

# 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 (1) ameliorate booms and busts by creating **counter**-cyclical incentives for banks to raise capital, and so encourage bank lending in bad times; (2) help solve the too-big-to-fail problem; and (3) reduce the regulatory system's reliance on accounting measures of capital. ERNs avoid the flaws of existing contingent convertible bonds (cocos)--in particular, they convert more credibly. Future required increases in bank-capital should be permitted to be in the form of **either** equity **or** ERNs. (88 words)*

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The banking system urgently needs reform. The expectation that "too-big-to-fail" banks may be bailed out by taxpayers implies both socially-inefficient decision-making by bankers and socially-inefficient risk-bearing. Perhaps even more damaging, the current regulatory system is pro-cyclical, forcing banks to cut back on investment in bad times when they face "debt overhang".

We propose a new form of hybrid capital for banks, Equity Recourse Notes (ERNs), which mitigates these problems. ERNs are a form of debt whose currently-due payments convert into equity if the issuer suffers a substantial decline in share price. 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 funds to make new investments?", we will show a capital structure of ERNs and equity is superior to all 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 proposals are that (i) banks issue ERNs when they would otherwise have issued cocos and (ii) 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 gives some choice to those who claim (rightly or wrongly) that equity is more costly than debt. In the longer run, substituting ERNs for most, or even all, 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 discusses other details, and Section 7 explains how introducing ERNs can begin a broader

program of reform. Section 8 describes how ERNs would have worked during the 2008-9 financial crisis and Section 9 compares their introduction with the alternative of requiring banks to hold more equity. Section 10 concludes. The Appendix contains proofs and examples.

## **1. What are ERNs?**

ERNs (Equity Recourse Notes) are a form of “contingent capital” that start life as debt, but any currently-due payment is automatically converted into equity if the share price is below a trigger on the day the payment is due. The crucial features are that

- (1) conversions are based on whether the share price is below a trigger that is a fixed fraction of the issue-date share price,
- (2) conversions into shares value those shares at the trigger price, and
- (3) conversions occur one payment at a time--only currently-due payments convert.

For example, consider an ERN that was issued when a bank’s share price was 80. 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 (say) 25 % of the price on the issue date, in this case 20.

The shares paid in any conversion are valued at the trigger price: for example, 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  $100,000 \div 20 = 5,000$  common shares. However, if the share price recovers to \$22 by the next payment date, the bank can make the next payment in cash. That is, whether any given payment must be made in shares is determined only by the share price on the date that the payment is due, independent of how previous payments were made.

Selling an ERN is clearly the same as promising a sequence of riskless payments while simultaneously buying the right to make those payments by selling shares at the trigger price. Equivalently, it is the same as promising a sequence of payments in shares, while simultaneously buying a matching sequence of warrants that give the right to buy and retire the promised shares for the trigger price, if that price is lower than the exercise price. So ERNs can be understood in terms of simple European put or call options (i.e., options to sell or buy shares at a fixed price on a specified date but not sooner).<sup>1</sup> In our example bondholders can completely hedge the risk of receiving shares instead of the \$100,000 in cash by purchasing 5,000 European put options with strike prices of \$20 per share.

The percentage of the issuing-date share price that is used to determine the trigger price is a regulatory choice, but the same percentage would apply to all ERN issues by all banks and other “Systemically Important Financial Institutions” (SIFIs). We will assume 25%, for simplicity, but discuss regulators’ choice of this number in Section 6.2.

Some other details are also important:

- ERNs cannot contain covenants limiting the issuance of future ERNs. (See Section 3; there can be covenants limiting the future issuance of conventional debt.)

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<sup>1</sup> If the current share price is  $p$ , the current value of a single promised ERN-payment of  $x$ , with conversion price  $p_c$ , and due on a particular date could be written as:

$$V(x, p_c, p) = d(x) - \frac{x}{p_c} \mathcal{P}(p_c, p) = \frac{x}{p_c} p - \frac{x}{p_c} \mathcal{C}(p_c, p),$$

in which  $d(x)$  is the current value of a riskless payment of  $x$  on that date, and  $\mathcal{P}(p_c, p)$  and  $\mathcal{C}(p_c, p)$  are the current values of European put and call options that give the rights to, respectively, sell and buy shares at strike price  $p_c$  on that date. We assume these rights are unaffected by any dividend payments or dilutions such as those that ERN conversions would cause. However, the value of those puts and calls will depend on the bank’s entire capital structure, as the issuance of new shares through conversions at above-market prices will directly impact the value of all shares and derivatives. Appendix A therefore takes the standard corporate finance approach of valuing ERNs in terms of puts and/or calls on the value of the bank rather than on the value of shares.

- Cash dividends and buy-backs are subject to regulatory approval. (This prevents a bank from undermining the role of ERNs by announcing that it will buy back the stock from any conversion or buy back ERNs prior to any repayment that would be converted; of course, major banks already require regulatory approval for dividends and buybacks.)
- Banks have the right to make payments on ERNs in shares (valued at the trigger price) even if the shares are trading above the trigger price. We would not expect to see this option used much, but it ensures that a bank will never fail because it cannot pay off an ERN.
- In bankruptcy, ERNs convert entirely into shares (that is, each ERNholder receives the number of shares equal to the ERN's face value divided by the trigger price).
- The full benefits of ERNs require restrictions on their term structure. We discuss these below (Section 6.1).

Further details are in Section 6, and in Bulow and Klemperer (2013).

In contrast to ERNs, existing “cocos” convert based on *regulatory* triggers, rather than on market triggers, and mostly convert *principal*, not merely currently-due *payments*, as soon as they convert at all. The reasons for these two differences are that (a) existing cocos focus on assuring adequate “*regulatory* capital” to satisfy existing regulations at every point in time, while we are concerned with the bank having sufficient *economic* capital whenever it needs it (see Section 5) and (b) existing cocos’ early conversions of principal create potential problems of “multiple equilibria” which can allow manipulation (see Section 4.2).<sup>2</sup> We have also

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<sup>2</sup> Cocos were first issued in 2009. The literature begins with Flannery (2005)--von Furstenberg (2014) gives a comprehensive survey; see also Pazarbasioglu et al. (2011) and Avdjiev et al. (2013). Cocos with regulatory triggers were strongly encouraged by the Squam Lake Working Group (2009). However, we are not aware of any proposals which convert one payment at a time, or that use our rule for determining the trigger price for conversion. So, in particular, we know of no other proposal that generates the countercyclical incentives we obtain. Some authors have suggested using market, rather than regulatory, triggers, for example Dudley (2009), Duffie (2009), Coffee (2010), McDonald (2010), and Pennacchi, Vermaelen and Wolff (2011), but most specific proposals for these are vulnerable to the

designed ERNs so that (by contrast with existing “cocos”) in the marginal cases in which conversions are made, the shares issued are worth exactly the cash that would have been paid absent the conversions. Finally, and crucially, the trigger for an ERN conversion is tied to the share-price at issuance—we will see that this yields countercyclical incentives to raise new capital.<sup>3</sup>

## 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, that is, *passively*, 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; and marginal ERN conversions *impose only small costs* on bondholders.

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“multiple-equilibria” problem. (See section 4.5. An exception is Bolton and Samama's (2012) “Capital Access Bonds”.) Other authors such as Perotti and Flannery (2011) and Calomiris and Herring (2013) propose hybrid triggers that combine market and regulatory information, but these also have significant problems. (For example, a trigger based on the ratio of the market value of equity to the book value of assets, or to the book value of liabilities, creates an incentive to shrink balance sheets by economizing on the holding of low-risk, liquid securities that are generally highly levered, like Treasury bills, and by using loan commitments and derivatives to retain risks while moving them off-balance sheet. If the trigger is based on liabilities, banks also have an incentive to repurchase long-term debt selling at a discount.) 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 7.

<sup>3</sup> ERNs are importantly different from a non-cumulative preferred stock which has the option to skip paying a dividend, because an ERN’s trigger is clear, and because a preferred shareholder gets nothing when a payment is missed but an ERNholder gets shares. ERNs are also very different from Reverse Convertible Notes (RCNs) which may convert principal (but not other payments) to shares upon maturity, because RCNs’ conversion triggers are based on *unconnected* companies’ share prices. (However, the market for RCNs indicates a healthy market for out-of-the-money put options with even higher exercise prices than the ERNs we propose.)

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

### 2.1. *Passive vs. “active” conversion*

It is now well understood that regulatory capital measures are only loosely related to solvency (see, e.g., Haldane, 2011, Bulow and Klemperer, 2013, sec. 2). In both Europe and the U.S., the major banks that required bail-outs were all rated as well capitalised until the bitter end. Unless regulators “opt in” by actively requiring undercapitalised banks to recognise losses on mis-marked assets --- unlike the way they behaved in the financial crisis --- cocos that are convertible based on regulatory values will not convert until reorganisation is required.<sup>4</sup> In contrast, ERNs’ market-based triggers mean that stopping a conversion would require a regulator to “opt out”, and regulatory passivity will imply that conversions will take place while banks are still going concerns.

Regulators are reluctant to actively force a recapitalization because doing so will send a negative signal about the bank’s current financial status, possibly exacerbating a bad situation. They may also feel under pressure from politicians who will prefer to “kick the can down the road” by waiting and hoping for good news. And if things worsen, they may be reluctant to take an action that will invite questions about why the problem was not dealt with earlier. By contrast, conversion of an ERN’s payment depends only on information already embodied in

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<sup>4</sup> As one market expert put it to us: “Cocos’ triggers are effectively a calculation of Common Equity Tier 1 to Risk Weighted Assets (RWAs), knowing that the bank is in charge of calculating its RWAs .... This leaves considerable room for manipulation, dissimulation and insider trading. .... it is not realistic to expect [bank supervisors to] be able to monitor the precise level of banks’ RWAs constantly and in real time.” (The flexibility in calculating RWAs is shown by Haldane (2013) who provides examples of risk weights which were miscalibrated by a factor of *fifty*.) Bulow and Klemperer, 2013, sec. 2 also give many examples of legal but misleading marking of assets. Commentators have debated the credibility of bank regulators at least since the financial crises of the mid-1800s (see *the Economist*, 2014). Walther and White (2015) provide a formal model showing the importance of credible conversion based on public information.

market prices. Moreover the fact that there is no additional news in a passive conversion is one reason (see Section 4.1) why managers should not feel the need to fight them.

## *2.2 Gradual conversion*

ERNs' payment-at-a-time conversions (and also the term-structure requirements suggested in Section 6.1) ensure that the fraction of any ERN 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. So both shareholder dilution and voting control only occur slowly, giving shareholders and managers much less reason to fight conversions (see Section 4.1).

## *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 are issued saves a dollar or more of cash for the bank's balance sheet. Note that converting payments that are not yet due (as when a conventional coco converts all at once) is of no help in solving a bank's cash flow problems, and provides no economic benefits—any accounting benefits are purely superficial, since the remaining payments will also convert if necessary when they become due.

## *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. But with ERNs, a marginal conversion takes place when the *share* price on the date of conversion just equals the trigger price (and the same price



is used to determine the number of shares paid in the conversion) so 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. Since ERN conversions are also only gradual, they should be much less contentious than conversions of traditional cocos.

### **3. ERNs create *Countercyclical* pressures--Banks will have *Countercyclical* Incentives to Lend**

Most important, ERNs create *counter*-cyclical investment incentives, mitigating both booms and busts. 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.

With traditional financing, a "debt overhang" problem arises when a bank that has suffered losses, as in 2007-8, wants to raise new 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. Since the new investors must be offered a market rate of return, the increase in existing creditors' wealth must come at equity holders' expense.<sup>5</sup>

Furthermore, 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

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<sup>5</sup> 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. In particular, 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). For more details, and a formal analysis incorporating the current regulatory-capital system and deposit insurance, see Bulow and Klemperer (2013, Appendix 1).

management's estimate of fair value) and, moreover, 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 their overhang loss.<sup>6</sup>

Meanwhile, selling conventional debt increases a bank's risk of default and is therefore limited by regulatory capital rules. Bulow and Klemperer (2013, Appendix 1) shows that even when banks are given access to government-guaranteed debt, this cheap "liquidity provision" of new debt is not enough to overcome the debt-overhang disincentive arising from the regulatory requirement to partly fund new loans by equity.<sup>7</sup>

So a bank with a traditional capital structure has strong incentives to avoid raising new funds, and to instead stop making new loans, in stressed times.<sup>8</sup> In short, "debt overhang" acts just like a tax on new investment by conventionally-capitalised banks in bad times.

By contrast, ERNs can create a "reverse debt overhang": an "overhang" of ERNs will encourage banks to sell new ERNs for additional investment in bad times (and selling new ERNs does *not* increase the bank's risk of default).

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<sup>6</sup> 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.

<sup>7</sup> As a simplified example, say a bank had assets with a *regulatory* value of 1000, liabilities of 900, and a regulatory capital requirement of 10%, that is, 100, but the equity's *market* value is only 20. Then to expand by 10%, the bank would need to raise equity of 10, and selling new shares at market prices will mean increasing the number of shares outstanding by more than 50% (since the price of shares falls with their dilution). However, debt increases by just 10%. Such a disproportionate dilution can leave shareholders in a sufficiently-stressed bank worse off, even though the new equity allows the bank to take on more government-guaranteed subsidised debt.

<sup>8</sup> Selling assets may be another alternative, but this only helps meet regulatory capital requirements if the regulatory value of the assets less their capital requirement exceeds the sale price. During the crisis, when regulatory values often far exceeded market values, selling assets would reduce economic risk but perversely increase the amount of equity the bank was required to raise. (See note 22 for further discussion.)

The crucial point 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. Assuming the new ERNs are fairly priced, and capital requirements are strong enough that any more-senior debt is relatively safe (and/or sufficiently small in quantity) the value lost by the previously-issued ERNs must be transferred to the equity. So the equity is made more valuable. That is:

*PROPOSITION 1: 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.*

Appendix C gives a proof, and a more-detailed intuition.<sup>9</sup>

*So issuing new ERNs in bad times transfers wealth to shareholders.* Banks therefore have incentives to recapitalise without the need for any regulatory intervention, and bank lending is encouraged in times of stress. 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.

Appendix D derives a formula for the size of the “reverse overhang” from financing a small new investment by ERNs under Proposition 1’s conditions, assuming the bank will make no further

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<sup>9</sup> Regardless of how the proceeds are used, issuing ERNs is always better for shareholders than issuing new equity. Furthermore, these results still hold if the bank also has (sufficiently) safe traditional debt in its capital structure.

investments. As an example, if the bank's previously-issued ERNs were all 25% ERNs issued when its stock price was twice the current level, and they now represent 60% of the firm's total market value, shareholders *profit* by one dollar for every seven dollars 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 "debt overhang" would mean the bank's shareholders would *lose* 13.5% 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 this example, a new zero-net-present-value investment that increases the total value of the same firm by 40% yields a shareholder profit of 11.7% of the investment's cost if it is financed by issuing ERNs, or a loss of 9.6% if the firm is conventionally financed, and finances the investment using equity.<sup>10</sup>

Furthermore, since in bad times shareholders are better off if the bank finances assets by selling ERNs than if it sells the assets at fair prices, and shareholders gain if the bank sells ERNs and uses the proceeds to buy new assets at fair prices, there is no signalling problem in doing these things. By contrast, as discussed above, there is a signalling problem in selling shares.

Finally, the balance sheet directly "self-repairs", because old ERNs become more equity-like as share prices fall, and indeed become equity if things get bad enough.

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<sup>10</sup> As discussed above, a conventionally-financed bank is likely to have to disproportionately finance with equity in times of stress. (Our result would be the same if the conventionally financed bank financed the investment with any other securities that are strictly junior to its existing debt.) Section 5 discusses why an ERN-and-equity financed firm should be able to finance using ERNs.

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

In addition to converting credibly, and generating countercyclical pressures, ERNs avoid critical flaws associated with both market-trigger and regulatory-capital-trigger cocos.

### 4.1 Managements should not fear ERNs conversions

It is sometimes argued that managers fear that a forced equity issuance (as when traditional cocos convert, or rights issues are made) might cost them their jobs. Unlike other new issuances, ERN conversions imply no information not already embodied in share prices (see section 2.1). But should managers be worried about the dilution conversions cause? The answer is no, because a strong bank that suffers from “excess” share issuance can always apply to repurchase more shares in the next regulatory review of its finances.<sup>11</sup>

While using all the cash saved in the conversion on a share buyback would leave the bank with exactly as much regulatory capital as if the payment had been in cash (and would reduce the number of shares outstanding, so leave the shareholders better off, since the repurchase price per share should be below the conversion price),<sup>12</sup> an important feature of ERNs is that regulators may not approve such buybacks if they think the bank’s finances are weak. However, even in this circumstance the regulators might allow the bank to issue new ERNs to raise the cash needed for the same size repurchase. The combination of the payment in shares, ERNs sale, and equity repurchase would then leave the bank with fewer shares outstanding, and

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<sup>11</sup> Even absent this repurchase option, note that ERN conversions create only gradual dilution (see section 2.2), so any concerns may be exaggerated: in 2007-9 banks raised hundreds of billions of new equity without managements being replaced (Acharya et al.,2012), and some managements that were slower to raise adequate equity (e.g., Citigroup, Lehman Bros) fared *less* well than others. Government bailouts, by contrast, *did* generally lead to changes in management.

<sup>12</sup> Note that such a repurchase is not possible with conventional cocos, since converting principal all at once may create little or no immediate cash savings relative to the amount of equity created. If the share price jumped between the time of the conversion and the completion of the buyback old shareholders might *ex post* suffer a dilution loss, but this jump should not put managers at risk.

more total risk capital, than if it had been financed with traditional debt. And because of the bank's depressed share price, the new ERNs would have considerable seniority over existing ERNs, so their issuance should be relatively easy and leave shareholders even better off.

#### *4.2 ERNs remove incentives to manipulate regulatory measures*

Because ERNs convert based on share prices, their existence creates no pressure on banks or regulators to relax regulatory capital standards, including asset valuations and risk models. By contrast, the value of securities that convert based on regulatory capital levels are, in times of stress, highly dependent on regulatory accounting, which was subject to much manipulation and political pressure during the crisis. Bulow and Klemperer (2013, Sec. 2a) give many examples of the distortions that these pressures cause.

#### *4.3 ERNs are easier to price and securitise than securities with regulatory-based triggers*

ERNs are equivalent to sequences of riskless zero-coupon bonds less simple European put options (and also to forward contracts to deliver equity less call options)—see note 1 and Appendix A. Capital markets have 40 years of experience in pricing and hedging such securities. By contrast, the conditions under which securities with regulatory triggers convert are opaque and manipulable. Moreover, these securities also suffer a discontinuous “cliff” loss when they convert, so are much harder to hedge (see, e.g., Damodaran, 2014).

For the same reasons, the securitization of ERNs (pooling and tranching to create claims that final investors might prefer to those generated by outright ownership of ERNs) is much more straightforward than for conventional cocos.

Likewise, securitization also seems much easier for ERNs than for either conventional unsecured debt (whose property rights in bankruptcy are at the mercy of judges, regulators, and politicians) or other commonly securitised loans such as mortgages and receivables (which are much more subject to gaming).

#### 4.4 ERN Conversions Stabilise Share Prices and Fight “Downward Spirals”

A 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.<sup>13</sup>

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<sup>13</sup> ERNholders who wished to “delta” hedge their risk (that is, dynamically hedge their ERN risk by selling short stock) would have to sell more and more shares (or buy more and more puts) as the bank’s value declines, and by the date of any conversion must have sold the number the number of new shares that will be created at conversion. Since (under standard assumptions) including ERNs in the capital structure has zero effect on the total risk of the firm, this could only create a problem if the bondholders want to get rid of the risk they have “gained” while the shareholders are unwilling to re-acquire the risk they have “lost”, although uncertainty about the extent of hedging might somewhat increase price volatility (see Grossman, 1987). This seems unlikely to be a significant concern, especially if (as we would anticipate) different issues of ERNs are issued at different conversion prices: at share prices where junior ERNs would be in the money, more senior ERNs would not be, so as the bank’s stock falls, any additional downward pressure on the bank’s share price might be fairly constant rather than “accelerating”.

A further concern is that the world may not behave according to standard finance models (Modigliani-Miller, Arrow-Debreu, etc.). However, even if for some reason investors gave a bank a lower total valuation if it converted an ERN payment, it would *not* follow that this would lower the *share* price and risk causing more conversions: even if transferring losses from shareholders to bondholders may help share prices less than it hurts bondholders, it seems unlikely that share prices would actually be hurt because of this transfer of risk.<sup>14</sup> Furthermore, ERNs seem particularly well-suited to securitization (see Section 4.3) so valuation arbitrage should inexpensively re-allocate ERN-risk among investors to maximise 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, as discussed in section 4.1, simply use its savings to buy back any newly issued stock while leaving shareholders with a profit.

We discuss these issues further 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 lower share price makes it harder to raise new finance, but with ERNs a lower share price facilitates the raising of new funds, as we have explained.<sup>15</sup>

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<sup>14</sup> 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. However, these effects are small. 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%. Furthermore, an ERN conversion does *not* increase the amount of risk available for investors to hold—it merely repackages that risk into more shares.

<sup>15</sup> ERNs also conserve capital, and so reduce the need to raise new funds and reassure creditors who might be reluctant to roll over debt if they were concerned that the bank might go bankrupt.



#### 4.5 ERNs avoid market conversion problems of manipulation

Sundaresen and Wang (2010) pointed out a significant problem with cocos in which *principal* that is not currently due converts based on market prices, even if the shares that are issued in a conversion are priced at the trigger price. The difficulty is that the bondholder has the downside if the share price falls below the cocos' conversion price prior to conversion, but has none of the upside. For example, say the conversion price is \$25, but the shares are currently selling at \$26. Then 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 (unlike the no-conversion case) it now gets to share in any gains that might occur if the stock rises in price before the bond maturity date. So conversion hurts shareholders (who now have to share more of the upside), and therefore justifies a lower share price. This "multiple equilibria" problem means that either share price manipulation, or a small decline in intrinsic value that causes a "leap" from the no-conversion to the conversion case, can cause a steep decline in share price.

ERNs do not have this problem because *only currently-due payments convert*. So the incentive for early conversion no longer exists.<sup>16</sup>

Another common concern about cocos with market triggers is manipulation to artificially push the share price below the trigger price so that a payment is made in shares. But with ERNs, the bank could then (with regulatory approval) repurchase the new shares issued for less cash than the conversion saved, leaving shareholders unambiguously better off than absent conversion, as discussed above.

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<sup>16</sup> A tiny multiple equilibria problem might remain because a conversion reduces the value of stock by reducing the debt/equity ratio, so can increase the value of the remaining outstanding ERNs, and therefore decrease the value of shares. Because ERNs convert gradually and at different prices, this problem should be small, and is also easily resolved by the bank using part of the cash saved by the conversion to repurchase shares (see section 4.1).

An opposite concern is manipulation to push the share price *up* above the trigger price by ERNholders who would prefer to receive 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.

## 5. Regulatory Accounting

ERNs respond to the concerns about cocos raised in the Basel Committee on Banking Supervision (2011) report. Nevertheless, ERNs would probably be classified similarly to cocos under current rules.<sup>17</sup> A potential problem for ERNs fitting into the current regulatory framework is that their payment-at-a-time conversions are designed to ensure that banks have adequate *economic* capital, while the existing rules are focused on providing *regulatory* capital which is facilitated by early conversion of principal even though there is no economic reason for it.

As a practical matter, requirements to hold common equity seem unlikely to fall, so our proposal is that ERNs qualify to meet any increases in capital requirements. That is, we would like to see ERNs that meet the mild maturity requirements outlined in section 6.1 classified as “Additional Tier 1 capital” along with perpetual non-cumulative preferred stock. (This would also qualify ERNs as part of the Financial Stability Board’s “TLAC”, or Total Loss Absorbing Capital—see Financial Stability Board, 2014.)

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<sup>17</sup> So perpetual ERNs might count as “Additional Tier 1 capital”, and the portion of ERNs that come due after 5 years might count as Tier 2 capital, if regulators accept that ERNs are at least as likely as “high trigger” cocos to convert prior to any bankruptcy. The Basel Committee on Banking Supervision (2013) proposed that globally systemically important banks (G-SIBs) be required to meet their higher loss absorbency requirements with Common Equity Tier 1 capital only, but that cocos should continue to be reviewed, and be used for meeting higher national capital requirements.

For example, if equity requirements were 7% and total risk capital requirements were raised to 20%, our recommendation would be that banks be permitted to use ERNs to satisfy the 13% increase, regardless of how ERNs were classified. That is, the 20% requirement would mean that a bank's non-ERN debt could not exceed 80% of its assets, and its ERNs plus its non-ERN debt could not exceed 93% of its assets (everything accounted for, as now, at regulatory values). We would also want to give regulators the flexibility to permit a bank to issue ERNs in lieu of equity in times of stress.<sup>18</sup>

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

Most important is the simple point that ERNs 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.

Second, ERNs are equivalent to a sequence of promised payments in stock offset by the bank owning a sequence of warrants to repurchase its shares (see section 1 and Appendix A). Since issuing ERNs therefore corresponds to issuing shares except that the bank also has rights to repurchase them, ERNs surely merit equity treatment.<sup>19</sup> (Exercising the "repurchase" rights, i.e., making a payment in cash rather than in shares, would reduce capital the same way that ordinary dividends and share repurchases reduce capital.)

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<sup>18</sup> That is, regulators could relax the 93% requirement. In times of stress, issuing ERNs is much less costly to shareholders than issuing equity, for the debt-overhang reasons explained above. But—as 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).

<sup>19</sup> An ERN can also be thought of as 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.

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.)

## 6. Other Issues

### 6.1 Maturity Rules

Because ERNs convert into equity whenever needed maturity requirements need not be as restrictive as those currently proposed for Additional Tier 1 or even Tier 2 capital but, to ensure our counter-cyclical feature, we prefer to avoid a situation in which new ERNs might be legally senior, but effectively junior, to old ones which mature sooner. So we might require, for example, that no more than 15% of all remaining ERNs will be scheduled to come due in any future 6 month period, assuming no further issuance or repurchases.<sup>20</sup> This ensures 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 then unambiguously senior.

### 6.2 Regulatory Choice of Percentage that Triggers Conversion

The exact percentage of the share price at issuance that determines the trigger price for ERN conversion is less important than that there be a fixed minimum percentage, so that ERNholders are assured that they will be senior to any new ERNs issued after a share price

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<sup>20</sup> Such a rule would also implicitly specify a minimum duration of ERN debt (the specific rule suggested in the text would imply a minimum duration of about 3 years), but a higher minimum duration could be specified independently. *De minimis* exceptions would be permitted and unencumbered liquid assets could offset any future payment obligation, but buy-backs would be constrained by the requirement to stay within the maturity rule.

increase and that the relative seniority of new ERNs issued in bad times will be strictly limited by the share price decline.

We therefore suggest regulators fix a *minimum* percentage. Banks could issue ERNs with higher conversion prices if they thought these were more attractive to investors, or in order to create securities that convert at a more dispersed set of prices. However, we would expect banks to choose the minimum in most cases to make the ERNs as much like conventional debt as possible (and so also minimise the interest rate that must be paid and maximise any transfer from existing ERNholders).

On the one hand, a very low minimum percentage, say 5% which would give ERNholders 20 times the shares of equity investors who put up the same money at the same time could mean that a single large payment in shares would produce a significant change in the voting control of the bank, possibly leading to lobbying to stop conversions, and conceivably even encouraging short-selling by bondholders to acquire control. Furthermore, a higher percentage means there will be some conversions prior to any period of general distress, which will demonstrate and test the system, and build credibility before any wide-spread conversions are required.

On the other hand, a higher percentage makes ERNs more equity-like, which might reduce their appeal to some of the target clientele.

We suggest a 25% minimum might be a reasonable compromise; the evidence from the crisis (see Section 8) suggests this would make conversion unlikely but not impossible.

### *6.3 Dilution*

An important feature of ERNs is that a bank that performs badly can issue new ERNs that dilute the value of the outstanding ERN issues. But banks cannot simply issue progressively more senior ERNs; new ERNs' seniority is limited if the share price falls (see previous subsection), and new ERNs must be junior if the share price rises. Furthermore, although ERNs lose from

potential dilution in these bad states, they also gain in the same states from the enhanced ability of the bank to raise new funds. Moreover, they gain in very-bad states from the avoidance of the transaction costs of reorganisation and/or bankruptcy costs that conventional debt incurs.<sup>21</sup>

#### *6.4 Gambles for Resurrection*

ERNs mitigate the incentive for an economically stressed bank to “gamble for resurrection”, that is, to take risks to try to restore its finances, leaving the taxpayer with the loss if it fails.

In the recent crisis, “gambling for resurrection” primarily involved banks’ responding to regulatory incentives to mis-mark and retain old “toxic”, under-collateralised, assets which are riskier than well-collateralised assets.<sup>22</sup> ERNs reduce these incentives by converting on market rather than regulatory measures, thus reducing the importance of regulatory accounting and regulatory capital calculations in determining the amount of debt a bank can incur. Gambling for resurrection did *not* occur in the form of banks making too many new risky loans in the crisis. In fact, the concern was that banks did not take on enough of these risks. As we explained in Section 3, more new risky investments would have required stressed banks to raise more equity, which was a very unattractive option for them. So the fact that ERNs make it somewhat

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<sup>21</sup> Investors’ anticipation of these incentives (and those discussed in the next subsection) obviously affects the price at which ERNs can originally be sold, and the stochastic processes that a bank’s share price and total value follow, but the formulae of Appendix A (and note 1) are unaffected. See also Appendix B.

<sup>22</sup> For example, if a loan asset marked at 100 has a risk weight such that its regulatory capital requirement is 10, its sale at 50, and the investment of the proceeds in cash, would require the bank to raise an additional 40 in equity even though the bank’s economic risk would be reduced. In one of the rare cases where toxic assets were sold, Merrill Lynch’s sale of risky mortgage securities that it had marked at \$11.1 billion to Lone Star for \$6.7 billion (and lending Lone Star ¾ of the price on a non-recourse basis) had to be booked as a reduction in regulatory capital, and Merrill simultaneously announced a capital raise. See Keoun and Harper (2008). Commercial banks had greater mis-marks, and therefore even less incentive to sell, than investment banks like Merrill. See Goldman Sachs (2008).

easier to raise funds in bad times for new projects with lower expected returns *is a feature, not a bug*.

Moreover, when a bank already has large losses, so has the greatest incentive to take long-shot bets with low expected returns (just as if it were a conventionally-financed firm), the interests of shareholders and existing ERNholders are almost fully aligned (since existing ERNs will almost certainly be converted). And, as we discuss in Section 7, if all conventional unsecured debt were replaced by ERNs, then all risk would remain in the private sector and the problem of banks gambling with taxpayers' money would be fully eliminated.<sup>23</sup>

### 6.5 Tax and Other Issues

It is likely that ERNs as currently designed would be treated as equity for tax purposes. Our preference would be for a tax system that did not discriminate between equity, ERNs, and other debt. (One example of such a system might be the Allowance for Corporate Equity (ACE) system that has been used in Belgium. Tax deductions could be set as a fraction of the bank's assets rather than as the amount of interest paid.) But, as a practical matter, if ERNs are to be treated like cocos rather than like equity for regulatory capital purposes, they will need their interest payments to be deductible to encourage banks to issue them. So it may be necessary to modify ERNs' design to meet tax requirements for being considered debt.

One possibility, which would also help investors who faced legal constraints against holding equity, would be to allow an ERNholder who would otherwise receive shares to opt instead to receive a zero-interest ERN with the same conversion terms as in the original bond and, say, a six-month term. (Such rollovers only help shareholders, since an unconstrained investor would

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<sup>23</sup> ERNholders do not have voting rights (except to the extent that they have received payments in shares). However, banks can always replace ERNs with equity to avoid any conflicts of interest between their owners. If taxpayers are not at risk either way, it seems sense for regulators to stay out of this decision.

always prefer to accept a conversion and sell the shares received than to take the rollover.) Allowing a security that has been rolled over enough times (e.g., for 99 years) to require cash repayment might help qualify ERNs as debt rather than equity for regulatory and tax purposes. However, we claim no expertise in this area. Our main point is that it may be possible to work around institutional roadblocks to our original design, without much affecting the underlying economics.

## **7. 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 cocos, ERNs 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-cyclical 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 (i) the recourse of secured debt holders is limited to the value of their collateral plus equity or ERNs (or other securities that



credibly leave risk with the private sector)--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, and (ii) ERNs replace all unsecured debt, with deposits either becoming money market accounts, with only accounts holding government securities being fully insured, or being ring-fenced in subsidiaries that only hold a narrow set of highly liquid assets as collateral—this would change the government from effectively being an unsecured lender/guarantor to the banks (although it theoretically manages its risk through complex capital requirements) to being a secured creditor, with its exposure limited to the difference between the value of collateral and the amount lent. (The central bank would retain the right to change both the haircuts it applied and the breadth of the collateral it accepted in times of stress.)

In a transitional phase deposits could be collateralised by a much wider set of assets in the ring-fence, with regulatory capital requirements based on applying market haircuts, or at least central bank haircuts, for the assets held in the subsidiaries.<sup>24</sup> 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 1.

## INSERT FIGURE 1 HERE

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<sup>24</sup> That is, if standard market haircuts for secured borrowing against an asset held in the subsidiary were 20%, then the regulatory capital requirement for that asset should also be 20%. 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. Bulow and Klemperer (2009) offered a proposal for handling failure of conventionally-capitalised banks (related to regulators' more-recent proposals for “single point of entry” resolution of failing banks).

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;<sup>25</sup>
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 1), with capital requirements similar to those the private market, or at least central banks, apply when lending against similar assets;
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. (In particular, “gambling for resurrection” in the form of banks taking excessive risks to benefit shareholders at the expense of taxpayers would cease to exist.) So although banks may still be risky and—just as now—there may be conflicts of interest between capital classes,<sup>26</sup> there would be no need for most of the detailed regulatory capital rules we have today. Banks could therefore be regulated much like non-financial firms; although our reform program may superficially seem complex, it actually reduces complexity by greatly simplifying regulators' problems.

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<sup>25</sup> Smaller banks, because they would be allowed to fail, would not be required to issue ERNs (or to implement step 3), but they would in steps 4 and 5 be required to fund deposits with equity plus unsecured long-term debt satisfying capital requirements similar to those that SIFIs would be required to satisfy for funding deposits with equity and ERNs.

<sup>26</sup> Replacing conventional debt by ERNs increases conflict between equity holders and bondholders when losses are small, because ERN value will be more sensitive to the bank's risk, but better aligns interests when losses are large and ERNs become more equity-like. Substituting ERNs for either conventional debt or equity also has ambiguous implications for the toughness of disciplining management.

Furthermore, because lighter regulation combined with private responsibility for losses would mean that the constraints on banks' ability to raise capital would be more like the constraints that banks themselves impose on their borrowers, assets and capital market functions would be more efficiently allocated. Regulatory arbitrage, where assets migrate between banks and "shadow banks" to take advantage of different regulatory requirements, or where accounting is manipulated to minimise requirements, would largely be ended.

Our system clearly relies heavily on markets to determine how much borrowing (other than ERNs) banks' assets can support.<sup>27</sup> Many commentators argue--in spite of evidence from the recent crisis, such as that in Haldane (2011, 2013)<sup>28</sup>--that debt capacity is better determined by regulatory values, risk weights, and the calculations of internal models. But when regulatory values significantly exceed market values, or regulatory capital charges are less than market haircuts, the current regulatory system forces taxpayers to provide cheap insurance against the risk that the market is right. Regardless of one's faith in markets, our argument is that this risk should reside with the bank's investors.

After our program, banks would *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". Wholesale lenders would all have secured debt, and with no possibility of bankruptcy they would have no incentive not to renew a loan made against adequate collateral. And ERNs' encouragement of countercyclical investment would help the economy recover in bad times.

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<sup>27</sup> In our system, if the market will lend 50 against an asset we need not distinguish between whether the market value is 100 and the market haircut is 50, or whether the value is 60 and the haircut is 10. This differs from the current regulatory system in which asset values and risk weights are determined separately and then combined. A decline in market price may not reduce an asset's value as collateral. For example, if an asset will be worth either  $L$  or  $H$ ,  $L < H$ , a change in market sentiment that puts more weight on  $L$  would reduce the asset's price but not the amount that can be safely lent against it.

<sup>28</sup> See especially Figs. 5 and 6 in Haldane (2011), and the discussion of distortions of risk weights in Haldane (2013).

## 8. How would ERNs have worked in the Crisis?

We do not know how the path of stock prices would have differed from the one followed in 2008-9 if banks' (conventional) debt had all been in the form of ERNs, but 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-capitalised major U.S. banks---J.P. Morgan, Wells Fargo, and Goldman Sachs---closed at less than 25% 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%. Simple calculations<sup>29</sup> suggest that Citi might have increased its share count by 35% in late 2008, another 80% of the initial share count in the first quarter of 2009, and smaller amounts in several subsequent quarters. Eventual dilution might have been around 50% greater than the factor of six dilution that shareholders actually suffered. However, ERNs' payment-at-a-time conversion would have meant that Morgan Stanley, which recovered more quickly than the others, would have had to issue considerably fewer shares.

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,

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<sup>29</sup> These calculations depend on many significant assumptions, so are strictly illustrative. For each bank we assumed a constant amount of ERNs outstanding per share of early 2008 stock; these amounts were based on the banks' long term debt in 2008 (\$150 per share for Morgan Stanley, \$85 for Citibank, £10 for Lloyd's). We assumed all debt was scheduled to be repaid at a rate of 2% of the remaining balance per month, an interest rate on new debt of ½% per month, and all debt to be issued (and come due) on the first day of the new month. We ignore the fact that the possibility of conversions (and conversions themselves at above-market prices) would boost stock prices--an important feature for banks that struggle, and one that would reduce ERNholder losses. But we also ignore the impact of the reduced prospect of a government bailout on share prices. See the online documentation, or [www.nuff.ox.ac.uk/users/klemperer/ERNdocumentation.pdf](http://www.nuff.ox.ac.uk/users/klemperer/ERNdocumentation.pdf), for more details.

since it traded below 25% of its all-time peak for six months from late October, 2008 (and again later). HBOS was taken over by Lloyd's at a price close to 25% of its peak, and weak banks RBS and Lloyd's traded far below 25% of their peak prices from October 2008 through the end of 2012—Lloyds might have had to issue new shares numbering around 40-50% of its initial share count each quarter through most of 2009-12, with a likely total dilution approaching that of Citibank's.

The greater the volume of ERNs, the more new shares would have been issued and the more risk would have been retained by private investors as asset prices fell. Policy could have been focused on stimulating the real economy instead of on bailing out the banks.

## 9. 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.<sup>30</sup> 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 is alleviated by selling ERNs instead (even if

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<sup>30</sup> 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).

the bank has no old ERNs outstanding), and because the seniority of new ERNs over old ones incentivises the issuance of ERNs in bad times (even absent asymmetric information). So in a crisis shareholders should welcome the option to sell ERNs. By contrast, the active regulation required to force bank recapitalisations with equity rights-offerings against shareholder opposition seems neither credible, for similar reasons to those we discussed in Section 2.1, nor efficient, as they discourage new investment.<sup>31, 32</sup>

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

These advantages of ERNs *cannot* be obtained when banks' capital consists only of traditional debt and equity, even if regulators can force rights-offerings. The reason is that 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 ERNs riskier. Obtaining the same countercyclical effect in a traditional capital structure would require making traditional debt riskier—which would increase the probability of the bank failing completely.

Furthermore, ERNs permit agnosticism on whether there are in fact efficiency costs of equity, as many practitioners (and also many economists) claim.<sup>33</sup> Although ERNs are always equity in the

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<sup>31</sup> 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. (Recall the difficulty European regulators have had requiring banks that were heavily dependent on taxpayer support to raise new capital in 2008-14.) Moreover, signalling concerns can lead to inefficient behaviour, including avoiding making new loans, to avoid rights offerings.

<sup>32</sup> It is easier for regulators to halt dividend payouts, but doing this raises no new cash and creates signalling problems, by contrast with ERNs which halt cash payments automatically. Cash payments would have been eliminated earlier with ERNs than with equity in many cases in the crisis. For example, Citigroup did not declare a (near) elimination of its cash dividend until its stock had fallen 94% from its peak.

<sup>33</sup> 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

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.<sup>34</sup> 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.<sup>35</sup>

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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. But Baker and Wurgler (2013, abstract) find “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” in their estimate of pre-tax cost of capital, and other empirical studies they cite also find that holding more equity significantly increases the cost of capital. Moreover, 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.

<sup>34</sup> 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.

<sup>35</sup> Appendix B 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.

## 10. 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 7, above. Although superficially more complex than adding equity within the current system, the programme actually reduces complexity by greatly simplifying regulators' problems.

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.

Moreover, we recommend permitting future required increases in bank capital to be in the form of *either* equity *or* ERNs. 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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## Appendix A: Valuing ERNs in terms of Calls or Puts on the Bank<sup>36</sup>

Consider a one-period model of a bank that has issued common stock,  $N$  outstanding issues of ERNs, and no conventional debt.<sup>37</sup> ERN issue  $K$  has a face value of  $D_K$  and is convertible into  $S_K$  shares, that is, at a price of  $D_K/S_K$ ,  $K = 1, \dots, N$ . The bank has  $S_0$  shares outstanding, and we define  $D_0 \equiv \infty$ . We assume  $D_K/S_K > D_{K+1}/S_{K+1}$  for all  $K$ , so ERN 1 has the highest conversion price and so is the most junior.<sup>38</sup> Let the terminal value of ERN  $K$  when the value of the bank is  $V$  be  $V_K(V)$ , and the terminal value of equity be  $V_0(V)$ . Let the values of a (European) call option to buy the bank, and of a (European) put option to sell the bank, at a price of  $X$  when the current value is  $V$  be  $C(X)$  and  $P(X)$ , respectively (suppressing the dependence on  $V$ ). Lastly, let  $X_K$  be the value of  $V$  at or below which ERN  $K$  will be converted.

Each ERN converts precisely when this increases the value of the shares so (although conversion is, in fact, mechanical) we can *think* of conversion as being chosen to maximise the bank's share price, which is equal to the value of the bank, less debt paid in cash, divided by shares outstanding, so the number of issues converting is  $\operatorname{argmax}_j \left[ \frac{1}{\sum_{i=0}^{i=j} S_i} (V - \sum_{i=j+1}^{i=N} D_i) \right]$ . So the payoff to the owners of ERN  $K$  is the minimum of the face value,  $D_K$ , and the value of  $S_K$  shares, that is,

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

At the value of the bank,  $X_K$ , at which ERN  $K$  will convert, the share price will equal  $\frac{1}{\sum_{i=0}^{i=K} S_i} (X_K - \sum_{i=K+1}^{i=N} D_i)$ , and will also equal  $D_K/S_K$  since other investors are indifferent to paying off ERN  $K$  in cash or shares. So

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<sup>36</sup> Note 1 gives simple formulae for valuing an ERN in terms of calls or puts on the bank's *shares*.

<sup>37</sup> In this one-period model, banks' investment decisions are given. In a more general model, the pricing of any contingent claim, including ERNs, equity, and conventional risky debt, is more complex, because first-period outcomes will influence banks' subsequent choices about risk taking and capital structure. See Appendix B.

<sup>38</sup> Ordinary (unsecured) debt with varying (absolute) seniority corresponds to the limit  $(D_{K+1}/S_{K+1})/(D_K/S_K) \rightarrow 0$  for all  $K$ .

$$X_K = \frac{D_K}{S_K} \sum_{i=0}^{i=K} S_i + \sum_{i=K+1}^{i=N} D_i \quad (\text{A.2})^{39}$$

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

Equations (A.1) and (A.2) allow us to write  $V_K$  either as a share of the bank's value when all ERNs are converted, plus and minus a set of call options, or alternatively as a fixed claim minus and plus a set of puts.

$$\text{For calls,} \quad V_K(V) = S_K \left[ \frac{V}{\sum_{i=0}^{i=N} S_i} + \sum_{j=K+1}^{j=N} \frac{S_j C(X_j)}{\sum_{i=0}^{i=j} S_i \sum_{i=0}^{i=j-1} S_i} - \frac{C(X_K)}{\sum_{i=0}^{i=K} S_i} \right] \quad (\text{A.3})^{40}$$

<sup>39</sup> See Bulow and Klemperer (2013, Appx. 2) for an alternative derivation of this equation.

<sup>40</sup> 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 owner of ERN 3 effectively own  $\frac{S_3}{\sum_{j=0}^{j=3} S_j}$  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 ERN 3 is worth  $V_3(V) = \frac{S_3}{\sum_{j=0}^{j=3} S_j} [V - C(X_3)]$ . ERN 2 also owns a share of the bank in the lowest states, increased in states in which ERN 3 but not ERN 2 is paid in full, and bought out in better states. More precisely, ERN 2 is worth  $\frac{S_2}{\sum_{j=0}^{j=3} S_j}$  of the bank plus the right to increase that share to  $\frac{S_2}{\sum_{j=0}^{j=2} S_j}$  by buying out ERN 3's share when the 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 ERN 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, ERN 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 (A.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  $V$ .

So in our numerical example the second ERN can be characterised as owning a 30% share in the bank if the value is less than 2000, plus a call option to buy another 30% at a valuation of 2000 (at which price the most senior ERN, ERN 3, is paid in full and its half ownership at the lowest values is effectively bought out by the holders of equity, ERN 1 and ERN 2), minus a call option for 60% at a valuation of 3500, at which value ERN 2 is paid in full (so does not share in further appreciation). The value of the ERN increases as a function of  $V$  with a slope of 0.3 when  $2000 \geq V \geq 0$ , then a slope of 0.6 for  $3500 \geq V > 2000$ , and then equals 1500 for  $V \geq 3500$ .

For puts, 
$$V_K(V) = D_K + S_K \left[ \sum_{j=K+1}^{j=N} \frac{S_j P(X_j)}{\sum_{i=0}^{i=j} S_i \sum_{i=0}^{i=j-1} S_i} - \frac{P(X_K)}{\sum_{i=0}^{i=K} S_i} \right] \quad (\text{A.4})^{41}$$

So in our example, ERN 2 can also be described as the combination of a riskless security worth 1500, short a put option requiring the ERNholder to purchase 60% of the bank at a valuation of 3500, so take 60% of the loss as  $V$  falls below 3500, plus a put option allowing the ERNholder to sell 30% of the bank to the senior (third) ERNholder at a valuation of 2000. This describes the value of the ERN as 1500 when  $V \geq 3500$ , declining at a slope of 0.6 until it reaches a value of 600 when  $V = 2000$ , and declining at a slope of 0.3 thereafter until  $V = 0$ .

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<sup>41</sup> This formula can be developed by a parallel argument to that for equation (A.3), starting by computing first  $V_N(V)$ , then  $V_{N-1}(V)$ , etc., so, for example, the most senior ERN is worth  $D_N$  minus the value of the right of the other stakeholders to put shares to it. Or, of course, equation (A.4) can be developed directly from equation (A.3) by using put-call parity:  $V + P(X) = X + C(X)$ ,  $\forall X$ .

For example, with  $N=3$ , the value of ERN 3 is  $D_3 - \frac{S_3}{\sum_{j=0}^{j=3} S_j} P(X_3)$ ;

the value of ERN 2 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 ERN 1 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.)

## Appendix B: Bond Yields and Capital Structure

A 25% ERN is the equivalent of a riskless bond minus four put options at 25% 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 annualised dividend equal to 3% of value, the riskless rate is 1% and the annualised volatility (sigma) of the stock price is 40%, then the value of the relevant European put options is  $4 \times \$1.27$ , or a little over 100 basis points per year, using the Black-Scholes formula.<sup>42</sup> For a three-year payment the Black-Scholes price is  $4 \times \$0.33$ , or 44 basis points per year.

This calculation is, of course, incomplete. In particular, as we have emphasised, the ability (and positive incentive) 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 ERNs. Their costs 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,<sup>43</sup> and banks' ability to raise new capital.

Note also that a bank can always add some equity to its capital structure to make its ERNs 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.<sup>44</sup>

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<sup>42</sup> 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.

<sup>43</sup> Replacing conventional debt with ERNs of course reduces the volatility of the equity (see Section 4.4).

<sup>44</sup> 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. See Bulow and Klemperer (2013 Sec. 5(a)) for how a bank can issue ERNs and new equity so

## Appendix C: Proof, and Additional Intuition, for Proposition 1

*Proof:* For simplicity, assume all payoffs are at a single time. Since the new ERN has a lower conversion price,  $p_c$ , 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,  $p_t$ , is below  $p_c$ . So conditional on  $p_t \leq p_c$ , 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  $p_t > p_c$ , assuming the new ERNs are sold for fair value. But all the old ERNs’ conversion prices are above  $p_c$  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  $p_t > p_c$  equity’s share of the total returns begins at its share of the increased losses imposed on old securities by the new investment when  $p_t < p_c$  and then rises as returns increase. So equity gets a higher share of the gains when  $p_t > p_c$  than it takes of the equal (expected) losses when  $p_t < p_c$  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.*<sup>45</sup>

A way to understand the intuition is that for a bank consisting only of equity and ERNs :

(1) Making a zero-NPV investment that increases returns proportionally in all states, and is

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that the payoff from the ERNs replicates the payoff of conventional debt (and investors can replicate old equity by buying the new equity and selling some ERNs), and for further detail.

<sup>45</sup> For equity to *strictly* gain, and existing ERNs to *strictly* lose in aggregate, we require, of course, that the distribution of bank returns is such that some existing ERN has a nonzero probability of conversion.

Note also that 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, 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 lose in “low-return” states (because the investment is zero NPV) the previously-most-senior ERNs lose overall. Whether more junior previously-issued ERNs gain or lose depends on whether they are effectively more like equity, or more like the previously-most-senior ERNs.

Proposition 1 can also be proved by working directly with Appendix A’s formula for equity holders’ expected value—see [www.nuff.ox.ac.uk/users/klempere/ERNdocumentation.pdf](http://www.nuff.ox.ac.uk/users/klempere/ERNdocumentation.pdf).



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.

Proposition 1’s result extends trivially to a capital structure of equity, ERNs, and riskless debt.

#### **Appendix D: Effect of ERNs on Debt Overhang**

Let the value of a bank at time  $t=1$  be  $V$ , and its value at  $t=2$ , after all uncertainty is resolved, be  $\theta V$ , in which  $\theta$  has an (atomless) density function  $f(\theta)$ . For simplicity, assume investors are risk-neutral and that there is no discounting, so  $\int_0^\infty \theta f(\theta) d\theta = 1$ . Write the number of shares outstanding after any conversion (at  $t=2$ ) as  $S(\theta)$ , assuming there are no new ERN issues (so the number of shares outstanding at  $t=1$  is  $S(\infty)$ ).

Now 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  $\theta mx$ . These ERNs convert into  $x/p$  shares, whenever  $\theta \leq \hat{\theta}$ , where  $\hat{\theta}(V + mx) = [S(0) + (x/p)]p$ . So, as a fraction of their face value, the new ERNs’ return is  $e(\theta) = \min[(\theta/\hat{\theta}), 1]$ , and their market value is  $m = \int_0^\infty e(\theta) f(\theta) d\theta$ . The gain to shareholders from a small new investment, as a fraction of the face value of the new ERN issued to finance it, can be divided into the shareholders’ share of the additional returns,  $[S(\infty)/S(\theta)]m\theta$ , less their share of the payment to the new ERNholder,  $[S(\infty)/S(\theta)]e(\theta)$ , plus the effect of any transfer between the existing shareholders and ERNholders due to changes in which old ERN issues convert. But if the new investment,  $x$ , is small, the changes in the critical values of  $\theta$  are also small. So the probability of a change in any particular ERN issue converting is small. Furthermore, the redistribution in value resulting from any marginal conversion is also small, so the expectation of this transfer is of second-order in  $x$ . So as  $x \rightarrow 0$ , the total expected return to equity, as a

fraction of the new ERNs' face value, is the sum of the first two effects, that is,  $\int_0^\infty \frac{S(\infty)}{S(\theta)} [m\theta - e(\theta)]f(\theta)d\theta$ . Moreover, as  $x \rightarrow 0$ ,  $\hat{\theta} \rightarrow pS(0)/V$ .<sup>46</sup>

For example, let the bank have one share, and a single 25% ERN issue with a nominal value of  $0.8V$ , and therefore a conversion price of  $0.2V$ , outstanding at  $t=1$ . Then  $S(\theta)=5$  for  $\theta < 1$ , and  $S(\theta)=1$  for  $\theta \geq 1$ . (That is, if no more investments were made and no more ERNs were issued, each ERN would convert into 4 shares at  $t=2$  if the value of the firm was then below  $V$ ; the shares would be worth exactly  $0.2V$  each if the firm's value was then  $V$ .) The initial share receives  $\theta V/5$  if  $\theta < 1$ , and  $\theta V - 0.8V$  otherwise. Let  $f(\theta)=1/2$  for  $\theta \leq 2$  (and  $f(\theta)=0$  for  $\theta > 2$ ), so it is easy to calculate that the share is worth  $0.4V$  at  $t=1$ . So the ERN was issued when the share price was twice its current level, and is now worth  $V - 0.4V = 0.6V$ , that is 60% of the value of the firm, at  $t=1$ , consistent with the example in Section 3 of the text. Also a new ERN issue at  $t=1$  will convert at  $p=0.1V$  and, if it is small,  $\hat{\theta} = 1/2$ , and for this  $f(\theta)$ ,  $m = 7/8$ . Evaluating the integral at the end of the previous paragraph, equity's total expected gain from a small sale of new ERNs (and the investment of the proceeds) is  $1/8$  of the ERNs' face value, hence  $(1/8)/m = 1/7$  of the proceeds. That is, the "reverse overhang" =  $1/7$ .

If a bank with the same return profile had conventional debt with a nominal value of  $0.735V$ , instead of the ERN issue, that debt would again be worth  $0.6V$ . In this case, using equity to finance a new investment,  $y$ , that yields  $\theta y$  means total returns are uniform on  $[0, \theta(V + y)]$ . Debt is then worth its nominal value, less an average of  $(0.735V/2)$  with probability  $0.735V/[2(V + y)]$ . Differentiating w.r.t.  $y$  shows that the value of debt increases, and therefore the value of equity falls, by  $0.135y$  for small  $y$ . So we have a "standard overhang" of  $0.135$ .

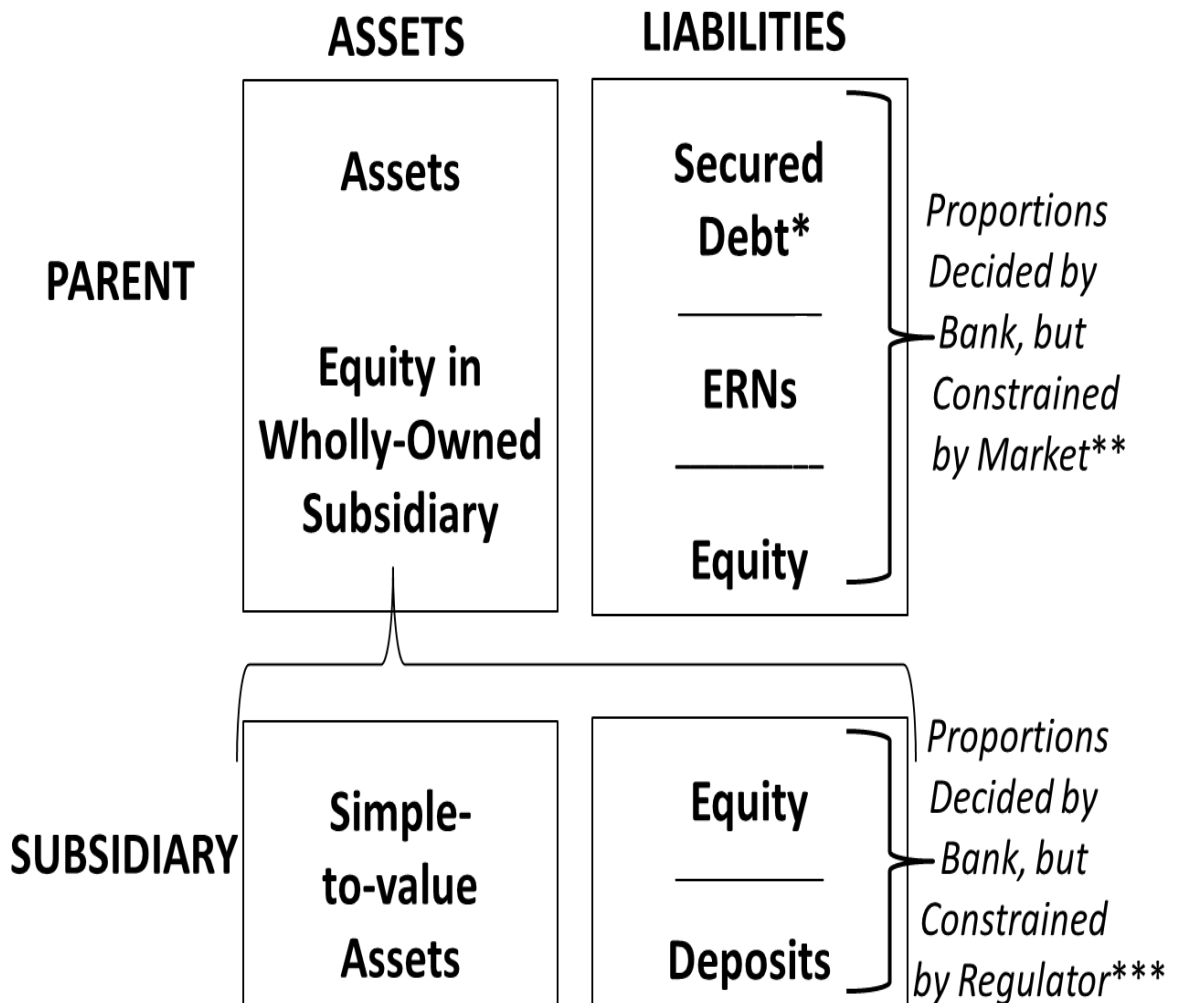
Bulow and Klemperer (2014, Appx. A5) analyses the debt-overhang effects of larger investments, including obtaining the other quantitative results in section 3. Bulow and Klemperer (2013, Appx. 2) uses the example we introduced in Appendix A to illustrate the effects of issuing new ERNs on the values of the shares and the existing ERN issues when there are multiple previous ERN issues.

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<sup>46</sup> These results can also be proved by working directly with Appendix A's formula for equity holders' expected value—see [www.nuff.ox.ac.uk/users/klemperer/ERNdocumentation.pdf](http://www.nuff.ox.ac.uk/users/klemperer/ERNdocumentation.pdf).



\*Creditors' recourse beyond collateral is 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 1**  
**Hypothetical Bank Balance Sheet with Large-Scale use of ERNs<sup>47</sup>**

<sup>47</sup> This figure ignores issues such as lines of credit and derivatives; Bulow and Klemperer (2013) discusses these issues.