Equity Recourse Notes:
Creating Counter-cyclical Bank Capital

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Abstract

We propose a new form of hybrid capital for banks, Equity Recourse Notes (ERNs), which ameliorate booms and busts by creating **counter-***cyclical incentives for banks to raise capital, and so encourage bank lending in bad times. They avoid the flaws of existing contingent convertible bonds (cocos)--in particular, they convert more credibly--so ERNs also help solve the too-big-to-fail problem: rather than forcing banks to increase equity, we should require the same or larger capital increase but permit it to be in the form of* **either** *equity* **or** *ERNs--this also gives some choice to those who claim (rightly or wrongly) that equity is more costly than debt. ERNs can be introduced within the current regulatory system, but also provide a way to reduce the existing system's heavy reliance on measures of regulatory-capital.*

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Introduction

That the banking system urgently needs reform is uncontroversial. Most obviously, the expectation that "too-big-to-fail" banks will always be bailed out by taxpayers implies both socially-inefficient decision-making by bankers, and also socially-inefficient risk-bearing. Taxpayers are not only at risk for guaranteed liabilities but for the subsidies required to encourage new investment when banks face "debt overhang".

ERNs mitigate these problems. As an answer to the static question of "can we bail out a bank without taxpayer subsidy?" ERNs are as good as additional equity. And as a solution to the dynamic problem of "can a weak bank raise new funds?", we will show ERNs are superior to equity.

Although ERNs superficially resemble traditional "contingent convertibles", they resolve the significant problems with these securities--in particular the credibility of their conversion. They are also unlike existing cocos in increasing incentives for bank lending in bad times, even compared to a bank with no risky debt.

So our initial proposal is that banks issue ERNs when they would otherwise have issued cocos. In the longer run, substituting ERNs for ordinary bank debt could substantially stabilise the banking system.

After introducing ERNs (in section 1), we explain why they convert more credibly than existing cocos (in section 2), and create countercyclical pressures (section 3). We show how ERNs avoid cocos' other flaws (section 4), and discuss their regulatory accounting (section 5). Section 6 explains how introducing ERNs can begin a broader program of reform, and Section 7 compares their introduction with the alternative of requiring banks to hold more equity. Section 8 concludes. The Appendix contains calculations and examples.

1. What are ERNs?

ERNs (Equity Recourse Notes) are a form of "contingent capital" that start life as debt but convert into equity *payment-at-a-time* when the issuer suffers large losses in market value subsequent to the original issue date. They have the following features:

1.1 Conversion is based on ***Market Triggers*** *tied to the issue-date share price*

For example, say that an ERN was issued when a bank's share price was 80. Then on any subsequent date on which an interest or principal payment was due, the bank would be required to pay in (newly created) shares if the shares traded at less than 25 percent of the price on the issue date[1] (in this case 20). The issuer would have the right but not the obligation to pay in shares if the stock were trading at a higher price.

1.2 Share payments valued at the trigger price

In the example above, if a payment of $100,000 were due to bondholders and shares were trading at $18—or any price below $20--the bank would be required to pay with 100,000 ÷ 20 = 5,000 common shares.

1.3 *Only* ***Currently-Due*** *Payments Convert*

Whether any given payment is to be made in shares or cash is determined by the share price on the date that the payment is due. In the example, if the share price is $18 on one payment date but climbs to $22 on a later payment date, the bank must make the first payment in shares but has the option of making the second payment in cash.

[1] The percentage is a regulatory choice. We assume 25%, for simplicity. Note that some conversions will inevitably take place prior to any period of general distress, so the system will be tested before any wide-spread conversions occur. Technically the payment would be determined by the closing share price on the date that the bank would be required to make the payment to a bond trustee for distribution to the investors. Investors would receive their cash or shares shortly thereafter.

1.4 Other terms

- ERNs cannot contain covenants limiting the issuance of future ERNs.[2]
- The full benefits of ERNs require restrictions on their term structure. We discuss these below (section 3.3).
- When a payment is to be made in shares, a creditor may opt instead to receive a six month zero-interest ERN with the same conversion terms as in the original bond, with another rollover possible every six months.[3]
- In bankruptcy, ERNs convert entirely into shares.[4]

1.5 Contrast with existing "contingent convertible" securities

In contrast to ERNs, existing "cocos" convert *principal*, not merely currently-due *payments,*[5] and existing cocos convert based on *regulatory* triggers, rather than on market triggers. The reasons for these two differences are that (a) existing cocos focus on assuring adequate regulatory capital, while we are concerned with economic capital,[6] and (b) existing cocos' early conversions of principal create potential problems of "multiple equilibria" which can allow manipulation--see below. ERNs are also designed so that the shares issued in marginal cases in which conversions are made are worth exactly the cash that would have been paid absent the

[2] There can be covenants limiting the future issuance of conventional debt. Cash dividends and buy-backs can also be constrained. (This prevents a bank announcing that it will buy back the stock from any ERN conversion or buy back ERNs prior to any repayment that would be converted.) Of course, major banks' dividend and buyback plans are already subject to regulatory approval.

[3] Finance theory says that it is always more attractive to accept the conversion and sell the shares received, than to use the rollover provision (conversion of existing "cocos" need not be beneficial but, with ERNs, conversion into shares gets the upside if the share price rises, without affecting the downside if the share price falls), but this rule accommodates ERNholders who are restricted from holding equity.

[4] That is, each ERNholder receives the number of shares equal to the face value of an investor's bonds divided by the conversion value.

[5] Existing cocos' terms differ. Some become worthless on conversion. Others that convert to equity, or are written down, at particular regulatory triggers also have discretionary coupon payments that are restricted on a mandatory basis at higher regulatory triggers.

[6] We explain further below (especially Section 5) why there should be no regulatory reason to convert ERN payments that are not immediately due.

conversions. Finally—and crucially--the trigger for conversion depends on the share-price at issuance. The importance of these distinctions with existing cocos will become clear below.[7]

2. ERNs convert more credibly than other Contingent Convertibles

Conversions of conventional contingent capital are vulnerable to forbearance by regulators who fear either market reactions to "bad news", or political reactions. By contrast, ERNs convert *automatically,* rather than requiring any active regulatory intervention. ERNs also convert *gradually,* rather than the entire security converting at once; ERN conversions have *immediate positive cash flow* consequences for the issuer in proportion to the amount of conversion;[8] and marginal ERN conversions *impose only small costs* on bondholders.

For all these reasons, the conversion process is much more credible than one that converts contingent capital as a function of regulatory capital requirements.

[7] The literature on cocos begins with Flannery (2005). Cocos with regulatory triggers were strongly encouraged by the Squam Lake Working Group (2009). However, we are not aware of any proposals for "payment-at-a-time" conversion (i.e., restricting conversion to currently-due payments; though non-cumulative preferred stock may be thought of as having payment-at-a-time forgiveness), or of any proposals that use our rule for determining the trigger price so, in particular, we know of no other proposal that generates the countercyclical incentives we obtain. A number of authors have suggested using market, rather than regulatory, triggers for conversion, for example, Coffee (2010), Dudley (2009), Duffie (2009), McDonald (2010), and Pennacchi, Vermaelen and Wolff (2011), but most specific proposals for these are vulnerable to the "multiple-equilibria" problem described in section 4.1. (An exception is Bolton and Samama's (2012) "Capital Access Bonds".) Some authors such as Calomiris and Herring (2013), and Perotti and Flannery (2011), propose triggers that combine market and regulatory information, but hybrid triggers such as these also have significant problems as we explain in section 3 [penultimate note prior to sec 3.1--now note 16]. Furthermore, an important merit of ERNs is that they open the way to a broader set of reforms that reduces, or even eliminates, our reliance on the current regulatory-capital system--see Section 6.

[8] Some existing cocos have limited gradual-conversion and limited immediate-positive-cash-flow features, mimicking non-cumulative preferred stock, see note [NOW 5] above.

2.1. Automatic vs. "active" conversion

It is now well understood that regulatory capital measures are only loosely related to solvency.[9] So it is likely that a bond which converts to equity based on *regulatory* capital will only be converted prior to a reorganisation if regulators actively require actions such as write-downs that might not occur with a normal application of the rules.[10] By contrast, ERNs' market-based triggers mean they require no actions by regulators and no regulatory judgments about the adequacy of a bank's capitalization.

2.2 Gradual conversion

ERNs' payment-at-a-time conversions (and also the term-structure requirements suggested in section 3.3) ensure that the fraction of any issue that will come due on any particular date will be small, so the amount of equity created on any given date will also be small. The proportional rate of conversion will become even more gradual as the bank issues ERNs when its shares are at different prices. For example, if a bank started issuing ERNs when its share price was 80 and continued to issue new ERNs as its shares fell to 15, then only payments immediately due on bonds issued when the share price exceeded 60 would convert.[11]

2.3 Immediate cash savings in excess of value of new equity

Every ERN payment in shares is the equivalent of a share sale at an (equal-to or) above market price, so a stressed borrower receives immediate cash relief; every dollar's worth of shares that

[9] In both Europe and the U.S., the major banks that required bail-outs were all rated as well capitalized until the bitter end; figure 1, from Haldane (2011), shows that regulatory (Tier 1) capital ratios were very poor predictors of which banks would go into crisis, and that ratios of market capitalisations to book values of total assets were much more meaningful. The U.S. stress tests are specifically designed to measure potential loss of regulatory capital rather than the ability to remain solvent without governmental assistance.

[10] Existing cocos typically convert based on a ratio of equity to "Risk Weighted Assets", which most banks calculate using their own models. This creates an obvious conflict of interest and considerable room for manipulation, as we discuss in detail in Bulow and Klemperer (2013).

[11] It is important not just that conversion is gradual, but also that only currently-due payment convert. See section 4.1.

are issued saves a dollar or more of cash for the bank's balance sheet. By contrast, regulators solve little if any of a bank's cash flow problems by allowing conventional principal conversion of bonds that are not yet due[12]—but regulators may fear that if they force an early principal conversion, the "bad news" inherent in their decision may trigger a crisis.

2.4 Marginal conversions cost creditors little

Finally, in marginal cases, whether or not a bond with a *regulatory* trigger converts is likely to significantly affect the bondholder's wealth.[13] But with ERNs, a marginal conversion (when the *share* price on the date of conversion just equals the trigger price) means that ERNholders should be able to liquidate their new shares for roughly the same amount of cash that they missed out on as a result of the conversion. So ERN conversions should be much less contentious than conversions of traditional cocos.

3. ERNs create *Counter*cyclical pressures--Banks will have *Counter*cyclical Incentives to Lend

Most important, ERNs create *counter*-cyclical investment incentives. Specifically, a fall in a bank's share price makes it *easier* for the bank to raise new capital (the *opposite* of the case with traditional financing). This both supports new lending in bad times, and makes our system more robust in protecting banks against failure.

[12] For example, if a security with three years remaining converts all at once, the immediate cash saving is only any interest payment that is immediately due, but the amount of equity created depends on the principal outstanding. The March 2010 Rabobank coco, which requires a cash payment to bondholders of 25 percent of the bond's face value when its trigger is reached, actually *withdraws* liquidity from a distressed bank.

[13] Market triggers that use different prices for determining whether a bond converts and determining the number of shares that it converts into are also problematic, since they impose an immediate loss on either bondholders or shareholders.

With traditional financing, a “debt overhang” problem arises when a bank that has suffered losses, as in 2007-8, needs to sell assets, stop making new loans, or raise new risk capital to repair its balance sheet. The reason is that new risk capital such as equity or very junior debt takes on some of the risk for potential losses which was previously borne by existing creditors, and so makes those existing creditors better off.[14] Since the new investors must be offered a market rate of return, the increase in existing creditors’ wealth must come at equity holders’ expense.

Furthermore, while selling stock sends an adverse signal about firm value even for an all-equity firm (since a share sale will not benefit current owners unless the current price is at or above management’s estimate of fair value), the signalling problem is exacerbated by “debt overhang” since it means that current owners will only benefit from a share sale if the stock is sufficiently overpriced to cover the overhang loss to creditors.[15]

So a bank with a traditional capital structure has strong pro-cyclical incentives to avoid selling equity, and to sell assets and/or forego making new loans instead, in order to meet its regulatory capital requirements in bad times.[16]

[14] More precisely, “debt overhang” occurs when raising money for a new zero net present value investment increases the total value of existing debt and so reduces the value of existing equity. For example, if the newly issued securities are entirely equity, and the returns on the new investment are proportional to the returns on existing investment, the bank’s debt:equity ratio, and so also its risk per unit of debt, would fall, helping existing creditors and therefore hurting old shareholders (if the new shares are fairly priced). The issuance of new debt which is senior to some but not all risky debt may help or hurt shareholders depending on its precise seniority. For more details, and a formal derivation, see the Appendix of Bulow and Klemperer (2013).

[15] If management is acting in the best interest of existing shareholders, the issuance of new equity in preference to the sale of fairly priced assets (with proportional risk to the rest of the bank’s assets) will lead to the inference that that shares are currently overpriced. Recall how little risk capital banks raised in 2007-8, beyond what was needed to make up for losses in regulatory (rather than market) capital.

[16] Proposals that cocos convert based on a combination of market and regulatory triggers have the same problem. For example, using the ratio of the market value of equity to the book value of assets as the trigger for conversion would create strong pressure on a bank to sell assets to avoid a conversion. (Any asset sale at fair value reduces this ratio, so failure to make such a sale to avoid the dilution of equity is a

By contrast, ERNs can create a *reverse* debt overhang in bad times. That is, banks can *benefit* shareholders (i.e., transfer wealth from existing creditors to shareholders) by selling new ERNs, and banks therefore have a positive incentive to raise new risk capital.[17] Since ERNs also make outside capital more expensive to raise in good times, they mitigate both booms and busts. There are several reasons for this *counter*-cyclicality.

3.1 ERNs create a "self-repairing" balance sheet

Because old ERNs become more equity-like as share prices fall, and indeed become equity if things get bad enough, the balance sheet "self-repairs" (and, as we explain in the next subsection, new capital can easily be raised by issuing additional ERNs rather than equity).

3.2 Issuing new ERNs in bad times transfers wealth TO shareholders from older ERNs issued at higher share prices

Of critical importance, banks have strong incentives to sell ERNs in bad times. The reason is that a decline in share prices makes new ERNs senior to existing ERNs: if, for example, the stock price declines from $80 to $40, new ERNs can be issued with a conversion price of $10 instead of $20 -- so the new ERNs will only suffer losses after the old ones have already taken a 50% haircut. If a stock hits a new low, new ERNs will be senior to, and so increase the riskiness, of *all* the outstanding ERNs.

That is, as we prove in Appendix A4: *if a bank's capital structure consists of equity and ERNs that were all issued when the share price was higher than presently, then issuing new ERNs with the same maturity structure as the existing ERNs, and using the proceeds to make an*

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very damaging signal about management's private information about the bank's prospects.) Using regulatory measures also encourages manipulation. In this example, they might write down assets; if, instead, the trigger were based on the ratio of the market value of equity to the book value of liabilities, a bank might reduce reported liabilities by borrowing short-term to repurchase its own long-term debt that is selling at a discount, even though this would make it less safe.

[17] We explain in Section 5 why regulatory capital rules should permit a distressed bank to issue ERNs rather than equity, even when the bank would not be permitted to issue traditional debt.

investment with zero net present value, with returns at every date proportional to the returns on the bank's current investments, makes the previously-issued ERNs in aggregate less valuable. *Therefore, (since we are assuming the new ERNs are fairly priced, so the value lost by the previously-issued ERNs must be transferred to the equity) the equity is made more valuable.* More generally, of course, new ERNs can increase the value of any conventional debt and/or any ERNs issued when the stock was performing even worse than currently, which would reduce or possibly eliminate the gains to equity, but if capital requirements are strong enough that any more senior debt is relatively safe, then the issuance of new ERNs in bad times must increase shareholder wealth.

This wealth transfer to shareholders creates a "*reverse* overhang" in times of stress. So banks have incentives to recapitalise without the need for any regulatory intervention, and bank lending is encouraged in bad times.[18] Conversely, when share prices are high, ERNs effectively require new financing to be more equity-like and so more costly to existing shareholders—though still less costly to shareholders than issuing equity would be.[19]

Appendix A5 illustrates this by considering a bank that had previously issued ERNs when its stock price was twice the current level; these ERNs now represent 60% of the total market value of the firm. In this example, the "reverse overhang" is large enough that shareholders profit by \$(1/7) dollar for each dollar of a small new zero-net-present-value investment that they finance by issuing new ERNs. If by contrast, the bank had previously issued traditional debt instead of ERNs, and now had the same 60/40 ratio of debt to equity market value, standard

[18] Because the new ERNs will be senior to older ones issued at higher share prices, they will be issued at a lower yield than the current yield of those older ones. Of course, the new ERNs may need to offer a higher yield than it had previously offered when it issued more junior ERNs, depending on changes in the bank's value and volatility as well as general changes in interest rates.

[19] Regardless of how the proceeds are used, issuing ERNs is always better for shareholders than issuing new equity. However if, for example, the proceeds of any risky debt offering (including ERNs) are to be used to hold cash then shareholders will always lose. These effects are, of course, of limited significance if ERNs represent only a sliver of the capital structure, but will become increasingly important if regulators insist on banks issuing larger amounts of risk-bearing capital and banks meet these requirements through ERNs.

"debt overhang" would mean the bank's shareholders would lose 13.5 cents for every dollar of the same new investment, if they had to finance it using equity. (For larger investments the rates of wealth transfer are a little smaller: for example, a new zero-net-present-value investment that increases the total value of the firm by 40% yields a shareholder profit of about 11.7 cents per dollar of zero NPV investment financed by issuing ERNs, or a loss of 9.6 cents per dollar of investment financed using equity).[20]

3.3 Maturity rules mean newly issued ERNs don't require longer maturities than existing ones

A caveat to the previous subsection is that new bonds might be effectively junior to older ones if the newer ones have a longer time to maturity, even if the newer ones are legally classified as being of equal or higher priority.[21] Reverse debt overhang is still guaranteed if there are enough ERNs that senior bank debt is riskless and the proceeds from the new ERNs are used in a way that increases share price volatility, but it is better to avoid this potential problem by requiring that no more than some fixed percentage of all remaining ERNs will be scheduled to come due in any future 6 month period, assuming no further issuance or repurchases.[22] *De minimis* exceptions would be permitted, but buy-backs would be constrained by the requirement to stay within the maturity rules.[23] These rules ensure that new ERNs can always be issued with maturities proportional to the maturities on the outstanding ERNs. So, since in bad times new ERNs have lower conversion prices than old ERNs, the new ERNs are unambiguously senior and must reduce the old ERNs' value, guaranteeing our reverse overhang effect.

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[20] We assume the conventionally-financed bank would have to finance the investment using equity, as is likely under standard regulatory-capital rules after a fall in share price; see Section 5 for more on why this should not be the case for ERNs.

[21] This is likely under the standard requirement that all new risk-bearing debt has a maturity of at least a fixed number of years.

[22] This maximum percentage is a regulatory choice. For example, 15% would allow ERNs to have a modest "duration" (about 3 years). Setting a maximum also avoids giving firms an incentive to signal "strength" by using shorter durations.

[23] We would ignore ERNs issued through the voluntary rollover of debt payments due in equity, since rollover is unlikely to be important (see Section 1.4), and anyway helps shareholders.

3.4 Selling ERNs does not generate the negative signal that selling stock creates

Furthermore, since in bad times shareholders are better off by the bank financing assets with ERNs than by selling them at fair prices (or issuing ERNs to buy new assets at fair prices), there is no signalling problem in doing this. By contrast, as discussed above, there is a signalling problem in selling shares to do this (or to buy new assets).[24]

4. ERNs avoid the flaws inherent in other forms of contingent convertibles

ERNS avoid several of the flaws associated with both market trigger and regulatory-capital trigger contingent convertibles. (See *e.g.* Avdjiev *et al.* (2013) or the Appendix of Pazarbasioglu *et al. (*2011) for a list, and description, of these problems.)

4.1 ERNs avoid market conversion problems of manipulation caused by "multiple equilibria"

A potentially significant problem with a coco in which *principal* converts based on market prices was demonstrated by Sundaresen and Wang (2010): say that the conversion price is $25 per share. Then the bondholder has the downside if the shares fall below $25, but has none of the upside. Say that the shares are currently selling at $26. If the bondholder can push the price down below $25, it gets immediate conversion: it is still stuck for a loss if the price falls further, but it now gets to share in any gains that might occur if the stock rises in price before the bond maturity date (which it would not if conversion did not occur). So conversion hurts shareholders (who now have to share more of the upside), and therefore intrinsically justifies a lower share price. Academics refer to this as a "multiple equilibria" problem: it means that either share price manipulation, or a small decline in intrinsic value that causes a "leap" from the no-conversion to the conversion equilibrium, can cause a steeper decline in share price.

[24] The signalling problem in selling shares is more severe in bad times, when selling new shares is unusual, than in good times when many firms are issuing new shares or making IPOs.

ERNs do not have this problem because *only currently-due payments convert*. Since early conversion of payments is ruled out, the incentive for early conversion no longer exists.[25]

4.2 ERNs are robust against other manipulation that contingent capital has been subject to

Another common concern about contingent capital is that if the shares were "really" worth $26 when there is a $25 conversion price, the bondholder might artificially push the share price below $25 to get paid in shares valued at $25. But with ERNs, if the bank believes that its share price is artificially low, the bank can repurchase the shares issued in a stock payment for less cash than was saved by the conversion (i.e., less money than would have been required to pay the bondholders in cash), leaving shareholders undiluted and unambiguously better off than absent conversion.[26] (With conventional conversion of principal this option does not exist because, as we have discussed, there may be little or no immediate cash savings relative to the amount of equity created.)

An alternative concern with traditional contingent capital is that if the shares were "really" worth $24, bondholders might trying to push the share price up from $24 to above $25 in the hopes of receiving cash. But with ERNs, the bank always has the option of paying in shares, even when the price is above the conversion level. So ERNs are robust to this concern, too.

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[25] Of course, ERNs also avoid the problems of multiple equilibrium (or failure of equilibrium) that arise (even when only a coco's currently-due payments convert) if the shares that are issued in a marginal case of conversion are worth something different from the cash that would have been paid absent the conversion. If banks cannot adjust their capital structures after conversions, then a multiple equilibrium problem remains, because a conversion reduces the value of stock by reducing the debt/equity ratio. Even if all the senior bank debt is completely safe, the value of the remaining outstanding ERNs may be increased, and so the value of shares decreased, by a conversion. However, this problem is easily resolved by the bank using part of the cash saved by the conversion, or else raised by the issuance of new senior ERNs, to repurchase shares. (While regulators may not approve a repurchase using the cash saved in a conversion if the bank's finances are weak, the issuance of new senior ERNs to offset any repurchases would protect senior bondholders and taxpayers.) In any event, because ERNs convert gradually and at different prices, this problem should be small.

[26] Although buybacks require regulatory approval, regulators who suspect manipulation have no reason not to permit one.

4.3 ERNs remove incentive to manipulate regulatory measures

Because ERNs convert based on share prices their existence does not put any pressure on banks or regulators to relax regulatory capital accounting standards in times of stress. Securities that convert based on regulatory capital levels will, on the other hand, have values that in times of stress will be highly dependent on regulatory decisions, creating pressure to avoid recognizing for accounting purposes the losses that were supposed to transfer risk to bondholders.

4.4 ERNs are easier to price and securitize than securities with regulatory-based triggers

ERNs are equivalent from a bondholder perspective to sequences of riskless zero-coupon bonds less simple European put options—see the Appendix (especially section A3) which shows how to value ERNs in a simple model. Capital markets have 40 years of experience in pricing and hedging such securities. (ERNs may also be thought of, for regulatory purposes, as forward contracts to deliver equity, less call options held by the issuer--see section 5.2 and the Appendix.)

By contrast, the conditions under which securities with regulatory triggers convert are opaque and manipulable, and these securities also suffer a discontinuous "cliff" loss when they convert, so they are much harder to hedge.[27]

These same advantages make the securitization of ERNs (pooling and tranching to create claims that final investors might prefer to those generated by outright ownership of ERNs) much more straightforward, and much less subject to gaming, than is the case with other commonly securitized loans including mortgages and receivables.

[27] See, e.g., Damodaran (2014). "While different risk hedging tools exist for [continuous and discontinuous risk]…, it can be argued that discontinuous risk is both more damaging and difficult to hedge."

4.5 ERN Conversions Stabilize Share Prices and Fight "Downward Spirals"

We showed in Section 4.1, above, that ERNs do not suffer from the "multiple equilibria" problem that dogs many market-trigger convertibles.

However, another common concern is that conversions might cause share prices to drop, forcing further conversions. This has indeed been a significant problem for "death spiral" bonds, where the number of shares that bondholders receive in any conversion is computed using a share price *below* the price at the time of conversion. But ERN conversions are the exact opposite: the number of shares that ERNholders receive in any conversion is computed using a fixed share price *at or above* the market price at that time, so their total market value is *less than* the cash the ERNholder would have received absent the conversion. ERN conversions therefore transfer wealth *to* current shareholders, and so shore up the share-price. That is, *ERNs are stabilizing.* In effect, banks buy puts from lenders every time they sell an ERN, which transfers risk from shareholders to ERNholders, and so *reduces* share price volatility relative to conventional debt. Of course, these effects will be reflected in stock prices gradually, rather than discontinuously, with bond prices bearing an increasing fraction of marginal losses as bank value falls and ERNs become more equity-like. That is, the transfer of risk from the equity to the ERNs will *continuously* reduce the volatility of the share price (i.e. the percentage change in share price for any change in bank value), relative to the case in which the ERNs were replaced by conventional debt with the same market value at issuance. [28]

A further concern is that the world may not behave according to standard finance models (Modigliani-Miller, Arrow-Debreu, etc.). One suggestion has been that investors may give a bank a lower total valuation if it converts an ERN payment. However, it does *not* follow that this would lower the *share* price and risk causing more conversions: even if transferring losses from

[28] Bondholders who wish to "delta" hedge their risk (that is, dynamically hedge their ERN risk by selling short stock) have to sell more and more shares as the bank's value declines and, in the limit, take on as much risk as the number of shares into which the bonds will convert.

shareholders to bondholders may help share prices less than it hurts bondholders, it seems unlikely that in any reasonable model share prices would be hurt because of this transfer of risk.[29] Furthermore, ERNs seem particularly well-suited to securitization (see section 4.4), by contrast with conventional unsecured debt, whose property rights in bankruptcy are at the mercy of judges or regulators or politicians. So valuation arbitrage should allow ERN-risk to be inexpensively re-allocated amongst investors to maximize value in the way that standard theory predicts.

Moreover, leaving aside the plausibility of "downward spirals" (especially since ERNs' payment-at-a-time conversion minimises their potential magnitudes), we note that ERNs would be ideally structured to reverse them: because conversions save the issuer more cash than the market value of the shares distributed, the issuer can simply use its savings to buy back any newly issued stock while leaving shareholders with a profit. And things are even better than that!--the bank can also issue new ERNs, which will have maximal seniority in times of stress, and use the proceeds to repurchase shares.[30]

We discuss these issues in more detail in Bulow and Klemperer (2013, Section 4).

Finally, it is not clear that regulators, at least, should be concerned by the falling share price of a bank that has issued ERNs in place of traditional debt: with a traditional capital structure, a

[29] Events that reduce demand for the risk represented by a stock (such as its leaving a market index and so being sold by index funds) or increase its supply (such as a lockup-expiration that permits those who did not wish to hold a stock to sell it) may slightly depress prices. (For example, Field and Hanka (2001) found abnormal returns of -2.7% as the number of shares free to trade tripled and trading volume increased by 40 percent.) But not only are these effects small. Importantly, an ERN conversion does *not* increase the amount of risk available for investors to hold—it merely repackages that risk into more shares.

[30] For example, if the shares are selling at 15 and the conversion price is 20, the bank could repurchase all the new shares issued with just ¾ of the cash saved by the conversion. (And if the regulator required the bank to raise new risk-bearing capital before undoing the share issuance, new ERNs should be saleable on very favourable terms to the issuer, with the proceeds then available for buybacks.)

lower share price makes it harder to raise new finance, but with ERNs a lower share price facilitates the raising of new funds,[31] as we have explained.[32]

5. Regulatory Accounting

Because cocos based on regulatory triggers are unlikely to convert prior to a reorganisation they are less helpful at solving debt overhang than common equity. Reflecting this, regulators classify them as either "other tier 1" or "tier 2" capital.

Our focus is on *economic* capital, not regulatory capital. As a practical matter requirements to hold common equity seem unlikely to fall, so our concern is that ERNs qualify to meet any increases in capital requirements, even if they would most likely be classified as "other tier 1 capital" along with perpetual non-cumulative preferred stock. For example, if equity requirements were 7 percent and total risk capital requirements were raised to 20 percent, our recommendation would be that banks be permitted to use ERNs to satisfy the 13 percent increase, regardless of how ERNs were classified. We would also want to give regulators the flexibility to permit a bank to issue ERNs in lieu of equity in times of stress.[33]

That said, we think ERNs can fully match equity in protecting taxpayers for three reasons:

[31] And, of course, ERNs also reduce the need to raise new funds. These effects are small if the number of ERNs issued is small—but so are all the other effects discussed in this subsection.

[32] Regulators may also be concerned about a low share price if it makes creditors concerned that the bank will go bankrupt, and therefore makes rolling over debt more difficult. ERNs help by serving as "going concern loss-absorbing capital" rather than as only "gone concern" loss-absorbing capital.

[33] In times of stress, issuing ERNs is much less costly to shareholders than issuing equity, for the debt-overhang reasons explained above. But—as we have also explained above--this limited form of regulatory forbearance would not place the taxpayer at any risk (by contrast with, for example, not requiring assets to reflect their fair values).

5.1 ERNs are credibly loss absorbing

Most important is the simple point that they are *credible* loss-absorbing capital. (Although other contingent convertibles are potentially loss-absorbing, we argued above that their conversion is not nearly as reliable.) Since ERNs turn into equity whenever it matters, there is no reason why they should not always count as equity for regulatory purposes.[34]

5.2 ERNs are promises to deliver common shares with an issuer option to repurchase

Second, in simple financial terms ERNs are equivalent to a sequence of promised payments in stock offset by the bank owning a sequence of call options against its shares.[35] Since ERNs therefore correspond to issuing shares except that the bank has rights to repurchase them, ERNs surely merit equity treatment.[36]

5.3 ERNs reduce debt overhang

Third, because ERNs can be undercut in seniority by new ERNs if the bank performs poorly, they are actually superior to equity in fighting debt overhang. (An all-equity bank would have no debt overhang, but does not have the counter-cyclical virtues of ERNs.)

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[34] Note that the suggested 75 percent share price decline that would trigger the automatic termination of cash payments for an ERN is comparable to the share price declines at which many banks eliminated most of their dividends on common shares in the crisis.

[35] See the Appendix, especially section A2. That is, we can think of the bank as having committed to make all the promised payments in shares (with the shares valued at 25% of the current share price), but also having the right to repurchase all those shares (at a price equal to 25% of the current share price)—if we assume that it will not exercise those rights when the share price is below the trigger price.

[36] Of course, ERNs are also equivalent to a sequence of riskless bonds offset by the bank owning a sequence of puts against its own stock. The distinction is that if the bank actually sold bonds meant to be riskless, and hedged its risks by separately buying put options against its own stock, we would have to worry about counterparty risk on the put options. But with ERNs, conversion does not rely on the promises of counterparties: at low share prices it is automatic, and at higher share prices the bank can make a unilateral decision to convert.

6. ERNs as the First Step of a Full Reform Program

Contingent capital bonds are generally thought of as replacing a relatively small share of bank debt. While ERNs can serve that role better than existing securities, they become even more effective when used on a larger scale.

Importantly, the more ERNs that have been issued, the more risk that new ERNs can transfer to old ERNs in bad times, and the less risk that is transferred from more senior debt to ERNs, so the greater the reverse debt overhang, and the more counter-cyclicality is generated.

Furthermore, as Bulow, Goldfield, and Klemperer (2013) and Bulow and Klemperer (2013) explain in detail, increasing the volume of ERNs would help fight liquidity crises. Whereas a conversion of traditional cocos does little or nothing to reduce immediate strains on liquidity, every dollar of equity created by an ERN conversion creates more than a dollar of immediate cash savings. So if ERNs represent a large fraction of unsecured debt, banks can deal, by conversions, with any refusal by the market to refinance their debt. Recognizing that banks have this ability, secured lenders and potential buyers of new ERNs would feel protected against panics. The protection against liquidity crises would be complete if ERNs replaced all unsecured debt, with deposits becoming secured debt, and if we also limited the recourse of secured debt holders to the value of their collateral plus equity or ERNs--in this case, no creditor would be able to force the sale of any asset other than those directly posted as collateral for the creditor's claims.

In a transitional phase deposits could be collateralized by holding them in wholly-owned isolated subsidiaries in which the deposits are the only liabilities, with regulatory capital requirements based on applying market haircuts for the assets held in the subsidiaries.[37]

[37] That is, if standard market haircuts for secured borrowing against an asset held in the subsidiary were 20 percent, then the regulatory capital requirement for that asset should also be 20 percent. Taxpayers would still bear some risk in this transitional phase, largely because of the risk that regulators might overestimate the value, or more generally the desirability as collateral, of the assets in the subsidiary.

Regulatory-capital requirements would then be needed *only* for these "ring-fenced" banking subsidiaries, and a simplified version of a bank balance sheet would look like Figure 2.[38]

So Bulow, Goldfield, and Klemperer (2013) and Bulow and Klemperer (2013)'s full program of reform has the following steps:

1. Have ERNs replace traditional cocos;

2. Require all SIFIs' long-term debt be substituted by ERNs;

3. Require secured debt (and defaulted contracts such as loan commitments) to have recourse (beyond specified collateral) *only* to shares or ERNs;

4. Isolate deposits in well-capitalised subsidiaries (as in figure 2), with capital requirements similar to those the private market, or at least central banks, apply when lending against similar assets;[39]

5. *Slowly* (to allay concerns about, and to respond to, any unintended consequences) narrow the eligible collateral in these subsidiaries.

If, in the final step, we can reach 100% backing of deposits by government securities, all taxpayer risk will have been eliminated, and regulatory capital rules can then be dispensed with altogether. Banks would then *never* fail suddenly. Poorly-run banks would gradually decline, and then either fail or recover: any failures would be "not with a bang, but with a whimper".[40]

Regulatory forbearance could be limited to allowing banks to issue ERNs in lieu of additional equity in stressed times, rather than (by permitting asset over-valuation) allowing enormous reductions in bank capital.

[38] This figure ignores issues such as lines of credit and derivatives. See Bulow and Klemperer (2013) for more details. The ring fencing proposed by the Independent Commission on Banking (2011) is now being implemented in the U.K.

[39] Our preference would be to keep derivatives out of ring-fenced subsidiaries. Banks could still use derivatives to hedge ring-fenced liabilities, and could transfer derivatives returns in and out of the ring fence so long as the simple ring-fence capital rules were always met. We provide a preliminary discussion of derivatives treatment in Bulow and Klemperer (2013).

[40] See Appendix A7 for how ERNs might have worked in the financial crisis, and see Bulow and Klemperer (2013) for further discussion of this program of reform, and of the costs of the current regulatory system.

7. Alternative Reforms: Introducing ERNs vs. Requiring More Equity

Proposals such as Greenspan (2010) and Admati *et al.* (2011) to require an increase in banks' equity would greatly improve on the current situation.[41] However, a requirement for the same size increase that could be satisfied by *either* equity *or* ERNs (or a mixture) would provide just as much protection to taxpayers, and also have significant advantages.

Most important, ERNs make it easier for distressed banks to raise capital, both because the asymmetric information problems of selling equity (especially in bad times) is alleviated by selling ERNs instead, and because—even absent asymmetric information---the seniority of new ERNs over old ones incentivizes the issuance of ERNs in bad times.[42]

Moreover, ERNs mitigate the extreme cyclicality of credit, and thereby protect the economy against these substantial social costs of banking crises, as well as protecting taxpayers.

[41] However, absent ERNs, we doubt sudden bank failures can be prevented with anything less than 100% equity. Bulow, Goldfield, and Klemperer (2013) explain that recent evidence (not just Cyprus, but also typical U.S. bank failures) shows that even, say, doubling or tripling current capital requirements wouldn't be enough to prevent the need for bailouts. And, importantly, higher capital requirements will make less-risky activities migrate, and mean even higher capital requirements are needed. Moreover, if people believe a higher capital requirement has made failure impossible, then banks may take even more risks, regulators may become slacker and less well-funded (cf. BP's Deepwater contractors turning off the alarms at night because they thought there were many other fail-safes), and there may be even more pressure for forbearance (since politicians will have argued bailout would never be needed, and decisions made on this premise may have made failure even more costly).

[42] Recapitalising banks with forced rights offerings seems much harder and less satisfactory. Signalling concerns may lead to inefficient behaviour (e.g., asset sales) to avoid them, and the tough regulation required may not be credible--recall the difficulty European regulators have had requiring banks that were heavily dependent on taxpayer support to raise new capital in 2008-14. (Rights offerings can hurt existing equity holders (by making debt safer), incur transaction costs, forego any advantages of debt (see below), and are likely to be based on regulatory rather than market triggers--so require active regulation with the problems we discussed for cocos in section 2.) Furthermore, rights offerings can be used to pay down less and less existing debt as share prices fall, while an ERNs conversion eliminates a fixed amount of debt.

These advantages of ERNs *cannot* be obtained when banks' capital consists only of traditional debt and equity, even by, e.g., forced rights offerings.[43]

Furthermore, ERNs permit agnosticism on whether there are in fact efficiency costs of equity, as many practitioners (and also many economists) claim.[44] Although ERNs are always equity in the states that matter for protecting taxpayers, they remain debt in other states, so may provide many of the benefits claimed for debt. So since ERNs also avoid the problematic features that have dogged traditional cocos, there is no reason not to let banks issue ERNs rather than equity if they wish.[45] Banks may prefer to issue ERNs – and they will certainly find it harder to argue against a requirement to issue ERNs *or* equity, than to argue against a requirement that gives them no choice but to issue equity (though they will likely argue against either reform). So it should be possible to require a significantly greater capital raise by permitting banks to satisfy it in the form of ERNs.[46] [47]

[43] Putting aside the difficulties associated with forced rights offerings (see the previous note) the countercyclical incentive to make new risky investments (as distinct from merely raise new funds that are held in cash) derives from the ability to make existing debt securities riskier. In a traditional capital structure, this would require making traditional debt riskier—which would increase the probability of the bank failing completely.

[44] Although such claims conflict with the simplest finance theory, efficiency costs of equity could relate to incentives effects (e.g., debt requires management to make regular cash payments when the bank is profitable), or 'habitat' or 'clientele' models in which the value of the whole is dependent on the slicing. (Of course, we only care about *social* inefficiencies of equity; reductions of tax savings and too-big-to-fail subsidies, etc., should not concern policy makers.) Empirical work such as Baker and Wurgler (2013) and studies cited therein find that holding more equity does have a significant effect on the cost of capital: "A simple calibration using historical data suggests that a ten percentage-point increase in Tier 1 capital to risk-weighted assets would have increased the weighted average cost of capital by between 60 and 90 basis points per year." (Baker and Wurgler, 2013, abstract.) And many firms with no tax motivation, e.g., master limited partnerships and levered hedge funds, use debt, while firms with a tax motivation to employ debt vary widely in its use--suggesting there are non-tax, non-bailout motivations for capital structure.

[45] If equity is indeed sometimes expensive, and we require banks to hold more equity against the same assets than non-banks are asked to hold by the market, there will be inefficient incentives to use the other regulatory form.

[46] Tucker (2014) argues that "for good or ill" authorities have chosen an equity requirement of 7 to 10 percent depending on a bank's size and complexity, and that to protect taxpayers a similar-sized layer of

8. Conclusion

The development of ERNs is the first step of the larger reform programme discussed in Bulow, Goldfield, and Klemperer (2013) and Bulow and Klemperer (2013), and overviewed briefly in Section 6, above.

However, the current paper has argued that the first step--replacing traditional cocos with ERNs –*on its own* would bring substantial benefits: relative to existing cocos, ERN conversion is much more credible, and ERNs counteract debt overhang and improve liquidity. ERNs also resolve the design flaws in cocos that have concerned many analysts and regulators. So ERNs provide much better protection to taxpayers than conventional cocos and they also encourage more bank lending in times of stress.

Relative to banks issuing more equity, having them issue the same value of ERNs gives taxpayers the same protection and also reduces credit cycles. So giving the banks the choice can only be an improvement, and may also simplify the politics of reform.

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other loss-absorbing capital is needed. Broadly similar estimates are obtained by looking at the "haircuts" that central banks apply for secured lending.

[47] Appendix A6 provides some illustrative calculations of the additional costs to banks of issuing ERNs instead of conventional debt.

If interest payments on ERNs are tax-deductible, ERNs can be introduced without resulting in the large increase in bank taxes that would come about from a big equity increase, all else equal, and also without needing a significant tax reform to be revenue-neutral.

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Appendix

A1. A Simple Model for Valuing ERNs

Consider a one period model of a bank that has issued common stock, N outstanding issues of ERNs, and no conventional debt. ERN issue K has a face value of $\mathrm{D_K}$ and is convertible into $\mathrm{S_K}$ shares, that is, at a price of $\mathrm{D_K/S_K},\ \ \mathrm{K}=1,\dots,\mathrm{N}$. The bank has $\mathrm{S_0}$ shares outstanding, and we define $\mathrm{D_0}\equiv\infty$. We assume $\mathrm{D_K/S_K}>\mathrm{D_{K+1}/S_{K+1}}$ for all K, so ERN 1 has the highest conversion price and so is the most junior.48 Let the terminal value of security K when the value of the bank is V be $\mathrm{V_K(V)}$, so for example the value of equity is $\mathrm{V_0(V)}$ and the value of the most junior issue of ERNs is $\mathrm{V_1(V)}$. Let the value of a (European) call option to buy the bank at a price of X when the current value is V be $\mathrm{C(X)}$, and let the value of the analogous (European) put option to sell at a price of V be $\mathrm{P(X)}$. Lastly, let $\mathrm{X_K}$ be the value of V at or below which security K will be converted.

Debt is converted when doing this increases the value of the shares, so we can think of conversion as being chosen to maximize the bank's share price, which is equal to the value of the bank, less debt paid in cash, divided by shares outstanding, so conversion will be chosen to

$$\max_j\left(\frac{1}{\sum_{i=0}^{i=j}S_i}\left(V-\sum_{i=j+1}^{i=N}D_i\right)\right)$$

and the payoff to the owners of security K is the minimum of the face value of their debt D_K and the value they would receive from S_K shares, or

$$V_K(V)=\min\left[D_K,\max_j\left(\frac{S_K}{\sum_{i=0}^{i=j}S_i}\left(V-\sum_{i=j+1}^{i=N}D_i\right)\right)\right]\qquad(1)$$

Using equation (1) we can calculate the values of the bank, X_K, at which the securities $K=1,\dots,N$, will convert. At the value where security K will be converted share price will equal

[48] Note that for ordinary (unsecured) debt with varying (absolute) seniority a similar analytical structure operates with $(D_K/S_K)/(D_{K-1}/S_{K-1})\to 0$ for all $K>0$.

$\frac{1}{\sum_{i=0}^{i=K} S_i}\left(X_K - \sum_{i=K+1}^{i=N} D_i\right)$ but will also equal D_K/S_K since other investors are indifferent to paying off security K in cash or shares.[49] So the value of the bank, $V = X_K$, at which security K will convert satisfies $D_K/S_K = \frac{1}{\sum_{i=0}^{i=K} S_i}\left(X_K - \sum_{i=K+1}^{i=N} D_i\right)$,[50] that is,

$$X_K = \frac{D_K}{S_K}\sum_{i=0}^{i=K} S_i + \sum_{i=K+1}^{i=N} D_i \qquad (2)$$

For example, say $S_0 = 100, S_1 = 100, S_2 = 300, S_3 = 500, D_1 = 1000, D_2 = 1500, D_3 = 1000$. Then conversion prices will be $X_1 = 4500, X_2 = 3500, X_3 = 2000$. So for example if the bank value is \$3500 on the date the bonds are due, shareholders are indifferent to the conversion of bond 2: with conversion of all $D_1 + D_2$ debt there are 500 shares and debt of $D_3 = 1000$, while without the conversion there are 200 shares outstanding and debt of $D_2 + D_3 = 2500$ so, with a total bank value of \$3500, the shares are worth \$5 each either way.

Equation (2) allows us to write V_K either as a share of the bank's value when all debt is converted, plus and minus a set of call options, or alternatively as a fixed claim minus and plus a set of puts.

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[49] An alternative derivation observes that on the date that the bonds come due the value of security N is $V_N(V) = \min\left[D_N, \frac{S_N}{\sum_{i=0}^{i=N} S_i}V\right]$. So, on the same date, the value of security $N-1$ is $V_{N-1}(V) = \min\left[D_{N-1}, \max\left(\frac{S_{N-1}}{\sum_{i=0}^{i=N} S_i}V, \frac{S_{N-1}}{\sum_{i=0}^{i=N-1} S_i}(V - D_N)\right)\right]$, and so on. Therefore $V_K(V) = \min\left[D_K, \max_{j\geq K}\left(\frac{S_K}{\sum_{i=0}^{i=j} S_i}\left(V - \sum_{i=j+1}^{i=N} D_i\right)\right)\right]$. Since the term $\max_{j\geq K}\left(\frac{S_K}{\sum_{i=0}^{i=j} S_i}\left(V - \sum_{i=j+1}^{i=N} D_i\right)\right)$ is maximized for *j* = *m* in those states that the *m*th and more junior, but not the *m*+1th and more senior, securities convert, and since security K will convert prior to all more senior securities, security K will convert when the value of the bank, *V*, is such that $D_K = \left(\frac{S_K}{\sum_{i=0}^{i=K} S_i}\left(V - \sum_{i=K+1}^{i=N} D_i\right)\right)$.

[50] Alternatively, from the equation for $V_N(V)$ in the preceding note, the value of the bank, X_N, at which security N will convert satisfies $D_N = \frac{S_N}{\sum_{i=0}^{i=N} S_i}X_N$. So if $V > X_N$, then $S_N V > \left(\sum_{i=0}^{i=N} S_i\right)D_N$ => $\left(\sum_{i=0}^{i=N} S_i\right)V > \left(\sum_{i=0}^{i=N-1} S_i\right)V + \left(\sum_{i=0}^{i=N} S_i\right)D_N$ => $\frac{S_{N-1}}{\sum_{i=0}^{i=N} S_i}V > \frac{S_{N-1}}{\sum_{i=0}^{i=N-1} S_i}(V - D_N)$. So since security $N-1$ will convert at a higher value of V than X_N, the value of the bank, X_{N-1}, at which security $N-1$ will convert satisfies $D_{N-1} = \frac{S_{N-1}}{\sum_{i=0}^{i=N-1} S_i}(X_{N-1} - D_N)$. Hence we obtain X_{N-1}, etc.

A2. Valuing ERNs in terms of Calls

For calls,

$$V_K(V) = S_K\left[\frac{V}{\sum_{i=0}^{i=N} S_i} + \sum_{j=K+1}^{j=N} \frac{S_j C(X_j)}{\sum_{i=0}^{i=j} S_i \sum_{i=0}^{i=j-1} S_i} - \frac{C(X_K)}{\sum_{i=0}^{i=K} S_i}\right] \qquad (3)^{51}$$

So in our numerical example the second bond can be characterized as owning a 30 percent share in the bank if the value is less than \$2000, plus a call option to buy another 30 percent at a valuation of \$2000 (at which price the most senior bonds, bonds 3, are paid in full and their half ownership at the lowest values is effectively bought out by the holders of equity, bonds 1 and bonds 2), minus a call option for 60 percent at a valuation of 3500, at which value bonds 2 are paid in full (so they do not share in further appreciation). The value of the bond increases as a function of V with a slope of .3 when 2000$\geq V \geq 0$, then a slope of .6 for 3500$\geq V > 2000$, and then equals 1500 for $V \geq 3500$.

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[51] This is easily checked by computing first $V_N(V)$, then $V_{N-1}(V)$, etc. For example, with N=3 outstanding issues of ERNs, the most senior bondholders (the owners of bond 3) effectively own $S_3/(\sum_{j=0}^{j=3} S_j)$ of the bank less the right of more-junior stakeholders to call this fraction of the bank away, which they will do when the bank is worth more than X_3, so bond 3 is worth $V_3(V) = \frac{S_3}{\sum_{j=0}^{j=3} S_j}\big(V - C(X_3)\big)$. Bond 2 also owns a share of the bank in the lowest states, increased in states in which bond 3 but not bond 2 is paid in full, and bought out in better states. More precisely, bond 2 is worth $S_2/(\sum_{j=0}^{j=3} S_j)$ of the bank plus the right to increase that share to $S_2/(\sum_{j=0}^{j=2} S_j)$ by buying out bond 3's share when share price exceeds D_3/S_3 and so when the bank is worth more than X_3, less the right of even-more-junior stakeholders to buy out all of those shares when share price exceeds D_2/S_2 and so when the bank is worth more than X_2. So bond 2 is worth $V_2(V) = \frac{S_2 V}{\sum_{j=0}^{j=3} S_j} + \frac{S_3 S_2}{\sum_{j=0}^{j=3} S_j \sum_{j=0}^{j=2} S_j} C(X_3) - \frac{S_2}{\sum_{j=0}^{j=2} S_j} C(X_2)$. Similarly, bond 1 is worth $V_1(V) = \frac{S_1 V}{\sum_{j=0}^{j=3} S_j} + \frac{S_3 S_1}{\sum_{j=0}^{j=3} S_j \sum_{j=0}^{j=2} S_j} C(X_3) + \frac{S_2 S_1}{\sum_{j=0}^{j=2} S_j \sum_{j=0}^{j=1} S_j} C(X_2) - \frac{S_1}{\sum_{j=0}^{j=1} S_j} C(X_1)$; and equity is worth $V_0(V) = \frac{S_0 V}{\sum_{j=0}^{j=3} S_j} + \frac{S_3 S_0}{\sum_{j=0}^{j=3} S_j \sum_{j=0}^{j=2} S_j} C(X_3) + \frac{S_2 S_0}{\sum_{j=0}^{j=2} S_j \sum_{j=0}^{j=1} S_j} C(X_2) + \frac{S_1}{\sum_{j=0}^{j=1} S_j} C(X_1)$. Using (2), $X_3 = \frac{D_3}{S_3} \sum_{j=0}^{j=3} S_j$; $X_2 = D_3 + \frac{D_2}{S_2} \sum_{j=0}^{j=2} S_j$; and $X_1 = D_2 + D_3 + \frac{D_1}{S_1} \sum_{j=0}^{j=1} S_j$. Of course, summing over all the claims, the total value is V.

A3. Valuing ERNs in terms of Puts

For puts,

$$V_K(V) = D_K + S_K \left[\sum_{j=K+1}^{j=N} \frac{S_j P(X_j)}{\sum_{i=0}^{i=j} S_i \sum_{i=0}^{i=j-1} S_i} - \frac{P(X_K)}{\sum_{i=0}^{i=K} S_i} \right] \qquad (4)^{52}$$

So in our example, the second bond can also be described as the combination of a riskless security worth \$1500, short a put option requiring the bondholders to purchase 60 percent of the bank at a valuation of \$3500, so take 60 percent of the loss as *V* falls below \$3500, plus a put option allowing the bondholders to sell 30 percent of the bank to the senior (third) bondholders at a valuation of \$2000. This describes the value of the bond as \$1500 when $V \geq 3500$, declining at a slope of .6 until it reaches a value of \$600 when $V = 2000$, and declining at a slope of .3 thereafter until $V = 0$.

A4. How do ERNs help with Debt Overhang?

Proposition: *If a bank's capital structure consists of equity and ERNs that were all issued when the share price was higher than presently, then issuing new ERNs with the same maturity structure as the existing ERNs, and using the proceeds to make an investment with zero net present value, with returns at every date proportional to the returns on the bank's current investments, makes the previously-issued ERNs in aggregate less valuable, and* increases *the value of the bank's equity.*

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[52] This formula can be developed by a parallel argument to that for equation (3), starting by computing first $V_N(V)$, then $V_{N-1}(V)$, etc., so, for example, the most senior bond is worth D_N minus the value of the right of the other stakeholders to put shares to it. Or, of course, equation (5) can be developed directly from equation (3) by using put-call parity: $V + P(X) = X + C(X), \forall X$.
For example, with *N*=3, the value of the senior debt is $D_3 - \frac{S_3}{\sum_{j=0}^{j=3} S_j} P(X_3)$; the value of intermediate debt is $D_2 - \frac{S_2}{\sum_{j=0}^{j=2} S_j} P(X_2) + \frac{S_3 S_2}{\sum_{j=0}^{j=3} S_j \sum_{j=0}^{j=2} S_j} P(X_3)$; the value of junior debt is $D_1 - \frac{S_1}{\sum_{j=0}^{j=1} S_j} P(X_1) + \frac{S_2 S_1}{\sum_{j=0}^{j=2} S_j \sum_{j=0}^{j=1} S_j} P(X_2) + \frac{S_3 S_1}{\sum_{j=0}^{j=3} S_j \sum_{j=0}^{j=2} S_j} P(X_3)$; and the value of equity is $V - \sum_{j=1}^{j=3} D_j + \frac{S_1}{\sum_{j=0}^{j=1} S_j} P(X_1) + \frac{S_2 S_0}{\sum_{j=0}^{j=2} S_j \sum_{j=0}^{j=1} S_j} P(X_2) + \frac{S_3 S_0}{\sum_{j=0}^{j=3} S_j \sum_{j=0}^{j=2} S_j} P(X_3)$. (The values of X_1, X_2, X_3 are as in the previous note.)

Proof: For simplicity, assume all payoffs are at a single time. Since the new ERN security has a lower conversion price, *Pc*, than all the other ERNs, a higher proportion of its investment is returned to it, than to any other security, from every dollar the bank repays when the payment-date stock price, *Pt,* is below *Pc*. So conditional on *Pt* ≤*Pc*, the new ERNs receive a larger fraction of the returns than the fraction of the total value of the bank that they represented when they were issued, and therefore (since the new investment was zero NPV and we are conditioning on the returns being in the lower tail) the "old securities" (that is, the aggregate of existing ERNs and equity) have lost value as a result of the new investment. So it also follows from the new investment having zero NPV, that old securities must gain an identical amount conditional on *Pt* >*Pc*, assuming the new ERNs are sold for fair value. But all the old ERNs' conversion prices are above *Pc* and so each receives a constant fraction of each dollar the bank earns up to that ERN's conversion price, and then nothing further. So in the states where Pt > Pc equity's share of the total returns begins at its share of the increased losses imposed on old securities by the new investment when Pt < Pc and then rises as returns increase. So equity gets a higher share of the gains when Pt > Pc than it takes of the equal (expected) losses when Pt < Pc and so gains. Assuming the new ERNs were sold for fair value, the old ERNs must lose the amount that equity gains. *Q.E.D.*[53]

A way to understand the intuition is that for a bank consisting only of ERNs and equity:
(1) Making a zero NPV investment that increases returns proportionally in all states, and is financed by proportional sales of all securities, leaves the values of all securities unchanged.
(2) So, since financing the same investment by leaving the amount of equity unchanged but increasing the rest of the capital structure in proportion increases the "debt/equity" ratio, it makes equity worth more.
(3) So financing the same investment by leaving the amount of equity unchanged and the amount of old ERNs unchanged, but adding new (more senior) ERNs, makes equity worth even more.

[53] Conversely, by similar logic, the ERNs that were the most senior prior to the new investment must lose: they receive the same share of the old securities' gains and losses from the new investment in all the "low-return" states in which they convert (whether or not the new ERNs convert), and none of the incremental gains and losses in the "high-return" states in which they do not convert. So since the old securities in aggregate gain in "high-return" states and in aggregate lose in the "low-return" states (because the investment is zero NPV) the previously-most-senior ERNs lose overall. The effect on more junior previously-issued ERNs is not *a priori* obvious; whether they gain or lose depends on whether they are effectively more like equity, or more like the previously-most-senior ERNs.

Of course, if the bank has any traditional debt in its capital structure, the result still applies provided the debt is sufficiently safe (and/or sufficiently small in quantity) that the new issue of ERNs makes sufficiently little difference to the debt's value.

A5. A Simple Example of how Issuing New ERNs makes Equity More Valuable[54]

At time t=1, a bank has 1 share of stock outstanding, and one ERN issue with a nominal value of \$80 which was issued at time t=0 when the stock was worth \$80, so the ERN conversion price is 25% of \$80, i.e., \$20. All payments are due at time t=2, so this ERN issue will pay off the lesser of 4 shares of stock or \$20 per share at this time. Assume all remaining uncertainty will be resolved at t=2, that the bank will then have a return uniformly distributed between 0 and \$200, that investors are risk-neutral and that there is no discounting. So (if no more investments are made and no more ERNs are issued) the stock can easily be shown to be worth \$40 at the current time, t=1, and the ERNs are now worth \$60.[55]

The bank now (at t=1) chooses to issue new ERNs with a nominal value of \$50, and to invest the proceeds in a zero net present value investment with returns proportional to the current returns on the bank's existing investments. Since the current share price is just \$40, the conversion price of the new ERNs is 25% of \$40, i.e., \$10. We can show that the new ERNs can be sold for \$41.14, and total returns at t=2 will now be uniformly distributed between 0 and \$200+2(41.14) = \$282.28.[56]

It is then also easy to check that the value of the *old* ERNs has fallen from \$60 to \$55.20.[57] Since the new investors must earn a fair return, and the new investment has zero net present value,

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[54] Bulow and Klemperer (2013) uses our numerical example of Appendices A1-A3 to illustrate the effect of issuing new ERNs when there are multiple previous ERN issues.

[55] The ERNs will convert if the return, x, <100. (At x=100, the stock is worth exactly \$20 either with or without conversion.) So if x<100 (with probability ½) the existing stock receives x/5; if x>100 (with probability ½) it receives x-80; hence in expectation it receives ½(50/5) + ½(70)=40. The ERNs therefore receive 100-40=60 in expectation. (We can also check the ERNs receive 4x/5 if x<100 (with probability ½), and 80 if x>100 (with probability ½), that is, \$60 in expectation.)

[56] The *new* ERNs will now convert if the total return, y, <100. (At y=100, the shares are worth exactly \$10 either with or without conversion of the new ERNs, since the old ERNs will already have converted.) So if y<100 (with probability 100/282.28) the new ERNs convert and receive (5/10)y; if y>100 (with probability (282.28-100)/282.28) they receive 50; so in expectation they receive \$41.14.

[57] See the previous note. The *old* ERNs convert if y<150. (At y=150, the stock is worth exactly \$20 either with or without conversion of the old ERNs, because the new ERNs will not convert and so receive \$50.)

the old ERNholders' loss must correspond to a shareholders' gain. That is, the market value of the bank's equity must have risen from $40 to $44.80 (as is also easily calculated directly[58]): there is a $4.80 "reverse debt overhang". From the shareholders' perspective, there is a transfer of 4.80/41.14 = 11.66 cents for every dollar of new capital raised.[59]

By contrast, with the same capital structure at t=1, the bank would have had to sell (approximately) 1.1 shares of equity at a price of $37.30 (which would also be the price after the offering), to raise the same funds of $41.14 for the same new investment. In this case, existing shareholders would lose $2.70, or about 6.6 cents for every dollar raised, reflecting traditional "debt overhang".[60]

With a conventional capital structure the "debt overhang" problem would be even worse. Assuming the same ratio (40/60) of the market value of equity to debt at t=1, the creditors would have a claim for the first $73.51 of the bank's returns. If at t=1 an additional $41.14 of equity were sold to fund the same investments, the value of the debt would rise from $60 to $63.94, and the existing shareholders would correspondingly be $3.94 worse off, or about 9.6 cents for every dollar raised.[61] [62]

So if y<100 (with probability 100/282.28) both issues of ERNs convert and the old ERNs receive (4/10)y; if 100<y<150 (with probability 50/282.28) the old ERNs receive (4/5)(y-50); if y>150 (with probability (282.28-150)/282.28) they receive 80; so in expectation they receive $55.20.

[58] To do this, observe (using the previous notes) that if y<100 (with probability 100/282.28) the shares receive (1/10)y; if 100<y<150 (with probability 50/282.28) they receive (1/5)(y-50); if y>150 (with probability (282.28-150)/282.28) they receive y-130. Of course, if this share price rise were anticipated, the new ERNs would be issued with slightly higher conversion prices—the calculations would not be greatly affected.

[59] Old ERNholders lose about 8 percent of their wealth--significant, but small relative to the losses that unsecured creditors may face upon the news of a default.

[60] The value of the ERNs would rise by the same amount. To check the calculations, note the ERNs convert if the return, z, <122. (At z=122, the 2.1 shares are worth exactly $42 either with or without conversion.) So if z<122 (with probability 122/282.28) the ERNs receive (4/6.1)z; if z>122 (with probability (282.28-122)/282.28) they receive 80. The 2.1 shares receive the remainder.

[61] Because conventional debt is strictly senior to equity, the issuance of new equity helps it more than it helps ERNs which share returns with stock in states that they are not paid in full. To check the calculations, note that prior to the new investment the debt expects to receive its full nominal claim of 73.51 less (on average) 73.51/2 with probability 73.51/200; after the investment, it expects a shortfall of 73.51/2 with probability 73.51/282.28.

[62] If we instead assumed the market debt/equity ratios had been equal in the conventional and ERNs cases at t=0, then the market debt/equity ratio would be (38.27/61.73) at t=1, and debt overhang in the conventional case would be even greater--10.3 percent.

Generalising this example, let the value of the bank at time t=1 be V and the value after the uncertainty is resolved (at t=2) be θV, in which θ has density function $f(\theta)$ (so $\int_0^\infty \theta f(\theta) = 1$). Write the number of shares outstanding after any conversion (at t=2) as $S(\theta)$ (so the number of shares outstanding at t=1 is $S(\infty)$). Consider new ERNs with face value x that convert into equity at a lower price per share, p, than any existing ERNs, and the proceeds of the issuance of which, mx, are invested to yield θmx. These ERNs convert into x/p shares, whenever $\theta \leq \hat{\theta}$, where $\hat{\theta}(V + mx) = (S(0) + (x/p))p$. So, per dollar of their face value, the new ERNs' return is $e(\theta) = (\theta/\hat{\theta})$ for $\theta \leq \hat{\theta}$, and $e(\theta) = 1$ for $\theta \geq \hat{\theta}$, and their market value is $m = \int_0^\infty e(\theta)f(\theta)d\theta$.

For a small new investment the function $S(\theta)$ is unaffected by the new investment, and $\hat{\theta} \rightarrow pS(0)/V$, so the gain to shareholders, per dollar face value of the new ERN issued to finance the investment, is the shareholders' share of the additional returns, $(S(\infty)/S(\theta))m\theta$, less their share of the payment to the new ERNholder, $(S(\infty)/S(\theta))e(\theta)$. So total expected returns to equity, per dollar face value of the new ERN, are $\int_0^\infty \frac{S(\infty)}{S(\theta)}[m\theta - e(\theta)]f(\theta)d\theta$.[63]

In our example, p=10, V=100, $S(\theta)$ =5 for $\theta < 1$, and $S(\theta)$ =1 for $\theta \geq 1$, so $\hat{\theta} = 1/2$. Also $f(\theta)$=1/2 for $\theta \leq 2$ (and $f(\theta)$=0 for $\theta > 2$) so m = 7/8, and total equity expected gains from the sale of new ERNs, per dollar of face value, are 1/8, implying a "reverse overhang" of (1/8)÷(7/8) =1/7.[64]

A6. Bond Yields and Capital Structure

A 25 percent ERN is the equivalent of a riskless bond minus four put options at 25 percent of the current stock price. If, for example, a payment is promised five years from the issue date, the underlying stock starts at $100 and pays an annualized dividend equal to 3 percent of value,

[63] Note that old investors as a whole break even from the new investment (since the new ERNs get a fair return), and the shareholders' fraction, $(S(\infty)/S(\theta))$, of the net additional old investor returns ($m\theta - e(\theta)$ per dollar face value of the new ERNs) is weakly increasing in θ (since $S(\theta)$ is weakly decreasing), so shareholders always gain on net (as we demonstrated was true more generally in the Proposition of Appendix A4).

[64] In our example, the debt is nominally worth $73.51 in the conventional-capital-structure case, and financing a new $*y* investment using equity means returns are uniform on [0, 200+2*y*] so debt then expects to receive its full nominal claim less (on average) 73.51/2 with probability 73.51/(200+2*y*). Differentiating w.r.t. *y*, debt gains (and therefore equity loses) 0.135*y* from a small investment of *y*.

the riskless rate is 1 percent and the annualized volatility (sigma) of the stock price is 40 percent, then the value of the relevant European put options is 4 x $1.27, or a little over 100 basis points per year, using the Black-Scholes formula.[65] For a three-year payment the Black-Scholes price is 4 x $.33, or 44 basis points per year.

This calculation is, of course, incomplete. In particular, as we have emphasised, the ability to issue senior debt in future bad times will make issuing ERNs more expensive; this effect will be only partially mitigated by existing ERNs' seniority over new ERNs issued in better times. But, to the extent that allowing more money to be raised in bad states of the world is efficient and stabilizing, this reduces the costs of capital. The cost of ERNs should also be reduced by their avoidance of the bankruptcy costs that conventional debt incurs after a firm's failure. On the other hand, the Black-Scholes assumptions used above may understate the price of tail risk. And a significant impact of replacing conventional debt with ERNs on banks' cost of debt capital will be through the loss of the government subsidies provided through implicit promises of bailouts.

Of course the actual interest rate that ERN investors would demand is less relevant than the effect of ERNs on efficiency, in particular through the total (social) cost of capital, and banks' ability to raise new capital.

Note also that a bank can always add some equity to its capital structure to make its ERN debt as safe as its conventional debt would have been. For example, ignoring government subsidies and the effects of future ERN issuance, and with 25% ERNs, increasing the percentage of equity in the capital structure by 25/(100-25)=1/3 of its current percentage (e.g., from 6% to 8%) would make ERNs at least as safe as (so its yield should be no higher than) conventional debt.[66]

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[65] Note that the replacement of conventional debt with ERNs reduces the volatility (sigma) of a bank's stock (see Section 4.5). A measure of the cost of conventional bank debt relative to riskless debt is that a 5 year CDS against Wells Fargo, the highest-rated US bank, cost about 50 basis points per year in August, 2014.

[66] A bank which lost 6% of its value would impose no losses on its debt if it started *either* with 6% of conventional debt *or* with 8% of ERN-debt, and subsequent losses would fall more heavily on debt in the former case. More generally, consider a model with a single period, at the end of which the bank will pay the first D in returns to debt holders, and any remaining amount to equity holders. The value of the debt in the bank is initially d_0 and the value of the equity is e_0. At the end of the period the bank will have the random value V. Then with strict priority, debt holders will receive a payoff of $\min\{V/D, 1\}$ per dollar promised and shareholders will receive $\max\{0, (V-D)/e_0\}$ per dollar of equity. With ERNs, creditors start sharing losses earlier. Say that debt can be converted into equity at a price of α times the initial price. Then if the bank wishes to issue debt with the same payoff as in the conventional case it has to issue debt worth $d^* = e_0 - d_0\alpha e_0/(D-\alpha d_0)$ and equity worth $e^* = e_0 + d_0\alpha e_0/(D_0-\alpha d_0)$. As before, creditors

A7. How would ERNs have worked in the Crisis?

While we do not know how the path of stock prices would have differed from the one followed in 2008-9 if banks had had ERNs instead of traditional debt at the time, we can say what would have happened to the ERNs of large banks had the path of stock prices been unchanged.

The stocks of three relatively well-capitalized major U.S. banks---J.P. Morgan, Wells Fargo, and Goldman Sachs---closed at less than 25 percent of their all-time highs on zero to four days during the crisis. Therefore it is unlikely that those banks would have made any payments in stock. However, three other major banks---Citigroup, Bank of America, and Morgan Stanley---all saw their stocks fall by over 90 percent.[67] All would have issued a considerable amount of stock, though perhaps less so Morgan Stanley, which managed a quicker recovery than the others.[68]

In the U.K. the story was similar. HSBC (the only one of the pre-crisis big five that never seemed likely to need government support) would never have required any conversions. Barclay's, which narrowly avoided taking government money, would have had to make conversions on any ERNs issued from mid-2006 to late 2007 that were still outstanding at the end of 2008, since it traded below 25 percent of its all-time peak for six months from late October, 2008. HBOS was taken over by Lloyd's at a price close to 25 percent of its peak, and weak banks RBS and Lloyd's traded far below 25 percent of their peak prices from October 2008 through the end of 2012.

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receive *min*{V/D,1} per dollar promised. Equity holders receive *max* {αV/D, (V-D)/e*} per dollar invested. An investor who wished to replicate the returns from one dollar of old equity could do so by purchasing e^*/e_0 dollars of new equity and selling short $(e^*-e_0)/e_0$ dollars of ERNs. See Bulow and Klemperer (2013) for more detail.

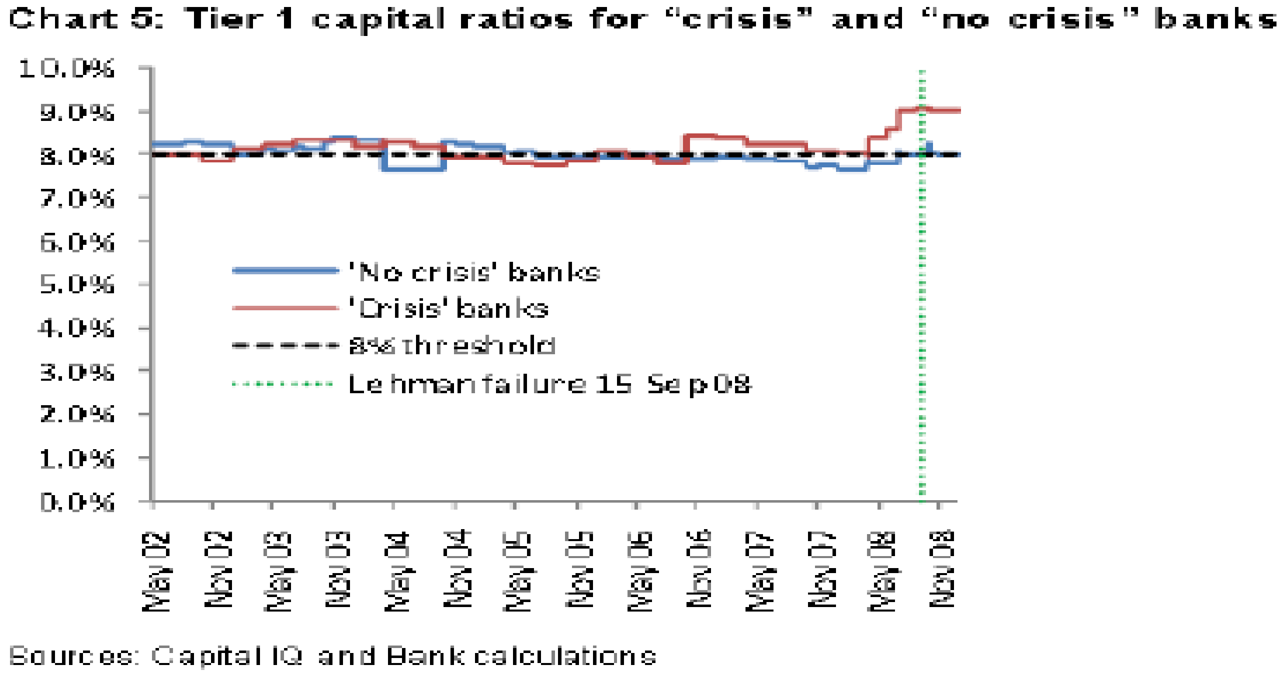
[67] Morgan Stanley and Bank of America share prices first recovered to more than 25 percent of previous highs in 2013; Citigroup was still below that level as of August 2014.

[68] Citigroup would have faced similar aggregate dilution with a conversion rate of 10 percent as with 25 percent, but the timing would have been different. At 25 percent a sample calculation (assuming all its debt was in the form of ERNs, and constant unsecured (ERN) debt of about $450 billion with an average duration of 40 months) suggests that dilution would have been 35 percent in the fourth quarter of 2008, with shares increasing by another 60 percent (compounded) in the first quarter of 2009. At 10 percent there would have been a trivial amount of share conversion in 2008, but shares would have increased by 135 percent in the first quarter of 2009. However, this simple comparison ignores the fact that the stock price path would have been affected by the ERN conversion rate---at a 10 percent rate dilution effectively involves selling large blocks of shares at 40 percent of the price that is received with a 25 percent conversion, and in both cases shares are sold at premia to the market price. Furthermore, while this dilution is substantial, note that Citigroup's shareholders were diluted by a factor of six during the financial crisis.

As stock prices fell and ERNs became more equity-like, the effective leverage of the banks would have been reduced, so the calamitous share price declines of weaker banks overstate the prospective losses of ERNholders. Starting with the same leverage ratio, unsecured bondholders would have taken losses, but not as large as implied by stock price declines. For example, if a bank with 50 in equity and 50 in unsecured debt lost 50, then equity would be wiped out in a conventional model. With 25% ERNs, equity would have lost 40 and ERNholders 10, or 20 percent of their investment.[69]

[69] That is, with ERNs convertible into equity at 25% of the initial equity price, the equity holders would end up with one fifth of the bank, worth 10, and the ERNholders would be left with shares worth 40.

From Haldane (2011) Figures 5 and 6:



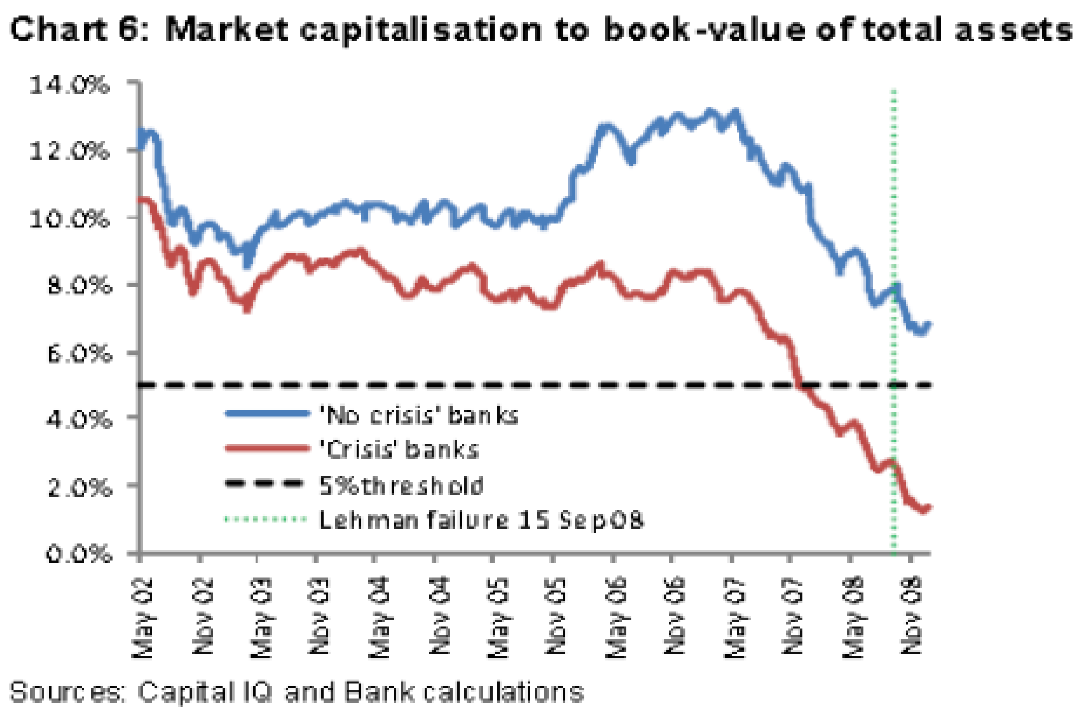
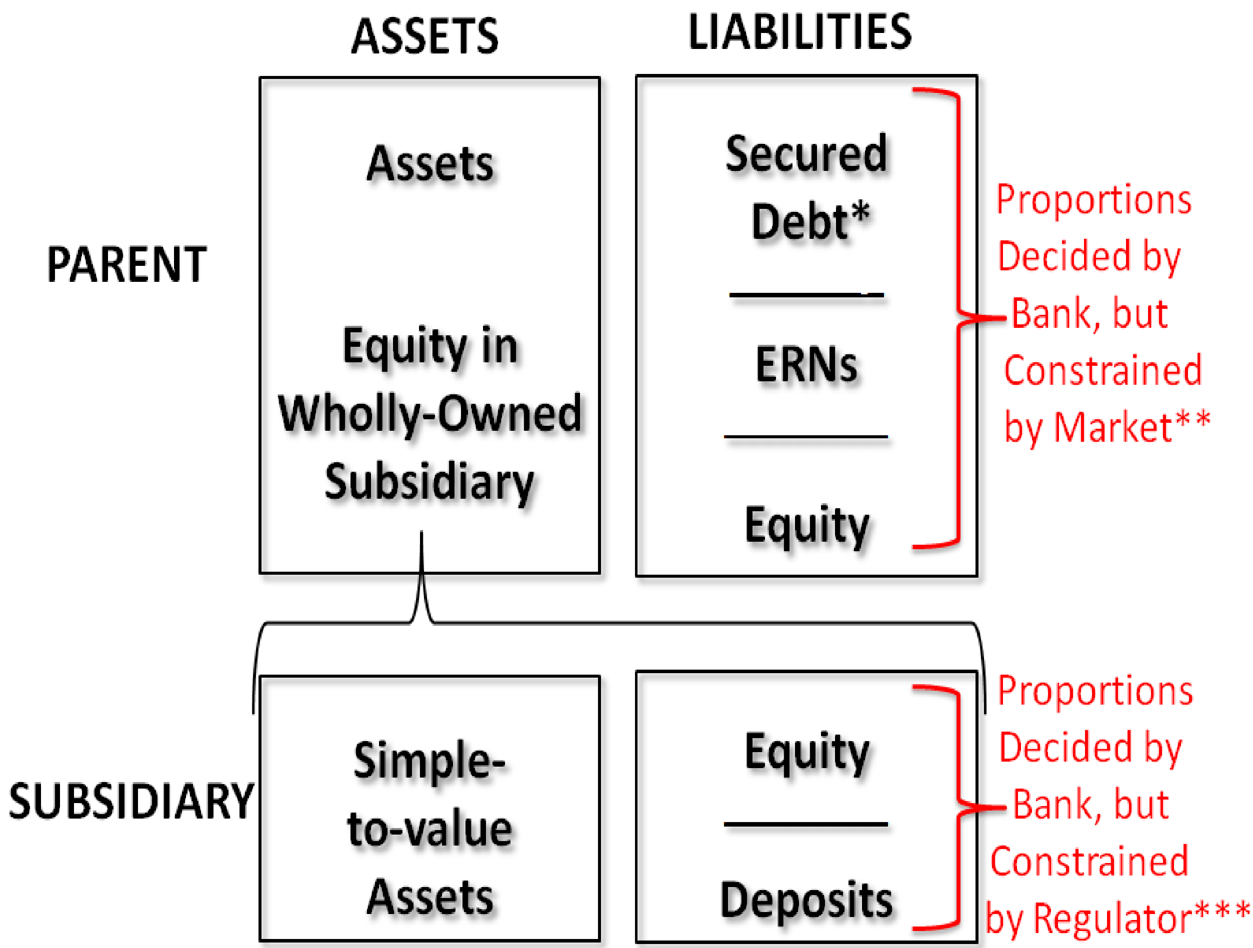


FIGURE 1 Regulatory and Market Measures of Strengths of "Crisis" and "NoCrisis" Banks



*Creditors' recourse beyond collateral limited to ERNs or equity

**The less equity the bank chooses, the more volatile its stock,
and the more likely there will be ERN conversions (which increase the amount of stock),
and that secured creditors will demand larger haircuts.

***Ideally based on a market measure for secured debt.

FIGURE 2

Hypothetical Bank Balance Sheet with Large-Scale use of ERNs