, shareholders may have incentives to borrow more when permitted to do so (and, as we will show, whether or not outside conditions warrant it), but, unless they are forced to do so, they will not decrease their borrowing even if outside conditions seem to call for such a decrease. The reason for this asymmetry is that the benefits of the leverage reduction accrue to incumbent debt holders, rather than the shareholders who must pay for it. On the other hand, incumbent debt holders absorb some of the costs of a leverage increase. The ratchet effect effectively creates an “addiction” to leverage which we formalize in Section 3.3.

From an ex ante perspective, shareholder resistance to value-enhancing leverage reductions and the resulting leverage ratchet should be seen as an additional source of agency costs that lower the value of the firm, ex ante, before the firm begins to borrow, as well as ex interim or ex post, when shareholders prevent such leverage reductions from taking place. In the standard “tradeoff theory” of capital structure that was pioneered by Modigliani and Miller (1963), this additional agency problem does not appear because all capital structure decisions are taken ex ante when firm value maximization and shareholder value maximization lead to the same results. However, in capital structure decisions that are taken later and that have not been committed to ex ante, firm value maximization and shareholder value maximization can be in conflict as shareholders do not take sufficient account of the effects of their choices on debt holders. We discuss the implications of this conflict in Section 3.4, using the leverage ratchet for illustration.

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 $D$. We suppose that, at date 1, the firm considers buying back a portion of this outstanding debt. In this section we maintain the (operating) assets of the firm fixed, so the debt buyback is accompanied with leverage reduction. The cash used for the buyback may be raised through a rights offering to existing shareholders, or a market offering of equity or other equity-like
securities (such as preferred shares). Alternatively, the firm may use cash on hand that it would either pay out as a dividend or retain to buyback debt. We will show that, independent of the source of funds or the potential benefit to total firm value, shareholders have a strict preference to avoid a recapitalization.\footnote{We take up whether the recapitalization is feasible and consistent with limited liability in Section 4. Throughout our analysis we assume that decisions are made on behalf of shareholders and we do not consider the governance issues associated with who can make the decision to issue shares or make a rights offering. Under U.S. law, a rights offering can be made without shareholder approval, though it may still fail if investors do not find it in their interest to acquire the new shares. Again, this issue is addressed in Section 4 when we characterize the conditions required for the recapitalization to be feasible.}

In order to establish our result, we must compare the amount needed to buy back the debt with the change in the total value of equity before and after the recapitalization. Because any new securities will be competitively priced, the difference between the change in the total value of equity and the cost of buying back the debt captures the gain or loss to existing shareholders from the recapitalization.

We begin by determining the price of the firm’s debt. Equation (1) above implies that, without the buyback, the date 1 market price of debt per unit of nominal face value is equal to:

$$q(D, A) = \frac{V^D(D, A)}{D} = \int_{D/A}^{\infty} dF(x) + \int_{0}^{D/A} \frac{xA - n(xA, D)}{D} dF(x).$$

\footnote{For extensive discussions of this point, see Frenkel et al. (1989) and Bulow and Rogoff (1990).}

Suppose that the firm considers buying back debt with a nominal claim equal to $\Delta$. 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. The buyback price of the debt must therefore be equal to the market price $q(D - \Delta, A)$ that prevails at the post-buyback debt level.\footnote{Whereas, in the US, rights offerings can be decided by management without shareholder approval, in most other countries, rights offerings must be approved by shareholder meetings.}

We assume that that the firm’s managers and shareholders assess such a buyback only on the basis of what it does to the shareholders’ wealth.\footnote{Recall that we are assuming that security values are determined by the pricing kernel $F$, which is unaffected by the firm’s leverage. Thus the impact on investor wealth is sufficient to determine shareholder preferences.} This assessment depends only on whether the difference between the market value of the firm’s equity with and without the buyback, $V^E(D - \Delta, A) - V^E(D, A)$, exceeds the cost $q(D - \Delta, A)\times \Delta$.\footnote{Recall that we are assuming that security values are determined by the pricing kernel $F$, which is unaffected by the firm’s leverage. Thus the impact on investor wealth is sufficient to determine shareholder preferences.} 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 taxes or default subsidies.

Proof: From (2) we have:

\[
V^E(D-\Delta, A) - V^E(D, A) = \Delta \times \left[ 1 - F\left(\frac{D-\Delta}{A}\right) \right] + \int_{(D-\Delta)/A}^{D/A} (xA - D) \, dF(x) \\
- \int_{(D-\Delta)/A}^{\infty} t(x, A, D-\Delta) \, dF(x) + \int_{D/A}^{\infty} t(x, A, D) \, dF(x)
\]  \tag{4}

In words, the first term captures the fact that the firm avoids paying the incremental debt \( \Delta \) when it remains solvent, the second term captures the loss of equity’s default option given final asset values between \( D-\Delta \) and \( D \), and the final two terms capture the change in the tax burden. Therefore, because the second term is negative and because taxes are non-increasing in \( D \), we have

\[
V^E(D-\Delta, A) - V^E(D, A) < \Delta \times \left[ 1 - F\left(\frac{D-\Delta}{A}\right) \right] \leq \Delta \times q(D-\Delta, A).
\]  \tag{5}

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 (and will be strictly higher if there is a positive expected recovery value).

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 if the debt tax shield increases with increases in debt, which we can see from (4). The loss is decreasing in expected net default costs, \( \int_{(D-\Delta)/A}^{D/A} n(xA, D-\Delta) \, dF(x) \), as default costs reduce the expect recovery value of the debt and thus lower the difference between \( q(D-\Delta, A) \) and the probability the firm does not default, i.e., \( 1 - F\left((D-\Delta)/A\right) \) in the final inequality.

The shareholders’ resistance to a recapitalization in Proposition 1 does not depend on the tax benefits of leverage. Even though shareholders may buy back debt at a discount relative to its face value, this discount is insufficient. By reducing the firm’s debt from \( D \) to \( D-\Delta \), shareholders forfeit the option to default when returns are between \( D-\Delta \) and \( D \); in a buyback at the price \( q(D-\Delta, A) \), they do not receive compensation for the loss of this option. If the recapitalization makes expected tax payments go up, shareholder resistance intensifies, and 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.
Finally, note that shareholders will resist a recapitalization even if the benefit to firm value will be large due to a reduction in default costs. Indeed, the magnitude of current default costs (with debt level $D$) does not enter the proof at all. Default costs only matter in that they may reduce the buyback price $q(D - \Delta, A)$, but they cannot reduce it sufficiently to make a recapitalization attractive to shareholders.

So far we have assumed that the firm has only a single class of debt outstanding. If the firm has several classes of debt outstanding, shareholders will find it most attractive to buy back the cheapest class first, which will be the most junior class of debt? The buyback price of these junior classes must be at least $\left(1 - F\left((D - \Delta) / A\right)\right)$ and will not exceed $q(D - \Delta, A)$. Since $\left(1 - F\left((D - \Delta) / A\right)\right)$ 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.

Propositions 1 and 2 refer to the preferences of equity holders. When default is costly to the firm, the interests of equity holders will 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 value of the firm (i.e. the combined wealth of shareholders and debt holders jointly). Yet, shareholders consider such a move harmful to their interests.

It follows that debt overhang can give rise to situations in which shareholders and debt holders jointly would benefit from a recapitalization, yet 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, with debt already in place, all of the benefits produced by a debt buyback accrue to debt holders. Since shareholders are unable to appropriate any of the gains due to reduced bankruptcy costs, and since they must buy back the debt at a price that reflects the reduced risk of debt holders after the buyback, shareholders will resist a recapitalization.

The observation that shareholders resist a recapitalization even when it would raise the value of the firm stands in contrast to the standard tradeoff theory of capital structure, where firms choose their debt levels so as to maximize total firm value given the countervailing frictions of tax benefits and distress and agency costs associated with leverage. In the standard tradeoff theory, where capital structure decisions are taken ex ante, before any debt has been issued, shareholder value maximization and firm value maximization lead to the same results. However, once there is debt overhang, shareholder value maximization and firm value
maximization may be in conflict as shareholders do not take sufficient account of the effects of their choices on debt holders.  

The consequences of debt overhang in the context of recapitalization are stronger than those in the context of equity-financed investment as described in Myers (1977). When a firm must issue equity to undertake a valuable project, the loss to the shareholders due to the wealth transfer to risky debt holders brought about by the reduction in leverage can be more than offset by the positive net present value (NPV) of the project, a portion of which the shareholders capture. Thus, if the NPV of the project is large enough, Myers’s underinvestment problem disappears, and the outcome is efficient. By contrast, when a debt buyback would increase the total firm value, debt overhang always results in a loss of efficiency. No matter how large the gain in value, shareholders will always resist the recapitalization.

Matters would be different if there were collective bargaining about the price of debt in the buyback. For example, if debt contracts had collective action clauses, the firm’s management, acting on behalf of shareholders, could negotiate a buyback agreement with debt holder representatives. In such negotiations, and with the no-buyback outcome as a default option, debt holders would end up sharing their gains from the buyback with the shareholders. This sharing of gains cannot be achieved in a market buyback. And even in a negotiation, if debt holders are dispersed, holdouts could be likely. In other words, at terms for which shareholders would not resist a recapitalization, we would expect (at least some) debt holders to resist, precluding a purely voluntary leverage reduction.

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. Return prospects per unit of debt improve, because the default probability goes down and because, in the event of default the available asset value, net of bankruptcy costs, is split among fewer claimants. Because return prospects improve, the market price of the debt must go up. 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.

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14 This point is central to the literature on dynamic theory of capital structure, see for example Strebulaev and Whited (2012). However, despite its name, this literature is more concerned with the dynamics of default and investment decisions for a given capital structure than with the evolution of capital structure through new issues and repurchases of debt and equity. Moreover, leverage changes are often restricted exogenously; e.g. Bhamra et al. (2010, p. 1499) state “In common with the literature, we assume that refinancings are leverage increasing transactions since empirical evidence demonstrates that reducing leverage in distress is much costlier.”

15 In a different setting the impact of collective bargaining on debt dynamics is also noted by Strebulaev and Whited (2012).

16 A recent example of this effect can be seen in the buyback of Greek debt in 2012. When about one half of the debt was repurchased. The market price in August 2012, before the news about the buyback plans transpired, was about 17c per euro of debt, whereas the buyback was transacted in different batches between 30c and 40c per euro. This was an almost exact replication of the Bolivian experience of 1988, which was documented and analyzed by Bulow and Rogoff (1990). In contrast, in the Mexican debt buyback in 1990, collective bargaining seems to have been used to prevent the private creditors from obtaining any windfalls; see van Wijnbergen (1991).
These observations raise 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 is not the price at which it would be able to buy back its debt. In other words, the firm should not take the prices of its securities as given and independent of its own actions.

Our results thus far establish the resistance of shareholders to pure recapitalizations for all equity-based sources of funding. In Section 4 we will consider leverage reduction modes that involve either asset sales or the acquisition of new assets using equity funding. In that context, we also discuss the compatibility of leverage reduction with limited liability of existing shareholders.

### 3.2. Leverage and Investment Distortions

Our analysis thus far has focused on a specific debt-equity conflict, recapitalization. But the presence of leverage in the firm is likely to lead to additional debt-equity conflicts related to investment. In particular, leverage may induce equity holders to increase the risk of the firm’s assets via asset substitution (as in Jensen and Meckling, 1976), or to fail to undertake new investment opportunities (as in Myers, 1977). In this section we generalize our analysis to allow for both asset substitution and underinvestment. These agency frictions raise the cost of leverage for total firm value, and thus increase the potential benefit of a recapitalization. Yet we will show that despite this benefit, future debt-equity conflicts only increase shareholder resistance to any recapitalization.

To see the intuition for this result, consider first the case of asset substitution. Suppose the distribution of asset returns, \( x \), may be affected by actions taken by shareholders (or managers acting on behalf of shareholders). We denote these actions by \( \theta \), and the resulting asset returns by \( x_\theta \), which has distribution \( F(x | \theta) \). In this setting, it is natural to extend our notation and define the value of equity as follows:

\[
V^E(D, A) = \max_{\theta} V^E(D, A, \theta) \\
= \max_{\theta} \int_{D/A} x A - t(x, A, D) - D \, dF(x | \theta)
\]  

(6)

We assume in (6) that the actions \( \theta \) are taken to maximize the value of equity. Let \( \theta^* \) be the action choice at the target level of debt, \( D - \Delta \), i.e.,

\[
\theta^* = \arg \max_{\theta} V^E(D - \Delta, A, \theta)
\]  

(7)
To see that asset substitution increases shareholder resistance to a recapitalization, note that

\[ V^E(D - \Delta, A) - V^E(D, A) = V^E(D - \Delta, A, \theta^*) - \max_{\theta} V^E(D, A, \theta) \]

\[ \leq V^E(D - \Delta, A, \theta^*) - V^E(D, A, \theta^*) \] (8)

Thus, the increase in the value of equity post-recapitalization is even smaller now than in the setting without agency costs (that is, with \( \theta \) fixed at \( \theta^* \), the level of risk that shareholders would choose given lower leverage).

As the above argument reveals, the result that agency costs increase shareholders’ resistance to recapitalization follows directly from their most basic consequence for the equity value function. Thus, we can apply the same argument to demonstrate that any shareholder discretion over future firm investment will lead to a similar result.

For example, suppose that in addition to determining asset risk \( \theta \), management (on behalf of shareholders) has the opportunity to invest in additional assets \( a \) by raising capital \( k \) from shareholders (or reducing planned equity payouts). Moreover, suppose these decisions will be made at a later date and conditional on some future information \( z \) that is relevant to both asset returns and the profitability of the investment opportunity. In this case, in addition to asset substitution, leverage may lead to future underinvestment due to the traditional debt overhang problem identified by Myers (1977). The next result demonstrates that, once again, the possibility of future underinvestment and risk shifting, while detrimental to total firm value, will only increase the cost to shareholders from a current recapitalization.

**Proposition 3 (Agency Costs):** Although shareholder-creditor conflicts regarding investment may raise the benefits of a leverage-reducing recapitalization for total firm value, they also raise the costs of a recapitalization for shareholders relative to a setting in which investments were fixed at the optimal policy given lower leverage.

**Proof:** Letting \( k(a, z) \) be the cost of making investment \( a \) given information \( z \), we have the following representation for the equity value function conditional on the investment policy functions \( a(z) \) and \( \theta(z) \):

\[ V^E(D, A, \theta, a) = E_z \left[ \int_{D(A+a(z))}^\infty \left( x(A+a(z)) - t(x, A+a(z), D) - D \right) dF(x \mid z, \theta(z)) - k(a(z), z) \right] \] (9)

Note that the expectation in (9) is with respect to the information \( z \). Then, using the same argument as in Proposition 1, holding the policy functions fixed,
As in Proposition 1, the inequality follows because shareholders forfeit their default option for final asset values between $D - \Delta$ and $D$, and have a higher expected tax burden. The last equality states that the increase in the value of equity per dollar of debt repurchased is less than the ex-ante probability of no default at the lower level of leverage.

The proof then follows using exactly the same argument as in (8) above. Let $\theta^*$ and $a^*$ be the optimal risk and investment policy functions for equity holders given debt $D - \Delta$:

$$V^E(D - \Delta, A, \theta, a) - V^E(D, A, \theta, a) = E_z \left[ \Delta \times \left( 1 - F \left( \frac{D - \Delta}{A + a(z)} \right) \right) \right] + \int_{(D - \Delta)/(A + a(z))}^{\infty} t(x, A + a(z), D - \Delta) \, dF(x \, | \, z, \theta(z))$$

$$- \int_{(D - \Delta)/(A + a(z))}^{\infty} t(x, A + a(z), D) \, dF(x \, | \, z, \theta(z))$$

$$+ \int_{D/(A + a(z))}^{\infty} t(x, A + a(z), D) \, dF(x \, | \, z, \theta(z))$$

$$< E_z \left[ \Delta \times \left( 1 - F \left( \frac{D - \Delta}{A + a(z)} \right) \right) \right]$$

$$= \Delta \times \text{Pr}[x_{\theta(z)}(A + a(z)) > D - \Delta]$$

$$\leq \Delta \times q^D(D - \Delta, A)$$

The first inequality follows since we have fixed the investment policy functions at a level that may not be optimal with higher leverage (due to agency costs), the second follows from (10) above, and the third follows since the repurchase price of the debt will be at least the no default probability (and will be strictly higher if the debt has a non-zero recovery rate in any default states).
3.3 The Leverage Ratchet Effect

The standard “tradeoff theory” of capital structure posits that firm’s choose debt in order to maximize total firm value given the countervailing frictions of tax benefits and distress and agency costs associated with leverage. Our prior results suggest, however, that once leverage is already in place, debt overhang will create a powerful dynamic that will distort shareholder incentives. In particular, we show that not only will the shareholders not choose to reduce leverage, they will always prefer to increase leverage if they have the opportunity to do so, and even if this additional leverage further reduces firm value. In other words, leverage begets additional leverage, creating a leverage ratchet effect.17

To demonstrate the leverage ratchet effect, consider our setting with taxes, default costs, and asset substitution, and suppose that any existing debt is protected so that any new debt issued is junior to all other outstanding debt claims. This assumption avoids any motivation to issue new debt in order to directly dilute existing creditors. Nonetheless, we show that under broad conditions, a levered firm will always find it optimal to increase its leverage. To formalize this result, let $G(D, D')$ be the gain to shareholders when a firm with existing debt $D$ increases its debt to $D' \geq D$, by issuing new junior debt with face value $D' - D$:

$$G(D, D') = V^E(D', A) - V^E(D, A) + (D' - D)q'(D, D', A)$$

(13)

where $q'(D, D', A)$ is the price at which the new junior debt is sold. Then we have the following key result:

**Proposition 4: (Leverage Ratchet Effect)** Given initial debt $D$, suppose the firm has the opportunity to adjust its debt on a one-time basis. Then,

- If the firm has no initial debt, then the amount of debt $D$ to issue that maximizes shareholders’ gain $G(0, D)$ also maximizes the total value of the firm.
- If the firm has outstanding debt $D > 0$, shareholders never gain by reducing leverage. Moreover, if the probability of default is continuous at $D$ and the marginal expected tax benefit of debt is positive, it is always optimal for shareholders to increase leverage by issuing new junior debt $(\arg\max_{D'} G(D, D') > D)$, even if this new debt reduces total firm value.

17 This result is closely related to results in Bizer and DeMarzo (1992). Similar forces due to the inability to commit to future funding decisions are explored in the context of the maturity structure of debt in Brunnermeier and Oehmke (2013). Brunnermeier and Oehmke show that shareholders will prefer to issue additional short-term debt due to its effective seniority over existing debt, whereas Bizer and DeMarzo demonstrate that shareholders gain even by issuing long-term junior debt due to the additional investment distortions induced by agency costs of leverage.
Proof: Note that \( q'(0, D, A) = q(D, A) \), and therefore \( Dq'(0, D, A) = V^D(D, A) \). That is, proceeds from issuing debt are equal to the total value of the firm’s debt. Hence,

\[
G(0, D) = V^E(D, A) - V^E(0, A) + Dq'(0, D, A)
= V^E(D, A) + V^D(D, A) - V^E(0, A)
\]

Thus, \( D \) maximizes \( G(0, D) \) if and only if it maximizes total firm value.

For the second result, note that our earlier results already establish that shareholders lose if the firm reduces debt \( (D' < D) \) regardless of the seniority of the debt that is repurchased. Therefore, it is enough to establish that the marginal benefit of an increase in leverage from its current level is positive. Specifically, we need to show the right-hand derivative of \( G \) at \( D' = D \),

\[
\left. \frac{\partial G(D, D')}{\partial D'} \right|_{D'=D} = \left. \frac{\partial}{\partial D'} \left( V^E(D', A) + (D' - D)q'(D, D', A) \right) \right|_{D'=D},
\]

is positive. Let \( \theta^* \) be the optimal risk choice with debt level \( D \). From the definition of \( V^E \), and using the fact that holding the risk choice fixed at \( \theta^* \) only reduces the gain to equity holders, we have

\[
\left. \frac{\partial V^E(D', A)}{\partial D'} \right|_{D'=D} \geq \left. \frac{\partial}{\partial D'} \left[ \int_{D'/A}^{\infty} (xA - t(x, A, D') - D') \, dF(x|\theta^*) \right] \right|_{D'=D}
= - \int_{D'/A}^{\infty} dF(x|\theta^*) - \int_{D'/A}^{\infty} t_D(x, A, D) \, dF(x|\theta^*)
> - \int_{D'/A}^{\infty} dF(x|\theta^*) = - \Pr(xA > D|\theta^*)
\]

where the final inequality follows from the assumption tax benefits are positive.

Next, for \( D' \geq D \), define \( \pi(D') \) to be the proceeds raised from the new debt:

\[
\pi(D') \equiv (D' - D)q'(D, D', A) = (D' - D) \int_{D'/A}^{\infty} dF(x|\theta') + \int_{0}^{\infty} (xA - n(\tilde{x}A, D') - D')^+ \, dF(x|\theta').
\]

Then let \( \hat{\pi}(D') \equiv (D' - D) \int_{D'/A}^{\infty} dF(x|\theta') \). Because \( \pi(D) = \hat{\pi}(D) = 0 \) and \( \pi(D') \geq \hat{\pi}(D') \) for \( D' > D \), we have

\[
\pi'(D_+) \geq \hat{\pi}'(D_+) = \lim_{\varepsilon \downarrow 0} \frac{\hat{\pi}(D + \varepsilon) - \hat{\pi}(D)}{\varepsilon} = \lim_{\varepsilon \downarrow 0} \int_{D'/A}^{\infty} dF(x|\theta') = \lim_{\varepsilon \downarrow 0} \Pr(xA > D'|\theta').
\]
That is, the marginal price per dollar of junior debt is at least the probability of no default (and could be higher in the presence of default subsidies). Thus we have shown

\[
\frac{\partial G(D,D')}{\partial D'} \bigg|_{D'=D} > \lim_{D'\downarrow D} \Pr(\{x_A > D'|\theta'\}) - \Pr(\{x_A > D|\theta'\}) = 0
\]

(16)

where for the final equality we use the fact that the probability of default is continuous at \(D\). ■

To illustrate the ratchet effect, we consider an explicit example. Normalize the asset size to \(A = 1\), and let returns have a binary distribution with either a zero payoff (failure) or a positive payoff (success), where the amount and likelihood of the positive payoff is subject to some degree of discretion. Specifically, we assume that once any debt is in place, the probability of success \(\rho\) is chosen by equity holders from the interval \([\rho_0, \rho_1]\), and the payoff of the assets given success is given by \(g(\rho)\). The expected payoff is thus \(m(\rho) \equiv \rho g(\rho)\), which we assume has the following form:\textsuperscript{18}

\[
m(\rho) = \mu - \frac{(\rho^* - \rho)^2}{2\lambda}
\]

(17)

where \(\rho^* \in (\rho_0, \rho_1)\) is the first-best risk choice. We restrict parameters so that \(m(\rho_0) - \rho_0 m'(\rho_0) \geq 0\), which together with the concavity of \(m\) implies that \(g(\rho) = m(\rho)/\rho\) is strictly decreasing in \(\rho\) on its domain.\textsuperscript{19}

Next, we assume all payments to equity holders are taxed at rate \(\tau\), whereas payments to debt holders are tax free. Given this specification, and given face value of debt \(D = g(\rho_0)\), the value of equity is given by

\[
V^E(D) = \max_{\rho} (1-\tau) \rho \left( g(\rho) - D \right) = (1-\tau) \max_{\rho} \left( m(\rho) - \rho D \right)
\]

(18)

Therefore, we can solve for the equity’s optimal risk choice from the first-order condition \(m'(\rho) = D\), which implies

\[
\rho(D) = \max \left\{ \rho^* - \lambda D, \rho_0 \right\}
\]

(19)

In other words, the probability of success falls as \(D\) increases, as equity holders find it optimal to engage in increased asset substitution. Total firm value is given by

\[18\text{ This particular functional form is for simplicity; the specific choice has no qualitative impact on the key results.}\]

\[19\text{ This assumption is to assure a conflict of interest; projects where } g(\rho) \text{ is increasing would never be chosen, as a safer project with a higher payoff would dominate for both equity and debt holders.}\]
\[
V^E(D) + V^D(D) = (1-\tau)\left[m(\rho(D)) - \rho(D)D\right] + \rho(D)D
= (1-\tau)m(\rho(D)) + \tau\rho(D)D
\] (20)

Because of the debt tax shield, total firm value is maximized with a positive level of debt \(\hat{D}\) and corresponding second-best risk choice \(\hat{\rho}\) where

\[
\hat{\rho} = \frac{\rho^*}{(1+\tau)} \quad \text{and} \quad \hat{D} = \frac{\tau \rho^*}{(1+\tau)\lambda}
\] (21)

Figure 1 below illustrates this example with parameter choice of \(\mu = 40\), \(\rho^* = 90\%\), \(\rho_0 = 10\%\), \(\lambda = 1\%\), and \(\tau = 40\%\). Given these parameters, the maximum payoff \(g(\rho_0)\) is equal to 80. The left panel shows the “unlevered” firm value – that is the value before the debt tax shield – as a function of leverage, given by \((1-\tau)m(\rho(D))\). This value is maximized at \(D = 0\) since this avoids any asset substitution. Because of the debt tax shield, however, total firm value is maximized as shown with \(\hat{D} = 25.7\) (and \(\hat{\rho} = 64.3\%\)). Note that the total value of the debt, \(V^D = \rho(D)D\) is non-monotonic; for \(D > \rho^*/(2\lambda) = 45\), the asset substitution problem is so severe that the decline in value from issuing an additional dollar of debt more than offsets the addition to the debt’s face value, leading to the familiar credit-rationing result (Stiglitz and Weiss, 1981).

**Figure 1: The Ratchet Effect**

The right panel in Figure 1 illustrates the ratchet effect result of Proposition 4. For each level of current debt \(D\), we show the optimal new debt choice \(D'\) if equity holders can make a one-time issuance of junior debt. Note that for the unlevered firm \((D = 0)\), the optimal debt choice is \(\hat{D} = 25.7\). But with higher initial debt, the optimal debt choice increases, as equity
holders ignore the losses imposed on existing creditors associated with a new issue. Moreover, for any level of leverage, no matter how inefficient for total firm value, equity holders would prefer to issue additional debt. Indeed, given the linear tax specification in our example, the marginal benefit of an additional $1 of junior debt is \( \tau \rho(D) \), the tax rate times the market value of the new debt.

### 3.4 Leverage Ratchet as an Ex Ante Cost of Debt

We have shown that leverage ratchet means that shareholders will not voluntarily reduce leverage, even if leverage reduction would increase total firm value. This leads to the question why equity holders would take on debt levels that might lead to the problems created by the leverage ratchet. What level of debt \( D \) will shareholders choose initially and what does the leverage ratchet mean for the dynamics of leverage?

Creditors who understand that they can be subsequently harmed by the leverage ratchet can insist on debt covenants aimed at preventing shareholder actions that harm their interests (e.g. caps or restrictions on future debt issuance\(^{20}\)). However, unless these covenants are extremely restrictive, losses due to the leverage ratchet (and other agency costs) will still be a problem. Indeed, absent complete contracts, leaving the firm with some flexibility to adjust leverage in response to changes in the environment is desirable. But debt holders must recognize that shareholders will exercise their discretion in an asymmetric manner – increasing leverage when the opportunity arises, but not reducing leverage even if doing so would be value enhancing.

Specifically, suppose that 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 leverage ratchet 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 creditors can do to force a recapitalization plan that reduces leverage. It is therefore possible that creditors would lose and the total value of the firm would decline because of the resistance of shareholders to recapitalization.

The asymmetry in shareholder leverage decisions has implications for the ex ante choice of debt. First, the leverage ratchet effect suggests that initial debt will trade for a lower price, as

\(^{20}\) Note that the common restriction that any new debt must be junior to existing creditors is insufficient to prevent the costs associated with the leverage ratchet effect. As the example in Section 3.3 illustrates, even the issuance of junior debt can harm existing creditors by increasing the likelihood of incurring any deadweight costs of bankruptcy, and by exacerbating the distortions due to agency costs such as underinvestment and asset substitution.
debt holders internalize the possibility of future value-destroying leverage increases combined with shareholder resistance to value-enhancing leverage reductions. This price effect will induce firms to take on less leverage initially.

The leverage ratchet effect has potential implications for leverage dynamics. It suggests that firms may have asymmetric responses to shocks in the environment that impact optimal leverage, such as changes in tax rates. Increases in the value of the debt tax shield would induce increases in leverage, but reductions in the value of the tax shield would not cause a similar fall in leverage. Similarly, we may observe temporary increases in the net benefit of leverage leading to increases in leverage that are not subsequently reversed. For a numerical example illustrating this possibility, see Appendix A.

4. Alternative Ways to Reduce Leverage

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. Two alternative ways to adjust leverage involve the following 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.\(^{21}\)

One important question is whether our finding of shareholder resistance to leverage reduction through a pure recapitalization also applies to these alternative ways to adjust leverage.

Comparing the different ways to adjust leverage is also important for assessing the impact of capital regulation. Apart from the need to reduce systemic risk, the preceding analysis suggests that statutory capital requirements that force institutions to limit their leverage and, if necessary, recapitalize can serve as a commitment device and can increase the *ex-ante* value of the firm. If such requirements are imposed, the question is which alternative shareholders actually want to follow.

The different alternatives are illustrated in Figure 4. In this figure, we assume that the ratio of debt to assets must be reduced from 90% to 80%. This can be achieved by selling half of the firm’s assets (asset sales), by issuing equity equal to 10% of the firm’s assets and using the proceeds to buy back debt (recapitalization), or by issuing equity equal to 12.5% of the firm’s assets and using the proceeds to invest in new assets (asset expansion). The figure exhibits shows how the firm’s balance sheet evolves under each of these alternatives.

\(^{21}\) 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. (2013) we observed that stricter capital requirements do not force banks to shrink as in (A) but can also be met either through recapitalization (B) or asset expansion (C). We now consider the incentives that shareholders have in choosing one course of action over the others. We first identify conditions under which all leverage reduction modes are equally undesirable to shareholders, and then relax these conditions to see how the choice of leverage reduction mode depends on various frictions associated with the types of assets or transactions involved.

**4.1 An Equivalence Result**

The different approaches to reducing leverage result in different sizes (assets levels) for the firm. 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 leverage reduction. We assume first 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 of asset heterogeneity in section 4.2.3 below.) We also assume that the frictions we have considered that
are related to taxes and net bankruptcy costs are homogenous with firm size. Letting $\delta = D / A$, we assume that for all $(A, D)$, we have

$$t(x, A, D) = t(x, 1, \delta) A \quad \text{and} \quad n(xA, D) = n(x, \delta) A.$$  \hfill (22)

In addition, we assume that if agency costs due to asset substitution exist, they are also homogeneous with respect to firm size. In particular this means that

$$\theta^* \equiv \arg \max_\theta V^E(D, A, \theta) = \arg \max_\theta V^E\left(\frac{D}{A}, 1, \theta\right)$$ \hfill (23)

for all $(A, D)$.\(^{22}\)

Using the expressions for the value of debt and equity in Section 3, we see that when the assets and frictions (including those due to asset substitution) are homogeneous, the total value of the firm (equity plus debt) is proportional to its asset holdings and is given by:

$$V(A, D) = x A - t(x, A, D) dF\left(x, \theta^*\right) + \int_0^\infty x A - n(xA, D) dF\left(x, \theta^*\right)$$

$$\equiv \int_0^\infty x dF\left(x, \theta^*\right) - \int_0^\infty t(x, 1, \delta) dF\left(x, \theta^*\right) - \int_0^\infty n(x, \delta) dF\left(x, \theta^*\right) A \hfill (24)$$

where $\theta^* = \arg \max_\theta V^E(\delta, 1, \theta)$.

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

---

\(^{22}\) To keep the focus on how shareholders’ preferences across the various modes of leverage reduction are related to changes in firm size, we do not consider the agency costs due to the Myers (1977) underinvestment problem that we discussed above. To consider the role that these underinvestment agency costs would play in the shareholders’ choice among the three ways to reduce leverage, we would need to make specific assumptions about how new investment opportunities are related to the size of the firm as given by assets in place.
Recall from Section 3 that if the firm has a single class of debt outstanding, it will be forced to pay the price \( q(\delta) \) 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 \( D_1 \leq D_0 \), the firm must spend \( q(\delta) \times (D_0 - D_1) \) on debt repurchases.

Assume that the firm is a price taker in the asset market and the price at which the firm can buy or sell assets is \( p \). It follows that to move from initial balance sheet positions \((D_0, A_0)\) to the new balance sheet positions \((D_1, A_1)\) with \( D_1 \leq D_0 \), the value of equity the firm must issue is:

\[
\text{New Value of Equity Issued} = N = p \times (A_1 - A_0) + q(\delta) \times (D_0 - D_1) \quad (26)
\]

The total change in the firm’s equity value from the transaction is given by:

\[
\text{Change in Total Equity Value} = \nabla V^E = V^E(D_1, A_1) - V^E(D_0, A_0) \quad (27)
\]

We can therefore determine the effect of the leverage change on existing shareholders by subtracting (26) from (27). Specifically, the gain or loss for existing shareholders is given by \( \nabla V^E - N \).

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 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
\[ v(\delta) = \int_0^\infty x dF(x, \theta') - \int_0^{\delta} t(x, 1, \delta) dF(x, \theta') - \int_0^{\delta} n(x, \delta_1) dF(x, \theta'), \quad (28) \]

is the expected payoff of the assets net of taxes and of (net) default costs. If \( p = v(\delta) \) then, conditional on the final debt-asset ratio being equal to \( \delta_1 \), buying or selling assets does not affect the value of equity, i.e., from the perspective of shareholders, the Net Present Value (NPV) of asset sales and purchases is zero. If \( p < v(\delta) \) then the NPV of asset purchases is positive, and if \( p > v(\delta) \) then the NPV of asset sales is positive. Notice that, in this comparison, the NPV of asset sales and purchases depends on the debt-asset ratio because the debt-asset ratio affects taxes and (net) default costs.

We begin with the following benchmark result, which assumes the asset price \( p = v(\delta) \). (The firm’s behavior at other values of the asset price will be considered in the next subsection.) In this case, given homogenous assets and liabilities, shareholder losses are equivalent for all forms of leverage reductions:

**Proposition 5 (An Equivalence Result):** Assume that \( p = v(\delta) \), there is only one class of debt, and the firm faces no transactions costs in buying or selling assets or the securities it issues. 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 \((q(\delta_1) - q(\delta_0)) \times D_0 + (v(\delta_0) - v(\delta_1)) A_0\) for all \((D_1, A_1)\) with \( D_1 = \delta_1 A_1 \leq D_0 \).

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

\[ V^E(A_1, D_1) = v(\delta_1)A_1 - q(\delta_1)D_1. \quad (29) \]

Therefore,

\[ \nabla V^E = (v(\delta_1)A_1 - q(\delta_1)D_1) - (v(\delta_0)A_0 - q(\delta_0)D_0). \quad (30) \]

Thus, the total change in value for existing shareholders is

\[ \nabla V^E - N = (v(\delta_1)A_1 - q(\delta_1)D_1) - (v(\delta_0)A_0 - q(\delta_0)D_0) - p(A_1 - A_0) - q(\delta_1)(D_0 - D_1) \]

\[ = (v(\delta_1) - p)A_1 - (q(\delta_1) - q(\delta_0))D_0 - (v(\delta_0) - p)A_0 \]

\[ = - (q(\delta_1) - q(\delta_0))D_0 - (v(\delta_0) - v(\delta_1))A_0. \quad (31) \]
Since this does not depend on either $A_i$ or $D_i$, it is the same for all changes that lead to a given reduction in the leverage ratio, proving the result.

As an immediate corollary, this proposition implies that, under the given conditions, shareholders will resist leverage reductions through asset sales or asset expansion just as they resist leverage reductions through pure recapitalization. The leverage ratchet effect that we discussed in the preceding section occurs regardless of what mode of leverage adjustment might be chosen.

At first sight, the result is perhaps surprising, but the intuition 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.

If the reduction in leverage is mandated by regulation, against the shareholders’ will, the question arises whether the regulation is compatible with limited liability of shareholders. For the move from $(D_0, A_0)$ to $(D_i, A_i)$ to be compatible with limited liability of existing shareholders, we must have $N \leq V^E(D_1, A_1)$; that is, the amount of equity raised cannot exceed the market value of the firm’s equity after the change – as this value is the maximum value of the claim that can be given to new investors. The following result shows that, under the assumptions of Proposition 5, the validity of this condition is independent of whether the reduction of leverage occurs through asset sales, pure recapitalization or asset expansion.

**Proposition 6 (Limited Liability):** Under the assumptions of Proposition 5, a move from $(D_0, A_0)$ to $(D_i, A_i)$ with $D_i = \delta_i A_i \leq D_0$ is compatible with limited liability of existing shareholders if and only if $\nu(\delta_i) \geq q(\delta_i) \delta_0$.

**Proof:** Compatibility with limited liability of shareholders requires that

$$V^E(A_i, D_i) = \nu(\delta_i) A_i - q(\delta_i) D_i \geq N = p \times (A_i - A_0) + q(\delta_i) \times (D_0 - D_i),$$

which is equivalent to

$$\nu(\delta_i)(A_0 + A_i - A_0) \geq p \times (A_i - A_0) + q(\delta_i) \times (D_0),$$

or,

$$\nu(\delta_i) \geq q(\delta_i) \delta_0 + p - \nu(\delta_i) \left( \frac{A_i - A_0}{A_0} \right)$$

(32)
which leads to the condition \( v(\delta_i) \geq q(\delta_i)\delta_0 \) when \( p = v(\delta_i) \). For a pure asset sale, we also need to check that the firm can deleverage without raising new equity; that is, there exists \( A_i \in [0, A_0] \) such that
\[
p \times (A_0 - A_i) = q(\delta_i) \times (D_0 - \delta_i A_i).
\]
Solving for \( A_i \) we have
\[
A_i = \frac{p - q(\delta_i)\delta_0}{p - q(\delta_i)\delta_i} A_0,
\]
which is in the range \([0, A_0]\) if and only if \( p = v(\delta_i) \geq q(\delta_i)\delta_0 \).

Because \( q(\delta_i) \leq 1 \), a sufficient condition for the leverage reduction to be feasible is \( pA_0 \geq D_0 \), which is the conventional condition for assessing the firm to be solvent. Under this condition, a leverage reduction can always be achieved via an asset sale from Eq. (33), and can be achieved under limited liability for any mechanism if, as we have assumed here, \( v(\delta_i) = p \).

### 4.2 Shareholder Preferences for Different Modes of Leverage Reduction

In many settings, the conditions under which Proposition 5 holds are violated, and shareholders have a preference for one mode of leverage reduction over the others. We discuss in this section some of the major factors that can invalidate the equivalence result and lead to a firm’s managers (acting in the interest of the firm’s shareholders) choosing one action over the others.

#### 4.2.1 Divergence of Internal and External Asset Values

Proposition 5 concerns the case in which \( p = v(\delta_i) \). In other words, we assume that the price at which the firm’s assets can be bought or sold is precisely equal to the value of the assets to the firm’s investors when the leverage ratio is \( \delta_i \). What can we say about shareholder preferences at other prices? In this analysis, we begin by taking the asset price \( p \) as parametrically given, without considering whether it is consistent with market equilibrium. This corresponds to the standard approach of analyzing the behavior of price-taking agents by considering their demand and supply choices at any parametrically given prices. We will introduce equilibrium considerations once we discuss the parametric analysis.

If \( p > v(\delta_i) \), the market price of assets exceeds the value of those assets when held by the firm. If \( p < v(\delta_i) \), the firm can increase shareholder value by purchasing assets at the market price and holding them. The change in shareholder value is:
\[ \nabla V^E - N = - \left( q(\delta_i) - q(\delta_o) \right) D_0 - \left( v(\delta_o) - v(\delta_i) \right) A_0 - \eta \left( A_i - A_0 \right) \]  

(34)

where \( \eta = p - v(\delta_i) \). The third term shows that shareholders will prefer reducing leverage through asset sales when \( \eta > 0 \). Moreover, a pure asset sale may be feasible even if a pure recapitalization (or asset expansion) is not.\(^{23}\) When \( \eta < 0 \), on the other hand, shareholders prefer asset purchases, and asset purchases may be feasible when a pure recapitalization is not.\(^{24}\)

Taking the asset price as given is justified if the individual firm or bank can be thought of as a price taker operating in a large market. However, when we consider what occurs when there is a policy change that affects a large number of firms, e.g., an increase in bank capital requirements, we must recognize that the price-taking assumptions may no longer be justified. Even though an individual firm acting alone may be justified in taking the market price of assets as given, when all firms change their behavior in response to changes in regulatory requirements, it can be expected that the equilibrium market price will change.

For example, in the case of banking regulation, assume that the initial capital requirements correspond to the debt-asset ratio \( \delta_0 \) and that, for this debt-asset ratio, the equilibrium asset price is equal to \( p_0 = v(\delta_0) \), the price at which banks with the debt-asset ratio \( \delta_0 \) are just indifferent about their asset holdings. Now suppose capital requirements are tightened, so that leverage must fall to \( \delta_i \), and that, because of a reduction in tax benefits and subsidies net of bankruptcy costs, we have \( v(\delta_i) < v(\delta_0) \). Then, at the price \( p_0 = v(\delta_0) \), all banks want to respond to the new requirement by selling assets to buy back debt. Unless there are third parties willing to hold assets at this price, the asset price \( p_0 = v(\delta_0) \) will no longer clear the market. The new equilibrium price of the asset must be lower. Indeed, if there are no third parties willing to hold the assets, the new equilibrium price must fall to \( p_i = v(\delta_i) \), as we are assuming in Proposition 5. Furthermore, while a bank might initially appear solvent with \( p_0 A_0 \geq D_0 \), if it is the case for some banks that \( p_i A_0 < D_0 \), these banks may only be revealed to be insolvent through their inability to recapitalize and satisfy the new requirements.

Throughout our discussion, we have assumed that the leverage regulation involves a debt-asset ratio \( D/A \), which is fixed without regard to current market prices. In practice, regulations such as bank capital requirements are often based (at least to some extent) on current values, imposing an upper bound on a ratio such as \( q(\delta_i) D/p_i A \) or \( D/p_i A \). The first corresponds to a

\(^{23}\) Specifically, a pure asset sale only requires \( p \geq q(\delta_i) \delta_o \) whereas a recap requires \( v(\delta_i) \geq q(\delta_i) \delta_o \).

\(^{24}\) An asset expansion is feasible iff \( v(\delta_i) \geq q(\delta_i) \times \delta_o + \eta \times \frac{\delta_0}{\delta_i} - 1 \).
ratio based solely on market values, the second corresponds to a case where assets are marked to market but debt levels are measured at the face value of liabilities. All of our results continue to apply with either of these measures (as they simply represent rescaling of the target leverage ratio). Note, however, that if \( \delta_1 \) has to be equal to either \( q(\delta_1)D / p_1A \) or to \( D / p_1A \), then, because \( q(\delta_1) > q(\delta_0) \) and \( p_1 < p_0 = \nu(\delta_0) \), the deleveraging effect is larger than it would be if \( \delta_1 \) had to be equal to \( D / A \). That is, when the leverage ratio is based on market values, rather than quantities, the effect of deleveraging is exacerbated.

### 4.2.2 Multiple Classes of Existing Debt

In this section we consider shareholder preferences 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. The price at which junior debt can be repurchased depends on the precise capital structure of the firm (as well as any default costs or subsidies). Without going into the details of this dependence, we note that the price \( q' \) at which junior debt can be repurchased should satisfy

\[
\int_{\delta}^{\infty} dF(x | \theta') \leq q' < q(\delta).
\]

where, as above, \( \theta' = \arg \max_{\theta} V^E(\delta, 1, \theta) \). The lower bound in (35) reflects the fact that the price of the junior debt should be no less than the probability that the firm does not default, since in that case it will be repaid. The strict inequality for the upper bound follows as long as seniority “matters” in the sense that there exist some states of the world in which junior debt holders have lower recovery rates in default than more senior creditors.

The fact that junior debt is cheaper to repurchase breaks the indifference obtained in Proposition 5. Now, shareholders will be better off the more junior debt that is repurchased. In particular, we have the following important result:

**Proposition 7 (Multiple Classes of Existing Debt):** Assume \( p = \nu(\delta_1) \) and (35) holds. Then,

1. **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.
2. **ii.** In the case of asset expansion, the ability to purchase junior debt makes no difference since no debt is repurchased.
3. **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 \( \nabla V^E = \left( v(\delta_i)A_i - q(\delta_i)D_i \right) - \left( v(\delta_0)A_0 - q(\delta_0)D_0 \right) \), but given the lower cost \( q' \) of repurchasing the junior debt, the total change in value for existing shareholders is:

\[
\nabla V^E - N = \left( v(\delta_i)A_i - q(\delta_i)D_i \right) - \left( v(\delta_0)A_0 - q(\delta_0)D_0 \right) \\
- p(A_i - A_0) - q' (\delta_i)(D_i - D_0) \\
= \left( v(\delta_i) - p \right) A_i - \left( v(\delta_0) - p \right) A_0 - \left( q(\delta_i) - q(\delta_0) \right) D_0 \\
+ \left( q(\delta_i) - q'(\delta_i) \right) (D_i - D_0) \\
= -\left( q(\delta_i) - q(\delta_0) \right) D_0 - \left( v(\delta_0) - v(\delta_i) \right) A_0 + \left( q(\delta_i) - q' \right) (D_i - D_0) \\
\tag{36}
\]

Note that for a pure asset expansion, we have \( D_0 = D_1 \), and thus the loss to shareholders in (36) is identical to that in the case of a single debt class. However, this loss is reduced in the case of a recapitalization or of an asset sale, since in that case \( (q(\delta_i) - q')(D_i - D_0) > 0 \).

While shareholders’ losses are smaller in a recapitalization, we know from Proposition 2 that shareholders still lose even if they can repurchase the junior debt at the minimal price in (35).

Next, we show that asset sales are preferable to a recapitalization. Because \( p = v(\delta_i) \), i.e. the asset is priced fairly, it suffices to compare the repurchase prices for the most junior classes of debt in the two cases. Because the firm’s final leverage ratio is the same, under our homogeneity assumption the probability of default is the same in either case. Thus, the only change to the payoff to a debt holder who “holds out” is that, as more debt is repurchased, the proportion of the remaining debt that is senior to it will (weakly) increase. As a result, the repurchase prices of the most junior debt classes will (weakly) decrease as their relative seniority, and therefore their expected recovery rates, declines. Thus, because more debt is repurchased at the same or lower price under an asset sale versus a recapitalization, shareholders will prefer an asset sale.

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. To simplify notation we normalize the initial asset level to be \( A_0 = 1 \) and similarly assume (without loss of generality) that the price at which the assets will be sold is normalized to 1 so that \( p = \int_0^\infty x \, dF(x) = 1 \). Consider now a decrease in leverage from \( \delta_0 \) to \( \delta_i (< \delta_0) \) accomplished through asset sales. Shareholders will gain if

\[
\nabla V^E = A_i \int_{\delta_i}^\infty (x - \delta_i) \, dF(x) - \int_{\delta_0}^\infty (x - \delta_0) \, dF(x) > 0 \\
\tag{37}
\]

The derivative of (37) with respect to \((\delta_i, A_i)\) at the point \((\delta_i, A_i) = (\delta_0, A_0)\), we have
Recall that for a pure asset sale, the value of the assets sold must equal the cost to repurchase the debt, so that

\[ 1 - A_i = (\delta_o - \delta_i A_i) q' \]  

where \( q' \) is the average price of the junior debt repurchased. Taking the derivative of (39) at the point \((\delta_1, A_1) = (\delta_o, A_o)\), we have

\[ q' d\delta_i = (1 - q' \delta_o) dA_i \]  

Combining (38) and (40), we have

\[
dA_i \int_{\delta_i}^{\infty} (x - \delta_o) dF(x) - d\delta_i \int_{\delta_i}^{\infty} dF(x)
\]

Because \( dA_i < 0 \), the derivative above is positive and shareholders initially gain from asset sales if the following expression is positive:

\[ \int_{\delta_i}^{\infty} dF(x) - q' \int_{\delta_i}^{\infty} x dF(x) \]  

Now, the value of the junior debt can be written

\[ q' = \int_{\delta_i}^{\infty} dF(x) + \alpha \int_{0}^{\delta_i} x / \delta_o dF(x) \]

where \( \alpha \in [0,1] \) is the expected recovery rate of the junior debt relative to average recovery rate of the firm’s debt (which is strictly positive given our assumption that \( F \) has full support). If the debt is fully prioritized so that all debt repurchased is junior to any debt retained, then \( \alpha = 0 \), whereas if the debt is pari passu then \( \alpha = 1 \) and \( q' = q \). Substituting this value for \( q' \) in (41), we get

\[
\int_{\delta_i}^{\infty} dF(x) \left( 1 - \int_{\delta_i}^{\infty} x dF(x) \right) - \alpha \int_{0}^{\delta_i} x / \delta_o dF(x) \int_{\delta_i}^{\infty} x dF(x)
\]

where we use the fact that \( E[x] = \int_{0}^{\delta_i} x dF(x) = 1 \). Thus, (42) is positive and shareholders gain from an asset sale if the debt repurchased is sufficiently junior so that its relative recovery rate satisfies \( \alpha < \delta_o / E[x | x > \delta_o] \).

This result explains why shareholders may 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. While it is well known that an asset sale that is used to fund payouts to equity holders will benefit shareholders at
the expense of creditors, our result (iv) above states that equity holders can gain even if the proceeds are used to buy back junior debt. While total leverage declines and junior creditors gain, senior debt holders lose even more (as their claims are backed by a smaller pool of assets). If allowed, shareholders therefore prefer this form of deleveraging over a pure recapitalization or asset expansion.

Note that in our analysis of asset expansion we have assumed that \( A_i = D_0 / \delta_1 \) so that \( D_1 = \delta_1 A_i = D_0 \). Increasing assets further would necessitate issuing new debt in order to achieve the target leverage ratio \( \delta_1 \). 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 \( A_i > D_0 / \delta_1 \) will be no more costly than it is with \( A_i = D_0 / \delta_1 \). 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 8 (Asset Expansion with Additional Debt):** Assume \( p = v(\delta_1) \). If \( D_1 = \delta_1 A_i > D_0 \) then:

i. shareholders are indifferent to any choice of \( A_i \) 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 \( A_i > D_0 / \delta_1 \); and

iii. if new debt can be senior to existing debt, then choosing \( A_i > D_0 / \delta_1 \) makes shareholders better off.

**Proof:** By the same logic as in (36), the impact on shareholders’ payoff associated with increased asset purchases which are funded by increasing debt beyond \( D_1 \) is given by

\[
(q^{\text{New}} - q(\delta_1))(D_1 - D_0)
\]

where \( q^{\text{New}} \) is the average price of the new debt issued. If new debt is equal priority to existing debt, then \( q^{\text{New}} = q(\delta_1) \) and shareholders are indifferent to any choice of \( A_i \) and \( D_1 = \delta_1 A_i \). But if new debt is junior to existing debt and \( D_1 = \delta_1 A_i > D_0 \), then \( q^{\text{New}} < q(\delta_1) \) and shareholders are worse off. Alternatively, if new debt is senior to existing debt, \( q^{\text{New}} > q(\delta_1) \) and shareholders gain by choosing \( D_1 > D_0 \), effectively by usurping the priority of the initial creditors. ■

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 financial institutions, which rely on significant amounts of short term debt. Short term debt is effectively senior to the bank’s long-term debt. Proposition 8 suggests that shareholder losses are decreasing in the scale of the firm in this case. This result suggests that in cases when new debt can be senior, shareholders might prefer additional asset expansion.

4.2.3 Heterogeneous Assets

Proposition 5 treats the firms’ assets as though they are homogeneous, with each asset unit having return of $x$ so that the total return on all assets is simply $xA$. In reality, assets are heterogeneous, with differing risk and return. Nevertheless, the results of Proposition 5 continue to apply even when assets are heterogeneous as long as any asset sales or purchases correspond to a “representative portfolio” and so have the same risk and return as the average asset in the firm.

Of course, given the option, 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. In contrast, they will prefer to purchase relatively risky assets if the firm expands. This preference is just another manifestation of the asset substitution agency problem that we have discussed above.

As a concrete example, suppose the firm holds a mix of risky assets and safe assets. In particular, suppose it holds quantity $A_r$ of risky assets with return $\bar{x}_r$ and $A_s$ of safe assets with a riskless return. Note that we can normalize quantities so that each “unit” of assets (risky or safe) has market price $p$. Thus the firm has total assets $A = A_r + A_s$ with aggregate return $\bar{x}$ given by

$$\bar{x} = \frac{\bar{x}_r A_r + p A_s}{A}.$$ 

Suppose the firm considers reducing leverage by selling safe assets and using the proceeds to buyback debt. At the conclusion of the asset sale, the firm’s leverage ratio $\delta_1$ satisfies

$$p a_s = q(\delta_1)(D_0 - D_1) = q(\delta_1)(D_0 - \delta_1(A - a_s)).$$

That is, the value of the assets sold must equal the value of the debt repurchased. We then have the following immediate corollary to Proposition 5, showing the equivalence of “selective” asset sales and asset substitution:

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25 On the shortening of debt maturity due to lack of commitments and as a way to dilute existing creditors, see Brunnermeier and Oehmke (2013). Also relevant is the bankruptcy exemption of repos and derivatives, which can encourage excessive leverage in ways that allow creditors to take advantage of the exemptions. See Jackson and Skeel (2012) and Bolton and Oehmke (2013).
**Corollary (Asset Sales and Asset Substitution):** Reducing leverage via the sale of safe assets is equivalent, in terms of shareholder payoff, to recapitalizing the firm (to the same leverage ratio) and simultaneously selling safe assets and purchasing risky ones.

**Proof:** Suppose the firm first exchanges its holdings \( a_s \) of safe assets for risky ones at the market price \( p \), and then sells those risky assets to reduce leverage through an asset sale. This transaction clearly has the same shareholder payoff as simply selling the safe assets directly. But since the firm’s assets are homogenous after the asset exchange, by Proposition 5 this has the same shareholder payoff as an asset exchange followed by a pure recapitalization.

Note that the equivalence between asset sales and asset substitution ignores potential transactions costs. Once these are considered, asset sales are likely to be strictly preferred, as it avoids both the need to purchase risky assets and to issue equity. We discuss additional impacts of transactions costs in Sections 4.2.4 and 4.2.5 below.

In the context of capital regulation for banks, an attempt is made under Basel II and Basel III to address the problems created by asset substitution and risk shifting. This is done by assigning risk weights to assets and formulating capital requirements in terms of the size of the risk-weighted asset base. If the risk weighting system worked perfectly and completely removed the ability of bank managers and shareholders to engage in asset substitution and risk shifting when assets are sold or purchased, asset heterogeneity would not necessarily undermine the equivalence result given in Proposition 5. In particular, if risk weighting effectively means that the value of debt depends only on leverage as measured by the risk weighting system, so that \( q(\delta) \) will be the same no matter what the mode of leverage reduction, then the conditions for Proposition 5 to hold are potentially restored even with heterogeneous assets.

In practice risk weighting falls short of removing the ability of banks to increase risk and engage in asset substitution. Indeed, the regulations often involve transparently inappropriate risk weights, e.g., a zero risk weight for sovereign debt or for highly rated securities even when they clearly carry some potentially significant risks. Making matters worse is the fact that in practice the implementation of the risk weighting system relies in part on the banks’ own internal risk models and is therefore highly manipulable. When risk weights are imperfect, the same logic as the preceding result implies that banks will have an incentive to reduce leverage by selling assets that are safer than their risk weight implies, and holding on to assets that are riskier than their assigned weights. Again, such selective sales are another mode of asset substitution that banks may engage in when capital regulations only impose capital ratios rather than specifying the mechanism by which they should be achieved.

**4.2.4 Transactions Costs**

Proposition 5 is based on the assumption that the firm faces no transactions costs in changing the scale of its assets or in issuing and retiring securities. Not surprisingly the introduction of transactions costs can lead to one alternative being preferred over the others,
since the three ways of changing leverage that we consider involve different pairs of transactions as shown below:

<table>
<thead>
<tr>
<th>The firm purchases:</th>
<th>The firm sells:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset Sales</td>
<td>Debt</td>
</tr>
<tr>
<td>Recapitalization</td>
<td>Debt</td>
</tr>
<tr>
<td>Asset Expansion</td>
<td>Assets</td>
</tr>
<tr>
<td></td>
<td>Equity</td>
</tr>
<tr>
<td></td>
<td>Equity</td>
</tr>
</tbody>
</table>

Asset expansion will be the preferred alternative if the transactions costs involved in repurchasing debt are particularly large relative to the other transactions, but this is unlikely to be the case. The transactions costs involved in equity issuance and asset sales are likely to be more important. If equity issuance costs are large relative to those in asset transactions, then asset sales, since they involve no equity transactions, will be the preferred alternative. If the transactions costs involved in selling assets are particularly large compared to equity issuance costs (e.g., the firm faces extreme “firesale conditions” in liquidating assets), then recapitalization or asset expansion will be preferred. Without making specific assumptions about the magnitude of the various transactions costs, little more can be said about what approach will be most advantageous for shareholders.

4.2.5 Asymmetric Information

A key component of transactions costs in settings such as the ones we are considering is due to the possibility that the firm’s managers have private information about the firm’s assets and growth opportunities. Managers will want to sell assets that the market is overvaluing and similarly will want to issue equity if they perceive the market is overpricing the firm’s shares. The possibility that managers will make strategic choices based on their private information can account for a significant part of the bid/ask spread for transactions involving the firm’s assets and securities. Information asymmetries can be particularly important in asset sales and equity issuance and this explains why transactions costs for these are likely to be larger than those associated with debt buybacks.

Asymmetric information factors that would affect the valuation of the firm’s assets in the asset sales approach clearly also give rise to asymmetric information issues affecting the market valuation of the firm’s equity when the firm issues equity directly (as opposed to a rights offering) to recapitalize or expand its assets. It is clear that if there is asymmetric information

26 Note that in Myers and Majluf (1984) the asymmetric information that makes management reluctant to issue equity relates to the value of assets in place as well as the value of the investment opportunity the equity issuance would finance. The key assumption in the Myers-Majluf analysis is that the firm can only raise equity through an offering of common shares and not, for example, through a rights offering. With symmetric information, as in Proposition 5, it does not make a difference whether new equity is raised through an offering of shares to the market or through a rights offering. With asymmetric information, it does make a difference. In a sale of new shares to the market, the market’s assessment of the firm directly impacts the amount of money raised by the firm. In a rights offering, if it succeeds, the market’s assessment of the firm does not affect the amount of money raised by the firm, but only the value of shares and therefore the value of the rights. The attitude of existing shareholders to a rights offering then depends on whether they are short-term investors, who are interested in the current share price,
about the value of the assets in place, there must be asymmetric information about the value of
the firm’s equity. If a recapitalization must be done through a new share issuance as opposed to a
rights offering, it is not immediately obvious whether it will be more expensive for the firm’s
shareholders to sell assets and deleverage or sell equity and recapitalize.

In some circumstances asymmetric information about asset values makes the
shareholders indifferent between deleveraging and recapitalizing. Assume that the market
undervalues the firm’s assets in the following sense: while managers know that the realized value
on the firm’s assets will be \( \tilde{x} (1 + \omega) A \) for \( \omega > 0 \), the market assumes that the realized value of
the assets will only be \( \tilde{x} A \). Essentially this means that for each asset unit that the market
perceives, the firm effectively has \( 1 + \omega \) units and this difference is perceived by the firm’s
managers.

**Proposition 9 (Equivalence with Asymmetric Information):** Assume that there is only one
class of debt, the firm faces no transactions costs in buying or selling assets or the securities it
issues other than that implied by the market’s undervaluation of its assets and the firm must
decrease its leverage from \( \delta_0 \) to \( \delta < \delta_0 \). Then for all \( \omega \geq 0 \), shareholders find pure
recapitalization through a common share offering and asset sales equally undesirable.

**Proof:** See Appendix B.

Asymmetric information imposes costs on the current shareholders in both the asset sale
and pure recapitalization cases because the firm is selling assets or equity at prices below their
values. Although a greater dollar amount of assets must be sold in the asset sales approach than
the dollar amount of equity that needs to be issued to effect a recapitalization, the underpricing of
equity is larger in percentage terms because of leverage, and this is just sufficient to make the
loss due to underpricing the same.\(^{27}\)

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\(^{27}\) One might wonder why the results we obtain for asymmetric information differ from those presented above in
4.2.1, where we assume that the market price for the firms’ assets differs by \( \eta \) from the value of the assets when
they are held by the firm. Since in section 4.2.1 we assume that there is symmetric information about the value of
the assets when they are held by the firm, it follows that when that value differs from the market price, there is
uniform agreement that the firm should either be selling assets if \( \eta > 0 \) and buying assets if \( \eta < 0 \). Whether the firm
should grow or shrink is unambiguous, and this makes the preferred mode of leverage reduction depend on the
amount of assets sold or bought. With asymmetric information the situation is quite different. When equity is issued,
the price is based on the market’s perception of the total value of the assets and any losses are due the market’s
undervaluation of that total. As discussed above, the same amount of assets is effectively sold at undervalued prices
when equity is issued as when assets are sold directly. This means that while in the analysis of 4.2.1 the losses or
gains are based on the amount of assets sold, while in the case of asymmetric information the losses are based on the
market’s valuation of all the assets. It does not matter whether the assets are directly sold or indirectly sold through
issuance of equity — the loss is the same. A long-term investor, who is patient enough to wait until the market has
learned the correct value for the assets, would however take a different view if equity were raised through a rights
offering; see the preceding footnote. Such an investor would prefer the rights offering to a sale of assets.

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or long-term investors à la Myers-Majluf, who are interested in returns and share prices in the future, when the
market will have learned about the underlying values.
If the firm’s assets are heterogeneous, the situation involving asymmetric information becomes more complex. Transactions costs due to asymmetric information are likely to be lowest on the least risky assets. As discussed above, asset substitution considerations indicate that the shareholders will want to sell low-risk assets when deleveraging, but will want to buy high-risk assets in the asset expansion approach to reducing leverage. This means that transactions costs concerns and asset substitution will tend push shareholders toward the deleveraging alternative. With deleveraging, incentives associated with asset substitution and transactions cost minimization are aligned. This is not the case with asset expansion.

Note, however, that deleveraging is not always the preferred alternative from a transactions costs perspective. If most assets are hard to value by outsiders and managers can pick the assets they sell, then the adverse selection effects can be greater with asset sales than they are when equity is sold. This is because equity represents a claim on a portfolio of assets rather than an adversely selected subset. The transactions costs associated with issuing equity can be lower than those involved in selling hard to value assets. This could tip the balance in favor of recapitalization.

Finally, it should be noted that one way that leverage can be reduced that involves almost no transactions costs due to asymmetric information is for the firm to retain earnings and build equity “internally.” Adverse selection costs can also be eliminated by raising equity through a rights offering. Shareholder resistance to these ways of reducing leverage is entirely due to debt overhang.

5. Implications for Banking Theory and Policy

While, in principle, our analysis applies to corporations in all industries, it is particularly relevant for banks. Over the past century, leverage in banking has steadily increased, and today banking institutions are by far the most highly leveraged corporations in the economy. Whereas nonfinancial firms are deemed to be highly levered if their borrowing reaches seventy percent of their assets, and many of them borrow hardly at all, banks often fund significantly more than ninety percent of their assets by borrowing.

The increase of borrowing was particularly pronounced in the years before the financial crisis of 2007-2009. Some of the increase was actually difficult to detect because it involved derivatives and because important commitments were left off the reported balances sheets of banks.

Much of bank borrowing, and much of the recent increase in bank borrowing, has involved short-term debt. Traditionally, short-term bank borrowing involved mainly deposits of retail customers. Today banks also borrow a lot through wholesale markets involving derivatives, asset-backed commercial paper, or repo contracts.

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28 Among the twenty largest European banks, in 1998, equity of less than four percent of total assets (under IFRS accounting rules, which disallow netting) was the exception in 1998 but had become the rule by 2007. For details on this point and more, see Advisory Scientific Committee (2014)
The high leverage of financial institutions played an important role in the financial crisis of 2007-2009 and meant that many of these institutions were unable to absorb the losses they suffered. Even those that did not become insolvent lost significant fractions of their equity, which induced them to deleverage by selling assets, putting further pressure on asset prices and on other institutions. Eventually, the chain reactions led to major breakdowns in funding and credit across the globe. Contagion was very intense not only because institutions were highly interconnected but also because the weakness of institutions caused them to react strongly to the adverse developments that affected them.29

The academic literature on banking has sought to explain the observed high leverage as a result of optimal contracting. One line of argument focuses on the idea that, if the bank’s debt is constantly in need of being rolled over, then bank managers will always be on their best behavior in order to forestall a breakdown of funding. Another line of argument focuses on the desire of investors to have assets that are “liquid” and can be turned into cash whenever they wish. As we have explained in some detail elsewhere, both lines of argument, as well as arguments using asymmetric information to justify high leverage and resistance to leverage reduction, have serious conceptual and empirical weaknesses that render them inadequate for explaining banks’ actual behavior and for guiding policy.30

By contrast, our analysis suggests that the observed high leverage of banks and the growth of this leverage over the past century may reflect the leverage ratchet rather than optimal contracting. The leverage ratchet effect suggests that banks will generally resist leverage reductions and will try to increase leverage whenever they have the opportunity to do so. And this is in line with much of what we observe.

For example, banks often seek to make payouts to shareholders in order to maintain or increase their leverage. This behavior is contrary to the “pecking order” theory of finance, which claims that retained earnings are unaffected by market frictions such as asymmetric information and are therefore the most preferred source of funding for any corporation. The banks’ preference for payouts to shareholders is however fully in line with our analysis.

The observation that bank leverage has been going up over time is also consistent with our analysis, particularly in light of the ever expanding system providing "safety nets" for banks in the form of explicit and implicit guarantees of their debt. For example, in the 2000s a significant expansion of short-term bank borrowing occurred through a dramatic increase in borrowing through repo contracts. Repo borrowing, which legally is not borrowing but a combination of a sale and repurchase, is effectively a way to issue new debt ahead of any incumbent debt, jumping the queue of claimants in default, getting ahead even of depositors because the repo collateral is not available to repay them or other creditors.

29 For detailed accounts see Hellwig (2009) as well as Admati and Hellwig (2013a, Chapter 5).
30 See Admati et al. (2013, Sections 5-7), Admati and Hellwig (2013a, b, c), Admati (2014, Section 4), Hellwig (2014), and Pfleiderer (2014).
The growth of repo borrowing accords with our result that, once significant leverage is in place, shareholders have an incentive to increase leverage if they need not internalize the consequences of additional leverage on existing creditors. This incentive is particularly strong if new debt can usurp the priority of existing claims.

While outright dilution may be ruled out by covenants prohibiting the issue of new debt that is senior or equal in status to incumbent debt, such covenants can be circumvented if the new debt matures earlier than the incumbent debt. Brunnermeier and Oehmke (2013) have referred to this development as a “maturity rat race”. The “maturity rat race” is fully in line with the logic of our analysis. The effect is strengthened if the bank is free to secure the new debt with collateral. The collateral that is used for repo borrowing or for asset-backed commercial paper is not available to incumbent debt holders in bankruptcy.

In the case of nonfinancial corporations, many of these effects are weakened or eliminated because there are few lenders and these lenders are in a position to exert effective control, through covenants and through direct interference with borrowers’ decisions if they don’t like them. By contrast, banks usually get money from many lenders. These lenders tend to be small, and none of them has the incentives or the power to control their borrower’s behavior. Shareholders, or managers acting on behalf of shareholders, are therefore much more in a position to take advantage of debt holders.

The decisions that are thus taken can be and generally are socially inefficient even when there is no further damage to third parties (e.g., the rest of the economy). These decisions would not be taken if contracts that prohibit them were feasible to write and were enforceable. In the context of banking, the scope for writing and enforcing such contracts is very limited because, individually, debt holders are not in a position to impose their will on managers and shareholders and, collectively, they are not sufficiently well coordinated.

These concerns are reinforced when debt holders feel they are protected by a government safety net in the form of explicit and implicit debt guarantees. With such protection, creditors have weak incentives (if any) to protect themselves by ex ante contracting or by ex post monitoring and control. Investor anticipations of bank bailouts perversely encourage further risk taking and leverage which increase the value of the implicit government guarantees. The leverage ratchet effect is reinforced. In this interpretation, the observed high leverage of banks cannot be presumed to be efficient. Indeed, even when only considered from the narrow perspective of the banks’ investors, it may be highly inefficient. Also the prominence of short-term debt in bank funding may reflect the maturity rat race, the desire of the borrower to use short-term borrowing as a way to jump the priority queue and the desire of lenders to protect themselves against such jumping of the priority queue by new lenders.

In contrast to the academic literature that tries to explain observed funding patterns of banks as being efficient, our analysis suggests that the observed high leverage of banks, the growth of this leverage over time, and the prominence of short-term funding should be seen as resulting from failures of commitment and therefore as highly inefficient. Regulation aimed at
reducing leverage can therefore be beneficial not only for the overall economy, but even for the banks themselves.

The case for government regulation of firms in an industry usually rests on the presence of significant externalities: the decisions of firms in the industry can adversely affect third parties. In the case of banks, particularly large banks, the external effects are indeed important because the failure of a large bank can cause severe damage to the entire economy. Here we have the added consideration that government policies reducing the force of the leverage ratchet effect can improve market outcomes for the banks and their investors themselves.

Regulatory limits on bank leverage increase the ability of banks to absorb losses and reduce the intensity of contagion in a crisis. Third-party damage from bank failures and their systemic implications are thereby contained. Moreover, from an \textit{ex ante} perspective, the institutions themselves may even be better off because regulatory limits on bank leverage also provide a remedy for the inability of banks to commit their future funding policies.

However, the implementation of such limits must be executed with care. Our results in Section 4 suggest that, if regulation forces a bank to decrease its leverage, shareholders will try to impose part of the cost on incumbent senior creditors or on the deposit insurance system. They can do this by selling relatively safe assets and buying back junior debt. The reduction in assets worsens the senior debt holders’ prospects; moreover, the effect is stronger the safer are the assets that are sold. By focusing on junior rather than senior debt, shareholders both minimize the cost of the buying back the debt and devalue any remaining claims. In fact, shareholders might gain by this form of deleveraging if the dilution of senior creditors (and the deposit insurance system) is sufficiently large.

This prediction from our analysis is again in line with what we observe. For an example consider what happened in the fall of 2011 when European authorities mandated banks to increase their core equity up to nine percent of risk-weighted assets by June 30, 2012. Many banks responded to this by using revenues from asset sales to buy back the most junior kinds of debt they had.

Asset sales and reductions in banks’ sizes are not necessarily undesirable. However, if policymakers are concerned that, if many banks are selling assets at the same time and pushing asset prices down, there may be adverse consequences for the overall economy, they should be sure to introduce the new regulation by setting targets for equity in terms of absolute amounts (derived, for example, by multiplying the new ratios with the asset positions on a fixed date).

\footnote{For example, the billions of dollars, euros or pounds that were lost by the creditors in the bankruptcy Lehman Brothers, declared in September, 2008, were dwarfed by the trillions of dollars that were lost by the subsequent disruption of economic activity.}

\footnote{In particular, they repurchased so-called \textit{hybrid} debt, which before Basel III, had to some extent been counted as “capital”, namely the so-called “Tier 2 Capital”. The scope for counting such hybrid debt as bank capital was much reduced under Basel III.}
rather than ratios. In this case, banks can only fulfil the new requirements if they increase their equity, either by retaining earnings or by getting new equity funding from investors.

Banks often claim that they cannot raise additional equity because the supply of equity in the market is too small. Quite often, this just means that they merely do not want to raise equity, which is consistent with our analysis of the pervasive resistance to leverage reduction by highly leveraged firms that we studied in Sections 3 and 4. If a bank is profitable, it can always raise equity by retaining earnings. A bank that is listed on a stock exchange can raise equity by selling new shares, e.g., through a rights offering. Reluctance to do so is likely to be due to the leverage ratchet effects we studied, reinforced by concerns that corporate taxes might be higher or subsidies from explicit or implicit government guarantees might be reduced if the bank replaced some debt by equity. As discussed in Admati et al. (2013, Section 4), none of these private considerations should be a concern from the perspective of public policy.

An inability of a publicly traded bank to raise new equity can be taken by itself as evidence that the bank might be insolvent. Proposition 6 presented conditions resembling solvency tests often applied under the law for a corporation to be able to reduce its leverage. The proposition implies that if a bank satisfies this condition, it can always meet a stricter equity requirement by issuing new shares and using the proceeds to invest in tradable assets.

If a bank is in fact unable to raise equity, this fact in itself should be a cause for concern. It is important that hidden insolvencies should not be allowed to persist. Weak, insolvent banks have strong incentives to engage in reckless lending and risky asset purchases and “gamble for resurrection,” or avoid recognizing losses by continuing to lend to insolvent debtors while rejecting loan applications from new entrepreneurs. Such banks should not be allowed to continue operating without regulatory intervention. Regulatory forbearance can exacerbate distortions in lending and increase the social costs when insolvencies are eventually dealt with.

For the same reasons, it is important that “liquidity” supports to banks should be accompanied by measures strengthening the banks’ equity positions and reducing their leverage. Central bank lending to banks against “good enough” collateral or government support in the form of preferred equity alleviate the immediate distress, but if the claims of central banks or governments are senior to the claims of shareholders on the banks’ assets, these measures

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33 It is incongruous that, for fear of transition problems, Basel III gives the banks until 2018 to satisfy the new requirements but at the same time, there is no restriction on dividend payments and share buybacks.
34 The Savings and Loans crisis in the US in the 1980s illustrates the first problem and the Japanese crisis of the 1990s illustrates second. Consistent with these warnings, neither the LTRO program nor TARP resulted in significant increases in (business) lending. On the LTRO program, see Acharya and Steffen (2013), who refer to the LTRO as “the greatest carry trade ever.” Anecdotal evidence that the program did not improve lending includes such stories as Louise Armistead, “ECB's LTRO plan flops as banks cut lending,” *Telegraph*, March 28, 2012. Cole (2012) shows that banks receiving capital injections from the TARP failed to increase their small-business lending, and instead decreased their lending by even more than other banks. Additional examples of distortions in lending include real-estate loans and mortgages in the United States, Ireland and Spain, or shipping loans in Germany with loan-to-value ratios kept low by relying on historical real estate or ship prices rather than current market prices.
35 See ASC Report 01/2012 and references given there and Admati and Hellwig (2013a, especially Chapter 11).
effectively increase the banks’ leverage and distort the incentives of shareholders (and managers). Distortions such as resistance to recapitalization, excessive risk taking, and underinvestment due to debt overhang, are thus exacerbated rather than alleviated by such bailouts. 36

6. Concluding Remarks

In this paper we analyzed an agency cost of debt that stems from subsequent capital structure choices of firms that already have debt in place. This agency cost, which we call the leverage ratchet effect, biases the shareholders of leveraged firms against reducing and towards increasing leverage.

In the absence of full commitments and complete contracts, the agency conflicts created by the presence of debt tend to increase the ex ante costs of funding mixes that include significant borrowing. Debt covenants that try to deal with the ratchet effect might try to address the problem, in some cases even going as far as to forbid all borrowing until the debt is paid, but such covenants may unduly reduce the subsequent flexibility of the firm.

Because it reflects an additional agency cost of debt, the leverage ratchet effect may help explain why some firms choose very low leverage. It is well known that low leverage gives firms more flexibility to take advantage of investment opportunities without constraints from covenants and helps them avoid the negative effects of subsequent debt overhang and asset substitution problems. The leverage ratchet effect strengthens this rationale for low leverage by the observation that low leverage helps firms avoid the inefficiencies associated with excessive subsequent leverage. This observation may contribute to our understanding of the so-called zero-leverage puzzle. 37

As we discussed, the leverage ratchet effect applies most obviously to banks and other financial institutions whose creditors, particularly depositors and other creditors who believe they will be paid by the government if not by the banks, do not constrain subsequent leverage increases through contracts. Because high leverage exacerbates the other agency costs of debt and increases the likelihood of costly default or bankruptcy, banks’ high leverage is a source of inefficiency, including social inefficiency if there is collateral damage of distress and default.

Moral hazard problems associated with explicit and implicit government guarantees exacerbate these problems. Regulation that allows a form of commitment to a more efficient capital structure with lower leverage can therefore play an important role. The analysis in this paper reinforces the conclusions of Admati et al (2013) that equity requirements significantly higher than those currently considered would provide large social benefits at little if any social cost.

36 Examples are the European Central Bank’s Long Term Refinancing Operation (LTRO) of 2011/2012, which provided cheap loans to banks, and the Troubled Assets Relief Program (TARP) in the US of 2008-2009, which provided funding in the form of preferred equity. Acharya and Steffen (2013) see the ECB’s LTRO as a basis for the "greatest carry trade ever," poorly capitalized banks borrowing at percent from the European Central Bank and investing the funds in their own sovereigns at four or five percent.

37 See, for example, Strebulaev and Yang (2013).
Politicians and regulators tend to shy away from imposing stricter capital requirements on banks. Despite narratives suggesting that the regulations have undergone major reforms, the actual changes since the final crisis have been minor. Basel III, the new international accord on banking regulation, still allows banks to fund up to 97% of their assets with debt and have as little as 3% equity to total assets. This reluctance to impose stricter capital requirements on banks reflects a fear that stricter capital requirements might induce banks to reduce their lending and this would harm economic growth.

As we have seen in Section 4 of the current paper, firms that are forced to reduce leverage may prefer to do so via sales or reductions of safe assets and reductions of their most junior debt, rather than by raising new equity. However when banks maintain higher equity levels on a regular basis, losses represent smaller fractions of the equity. Moreover, if banks are profitable regulators can avoid undesired spillovers from asset sales by requiring that leverage reductions be achieved via retained earnings or rights offerings, thereby mitigating shareholders’ ability to impose further losses on creditors when they reduce leverage. Well-designed capital regulations, which take into account the effects identified in this paper, will improve the quality of bank lending, as well as the stability of bank lending and the financial system.

39 Admati and Hellwig (2013, Chapter 11) outline how capital regulations in which equity requirements are significantly higher than current levels can be designed and implemented to achieve their objectives. Admati et al (2013, Section 9) discuss in more detail the relation between capital requirements and lending.
Appendix A: The Ratchet Effect and Leverage Dynamics

In this appendix, we consider how the leverage ratchet effect can affect the dynamics of leverage adjustment. To do so, we analyze the equilibrium outcomes for the example in Section 3.3 when the firm cannot commit to a leverage ratio. In particular, we show that in response to shocks that raise the cost of leverage, so that a leverage reduction would raise firm value, shareholders will not voluntarily decrease leverage, but instead may choose to increase leverage.

Consider the example in Section 3.3 where there is no commitment at all. We demonstrated there that given any choice of leverage, equity holders would like to increase leverage if given the opportunity to do so on a one time basis. But if equity holders have the flexibility to increase leverage in the future, this will impact the price that creditors will be willing to pay for any current debt issue. This raises the question of what the equilibrium debt choice will be absent any commitment by equity holders not to issue junior debt in the future.

The question of equilibrium when the firm has sequential opportunities to borrow is a delicate one. Bizer and DeMarzo (1992) consider this problem from the perspective of a risk averse borrower and demonstrate the likelihood of inefficient equilibria in which the debtor borrows beyond the level of debt at which the total value of debt is maximized (so that debt forgiveness coupled with restrictions on future borrowing would be optimal for creditors). Bizer and DeMarzo (1994) consider a more general common agency setting in which multiple equilibrium outcomes are possible; we use a similar methodology here to illustrate this possibility in the specific context of corporate leverage.

In our example above, once the firm has issued debt equal to the maximum possible payoff $D_0 = g(\rho_0) = 80$, there is no incentive to increase debt further (all tax shields have been exhausted, and new junior debt would be worthless). Thus the debt level $D_0$ is (trivially) sustainable as an equilibrium even without commitment. Next note that for $D$ sufficiently close to but less than $D_0$, equity holders gain by increasing debt to $D$; that is, $G(D, D_0) > 0$. This is true until debt level $D_1 < D_0$ such that

$$G(D_1, D_0 = g(\rho_0)) = 0$$

Absent commitment then, a debt level of $D \in (D_1, D_0)$ cannot be sustained in equilibrium, as shareholders would gain by increasing leverage to $D_0$ and the new debt would be priced accordingly since debt will not be further increased. But note that debt level $D_1$ is sustainable in equilibrium. While shareholders could gain by increasing debt to some level $D > D_1$, new creditors recognize that the firm will continue to increase leverage until $D = D_0$. Thus, any new debt beyond $D_1$ will be priced accordingly at $\rho(D_0)$, and at this price (43) implies that shareholders will not strictly gain.

44
We can repeat this argument and find a set of stable leverage choices \( D_n < D_{n-1} \) by recursively solving

\[
G(D_n, D_{n-1}) = 0
\]  

(44)

Together, (43) and (44) define an equilibrium without commitment of the following form: Given current debt \( D \), shareholders increase leverage to the next highest leverage level \( D_n \) such that \( D_n \geq D > D_{n-1} \), and receive price \( \rho(D_n) \) for the debt. We illustrate the calculation of this equilibrium and the resulting stable debt levels in Figure 3. There we can see the “ratchet” nature of the equilibrium – firm’s never reduce leverage, but “ratchet up” to the next stable leverage level, in this case 35.6, 66.7, or 80. Note that in this case all three stable points are beyond the efficient level of leverage.

**Figure 3: Stable Debt Levels**

Figure 4 shows the equilibrium calculation with the same parameters but with a tax rate of 50% rather than 40%. Note that the efficient level of leverage increases with the higher tax benefit. However, the lowest stable point is now zero – that is, we might see firms choosing zero leverage despite the increased tax benefit. This outcome is supported as an equilibrium as creditors presume the firm will issue debt with face value of 60 if it begins to issue any leverage at all.
The two figures together also imply the following possibility – suppose that starting from an initial tax rate of 40%, the firm issued debt of 35.6 as per the earlier equilibrium. If tax rates then unexpectedly changed to 50%, the firm would increase debt to 60 as shown in Figure 3. Finally, if tax rates were to again unexpectedly change back to 40%, the firm would not reduce debt but would increase it yet again to 66.7. In other words, a temporary increase in the tax benefit of leverage would lead to an increase in debt which is not undone when the tax benefit disappears.

Of course, to fully assess the dynamics of leverage we would have to build a fully dynamic model in which tax rates, or other factors affecting shareholder preferences, as well as asset values are changing continuously and the firm can adjust leverage at any time in response to these changes. While such a model is beyond the scope of the current paper, the leverage ratchet effect that we have documented here is a force that will lead to a gradual upward drift in the firm’s leverage. This upward drift may be mitigated by firms being forced to repay maturing debt, at which point increases in leverage require new debt issues, with creditors in a position to adjust contractual conditions to take account of the risks implied by the higher leverage. The upward drift may also be mitigated by positive innovations in the firm’s asset values (through returns or new positive NPV investments). However, positive return shocks may well be neutralized by payouts to shareholders, through dividend payments or buybacks of shares.

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40 See DeMarzo and Urosevic (2006) for a similar dynamic related to the selling of shares by a large shareholder in the presence of agency costs. They show that in a continuous time model a similar ratchet effect – identified by Admati, Pfeiderer and Zechner (1994) in a static context – leads to a gradual unloading of shares by the large shareholder.
Appendix B: Asset Sales vs. Recapitalizations with Asymmetric Information

Proof of Proposition 9:
Let \( q(\delta) \) is the market value of a unit of debt (face value is equal to 1) when the perceived leverage is \( \delta \) and let \( e(\delta)pA \) be the total market value of equity when the market value of assets is equal \( pA \) and the (perceived) leverage is \( \delta \).

In a recapitalization the firm must issue equity sufficient to buy back \( \Delta_D \) units of debt so that

\[
\frac{D - \Delta_D}{A} = \delta_1, \text{ or } D - \Delta_D = \delta_1A \tag{45}
\]

The true value of current equity holders’ claim after recapitalization will be:

\[
\left(1 - \frac{q(\delta_1)\Delta_D}{pA - q(\delta_1)(D - \Delta_D)}\right)e^\left(\frac{\delta_1}{1 + \omega}\right)p(1 + \omega)A \tag{46}
\]

The total value of equity (from the perspective of the informed insiders) is \( e(\delta_{true})p(1 + \omega)A \) where \( \delta_{true} = \delta_{Market} / (1 + \omega) \) and \( p(1 + \omega)A \) is the managers’ assessment of the value of the assets. Note that true leverage as perceived by the managers is less than the market perceived leverage since the market is undervaluing the assets. The fraction of the total equity claim retained by current shareholders is based on the amount that must be raised through issuing equity to buy back the debt, i.e., \( q(\delta_1)\Delta_D \), and the market’s valuation of equity after the recapitalization, i.e., \( pA - q(\delta_1)(D - \Delta_D) \).

Substituting (45) into (46), we have

\[
\left(1 - \frac{q(\delta_1)\Delta_D}{pA - q(\delta_1)(D - \Delta_D)}\right)e^\left(\frac{\delta_1}{1 + \omega}\right)p(1 + \omega)A = \left(\frac{pA - q(\delta_1)D}{pA - q(\delta_1)(D - \Delta_D)}\right)e^\left(\frac{\delta_1}{1 + \omega}\right)p(1 + \omega)A
\]

\[
= \left(\frac{pA - q(\delta_1)D}{pA - q(\delta_1)pA\delta_1}\right)e^\left(\frac{\delta_1}{1 + \omega}\right)p(1 + \omega)A \tag{47}
\]

\[
= \left(\frac{pA - q(\delta_1)D}{1 - q(\delta_1)\delta_1}\right)e^\left(\frac{\delta_1}{1 + \omega}\right)(1 + \omega)
\]

In reducing leverage through assets sales the amount of debt bought back must solve:
\[
\frac{D - \Delta_D}{pA - q(\delta_i)\Delta_D} = \delta_i \quad \text{or} \quad \Delta_D = \frac{D - pA\delta_i}{1 - q(\delta_i)\delta_i} \tag{48}
\]

Since \( A - q(\delta_i)\Delta_D / p \) will be the new level of assets after the deleveraging is completed, the value of the equity claim after the asset sales is:

\[
e\left(\frac{\delta_i}{1 + \omega}\right)p(1 + \omega) \left(A - \frac{q(\delta_i)\Delta_D}{p}\right) \tag{49}
\]

Using (48), we find that the new level of assets will be:

\[
\left(A - \frac{q(\delta_i)}{p} \frac{D - pA\delta_i}{1 - q(\delta_i)\delta_i}\right) = \left(\frac{pA - pAq(\delta_i)\delta_i - q(\delta_i)D + pAq(\delta_i)\delta_i}{p - pq(\delta_i)\delta_i}\right)
\]

\[
= \left(\frac{pA - q(\delta_i)D_1}{p - pq(\delta_i)\delta_i}\right) \tag{50}
\]

This means that (49) becomes

\[
e\left(\frac{\delta_i}{1 + \omega}\right)p(1 + \omega) \left(A - \frac{q(\delta_i)\Delta_D}{p}\right) = e\left(\frac{\delta_i}{1 + \omega}\right)p(1 + \omega) \left(\frac{pA - q(\delta_i)D_1}{p - pq(\delta_i)\delta_i}\right)
\]

\[
= e\left(\frac{\delta_i}{1 + \omega}\right)(1 + \omega) \left(\frac{pA - q(\delta_i)D_1}{1 - q(\delta_i)\delta_i}\right) \tag{51}
\]

Since this is precisely equal to (47), the shareholders are indifferent between recapitalization and asset sales.
References


3) Admati, Anat R., Peter M., DeMarzo, Martin F. Hellwig and Paul Pfleiderer (2013), “Fallacies, Irrelevant Facts, and Myths in the Discussion of Capital Regulation: Why Bank Equity is Not Socially Expensive” [Note: This is a new version that replaces the 2011 paper with a similar title.]


