Contingent Capital with a Dual Price Trigger[1]

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April 11, 2011
First draft: December 19, 2009

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Abstract

This paper evaluates a form of contingent capital for financial institutions that converts from debt to equity if two conditions are met: the firm's stock price is at or below a trigger value and the value of a financial institutions index is also at or below a trigger value. This structure potentially protects financial firms during a crisis, when all are performing badly, but during normal times permits a bank performing badly to go bankrupt. I discuss a number of issues associated with the design of a contingent capital claim, including susceptibility to manipulation, whether conversion should be for a fixed dollar amount of shares or a fixed number of shares; uniqueness of the share price when contingent capital is outstanding; the susceptibility of different contingent capital schemes to different kinds of errors (under and over-capitalization); and the losses likely to be incurred by shareholders upon the imposition of a requirement for contingent capital. I also present an illustrative pricing example.

The 2008 Financial Crisis illustrated the fragility of financial institutions and the difficulty of resolving the commitments of institutions in distress. A frequently discussed reform is to have banks issue claims that behave like debt during normal times and which convert to equity during a crisis. Such claims are variously referred to as "reverse convertibles" and "contingent capital".[1] Because these claims convert to equity, contingent capital is a buffer aginst default. Prominent examples of contingent capital proposals include Flannery (2009b), Squam Lake Working Group (2009), and Pennacchi et al. (2010). Contingent capital has been issued by Lloyd's Bank, (Ineke et al., 2009), Rabobank, and Credit Suisse.[2] Finally, contingent capital broadly defined is an important component of Basel III, which calls for all Tier 1 and Tier 2 instruments to be convertible into equity or written off.[3] In general, contingent capital is envisioned as an addition to equity capital, rather than a substitute for it.

Contingent capital proposals all envision debt relief for financial institutions during stressful times. Specific details of the proposals differ greatly, however. Important distinctions concern the details of conversion (into how many shares does the debt convert) and the conversion trigger (the specified event or events that contractually cause conversion). All proposals make im-

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[1]Contingent capital is usually discussed in the context of preventing failure in designated cirumstances. A variant on contingent capital is "bail-in capital" (Calello and Ervin, 2010), which is really an alternative to either traditional bankruptcy or a government bail-out. The idea is for regulators impose a restructuring of the bank when failure is imminent, eliminating debt claims or converting them to new equity. Basel III permits certain bail-in-type claims to count as capital (Basel Committee on Banking Supervision, 2011).

[2]In November 2009, Lloyd's swapped existing subordinated debt for £7.5 billion in bonds that would convert to equity if its Tier 1 capital ratio fell below 5%. Along similar lines, in March 2010, Rabobank isssued €1.25 in notes that would mature and pay 25% of face value if Tier 1 capital fell to 5%. In February 2011, Credit Suisse announced an agreement to issue approximately $6 billion in contingent notes that would convert if Basel III common equity fell below 7%. The conversion price would be based on the market price (a weighted average of market prices before conversion), with a floor. The coupon on the dollar-denominated portion was 9.5%

[3]See Basel Committee on Banking Supervision (2011). The stated trigger event for conversion is either (1) that a write-down of liabilities is necessary for viability,in which case lenders would at best receive shares or (2) that a government injection of capital will occur.

plicit or explicit assumptions about the behavior of regulators, accountants, managers, investors, and markets.

This paper discusses design goals for contingent capital, outlines some of the challenges in implementing contingent capital, and describes a claim that is a variant on the Flannery and Squam Lake proposals. The contingent capital claim that I describe, "dual trigger contingent capital", converts automatically based on market prices, without reference to accounting-based measures of capital and without the need for regulatory intervention. Specifically, it converts to equity when the bank's own stock price falls sufficiently, and then only if a broad financial stock index is also below a trigger value. This structure reduces the debt load for poorly-performing institutions when the institution and financial industry are performing poorly, but permits individual banks to fail in good times.

Any type of contingent capital will have relative advantages and disadvantages; I point out both the virtues and problems of the dual-trigger structure and use the dual trigger design to provide a specific reference point for the discussion. I conclude that virtually all proposed designs are replete with tradeoffs and that it will be difficult to implement a robust design.

The proposal in this paper explicitly and intentionally does not address either the problem of institutions being too-big-to-fail or too complicated to supervise. Contingent capital is only one tool in the regulatory toolbox, albeit a potentially important tool. Contingent capital cannot prevent flawed accounting, excessive risk-taking, duplicitous financial engineering, or fraud. It is simply a financial claim that reduces a firm's debt load when prespecified events occur. Regulators, on the other hand, are charged with proactively monitoring the management and performance of financial institutions. Contingent capital is thus a backstop for regulatory failures or unforseen market events, not a regulatory substitute.

In Section 1 I describe dual-trigger contingent capital in detail and in Section 2 I compare it to the Flannery and Squam Lake proposals. Explicit design goals are to keep the contingent security relatively simple and the likelihood of a conversion event transparent by basing conversion on market prices only. Simplicity and transparency should facilitate market acceptance

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and reduce the (appropriately-measured) cost to banks of issuing convertible claims. The use of market-based triggers, with no reliance on accounting numbers, means that conversion is unaffected by accounting rule reinterpretations or changes. Making conversion automatic and based only on market prices should reduce pressure on regulators and the accounting community at critical times. Also, private information of the firm and the regulator should have no bearing on the conversion decision.

A critical issue is the precise manner in which conversion occurs, and the possibility of stock price manipulation. In Section 3 I discuss a number of design considerations, including manipulation and multiple equilibria.

The fact that the dual-trigger structure permits banks to sometimes fail addresses the concern that contingent capital would blunt the incentive effects of debt. It is of course possible to set the index trigger so high that conversion would effectively depend only on the bank's own stock price. This is a policy choice: a single contingent capital claim with a conversion policy based only on market prices can be designed either to unconditionally reduce the probability of bankruptcy or to forestall bankruptcy only in times of systemic crisis.

I also discuss in Section 3 the possibility that contingent capital may increase a bank's capital when more capital is not required or fail to provide capital when it is required. I refer to the provision of excess capital as a "type I" error (by analogy with the same term in statistics, which refers to a false positive) or fail to provide capital when the bank requires it, which I call a "type II" error (in statistics, a false negative). Weighing the relative costs of type I and type II errors requires a theory of capital, but in general it seems likely that a type I error is much less costly than a type II error. I argue that the claim I propose seems likelier to err on the side of giving banks too much capital. Section 3 also discusses the tax deductiblity of an contingent claims and the cost for shareholders of requiring firms to issue contingent capital.

Section 4 contains pricing examples and Section 5 concludes.

1 An Example of Contingent Capital With Dual Market Triggers

In this section I describe dual trigger contingent capital, a security that is issued as a debt claim and that converts to equity based solely on market-based triggers. In Section 3 I will discuss some important practical concerns that would arise with this form of contingent debt.

Suppose that the stock price of the bank is $100 and the value at issuance of a broad financial firm index is also $100. The bank issues a 5-year, $1000 par value bond which under certain circumstances will convert into common equity. The bond will convert if two conditions are satisfied:

- The stock price of the bank, appropriately adjusted for splits and stock dividends, falls below $50 (the stock trigger)

- The value of the financial index falls below 90 (the index trigger).

If both conditions are satisfied, the debt will convert into 20 shares (the $1000 par value divided by the $50 trigger price). This conversion ratio of 20 shares per bond is specified at issue and does not change.[4] If neither condition is satisfied, the bond is a regular bond and is retired after 5 years. Presumably at that point it would be replaced by a similar contingent bond with newly set price triggers, but maturity would be an opportunity for regulators to explicitly reassess both current and contingent capital needs. If the stock price condition is satisfied, but the index condition is not, there is no conversion. In this case, if the bank defaults, bondholders are subordinated and receive recovery value for the bond, as with any other form of subordinated debt.

In principle, a contingent bond can convert into shares in a number of different ways, most obviously by fixing either the number of shares received on conversion or by fixing the dollar value of shares received. I will use this terminology to describe conversion:

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[4]In all cases I assume that triggers are adjusted for notional share value changes, such as splits and stock dividends. The trigger would not be adjusted for cash dividends.

- *Fixed share* conversion: convert into a fixed number of shares (e.g., 20)

- *Fixed dollar* conversion: convert into shares with a fixed dollar value (e.g., 20.833 shares at $48)

- *Par conversion*: the shares after conversion are worth the par value of the bond (e.g., a $1000 bond converts into $1000 worth of shares)

- *Premium conversion*: the shares after conversion are worth less than the par value of the bond (e.g., a $1000 bond converts into $900 worth of shares; the bondholders overpay for the shares)

- *Discount conversion*: the shares after conversion are worth more than the par value of the bond (e.g., a $1000 bond converts into $1100 of shares; the bondholders underpay for the shares)

For example, suppose that the financial index is below 90 and the stock price reaches $50. Typically, the stock price will not close exactly at $50; suppose it is $48. In this case, with a fixed share conversion, the bondholders receive shares worth $20 \times \$48 = \$960$. Thus, conversion on average will leave the bondholders slightly worse off than if the bond paid par value. As a result, the market will demand a slightly higher interest rate on the bond than if it were sure to convert into $50 worth of shares.[5] With a par fixed dollar conversion, the number of shares would vary so that the shares evaluated at their conversion-day market price are worth the bond par value. In this example, the bondholder would receive $1000/\$48 = 20.833$ shares.

In theory the number of shares could be fixed to be worth less than the par value when evaluated at the trigger price. For example, instead of converting into 20 shares when the price falls below $50, the bond could convert into 18 shares, worth $900.[6] This is a *fixed share premium conversion*.[7]

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[5]An alternative would be to adjust the number of shares to make their value equal to the par value of the bond. As I discuss in Section 3, this alternative conversion scheme increases the returns to stock price manipulation.

[6]Flannery (2009a) discusses the value of such a wedge between bond par value and conversion value as a way to reduce the incentive of investors to manipulate the stock price. I discuss this further in Section 3.

[7]I use the term "premium" because the bondholder is implicitly paying $1000/18 =$

The conversion specification is a critical design issue. As I will discuss in Section 3.1, a premium conversion reduces the gains to stock price manipulation. However, Sundaresan and Wang (2010) prove that if there is a stock price trigger, any conversion rule other than a par conversion gives rise to the possibility of multiple equilibria for the stock price.[8] Thus, par conversions appear to be the only feasible conversion method. This is a specific example of the general problem noted by Bond et al. (2010), who show that policies based on market prices are potentially problematic.

The dual market trigger structure accomplishes several things:

- The conversion of bonds to shares occurs only if there is a *widespread* fall in the value of financial firm shares. One would expect such a widespread fall during a financial crisis, not at other times.

- A dual trigger convertible permits the failure of an institution as long as the financial industry as a whole is peforming well. Without a fall in the index, bonds would not convert and the financial institution could go bankrupt. The note can be structured to avoid this.[9]

- There would be no regulatory involvement in the conversion decision

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$55.555 per share, a premium over the current market price of the stock. Confusingly, this could also be described as a discount conversion because the bond is converted at a discount to par. I will continue to use the "premium" terminology.

[8]Uniqueness can be restored if conversion is based on the value of assets rather than the stock price (Pennacchi, 2010). See Section 3.2 for a discussion.

[9]If an institution is too-big-to-fail, the use of an index trigger raises the possibility of multiple equilibria. Consider a circumstance where a) the financial index would fall below the trigger if and only if the too-big-to-fail institution were to fail and b) conversion of the contingent capital would prevent failure. If the contingent capital were expected to convert and prevent failure, the index would never fall below the trigger value and thus the contingent capital would not convert. If the contingent capital were expected not to convert, the index would fall below the trigger value and the capital would convert. This equilibrium would likely hinge on the large institution being connected to the rest of the industry in such a way that failure would damage other banks. Obviously it is important to understand the likelihood that this equilibrium that could obtain. However, the possibility of a multiple equilibrium illustrates the desirability of addressing the too-big-to-fail problem with approaches other than contingent capital, including the use of a derivatives clearinghouse and new procedures for liquidating large financial institutions. I thank Zhenyu Wang for pointing out this issue.

- Conversion would not depend upon acccounting rules or the institution's reported capital. If the market believed that a bank's assets were worth less than the bank reported, conversion would occur if the share price and index conditions were satisfed.

It is important to note that this claim ignores capital structure changes that would affect bank capital subsequent to the issue of the contingent debt. For example, the bank might retire debt or issue equity after issuing the contingent convertible. If the stock price fell sufficiently, even if the reported capital ratio were high, conversion would occur. Conversion in this case would be a visible event, perhaps leaving the institution with significant excess capital. In that case it would be easy for the institution to reverse the conversion, but presumably regulators would also be in a position to prevent it from doing so.[10]

2   Comparison with Other Contingent Structures

Other proposals for contingent capital are those offered by Flannery (2009a,b), Squam Lake Working Group (2009), and Pennacchi et al. (2010). In this section I briefly describe these proposals. In Section 3 I will discuss more broadly some of the design issues and compare the proposals along various dimensions. The claim I describe in this paper has elements in common with both the Flannery and Squam Lake instruments, but differs in being more market-based than either. Conversion only in bad times resembles the Squam Lake proposal, while the reliance on market equity resembles the Flannery proposal.

- **Flannery (2009b)** calls for systemically important banks to issue "contingent capital certificates" (CCC), which would convert to a fixed dollar value of equity when a market-based measure of capital reaches a trigger level. For example, a firm might have outstanding common

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[10]Financial institutions might be inclined to adhere to the maxim: "It is better to ask forgiveness than permission." The regulatory version might be: "It is better to require permission than have to grant forgiveness."

stock with a market value equal to 4% of book assets, and 4% CCC (measured as the ratio of par value to assets). When assets (and therefore market equity) fall sufficiently in value, the equity to asset ratio would be reduced. Enough of the CCC would convert to common shares so as to restore capital to a desired level. Conversion would replace debt at its face value with an equivalent value of shares. Not all outstanding CCC would be converted at a point in time, but enough would be converted to restore capital to a target level.

Flannery's proposal is intended to address the too-big-to-fail problem as well as permitting capital adjustments during systemic crises. Dual-trigger contingent capital is quite similar in spirit to Flannery's CCC, but differs in permitting bankruptcy and with conversion not hinging on measured capital.

- Under the **Squam Lake Working Group (2009)** proposal, there is also a dual trigger for conversion, but the triggers are based on regulatory and accounting values rather than market values. . Banks would issue financial claims that resemble debt, but that would convert to equity under two conditions: a declaration by regulators that there is a systemic crisis, and the individual institution violating covenants specified in the claim. The Squam Lake proposal is specifically concerned with provision of capital during a systemic crisis.

- **Pennacchi et al. (2010)** propose a Call Option Enhanced Reverse Convertible (COERC). When a market value trigger is reached, two things happen: contingent bonds convert to equity at a deep discount, and shareholders receive rights permitting them to purchase the shares at the conversion price. Pennacchi et al. (2010) show that there is a broad range of asset values over which, in equilibrium, the bonds convert and shareholders exercise their rights, so that bondholders are paid at par.

The three proposals differ in the nature of the trigger, but more importantly they differ in the severity of the event that will cause conversion.

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The Squam Lake proposal implicitly seems to view hybrid convertibles as a last-ditch measure: banks would have violated covenants and more importantly, regulators would have declared the existence of a crisis. Presumably one reason for using contingent capital would be to prevent a systemic crisis from occurring in the first place. Is it possible that the use of a regulatory trigger creates multiple equilibria? Could regulators declaring the existence of a crisis induce or worsen a crisis? It seems possible that regulators concerned about maintaining confidence in capital markets would be reluctant to declare the existence of a crisis until it is too late.

Like the proposal by Squam Lake Group, the structure I describe does *not* attempt to address the problem of too-big-to-fail, though the requirement to issue contingent capital can be skewed towards bigger institutions. My presumption is that too-big-to-fail will remain problematic until explicitly addressed by regulators in other ways.

3   Discussion

In this section I discuss a number of issues that arise when evaluating contingent capital proposals. Specifically, I discuss market manipulation, the nature of errors resulting from relying on contingent capital, and the pitfalls of relying on accounting reports to trigger conversion. I also discuss how contingent capital compares to alternative policies.

An important theme running through this section is that there is much we do not understand about the behavior of financial institutions and the consequences of policies. Thus, it is important to consider the robustness of policy with respect to uncertainty and unanticipated consequences.

3.1   Market Manipulation

During the financial crisis both regulators and market participants expressed concern about market manipulation. The subject of market manipulation is wide-ranging. The question I address here is whether and to what extent the possibility of market manipulation affects the viability or design of con-

tingent capital contracts. Flannery (2009a,b) also discusses manipulation at length.

There are two distinct questions: whether the trader can affect the price of an asset (for example drive it down by selling), and whether the trader can profit from affecting the asset price. Clearly trading on inside information or releasing false information can generate profits. However, academics are generally skeptical about the feasibility of legal *profitable* manipulation, for example the notion that a trader can short a stock, drive the price down, and then buy the stock to cover the short, profiting in the process. If the act of shorting drives the price down and the act of covering the short drives the price up, it is not clear how this transaction can be profitable.[11]

In the context of contingent capital, a concern is that *unprofitable* manipulation of the stock can become profitable when the trader also has a position in market-triggered contingent convertibles. This seems to be a legitimate concern. In this discussion we will suppose for the sake of argument that it is possible for traders to temporarily move the price (for example temporarily push it down), while maintaining the traditional academic skepticism that such trading in shares alone can be profitable. Ultimately the possibility of extensive manipulation and its importance is an empirical question.[12]

In this section I will discuss the effects of different conversion options with respect to the incentive they create for manipulation, assuming that the alternative conversion schemes are feasible. It is important to keep in mind, however, the non-uniqueness result of Sundaresan and Wang (2010), which sharply limits the ability to alter the design of the bond.

[11]The academic literature has explored circumstances in which profitable manipulation is possible. See, for example, Allen and Gale (1992), in which the trader is believed by others to possess private information, and Fishman and Hagerty (1992), in which trading is disclosed after the fact.

[12]In one example of possible manipulation, Ni et al. (2005) document that stock prices cluster near strike prices when options expire, and attribute this in part to manipulation by proprietary traders. There are alternative explanations for their findings, however, so the paper in part illustrates the difficulty of demonstrating that manipulation has occurred.

3.1.1   Firm Stock Price Manipulation

One important concern is a scenario in which an arbitrageur would buy the contingent convertible, short-sell the stock to push its price down into the conversion region, convert, and benefit from the gain on the newly converted shares as the stock returns to its "correct" level above the trigger price. I will argue here that a fixed share premium convertible structure is least exposed to profitable manipulation. Flannery (2009a) makes a similar argument about the value of converting at a premium although he appears to prefer a fixed dollar conversion.

Example of Profitable Conversion   To see how manipulation could be profitable, suppose that the stock is \$51, and a \$1000 bond converts into 20 shares when the price goes below \$50. A trader owning this bond could possibly manipulate the price down to \$49. This forces conversion, and the bondholder now owns 20 shares. When the price returns to \$51, the bondholder has a position worth \$1020, and has induced a 2% gain on the convertible (from \$1000 to \$1020) by triggering conversion.

The Effect of a Conversion Premium   The difficulty of the manipulation just described can be increased by creating a wedge between the par value of the bond and the conversion value of the shares, i.e, the bond could convert at a premium price for the shares. For example, the bond could convert into 19 shares rather than 20. The bondholder who forced conversion would then receive a position worth \$950 at the \$50 trigger price, a loss of $(\$1000 - \$950)/19 = \$2.63$/share generated by conversion. If the share price were \$51 as in the previous example, the bondholder would lose \$1.63/share by manipulating the price below \$50. Temporary manipulation to a price below \$50 would not become profitable until the true share price was at least \$52.63. Hence, any manipulation would have to be by a greater amount to compensate for the premium price. Because conversion at a premium price would require a greater manipulation to make conversion profitable, manipulation would be both less likely and easier to detect. In fact, if shares

convert at a premium, bondholders would have an incentive to manipulate the price *up* to avoid conversion. This seems likely to be more difficult than the downward manipulation just discussed, because the price has to be kept up indefinitely (or until the bond matures) to forestall conversion. If at any time the price falls, the bond converts. Also, propping up the price will be increasingly difficult to accomplish if the bank is in distress.

Fixed Share vs. Fixed Dollar Conversion   Other things equal, manipulation is more profitable with a par fixed dollar conversion instead of a fixed share conversion. A fixed dollar convertible offers a floating number of shares with a fixed dollar value. With such a bond, it is in the interest of a bondholder not only to trigger conversion, but also to temporarily manipulate the share price as low as possible, since this increases the number of shares upon conversion. For example, consider again the case where the share price is $51 and the trigger is $50. If the trader can temporarily force the price down to $48, bondholders will receive $1000/$48 = 20.833 shares. If instead the trader forces the price down to $47, the bond converts into $1000/$47 = 21.277 shares, which provides an additional 2% gain once the price returns to $51. In general, fixed dollar conversions offer more incentive to manipulate, suggesting that they should be avoided or at least adopted with care.

3.1.2   Index Price Manipulation

Another manipulation scenario arises if the index trigger condition is not met but the stock price trigger is met. In this case, by the time the index falls enough to permit conversion, the conversion value of the stock can be much less than $1000. For example, suppose that when the stock first reaches $50 the index is at 150. The stock then falls to $20 and the index falls to $90 (the trigger). At this point, 20 shares are worth $400, so the bondholders take a significant loss that is avoided if the index trigger is not reached.

It would presumably be difficult for a trader to manipulate the price of

a broad index upwards for even a brief period, let alone a sustained period. The difference between the converted and unconverted bond is greatest when the bond is close to maturity and the payment of par is a few days away. This is clearly a case where traders might try to manipulate the index to avoid conversion: The bond is worth $400 if converted and $1000 if not converted. To reduce the effect of this knife-edge case, the index conversion trigger could be based on an n-day average of the index.[13] The disadvantage of multi-day averages is that this could delay the conversion. Another anti-manipulation feature would be to gradually and randomly exempt the bonds from conversion as maturity approached.

3.1.3   Manipulation of the Bankruptcy Process

Under some circumstances bondholders could have an incentive to try to force the institution into bankruptcy before conversion can occur. Suppose the share price is very low but the index price is above the trigger. Bondholders may believe that they will receive a greater percentage of principal as subordinated bondholders in bankruptcy as oppposed to the value of shares they would receive in default.

Given that there is an index trigger, I do not see an obvious way to design the claim differently to solve this problem. However, this is similar to the general class of problems created by derivatives, which can permit claim holders to unbundle the package of rights inherent in a claim. See, for example, the series of papers by Hu and Black (2006, 2008a,b).

3.1.4   Share Issues and Repurchases by the Firm

Firms can issue shares and repurchase outstanding shares. The Modigliani-Miller theorem implies that this activity should not change the share price. However, it is well known that an announcement by a firm that it will transact in its own shares does on average cause a price change, with prices

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[13]Based on anecdotal observation, the use of 20-day averages seems to be common when the terms at which securities convert are based on a price. I am not aware of any systematic study of conversion terms, however.

declining on announcement of an issue and rising on annoucement of a re-purchase. This is frequently attributed to managerial private information about the firm. The idea is that the share transactions in equilibrium reveal something about management's perception of the firm's value, and thereby change the price that investors believe to be fair. It is not clear that the firm could (or even would want to) systematically manipulate its own price using share transactions.

Suppose that for some reason the firm repurchases shares, attempting to raise the firm's price so as to forestall conversion of a convertible. The documented effect of a repurchase announcement is small (on the order of a few precent), and if the market suspected that the shares were being repur-chased for this purpose, the share price might not rise at all (there would be no favorable managerial information being conveyed by the repurchase an-nouncement, in fact the market might infer unfavorable information from a manipulation attempt by the firm). Even if a repurchase did raise the share price, it seems unlikely that the firm could sustain a higher price that was not warranted. Finally, regulators presumably would have some say about a bank's ability to repurchase shares if it were close to violating its capital requirements.

3.1.5 Design Implications

This disussion suggests that it is possible to reduce the potential impact of manipulation by doing the following:

- Use a fixed share conversion

- Have the shares convert at a premium (the value of newly converted shares is worth less than the par value of the bond). Unfortunately, as noted, this structure gives rise to multiple equilibrium. We discuss this below in Section 3.2.

- Have the index conversion condition be based on an average price over time

- Retire bonds gradually and randomly as maturity approaches in order to avoid the very large gains from manipulation that can occur at maturity

It is important to keep in mind that there is nothing novel about financial claims with a payoff based on the stock price. Numerous financial claims convert, go into or out of existence, or otherwise have their value determined in part by the movement of market prices. Examples of securities issued by firms, and based on their own stock price, include convertible bonds and warrants. When third-party issues are considered, there are ordinary and exotic options on equity, interest rates, and exchange rates. There has been a recent surge in issues of reverse convertibles; by one report, 632 reverse convertibles were issued in the fourth quarter of 2009.[14]

One can imagine successful manipulations that hinge on discrete events, such as the exercise or expiration of an option. For example, a trader with the ability to push the stock price up could sell at-the-money put options very close to expiration, then push the stock price up so the option is out of the money. This is the sort of manipulation discussed by Ni et al. (2005). As long as the stock price reversal occurs after expiration, the trader keeps the put premium and breaks even on the stock. Manipulation is an ongoing concern in these markets, but the markets continue to operate.

3.2 Multiple Equilibria

Sundaresan and Wang (2010) demonstrate that multiple equilibria for the stock price can arise when there is a stock price trigger and when the value of stock exchanged for the bond differs from the value of the bond. This result is easy to illustrate with a numerical example. Suppose that a firm has outstanding $80 of senior debt and $10 of contingent debt that converts

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[14]See http://www.investmentnews.com/article/20100214/REG/302149984. Some of these issues employed price triggers to determine whether the reverse convertible feature was activated. For example, Barclays in February 2009 issued a reverse convertible linked to the US Oil Fund (USO). Conversion was triggered if any closing price of USO during the life of the note was 50% below the value of USO at the time when the note was issued.

into one share when the stock price is $7. Suppose further that there is one share of stock outstanding and that both bonds mature tomorrow.

If we know for sure that the value of firm assets tomorrow will be $90, we can compute the stock price contingent on the belifs that conversion will and will not occur. If investors believe that conversion will occur, the stock price is $8:

$$S = \frac{\$96 - \$80}{2} = \$8$$

The price of $8, is greater than the trigger price, so the belief that conversion will occur is inconsistent with the trigger price. On the other hand, if investors believe that conversion will not occur, the share price is

$$S = \frac{\$96 - \$80 - \$10}{1} = \$6$$

The belief that conversion will not occur is inconsistent with the price conditional on that belief.

Sundaresan and Wang (2010) emphasize that this lack of equilibrium occurs because, if there is a non-par conversion, there is a transfer of value between shareholders and contingent bond holders, and this transfer affects the share price. They show that there is a unique equilibrium share price if conversions occur at par. They also show that a way to achieve this is to issue floating rate contingent convertibles for which conversion occurs at par. Prior to conversion, the bond always trades at par because the interest rate is set to make it so.

To see how a par conversion fixes the multiple equilibrium problem, consider again the numerical example above. A par conversion at stock price S will require that the $10 contingent capital bond be exchanged for $10/S shares. Thus, the share price will be

$$S = \frac{96 - 80}{1 + 10/S}$$

The solution is a share price of $6, with 1.67 shares are exchanged for the bond.

Pennacchi (2010) notes that basing conversion not on equity, but on the value of assets (or, in the example above, on the sum of contingent debt plus equity), will restore uniqueness. Non-uniqueness arises because the belief about the value of equity and hence about conversion affects the allocation of value between bonds and equity. The total value of assets is unaffected, however, by beliefs about the value of equity. Therefore conversion based on total assets is unaffected by the equity price.

This fix presumes that all claims with a value affected by the stock price have observable market prices, which is necessary for their value to be part of the trigger. This would include the value of equity compensation, preferred stock, debt that is *pari passu* with contingent debt, and the like. Depending upon their importance and the observability of a market price for these claims, basing conversion on their value may or may not be feasible.

If conversion based on assets (or based on junior claims plus equity) is not feasible, then par conversions are required to minimize the occurrence of multiple equilibria when conversion is based on the firm's own stock price (or market value of equity). The requirement of par conversion raises the possibility that the firm will have to issue increasing numbers of shares at lower prices to pay the par value of the bond. If conversion occurs at a very low stock price (say the stock jumps from a high price to a price well below the conversion barrier) it may be feasible to cap the number of shares — thereby limiting the effects of the share spiral — without giving rise to multiple equilibria. In other words, there would be a range below the conversion trigger where conversion occurred at par, but below the bottom of this range conversion would occur at a fixed number of shares. This would work because multiple equilibria are not a problem when asset values are so low that the stock price is low whether or not conversion occurs.

3.3 Delta-Hedging

Delta-hedging refers to a situation where a trader holds a position in a contingent claim and hedges that claim using the underlying asset. For example, the owner of a convertible bond could short a particular number of

shares to hedge the bond. One well-known example of delta-hedging arises if investors buy put options ("portfolio insurance") from market-makers. The market-makers will short-sell stock to delta-hedge the sold puts. As the price drops, market-makers increase their short position to maintain the delta hedge.[15]

The amount of delta-hedging likely to occur with fixed-share reverse convertibles seems small. Consider the benchmark case where a $1000 bond converts into 20 shares at a stock price of $50. If the stock prices moves continuously and conversion is instantaneous, at the moment of conversion investors will receive $1000 of stock in exchange for $1000 of bond. No delta-hedging is required prior to conversion because the bond is risk-free.

In practice, prices will not move continously. Also, if conversion were to occur at a premium, the bond will then be priced in anticipation of conversion, and it will respond to the stock price, with the bond price falling as conversion becomes more likely. In this case delta-hedging could be used to reduce the risk of holding the bond, but the delta would be only a fraction of the shares into which the bond converts.

3.4   Type I and Type II Errors

Any contingent capital scheme can fail. The language of statistical hypothesis testing provides terminology for a discussion of failure. Contingent capital converting into equity when the bank does not require capital is analagous to a type I error in statistics, which is a false positive (the hypothesis is not rejected when it should be). Contingent capital failing to convert when the bank is in need of capital is analogous to a type II error, which is a false negative (the hypothesis is rejected when it should not be). In the context of contingent capital, a type II error seems much more serious

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[15]Some have argued that this selling creates a spiral in which prices continue to fall. In the context of portfolio insurance strategies, Grossman (1988) emphasizes the importance of a benchmark in assessing this concern. He points out that the price of puts provides information to the market about the prevalence of portfolio insurance; if there were not puts, investors could nevertheless mimic a put by selling into a falling market. If the market underestimated the number of investors following this strategy, the price pressure produced by this selling could make the price even more volatile than when puts exist.

than a type I error.

3.4.1 Type I Errors

If contingent capital converts when capital is not required (a type I error), then by definition the bank is healthy and markets are functioning normally. The bank should be able to repurchase the newly converted shares and fund this repurchase with a new issue of contingent capital or other security. Transactions that unwind a conversion will carry transaction costs, but it is not necessary for the bank to undo the conversion immediately.

While low capital can threaten an institution, it is not clear why high capital should be a policy concern. From a social perspective, leverage has no inherent value. In particular, the Modigliani-Miller theorem implies that banks could replace straight subordinated debt with equity. If equityholders and managers wish for more leverage, it should be possible to create new contingent claims providing a more levered return outside the firm.[16]

There can be a *private* advantage of high leverage in that shareholders and managers earn a greater return when risky bets succeed. In theory there is a countervailing effect of greater losses on the downside when bets fail. However, the government's willingness to bail out the financial sector blunts the incentive effects of failure and may give levered risk-taking a positive net present value. Levered bets created privately, outside the firm, are less likely to be rescued, and presumably are less desirable for that reason. The one dimension of leverage that may be hard to replicate privately is the tax deductibility of interest payments at the level of the firm. However, what is the social value of providing tax deductions that encourage financial

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[16]Care is required in applying the Modigliani-Miller theorem to financial institutions. Some bank liabilities are cash-equivalents and provide a convenience value to holders. Such claims are outside the scope of the Modigliani-Miller theorem. Moreover, some authors have argued that high leverage is a critical component of banking. Calomiris and Kahn (1991) and Diamond and Rajan (2001) develop theories of banking in which financially fragile banks arise naturally. In the Diamond-Rajan setting, for example, excess capital would reduce the incentive of managers to optimally manage lending and thus would have social costs. Diamond and Rajan observe that highly levered financial institutions are ubiquitous but it would be valuable to have an empirical test of the theory.

institutions to have high leverage?[17]

3.4.2 Type II Errors

A Type II error is more concerning. If contingent capital does not convert when the bank requires capital, the security fails to do its job. Firms are reluctant to issue equity during a crisis. This reluctance can be rational if asymmetric information is particularly great during a crisis.[18] It is therefore critical to understand the scenarios in which conversion would fail.

For a market-based trigger, there are at least two obvious failure scenarios:

- Markets might shut down, so that no equity price is observable. This contingency would need to be dealt with at the outset in the contingent capital documentation. The appropriate action is not obvious, but if all conversion details were specified *ex ante* in the convertible's documentation, it should be possible simply to convert in this event.

- The anticipation of government action to rescue the financial system could prevent share prices from falling. This will defer conversion only to the extent that the market believes a rescue will wipe out shareholders.

For a regulatory based trigger, failure scenarios include[19]

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[17]Tax deductibility has *political* value by virtue of eliminating a reason for banks to oppose contingent convertibles.

[18]One advantage of contingent capital is that its issuance is not subject to the adverse selection problem of the type emphasized by Myers and Majluf (1984). The literature explaining why firms would issue convertible bonds emphasizes that the decision by a firm to issue a convertible conveys information to the market. However, if firms are required to issue reverse convertibles with expected long times to conversion, investors would infer nothing from such an issue and asymmetric information should play no role in pricing. A reverse convertible is thus a way to avoid the asymmetric information costs of equity issues. This is reminiscent of the account of convertible bonds in Stein (1992).

[19]Regulatory failure seems especially dangerous when considering proposals for bail-in capital (Calello and Ervin, 2010). Bailing-in is a restructuring that occurs when a firm is on the verge of failure. It is unknown whether adoption of a bail-in regime would prevent runs. Moreover, the presumption that regulators would, in the midst of a crisis, have the will and ability to act promptly, clearly, and decisively to wipe out billions of dollars of a firm's liabilities seems at best uncertain.

- Regulators might fail to take prompt action. This could occur because regulators deem action unnecessary, because legislators interfere with regulation, or because regulatory squabbles create gridlock[20]

- Regulatory measures might not permit action. For example, if regulatory capital is mismeasured, it might be impossible for regulators to act when it otherwise seems clearly desirable.

- Regulatory action could take time

The regulatory system has numerous moving parts, many of which are subject to political pressure in the short run, all of which are subject to political pressure in the long run. Actions and policies that seem obviously desirable today in the wake of a crisis may not seem so at a future date, especially given that regulators may have differing capabilities and ideologies, and that regulatory institutions may be restructured over time. Regulatory action necessarily conveys gravity and carries overtones (to which the market is attuned) of future regulatory action. It therefore might be desirable to have contingent capital in routine use, so that issuance and conversion would not taint either the institution or the system.

3.4.3 Summary

Market-based triggers seem prone to type I errors, and regulatory and accounting-based triggers seem prone to type II errors. It seems unlikely that there would be a systemic crisis without financial firms having low stock prices. This would reduce the likelihood of a type II error for market-based triggers. Accounting and regulation, however, are not automatic, and both are subject to political winds and whims. Basing conversion on regulatory judgment would reduce the likelihood of a type I error, in which bonds converted into stock without any crisis. But as discussed, one can imagine regulators failing to act. Both the Flannery and Squam Lake proposals try

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[20]Political pressure should not be ignored: One notable event during the recent financial crisis was the FASB being pressured in early 2009 to relax the fair-market-value requirements of FAS 157. It did so with FAS 157-e.

not to saddle financial firms with "too much" equity. Flannery's would convert only enough bonds to meet a capital requirement, and Squam Lake's would convert only for banks with a low capital ratio.

In the end, an assessment of type I and type II errors hinges on having an economic model of optimal capital.[21] A major difficulty in assessing relative error costs of over- and under-capitalization is that capital standards are set by regulatory judgment; there is no quantitative theory to support 8% as the correct capital level, as opposed to, say, 15%. Capital standards have evolved historically with some trial and error.[22] To the extent capital-setting rules are subject to lobbying, one form of moral hazard is that the banking industry will seek to minimize required capital levels *ex ante*, anticipating assistance during financial crises.[23]

3.5 The Use of Accounting Measures

Most contingent capital proposals to date rely to some extent on accounting measures. Flannery's proposal has a market-based trigger but relies on an accounting measure of assets as the denominator.

Among the issues are:

- *Most accounting is done periodically rather than continuously.* The accounting process takes time and accounting statements are audited. In many cases the state of a financial institution is revealed in quarterly earnings announcements, by which time the damage may have been done. Regulators can access information at any time, but it is strictly speaking

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[21]Notably, Admati et al. (2010) argue in favor of increased capital requirements.

[22]For a history of capital regulation as a tool of financial supervision, see Tarullo (2008), especially chapters 2 and 3.

[23]Heaton et al. (2010) discuss the measurement of bank capital in a context where bank stock prices can fall because risk premia rise. In their setting excess capital is costly because issuing equity is costly. Contingent capital has the potential to reduce these costs through the issuance of a convertible security. Their paper emphasizes that assessing capital requirements and devising systems and closure rules depends upon the reason for a capital requirement in the first place. An implication of their analysis is that it may not be optimal for regulators to take costly action just because measured capital falls.

- *Accounting rules are subject to political pressure.* Accounting rules have force because the SEC requires companies to adhere to them. The SEC in turn is subject to Congressional oversight. Congress has in the past intervened in the process of accounting rule creation. Two leading examples were the FASB's attempts to have option grants treated as an expense and the partial repeal of fair value accounting (FASB, 2009) during the crisis. It seems reasonable to suppose that accounting rules would potentially be subject to manipulation in a future crisis.

- *Accounting rules are subject to arbitrage.* Banks have a long-run incentive to understate assets, so as to minimize required capital, and a short-run incentive to overstate assets, avoiding writedowns that would reduce reported income. Prior to the crisis, many banks created structured investment vehicles (SIVs), which moved risky assets off the balance sheet and avoided capital requirements on those assets. This understated assets. During the crisis, banks elected not to sell apparently-depreciated assets, thereby expanding the value of assets. Perhaps accounting rules can be modified to make such arbitrage impossible, but it would seem imprudent to base policy on the assumption that failsafe accounting is possible.

- *Accouting measures are often backward-looking* With the move toward fair value, accounting measurement increasingly relies on forward looking market values. However, hold-to-maturity assets are measured at historical cost unless there is an "other than temporary impairment" in value (OTTI). Other financial assets are marked to market, but during the past crisis major financial institutions had a high percentage of assets that, for the purpose of fair value accounting, were recorded as level 3 (also known as "mark to model"), meaning that their valuation occurred as a "best efforts" exercise. If financial institutions are honest, if auditors are capable, and if regulators are vigilant, then accounting measures may provide a fair assessment of value. Flannery (2009a) points out that the five largest U.S. financial institutions

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that ultimately failed or were rescued all reported excess capital in the quarter prior to their failure/rescue.

One way to summarize this discussion is to say that the accounting *system* gives banks an option. If they are unhappy with the outcome in a particular state of nature, it is possible for them to lobby both regulatory and accounting authorities.

If conversion is based on accounting values and there is mark-to-market, traders may have an incentive to manipulate markets for assets that the bank holds. For example, if a bank has large positions in CDOs that will be marked to market, owners of contingent convertible might like to temporarily raise the value of CDOs to reduce the stock to asset ratio. Flannery's proposal would allow conversion nevertheless as long as the stock price fell.

3.6   Tax Considerations

Flannery emphasizes the importance of interest payments on contingent capital claims being tax deductible so that issuing banks are not penalized. It is not obvious that payments on instruments that always convert before default would be deductible. One key criterion for an instrument to receive treatment as debt is the payment of a "sum certain" (see IRS Field Service Advice 199940007). Flannery's proposed CCC might or might not satisfy this requirement. Dual-trigger instruments and the Squam Lake proposal, which permit bankruptcy in some circumstances, seem likelier to satisfy this requirement.

There are ways to effectively create tax deductible instruments that convert into equity; upper DECS are a structure that accomplishes this.[24] But such structures are complicated and the 2010 Dodd-Frank Wall Street Reform and Consumer Protection Act has made such claims ineligible to count as capital. An immediate fix for contingent convertibles would be to enact a tax law change to permit interest on these specific claims to be deductible. An alternative would be to harmonize the taxation of debt and equity so that financial institutions have no *tax* incentive to become highly levered.

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[24]For a detailed discussion of such a structure, see McDonald (2006, pp. 495–498)

From a policy perspective, it would seem absurd to perpetuate a tax code that increased the chance of a financial crisis. Eliminating the tax benefit of debt seems to be a desirable reform that has received surprisingly little attention (but see Shaviro, 2009).

3.7   Overhang as an Implementation Cost

A requirement that a financial institution issue contingent capital can affect the share price for that firm.[25] I will discuss this in the context of several examples in which I make different assumptions about the timing of contingent capital issuance, and also whether the bank is too-big-to-fail, meaning that the bank's debt is guaranteed by the government. To focus the discussion, I will assume that tax benefits from issuing debt are preserved with contingent capital.

First, it is possible for the share price to be approximately unaffected by the requirement to issue contingent capital. Suppose that a bank that is not too big to fail is financed with a one-year bond and equity. When the bond matures, the bank will be required to replace a portion of the bond with contingent capital. The price of existing bonds will not be affected, because the contingent capital will not be issued until after those bonds have matured. The value of equity will be affected only to the extent that shareholders today receive value from issuing debt in the future. If the future bonds will be fairly priced at issuance, shareholders bear no cost from the future requirement to issue contingent capital.

In practice, however, the firm will have fixed obligations, the value of which *is* affected by the issuance of contingent capital. To think about this possibility, suppose that the bank issues contingent convertible bonds immediately and uses the proceeds to buy Treasury securities.[26] The existing remaining bonds will become safer, and by the Modigliani-Miller theorem,

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[25]As a preliminary point, it seems reasonable to presume that a requirement to issue contingent capital would reduce shareholder value. If not, the question is why firms would not already have issued contingent capital.

[26]The bank could also buy back some of its uninsured bonds, but this raises the problem of whether the bank would pay the low pre-contingent-capital price for the bonds or the high post-contingent-capital price.

the price of equity should drop by the same amount that the bond price increases.[27] In the future, when the firm issues new bonds to replace existing bonds, these will be priced reflecting the new capital structure and will carry terms such that they are priced at zero net present value (NPV). The terms will be different with a contingent capital program in place than without one, but the new bonds will have zero NPV, whether or not contingent capital is also issued. The effect of the contingent capital requirement, therefore, is a straight transfer of value from shareholders to existing bondholders. This is a one-time transfer. Future issues of bonds will occur at a price taking into account the effect of contingent capital, and shareholders today will be unaffected by changes in the terms at which future bonds are issued.

Finally, consider a financial institution that is too-big-to-fail. If the market genuinely perceives the firm in this way, then the firm's bonds will be priced as if insured by the government and they will therefore carry a high price (low coupon rate) reflecting the low perceived default risk. Shareholders in the too-big-to-fail firm earn rents from the ability to issue bonds priced to reflect a low risk of default. Importantly, equity today will be priced to reflect the firm's expected *ongoing* ability to issue bonds that are *de facto* insured.[28] Shareholders today value the government's implicit insurance now, as well as the insurance from which they will benefit every time bonds are issued in the future.

The requirement that too-big-to-fail institutions issue contingent capital thus has very different effects than with a firm that is not too-big-to fail. The requirement that too-big-to-fail firms routinely carry contingent capital will

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[27]It is important to emphasize that bankruptcy costs and tax benefits from debt issuance will cause the Modigliani-Miller theorem to break down, but the goal in this discussion is to understand more narrowly the effects of debt overhang.

[28]This point is emphasized in Lucas and McDonald (2010) in the context of measuring the value of the government guarantee for Fannie Mae and Freddie Mac. They show that the value of a government guarantee is the annuity value (adjusted for default) of the one-period debt guarantee. They also point out that insured and uninsured institutions will follow different bankruptcy rules, with insured insitutions more reluctant to declare bankruptcy so as to retain the right to issue insured debt. It follows that reducing the value of insurance would make the shareholders of insured firms more willing to default.

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have no effect on the value of outstanding debt because it is insured. But it will lower the value of equity because it reduces the ability of shareholders to exploit the insurance guarantee, both currently and in all future periods. The decline in equity value for a too-big-to-fail institution could therefore be large, as it reflects a reduction in the rents shareholders expect to receive both currently and for years into the future.

3.8   Why Contingent Capital Instead of Equity?

The most important question about contingent capital is why it should be used instead of simply requiring institutions to have more equity capital.

One commonly-made argument is that equity capital is expensive, and that if banks were required to have more equity, bank profitability would fall and interest rates on loans would increase. The simple notion that equity has a high required rate of return that is independent of leverage is a fallacy routinely debunked in introductory finance courses. The Modigiliani-Miller theorem states that absent other frictions, if banks were less levered, the cost of equity would be less. Admati et al. (2010) dispute a number of arguments made against simply requiring banks to have more leverage. At a minimum, the Modigliani-Miller theorem implies that banks should be able to replace subordinated debt with equity.

The Modigliani-Miller theorem assumes a frictionless world, without taxes and bankruptcy costs, and in which debt is a pure financial claim that does not have convenience value to holders. The tax deductibility of interest does create a reason for banks to actively prefer high leverage. From a policy perspective, however, it is convoluted to allow concern about the loss of interest deductions to govern bank capital rules. Since there is no social benefit to leverage *per se*, a more direct response would be to legislatively remove the tax advantage of debt finance for financial institutions.

Probably the most important argument against a simple requirement for more equity capital is that high leverage forces bankers to manage loans efficiently, and is therefore an inherent part of efficient banking (see, for example, Diamond and Rajan, 2001). While theoretically elegant, I am

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aware of no empirical evidence in support of this view. There are also other reasons for banks to prefer leverage, such as the government safety net. One could also argue that high leverage permits inefficient banks to fail, but the same is true for non-financial institutions. There is no comparable call at present for high leverage of non-financial institutions. Finally, if debt does provide incentives for management, could these incentives be provided at less cost via compensation policies or the market for corporate control?

If equity capital is not costly, why consider contingent capital? One possible answer is that policy undertaken with incomplete information runs the risk of "unintended consequences." Contingent capital with an aggregate trigger permits regulators to build into the system a capital cushion that will be activated in times of financial distress, without radically altering the form of the current system. The fact that there is more capital during systemic events should reduce the incentive of banks to take systemic risks, as compared to a system where contingent capital is replaced by debt. Individual banks are still permitted to fail. If there *is* an inherent and important reason for banks to be highly levered, contingent capital permits banks to be highly levered while contributing less to systemic risk.

4   Pricing Example

In this section I perform a simple pricing exercise to illustrate characteristics of a dual-trigger contingent convertible under the assumption that both the stock price of the firm and the index are lognormally-distributed. Specifically, I assume that the stock price, S_t, and index price, Q_t, both follow Itô processes, which is the standard assumption in the Black-Scholes model:

$$dS_t = (\alpha_S - \delta_S)S_t dt + \sigma_S S dZ_S \tag{1}$$

and

$$dQ_t = (\alpha_Q - \delta_Q)Q_t dt + \sigma_Q Q dZ_Q \tag{2}$$

The correlation between dS_t and dQ_t is ρ. Appendix A details the calculations.[29]

Conversion of contingent capital is triggered the first time that the stock and index triggers are both satisfied. If conversion into equity is always at par, then pricing is simple: the bond yield is the risk-free rate. The reason is that bond pays either the maturity value in dollars or the maturity value in shares, but it always pays the maturity value.

A more interesting pricing experiment is to have the bond pay par value *unless* it is the index that triggers conversion. Suppose that the stock price falls below the trigger but the index does not. At this point, the index governs conversion. There is no concern about multiple equilibria at this point because it is not the firm's own stock price, but rather an exogenous price — the index — that controls conversion.

Critical inputs into the pricing model are the volatility of the index, which I set to equal 20%, approximately the historical volatility of the Dow Jones Financial Services index from 1992 to 2007, and the stock volatility, which I set to 30%, approximately the historical volatility of banks like Citi, BofA, and Wells Fargo over this period. The correlation between the firm stock return and that of the index, again selected based on history, is 0.85.

The stock price cannot reach zero in equation (1), so the yield calculation occurs in a context where bankruptcy is impossible. The yields I report therefore reflect only the effects of conversion.[30]

Table 1 illustrates the pricing of the convertible in a simple setting where bankruptcy of the firm does not occur under any circumstances, but the convertible converts when the stock and index triggers are both satisifed. Pricing is by Monte Carlo. Specifically, I simulate the stock and index price, drawing new prices every day. The first time the stock and index prices are both below the trigger, the bond converts into a fixed number of shares.

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[29]Pennacchi (2010) uses a significantly more sophisticated model of bank capital structure to study various contingent capital designs, including the dual-trigger design.

[30]An alternative approach to calculating the yield would be to model the behavior of the assets of the firm and to have bankruptcy occur when assets fall sufficiently below the value of assets. This approach was pioneered by Merton (1974) and requires modeling the financial policy of the firm. For an example of this, see Lucas and McDonald (2006).

This simulation thus explictly models conversion occurring at a price below the trigger price, and thus generates a yield greater than the risk-free rate.

The number reported in the table is the annual yield premium above the risk-free rate.[31] Because the stock is lognormally distributed, the stock price never reaches zero and therefore bankruptcy never occurs in this calculation — it is simply a calculation of the likelihood that conversion will occur and the terms at which it will occur.

The table should be viewed as providing a rough estimate of the premium on the bond. As discussed earlier, under the assumption of geometric Brownian motion for the stock and no index trigger, the yield on the bond will be the risk-free rate. Because of the index trigger, however, the bond may not convert even if the stock price trigger is satisfied. There may be scenarios where the stock trigger is satisfied and the index trigger is satisifed later, after the stock has drifted lower. In this case, there will potentially be a large gap between the stock trigger and the price at conversion. The possibility that this occurs induces a premium that is lower when the index trigger is higher.

Table 1 presents the bond yield premium when conversion occurs at the trigger price: If the bond has a par value of $1000 and the trigger price is $50, the bond converts into approximately 20 shares. The maximum yield occurs when the stock trigger is relatively high (70% of the initial price) and the index trigger is at an intermediate value (60% of the initial index price). In this case it is relatively likely that the index trigger will not be satisifed when the stock reaches the trigger price, and thus on average conversion will occur when the stock is significantly below the trigger price. The resulting premium is over 1%. Moving further to the right, conversion becomes less likely, and thus the yield decreases.

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[31]To compute the yield premium I do the following. Along each simulated path I compute the loss due to time value of money and — if conversion occurs — due to conversion. I then compute an average annuity factor taking into account the time on each path until conversion or maturity. The premium reported in the tables is the difference between the yield computed in this fashion and the risk-free rate.

Table 1: Debt premium as a function of the index trigger and stock trigger. Assumes $S_0 = \$100$, $Q_0 = \$100$, $\sigma_i = 0.20$, $\rho = 0.80$, $T = 5.00$ years, time between simulated prices $h = 0.0040$, $r = 0.0400$, with 50000 simulations.

Stock Trigger	Index Trigger				
	80	70	60	50	40
70	0.0121	0.0161	0.0143	0.0089	0.0036
60	0.0055	0.0088	0.0098	0.0070	0.0031
50	0.0023	0.0038	0.0054	0.0048	0.0025
40	0.0008	0.0013	0.0021	0.0025	0.0017
30	0.0003	0.0004	0.0005	0.0008	0.0008

5   Conclusion

In this paper I have presented and discussed contingent capital in general, and a contingent capital claim that converts from debt into equity based only upon share prices, and only when the financial industry as a whole is doing badly. When compared to other contingent capital proposals, this structure has both benefits and costs. The primary benefits are the complete reliance on market prices as opposed to accounting numbers or regulatory pronouncements of a crisis. The claim also permits bankruptcy for a bank performing badly in good times. Finally, the dual-trigger claim is likely to err on the side of giving firms too much capital rather than too little, except when other banks are doing well.

There are also disadvantages. The conversion scheme that avoids multiple equilibria also is vulnerable to manipulation and can lead to equity spirals

In addition to discussing the dual-trigger contingent claim, I also discuss a number of issues surrounding the design of contingent capital in general. Overall, contingent capital seems problematic. Most importantly, there is not an empirically persuasive argument for using contingent capital as opposed to requiring that banks issue at least some additional equity.

An argument in favor of contingent capital, as opposed to higher equity requirements, is political acceptability. If regulators want more capital and

bankers do not, contingent capital may provide a compromise. Contingent capital seems like to be part of the regulatory landscape. The Basel III rules permit particular kinds of contingent capital. The contingent capital bonds that have been issued are like those proposed by Flannery (2009b) except for their reliance on accounting rather than market measures of capital. Relative to equity, they increase leverage in good times, which may encourage risk-taking (Coffee, 2010). But at least there is the possibility that the contingent capital will be helpful in bad times.

Appendices

A   Pricing the Contingent Convertible

The notation is as follows: A bond with maturity value M maturing at time T has conversion triggers $\bar{S}$ and $\bar{Q}$ for the stock and index. The bond converts into $\beta M/\bar{S}$ shares, and pays a continuous coupon of $(r+\lambda)M dt$, where r is the risk-free rate and λ is the premium attributable to the conversion feature. When $\beta < 1$ the bond converts at a premium.

A.1   Determining The Yield Premium, λ

Let τ denote the first time that the trigger conditions are satisfied. The value of the bond under the risk-neutral measure is

$$V(\lambda) = E_\tau \left[\int_0^\tau e^{-rt}(r+\lambda)M dt + e^{-r\tau} S_\tau \beta \frac{M}{\bar{S}} \right] \tag{3}$$

I simulate S_t and Q_t daily in order to determine τ, and then evaluate equation (3) for each $\{\tau, S_\tau\}$ pair assuming that λ is 0. I then use the simulated τs to amortize the difference between $V(0)$ and M to determine the λ such that $V(\lambda) = M$.

Note that because the simulation models daily price moves, the difference between S_τ and $\bar{S}$ is positive on average.

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