Capital Access Bonds

SUMMARY

This paper argues that there is a Coasean bargain available to banks, long-term investors, and bank regulators around a particular form of "contingent capital". By purchasing rights to issue equity in crisis events at a pre-specified price from long-term investors, banks can ensure that they will have sufficient regulatory capital available when they need it most: in a crisis. By selling these rights (effectively, a form of crisis insurance) long-term investors can monetize their counter-cyclical investments strategies in banks and, thus, obtain an adequate return as long-term investors. Bank regulators, in turn, gain as they can thereby implement a more efficient (transparent and flexible) form of equity-capital regulation. The form of contingent capital we propose (capital access bond) reflects a balance between investors' preferences, issuers' constraints, and regulators' objectives.

— *Patrick Bolton and Frédéric Samama*

Capital access bonds: contingent capital with an option to convert

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1. INTRODUCTION

The financial crisis of 2007–2008 has painfully revealed a major weak link in the financial system: *excess leverage* at many of the major financial institutions. The very high leverage ratios of Bear Stearns, Lehman Brothers and others as they entered the crisis, put them at risk of bankruptcy even in the event of relatively moderate shocks to their earnings or the value of their assets. Moreover, by putting themselves at risk these institutions also exposed the entire financial system to failure. It is not surprising, therefore, that a key concern of financial regulatory reform has so far been to make sure that banks are well capitalized. However, while improving banks' resilience in a future crisis, higher equity-capital requirements also raise the cost of capital for banks

(at least in the short run) and increase the risk of a *credit crunch* (Bernanke and Lown, 1991), that is, a significant deceleration in the expansion of credit, with the risk of choking off a recovery and prolonging the current recession.

A second key concern of regulators has been to reduce the risk of another round of bail-outs in a future crisis. If *ex ante deleveraging* by banks is not sufficient to avoid bank failures in another crisis, then *ex post* deleveraging through debt restructuring should be facilitated. One way of easily achieving such *ex post* deleveraging is to require banks to hold debt instruments that convert into equity in the event of a crisis, or in the event that an institution approaches a dangerous leverage ratio. This mechanism generally comes under the name of *contingent capital* or *CoCos*. Different versions of contingent capital have been proposed (see e.g. Flannery, 2002, 2009; Raviv, 2004; Duffie, 2009; McDonald, 2009; Albul *et al.*, 2010; Pennacchi *et al.*, 2010; the Squam Lake Report, 2010; Coffee, 2010; Glasserman and Nouri, 2010; and Calomiris and Herring, 2011), but the basic idea underlying these proposals is to put in place a mechanism that more or less automatically reduces leverage by implementing a debt-equity swap akin to a debt restructuring in bankruptcy. One proposed way of implementing such a mechanism is to require that banks issue subordinated debentures, which automatically convert into equity in the event that the bank's leverage hits a pre-specified upper bound or, under other variants, when the bank's stock price hits a pre-specified floor.

There are already several precedents for this type of financial contract. One example is the contingent capital contract between the *Royal Bank of Canada* and *Swiss Re* (see Culp, 2009).[1] A second example is *trust-issued contingent capital*, a form of funding *monoline insurers* often relied on before the crisis (see Culp, 2009).[2] A third set of examples is the contingent capital issues by several banks following the crisis, including Lloyds, the Royal Bank of Scotland (RBS), Rabobank and Credit Suisse.[3] However, it is fair to say that besides Credit Suisse's *CoCo* emission, the market for contingent capital has so far been limited and falls well short of the $1trillion that banks[4] in the United States and in Europe will need to raise in replacement of outstanding subordinated

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[1] Swiss Re committed to purchase preferred stock conditional on the Royal Bank of Canada incurring pre-specified exceptional credit losses. The Royal Bank of Canada's explicit intent with this contract was to limit the amount in loan-loss reserves it needed to hold.

[2] A special purpose entity (SPE) on one side issued securities to investors and invested the proceeds in low-risk assets serving as collateral, and on the other side wrote put options to a monoline, giving it the right to issue new capital securities. As long as the option remained unexercised investors received the interest on the collateral and the put-option premium. When, however, the monoline exercised its option, investors ended up holding the newly issued monoline equity.

[3] First, in November 2009, Lloyds issued £7.5 billion of Enhanced Capital Notes (ECN). The ECN are subordinated debt (Lower Tier 2 capital) of fixed maturities ranging from 10 to 15 years that are convertible by Lloyds into common stock if Lloyds' core Tier 1 capital ratio falls below 5%. A second scheme gives RBS access to recapitalization by the UK Treasury should its core Tier 1 capital ratio fall below 5%. In return for this commitment RBS is paying the UK Treasury a 4% annual premium. Third, Rabobank has issued a contingent capital instrument on 12 March 2010 such that investors face a 75% automatic haircut in the event that the bank's Tier 1 capital ratio falls below 7%. Finally, Credit Suisse has issued contingent capital notes on 17 February 2011, which convert into equity if its risk-based capital ratio falls below 7%.

[4] Interestingly S&P predicts a similar figure of $1 trillion of CoCos which should be needed to fund banks' needs in the coming years. Himmelberg *et al.* (2011) also provide an estimate for the potential issuance of loss-absorbing securities issuance by banks in the next decade between $926 billion and $1.9 trillion, for the US market.

and hybrid debt that will be phased out by 2022.[5] Indeed the new Basel III directives will not allow these forms of debt to count towards regulatory capital any more and it could well be that contingent capital becomes one of the main alternatives.[6]

As some commentators have been quick to point out, however, contingent capital instruments with automatic conversion triggers of debt into equity have potentially important design flaws, as they may be vulnerable to manipulation, and they may support multiple self-fulfilling conversion equilibria, which generate endogenous volatility and valuation uncertainty (Sundaresan and Wang, 2010).

In this paper we propose another, more flexible, design of contingent capital that all but eliminates the problems created by automatic triggers. Under our contingent capital mechanism banks[7] would simply purchase a (collateralized) option to issue new equity at a pre-specified strike price. Far from being a minor technical fix, this contingent capital mechanism reflects a fundamentally different analysis of the economic purpose of contingent capital. It is not just conceived as a somewhat blunt substitute for a bankruptcy (or debt resolution) procedure, but mainly as a *capital line commitment* for banks, or in other words, a form of insurance against adverse changes in equity markets, for banks who expect to need to raise equity capital in a crisis. We argue that such a capital line commitment can substantially lower the costs of holding an equity capital buffer for banks, as it allows banks to only raise costly equity capital when they need it.[8] Moreover, this form of contingent capital provides a simple and remunerative way for long-term investors to implement counter-cyclical equity investment strategies, whereby they may increase their weighting in a stock when its price is below trend.

Interestingly, this type of investment is similar to one already profitably implemented on a large scale by the legendary long-term investment fund *Berkshire Hathaway,* who is selling insurance against sharp market downturns in the form of long-term index put options. Indeed, Berkshire Hathaway disclosed writing substantial amounts of equity-index put options on four major indices (S&P 500, FTSE 100, Euro Stoxx 50 and Nikkei 225) for periods lasting up to a decade.[9] These

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[5] This is a huge amount, even compared with the $35.5 trillion aggregate market capitalizations of the stock exchanges of these areas.

[6] Furthermore in Switzerland Contingent Capital is the only other form of capital besides common equity that will count towards regulatory capital.

[7] And what is true for banks could also be true for other companies.

[8] An early proposal that is close in spirit to ours by Kashyap *et al.* (2008) is to allow banks to purchase capital insurance from non-bank counterparties. They suggest that the trigger for the insurance payment be based on a 'systemic' event, and recommend that counterparty risk be eliminated by requiring the insurer to post collateral invested in Treasuries. The key differences of their proposal relative to ours is in the choice of the automatic 'systemic' trigger they favour and in the potentially more complex pricing problems posed by this solution.

[9] Berkshire Hathaway discloses in its annual reports of 2007, 2008, 2009 and 2010 positions in excess of $37.1 billion and premium revenues of $4.9 billion. Furthermore, Warren Buffett argues in the report that these options were mispriced at inception, as they were based on theoretical models that did not reflect plausible movements in major market indices. For example, he highlights that if Berkshire sells a 100-year $1 billion put option on the S&P 500 at a strike price of 903 (the index's level on 12/31/08) and if one assumes a possible crash in the index of 100% with a probability of 1% over a 100-year period, then the borrowing cost to cover Berkshire's loss in this event on its put options would come to only 6.2%.

options are in principle available to any investor and serve a similar purpose as the put options on bank equity described above.

One concern with the types of put options written by Berkshire Hathaway is that the buyer of such options exposes itself to both market risk and counterparty risk. In the case of Berkshire Hathaway counterparty risk concerns are mitigated by the large pool of cash that it holds and by Warren Buffett's reputation. The typical writer of puts, however, has to be able to reassure buyers about counterparty risk and cannot rely on such a stellar reputation as Berkshire Hathaway. Our main proposal is thus to deal with this counterparty risk by *collateralizing* the put with cash. This can be done straightforwardly by letting the bank issue a 'reverse' convertible bond, whereby the issuer, rather than the investor, gets to decide whether to convert the bond into equity. By issuing such a bond the bank effectively gets the investors in contingent capital to 'assign' upfront the cash necessary to purchase the equity. We underscore the nature of this instrument as an equity capital commitment for the issuer by referring to it as a *Capital Access Bond* (or CAB).

In the remainder of the paper we begin by setting the analysis of CABs in the broader context of recent debates on the optimal design of bank equity capital regulation in Section 2. We then describe in greater detail how our proposed contingent capital contract might be structured in Section 3, and how it can both help banks hedge their equity-market risks, provide a high return to long-term investors and implement regulators' objectives in Section 4. We then compare our contingent capital contract to the other recent proposals and discuss in what respect our approach may avoid some of the instability problems of other contingent capital solutions in Section 5. Finally, we discuss some refinements and other issues in Section 6.

2. CONTINGENT OR STRAIGHT EQUITY CAPITAL?

There has been considerable debate recently on the appropriate level and form of bank regulatory equity capital. Prominent commentators, in particular, Admati *et al.* (2011), Greenspan (2010) and Hanson *et al.* (2010), have called for minimum capital requirements (book equity to asset ratios) in excess of 14%, far higher than the current minimum requirements under Basel III. Undoubtedly, such high ratios will go a long way in protecting bank regulators against future bail-outs. Corrective action in poorly performing or troubled banks will occur more promptly, and the equity capital cushion is more likely to be sufficient to cover bank losses when intervention occurs, without requiring further bail-outs or bail-ins. Such high levels of equity capital would clearly provide an important benefit in terms of greater financial stability. There is little disagreement about this benefit. The debate is more about the costs of such high equity capital requirements.

Banks argue that it will become much more difficult to meet the return on equity (ROE) demanded by shareholders with such high capital requirements and that as

a result a significant credit crunch may be caused by such a sharp increase in required capital (e.g. Ackermann, 2010). There has been considerable debate and confusion around this assertion. As Admati *et al.* (2011) and others have pointed out, under classical Modigliani and Miller perfect capital markets reasoning the required ROE should be lower when bank leverage is lowered, as bank equity is then less risky. Hanson *et al.* (2010) also argue that even when one accounts for the tax deductibility of interest payments, an increase in required equity capital only translates into a small increase in banks' weighted average cost of capital (WACC).[10] By these analyses it is difficult to understand why there has been such resistance by banks to the proposed sharp increases in regulatory capital.

But, as Stein (2010) notes, 'this calculation comes with a number of caveats. First, and perhaps most important, it should be thought of as capturing the long-run steady-state costs of having to hold more equity on the balance sheet, while disregarding the transitional flow costs associated with raising the required new equity. Given the adverse selection problems associated with new equity issues (Myers and Majluf, 1984), these flow costs may be significant.' There is indeed a very large empirical literature in corporate finance that finds large costs of issuing new equity over and above the classical WACC (see, e.g. the surveys by Eckbo *et al.* (2007) and Ritter (2003)). These costs comprise the underwriter's fees, the under-pricing of the equity issue, and the negative stock price reaction to the announcement of a new issue (the Myers and Majluf 1984 dilution costs). Some early estimates of the total fixed cost of a new equity issue exceed 21% of the market value of the new issue for firm commitment offers, and 31% for best efforts offers (see Ritter, 1987). Estimates for more recent issues are somewhat lower, but they remain very large, so much so that corporations very rarely choose to tap equity markets with new issues (see again Ritter, 2003).[11]

Admati *et al.* (2011) do not deny that these dilution costs of equity exist, but argue that

> While information asymmetry might make the issuance of equity more costly, it does not follow that this is a valid reason to allow high leverage and to argue against higher equity requirements. First, equity issuance is less needed and is less costly when banks use less debt financing on an ongoing basis, such as would be the case if equity requirements were significantly higher. In that case retained earnings, which do not entail issuance costs and which will be more plentiful with lower debt service requirements, can be used to maintain or even grow banks' operations. Second, regulators can mitigate issue costs associated with asymmetric information by removing banks' discretion over payout and issuance decisions.

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[10] In their estimate a percentage point increase in equity capital only raises WACC by 2.45 basis points when one takes the coupon on long-term debt to be 7%.

[11] The estimates underlying our ROE assumptions taken from Calomiris and Himmelberg (1997), are between 2% to 6% of the market value of a new issue for investment banking fees, plus another 10% in under-pricing of an issue, and finally another 2% of the total equity value lost in the negative price reaction from the issue.

These could well prove to be true observations, but in the absence of any solid empirical evidence they remain largely speculative. Note, in particular, that although, equity holders face lower risk when the bank is less levered, dilution costs (due to balance sheet opaqueness[12]) from new equity issues could be just as high as when the bank has higher leverage.[13] In addition, a dividend cut or a reduction in payout, also comes with a substantial negative impact on equity value, as a large corporate finance literature on dividends has established (see Allen and Michaely, 2003). Finally, removing discretion over payout and issuance decisions is unlikely to significantly reduce information dilution costs, as investors will continue to worry about the quality of the claims they are holding or purchasing. What is more, it is not entirely clear how discretion over equity issuance can be removed. A bank can always refuse to issue new equity and simply comply with the higher equity requirements by selling assets. It is far from obvious how regulators could stop such compliance through such asset sales.

All in all, the existing evidence shows that there are significant costs of issuing equity over and above the Modigliani and Miller risk-adjusted required ROE. Even if these costs can be brought down through such regulatory intervention as suggested by Admati *et al.* (2011), they will remain significant. Because of these costs we show in this paper that there are efficiency gains from allowing banks to rely at least in part on contingent capital financing to meet their prudential regulatory requirements, as is the case currently under the new bank regulatory regime in Switzerland. We focus our discussion on CABs, which do not have some of the design flaws of other contingent capital instruments, but our analysis of the benefits of contingent capital applies more broadly to other existing contingent capital instruments.

There are three major advantages of contingent capital over straight equity capital. First, by purchasing a capital line commitment – a form of insurance policy – banks can guarantee that they will have the required capital when it is needed. As Bolton *et al.* (2011) show, such an *ex ante* capital line commitment dominates a straight equity buffer, if the economy is composed of two investor clienteles, short-term investors and long-term investors. In our quantitative analysis of CABs in Section 3 we do not build in the full formal model of Bolton *et al.* (2011), but the basic argument is the same: CABs improve the pay-offs of both long-term investors, who get to implement a counter-cyclical investment strategy, and banks' pay-offs, as banks are then able to originate a higher volume of profitable loans with the same equity-capital base. In other words, CABs allow banks to avoid paying the extra cost of an equity issue with probability one. By purchasing a commitment to issue new equity when it is needed, they are able to lower the probability that they will

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[12] Note also that banks' balance sheets in 2007–2008 were so opaque that even the biggest losers appeared to have sufficient regulatory capital. See Haldane (2011).

[13] Indeed, in Myers and Majluf's (1984) article equity dilution costs of new equity issues are derived for an all equity firm.

pay this cost. At the same time, long-term investors get to extract an insurance premium for implementing their counter-cyclical investment strategy (that is, for writing a put option on the bank's equity). As Bolton *et al.* (2011) show, the gains from trade arise from the fact that long-term investors have a lower cost in shouldering the burden of supplying equity capital in a crisis. As long-term investors they are natural providers of insurance and can extract an insurance premium. By requiring banks to hold an equity buffer, regulators are in effect denying banks' access to capital insurance, a more efficient risk-sharing contract.

A second, more subtle, advantage of CABs also highlighted in Bolton *et al.* (2011) is that by setting a (strike) price for a contingent equity-issue long in advance the issuer can reduce equity dilution costs *à la* Myers and Majluf (1984). Indeed, as the bank is less likely to have an informational advantage over investors about its distant future balance sheet, the risk of *adverse selection* for the investor in a CAB is reduced. This advantage plays an important role in the analysis of Bolton *et al.* (2011), as it ensures that there could be gains from trade *ex ante* in the form of a contingent capital issue even though *ex post* the adverse selection problem is so severe that no new equity issue is feasible in the crisis state. This dynamic adverse selection effect underscores another insurance advantage of equity capital commitments through contingent capital issues. In our quantitative analysis in Section 3, however, we do not take account of this benefit.

A third advantage of contingent capital, which is outside the scope of the analysis in this paper, is that it helps overcome a major drawback of bank equity capital regulation, namely its pro-cyclical amplification effects. As the costs of building or maintaining a capital buffer fall in boom times and rise in recessions, bank lending may amplify rather than dampen boom-and-bust cycles (see e.g. Repullo and Suarez, 2010). In particular, in recessions when it is extremely costly to raise outside equity, banks mostly scramble to meet their capital requirements by cutting lending, selling assets and deleveraging. In the process they amplify the recession by contributing to lowering 'fire-sale' prices of assets. The most compelling evidence to date of these pro-cyclical effects of capital requirements on bank lending is by Jiménez *et al.* (2011). They exploit a 'natural experiment' in Spain around the introduction of a new counter-cyclical capital–buffer prudential regulation as well as a detailed panel dataset of all bank loans to firms, to determine how changes in regulatory capital constraints affect bank lending. As they point out, this policy experiment allows for exceptionally accurate identification. They find that when capital constraints become tighter banks uniformly respond by cutting back lending; they never respond by relaxing the constraint through a new equity issue. Moreover, the countercyclical capital constraints unambiguously contribute to dampening credit supply cycles.

One way of implementing countercyclical capital constraints is through contingent capital issues, and more specifically through CABs. Indeed, by providing a capital line commitment, a CAB gives the bank the option to issue new capital at

favourable terms in a recession and thus to relax its capital constraint. Effectively, a CAB is a form of countercyclical capital constraint but with the added flexibility that the issuer can decide when it is appropriate to relax the constraint, thus reducing the risk of regulatory error and the pressure on regulators to decide when it is appropriate to relax the capital constraint. Moreover, under a CAB relaxing the capital constraint takes the form of a recapitalization, which further strengthens the bank's balance sheet in a downturn, while under the dynamic provisioning policy in Spain, the relaxation of the capital constraint takes the form of allowing banks to eat into their capital buffer in downturns.

Admati *et al.* (2011) strongly support a substantial increase in equity-capital requirements and argue that 'Approaches based on equity dominate alternatives, including contingent capital'. However, the declared superiority of equity capital over contingent capital does not follow from their basic logic. Indeed, they explicitly point to the fact that in terms of outcomes in a crisis state the balance sheets of a highly capitalized bank and a lower capitalized bank, but with added contingent capital, can be identical (see their Figure 5). It is only in the pre-crisis state that the two balance sheets look different. Our argument is that when there are equity-issuing costs over and above the risk-adjusted required ROE then the balance sheet of the bank with contingent capital is more efficient. The extent of the efficiency gain, of course, depends on the size of this issuing cost. If this cost is lower the net benefit of contingent capital is smaller, but still remains positive. In the end Admati *et al.* (2011) simply assert that contingent capital is too complicated and that straight equity capital requirements are simpler and more effective. Their criticism is targeted at some of the design flaws of other contingent capital instruments and does not directly apply to our design of CABs.

3. CONTINGENT CAPITAL AND CAPITAL ACCESS BONDS

The design of contingent capital we are proposing in this paper, a *capital access bond*, gives the issuer of the bond the unconstrained right to exercise the option to repay the bond in stock at any given time during the life of the bond. This instrument is straightforward to set up, easy to value, and hence potentially a highly liquid and marketable derivative. It is effectively an option to issue equity at a pre-specified price, with the added feature that the writer of the option puts up collateral to guarantee that it is able to fund the purchase of new equity should the buyer of the put option choose to exercise the option. Indeed, by structuring the bond in this way, the issuer effectively gets the seller of the put (the investor) to assign cash upfront as collateral.

More specifically, under a CAB the bank would issue a bond of a given maturity (say, ten years) with a promised redemption at maturity in the form of either a given amount of common shares, or cash. At maturity, if the stock price falls below the *strike price* – which is simply given by the principal payment divided by the number of shares the issuer must deliver in lieu of the principal payment – the issuer will choose

to deliver shares rather than cash, and if the share price is above this strike price, the issuer has a strong incentive to repay in cash. Up to expiration of the bond the bank can at any time choose to exercise the option by paying back the bond in full with shares. Converting the bond into equity before maturity, however, involves an opportunity cost (namely giving up the option not to convert at a later date). Therefore, the issuer will only do so if the stock price falls sufficiently below the strike price. Finally, as long as the issuer has not exercised the option to repay in shares it pays a periodic coupon, which represents the sum of the regular coupon on a bond and the insurance premium on the contingent capital commitment.[14]

3.1. Valuing the capital access bond

The CAB is a relatively simple instrument: it is like a plain vanilla convertible bond, with the key difference that the option to convert resides with the issuer and not the investor. Given that it is a relatively standard derivative product, it is straightforward to value using standard option pricing tools, as we discuss next. The main difficulty in valuing this instrument relates to the combined options the issuer has, to both call the bond any time before maturity, and to convert the bond into equity. A 'back-of-the-envelope' approach to valuing a CAB is to treat it as a combination of a callable bond and a put option, with the payment of the put premium and call premium spread over the life of the product in the form of regular coupons. We illustrate how to price a CAB using this approach and also using a more rigorous approach based on the classic trinomial tree method in a numerical simulation using reasonably accurate parameter values for the current market environment (see Table 1 below).[15]

3.2. Valuation by replication

After selling a capital access bond as specified in our numerical example the issuer is effectively long two put options on the bank's own stock (as the conversion ratio

Table 1. Parameter values for numerical resolution

Principal payment: $100	Issuer's spread[a]: 1.5%
Initial stock price: $100	Strike price: 50% of initial stock price
Maturity: 10 years	Stock volatility: 35%
Conversion ratio: 2	Bond volatility: 5%
Treasury yield: 2.50%	Dividend yield[b]: 2%

[a] The issuer's spread is based on the CDS spread for the firm (equal to 90 basis points for a 1.50% default hazard rate).

[b] Continuous dividend rate.

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[14] Note that the bond cannot be called by the issuer before maturity by paying the principal back in cash.

[15] In addition, for a more rigorous 'state-of-the-art' approach to price the CAB, we refer the reader to Appendix 2.

is 2 in our numerical example) and long one option to call the bond at par. Using the parameter values above as inputs in the classic formulae for respectively American put and call options, we obtain that the two American put options are worth $18.30 and the American call on the bond is worth $1.05, which together amounts to a total of $19.35.[16] The issuer must therefore transfer the combined value of these two options to CAB investors to make them whole. The CAB-holders may obtain this value in the form of an additional spread on each coupon. Thus, if we turn the $19.35 into 20 equal semi-annual payments,[17] we obtain an additional annual coupon spread of 2.37%.[18]

But, given that there is a positive probability of conversion and that the payment of the option premiums is suspended upon conversion, this estimate must be adjusted so that the expected option premium payments received by the investor (taking into account the probability of conversion) are equal to 2.37% per year, which by our calculations amounts to an annual coupon of 3.08%.[19] The latter estimate is obtained by using the probabilities of conversion at the end of each time period, which we derive from the price conversion frontier at which the issuer must be indifferent between converting or not converting the CAB. However this ballpark figure is likely to overestimate the size of the coupons,[20] we thus turn to a more rigorous dynamic programming approach.

3.3. Valuation using a classic trinomial tree

We take a standard dynamic programming approach based on a trinomial tree to describe the possible time paths for the stock price for the whole time period of the CAB. Under this tree there is at any date (or node) a possible constant upward increment in stock price, a downward increment, and no change in price with

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[16] Note that exercising the option to call the bond here means that the issuer redeems at par at a dollar value equal to the strike price.

[17] This transformation is simply finding x, such that 20 equal payments of x uniformly distributed over 10 years have a total present value of $19.35 with the appropriate discount rate (10Y Treasury rate + issuer's spread)

[18] We here and in the rest of the paper use the market convention to convert semi-annual coupons into annual payments by simply multiplying by 2 the semi-annual payments.

[19] Adding the Treasury yield and the Issuer's spread to this additional annual coupon, the total annual coupon amounts to 7.08%.

[20] Adding the issuer's spread to the call and put premiums is excessive as the default risk is already partly incorporated in the put premium (which means that we are double-counting the default risks). Put differently, if the firm goes bankrupt or decides to convert, then the bond part of the product disappears. On the other hand, the put premium does not totally reflect the risk of default (as the CDS spread does). Thus, in order for the risk of default to be properly reflected in the coupon, a fraction of the CDS spread must be added to the put premium. Although, it is difficult to precisely define this extra coupon, what is clear is that the CAB would have a bigger coupon than subordinated debt: from the investor's perspective, subordinated debt offers a better protection (and so the CAB should offer a better yield to compensate for this) and from the issuer's perspective, the CAB mitigates the costs of bad states of the world (and so the issuer should be willing to pay a premium compared to subordinated debt).

given constant probabilities.[21] Following each change in price the issuer can decide whether to convert the bond into stock, or whether to continue servicing the bond. As long as the issuer decides to continue servicing the bond it retains the option to convert into equity, but once conversion has been decided the CAB is forever converted into equity. This trinomial tree approach gives the same result as when solving the differential equation for the CAB numerically. A similar approach has been used by Glasserman and Wang (2009) to price their CoCo instrument. As one might expect, the only time when the issuer may choose to convert is just before a coupon distribution.

Using the same parameter values as above, this approach yields an annual coupon of 5.76%. One way to make this tree more realistic is to add a positive probability to jump to 0 at each time step. This corresponds to a sudden bankruptcy of the bank.[22] When we do this valuation with a probability of a sudden default (or jump to 0) of 0.5% per year, we get an annual coupon of 6.28%.[23]

The conversion price frontier over the life of the CAB at which the issuer prefers to convert is plotted in Figure 1[24] and the conversion probabilities[25] at each pre-coupon date are plotted in Figure 2.

Note that in the early years of the CAB, conversion takes place only at very low prices (around $30). The reason is that there is a valuable put option built into the CAB: by delaying conversion the issuer preserves the valuable option not to grant
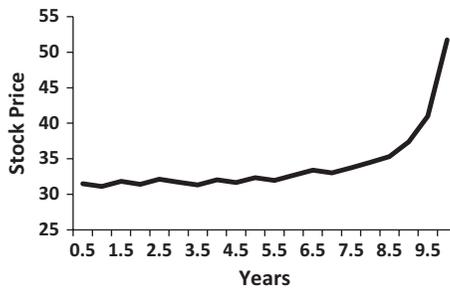

Figure 1. Conversion frontier for the issuer

[21] In other words, we build a classic recombining trinomial tree with constant volatility and discrete dividend. In our computation we used Matlab with 1,000 time steps. More details are provided in Appendix 1.

[22] Indeed, had the firm seen such a bankruptcy arrive, it would have definitely converted the CABs before. Hence this sudden default probability should only be a fraction of the default probability as given by the CDS spread of the firm.

[23] Other valuation models include the state-of-the-art method performed by Ito33, see Appendix 2. Another valuation exercise we could have tried is replicating the CAB by using a *down-and-out* put option with a *knock out* barrier at 0 to capture that the CAB will definitively be worth 0 when the stock price reaches that level. Furthermore, a natural way of also computing jumps would have been to perform a Monte Carlo simulation. We could further complicate this model to get even more accurate prices by adding local volatilities depending on the level of the stock price. We could also allow for jumps in stock prices that do not necessarily go to zero but which increase volatility.

[24] The sensitivity of the conversion frontier to the volatility parameters is provided in Appendix 3.

[25] In order to compute these conversion probabilities we have simply computed the probability of each node in the tree of being reached without taking into account the paths which crossed the conversion frontier before reaching the given node.
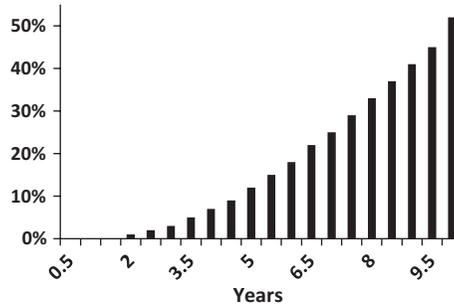
Figure 2. Conversion probabilities

an equity share to the investor, which may turn out to have a high value. Given that the initial stock price is at $100, it is very unlikely that the price will drop in a very short time period below $30.[26] This is why the probability of conversion is essentially zero in the early years of the CAB, and gradually rising thereafter (see Figure 2). As we highlight in Section 4, this feature of the CAB is the main reason why the risk of investing in a CAB is small. It is also worth emphasizing how much more flexible the CAB is relative to a contingent capital instrument with an automatic conversion trigger. Indeed, the latter instrument is likely to result in excessive conversion early on.

3.4. Five caveats and a remark

Although this valuation approach is likely to deliver reasonable estimates in practice, five caveats are nevertheless in order.

1. *Equity-capital constraints*: First and foremost, this valuation model does not take into account any regulatory equity-capital constraints the bank faces. Should the bank approach its equity-capital constraint (e.g. because it faces an unexpected highly profitable investment opportunity) it may want to convert the bond even if this raises the value of the security to investors, simply as an expedient way of relaxing that constraint. The CAB valuation estimates from the model would have to be adjusted to take account of this potential benefit to CAB holders.

2. *Signalling effects*: As the bank may be perceived by the market to have superior information about its underlying asset volatility and earnings growth its decision to convert may itself involve signalling effects. For instance, the bank could choose not to convert simply to be able to signal a higher equity value to the market. On the other hand, not converting when the market expects conversion

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[26] Note that in year 10, the only conversion time would be the day before maturity (it then maximizes the possible non-payment of the total coupon). On that day, the conversion price could even be $53.14. The issuer then has the choice between issuing two shares which are worth $106.28, and thus avoid paying a semi-annual coupon of $6.28 and possibly the nominal value of $100 the day after.

could be counter-productive as it would signal irrational behaviour by the bank, and thus be taken as a 'red flag' by investors. In short, there will undoubtedly be signalling effects, which will bias bank's conversion decision. However, it is far from obvious *a priori* in which direction the bias will be, and how large it will be.

3. *Jumps in stock price*: Our valuation model assumes that the stock price dynamics are smooth and takes volatility to be constant. In practice, however, the price may jump down in the event of a crisis and/or volatility may increase sharply at the onset of a crisis. We have excluded these elements from the model mainly for expositional simplicity. It is straightforward to generalize the underlying price dynamics to allow for jumps in stock price and time-varying or stochastic volatility. Other things equal, conversion is more likely following a jump down in stock price or as the probability of a negative jump increases. Thus, at the onset of a crisis the conversion probability may increase, so that the bank is more likely to 'draw down its line of equity capital'. On the other hand, a higher volatility increases the value of the option to delay and thus ought to reduce the probability of conversion.

4. *Public interventions*: Our valuation approach assumes away any public intervention in the bank in the form of a bail-out or the like, which would distort the dynamics of the underlying stock price. To the extent that bail-outs tend to prop up stock prices they reduce the incentive for the bank to convert. But, conversion reduces the need for a bail-out. All in all, how to take account of such interventions is far from obvious *a priori*.

5. *Price feedback post conversion*: Our valuation model assumes an exogenous process for the stock price. However, the issuer's actions may have an impact on stock prices, resulting in endogenous price dynamics. For instance, when the bank converts a CAB, the resulting recapitalization at favourable terms ought to have a positive impact on stock price. Again, by ignoring this feedback we err on the side of underestimating the value of the CAB. Generally, any actions of the bank that endogenously affect stock price dynamics will give rise to price distortions. This is well recognized and true for all options, including executive stock options and convertible bonds. While option valuation models can be modified to take account of endogenous price dynamics, it is also possible as is often done in practice to simply adjust the value estimates from the model on an ad-hoc basis. Thus, although the valuation model above may not be fully accurate it is still an indispensable guide to the valuation of CABs.

We conclude this section with an important remark concerning dilution effects of conversion for existing shareholders and the possibility that there may by multiple self-fulfilling equilibria around conversion, as pointed out by Sundaresan and Wang (2010). The CAB is like an American put option, and as such has a well-defined unique conversion frontier. Note also that the economic reason why Sundaresan and

Wang (2010) obtain multiple conversion equilibria for contingent capital instruments with an automatic conversion trigger is absent for CABs. The basic economic reason why there may be multiple equilibria in Sundaresan and Wang (2010) is that conversion has the effect of diluting existing shareholders, and therefore to depress the stock price further. This is why expectations of conversion can become self-fulfilling: if the market believes that conversion will take place, the price goes down, which triggers conversion; vice versa, if the market believes there will be no conversion, the price remains above the trigger point and the market is again confirmed in its beliefs. Under a CAB, however, conversion is not automatic and there is no positive transfer of value from shareholders to CAB holders at the optimal conversion point (that is, why there is no dilution of existing equity holders upon conversion of the CAB). In other words, the issuer will not choose to convert the CAB if this lowers the value of equity.

4. A 'COASEAN BARGAIN'

Having outlined how to structure and value a CAB, we now turn to the analysis of why CABs are a *Coasean bargain*, making all interested parties better off, issuing banks, investors and regulators. Issuers are able to maintain an adequate equity capital cushion in bad states of the world at a lower cost than issuing straight equity upfront. Long-term investors obtain a higher return on investment in CABs than the coupons earned on regular debt instruments by accepting some downside exposure. And, regulators can achieve greater stability of the banking system, with a lower risk of bail-outs.

4.1. Expected gains to issuers

Issuing contingent capital in the form of a CAB, instead of issuing straight equity, to achieve the same equity capital ratio in a bad state of the world lowers the bank's cost of capital as we now illustrate. Using the same parameter values as in our numerical simulation in Section 3, we compare the expected cost of a contingent capital issue at time zero over the entire 10-year period of the model, to a straight equity issue of the same value.

   To determine the expected cost of the contingent capital issue, we first compute for every time t the total costs incurred by the issuer if she converts at time t. By converting at time t, the issuer will have paid the coupon on the CAB[27] between time 0 and time t, and subsequently (from time t to 10) will pay the return on equity on the new shares issued to the holder of the CAB. Second, by summing the coupon payments and the future costs of the equity newly issued we obtain the total

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[27] The costs incurred by the issuer up to time t include both the payment of the put premium and the coupon for a regular bond.

costs to the issuer for a conversion at time t. Finally, by taking expectations for all possible conversion times, we obtain an estimate of the expected cost of a contingent capital issue.

Our estimate of the cost of a straight equity issue, in turn, is given by the cumulative required return on equity (from time 0 to time 10) times the amount of equity issued with the appropriate discounting. As the large body of theoretical and empirical corporate finance literature following Myers and Majluf (1984) has established, the required return on an equity issue is significantly above the return on equity from the CAPM.[28] Indeed the required return on equity corresponds to the external cost of equity financing for the bank.[29] Our ballpark numbers for the required return on an equity issue are 10% on the low side and 20% on the high side. The annual coupon of 6.28% we use for the CAB is the one obtained in the trinomial tree model with a jump to 0. With a 10% required return on equity the cost of a contingent capital issue is 33% less than the cost of a straight equity issue for our parameter values (respectively 50% less taking account of the full tax deductibility of coupon payments), and the reduction in expected cost is even bigger with a 20% required rate of return, since it amounts to 58% (respectively 67% taking account of full tax deductibility) (see Table 2 below).[30]

These estimates (which, admittedly, are only based on a partial equilibrium analysis, and do not take into account any possible effects of either form of financing on the costs of the other capital raised by the bank) give an idea of the benefits for an issuer of a CAB issue. They are conservative given that we take the same ROE for a classic equity issuance and for an equity issuance through conversion of a CAB. The under pricing cost is likely to be lower for CABs since there is probably

Table 2. Comparison of the costs of a regular capital issue and a CAB issue

Costs (present value in $)	Regular capital issue	CAB issue	Cost impact	CAB issue with tax deductibility	Cost impact with tax deductibility[a]
ROE = 10%	88	59	−33%	44	−50%
ROE = 15%	131	66	−50%	51	−61%
ROE = 20%	175	73	−58%	57	−67%

[a] See Section 6 for further discussion on tax deductibility.

[28] See, e.g., Bolton and Freixas (2006) for a theoretical model of bank equity issuance under asymmetric information in the line of Myers and Majluf (1984). As for empirical studies of the costs of equity issuance including costs due to asymmetric information see, e.g., Eckbo *et al.* (2007).

[29] This ROE can be broken down as follows: ROE = Risk-free rate + β*Risk Premium + Investment Bank Fees + Under-pricing at issuance + Negative stock price reaction. The investment bank fees, for instance, vary from 2% to 6% of the issued capital. The under-pricing usually accounts for another 10% of the issued capital. The negative price reaction is estimated to be about 2% of the total equity value on average (see again Eckbo *et al.*, 2007).

[30] Note that these calculations do not include some additional costs for CABs that are bound to be present in practice, such as a possible volatility premium demanded by the market as well as bank fees for issuing the CAB. However, given the large cost advantage found for the CAB, it is unlikely that accounting for these charges would reverse our conclusion that CABs are a more efficient source of capital than straight equity issues.
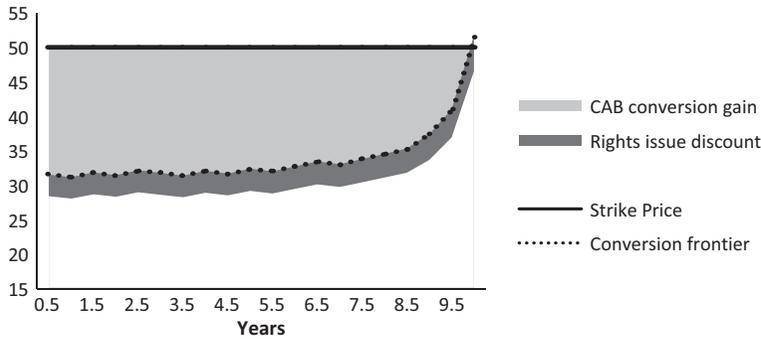
Figure 3. Gain of converting CAB compared to a discounted rights issue

less asymmetry of information at the time of issue about the future asset values of the bank (see Bolton *et al.*, 2011).

The *ex post* gain for the bank of converting CABs once the stock price reaches the conversion frontier, can also be compared to the discount required for a new rights issue at that time. Considering a discount of 10%, Figure 3 shows how favourable the CAB conversion is relative to a discounted rights issue.

There is also a gain of using CABs over other Contingent Capital (CoCo) instruments, but this is difficult to quantify as there is no standard pricing model available to value CoCo instruments with an automatic conversion trigger. While other CoCo instruments share with CABs the main benefits over straight equity, their design flaws introduce unnecessary uncertainty around the trigger point, as well as valuation opacity. We discuss these issues at greater length in Section 5.

4.2. Expected gains to long-term investors

The coupon rate (6.28%) we have chosen for the CAB already offers actuarially fair terms to CAB investors. Note also that in light of the substantial net gains for the issuers of CABs, they can afford to offer even more than actuarially fair terms to attract investors. Judging by the large oversubscription of some contingent capital issues, this is likely what existing issuers (e.g. Credit Suisse) of contingent capital have done. Given that pretty much any investor in a CAB would gain given the terms we specified, we have already established that the CAB would be a Coasean bargain for issuers and investors. Having said this, it is also interesting to show how much long-term investors – who at the margin face a choice of either holding cash and liquid fixed-income securities, or holding CABs – would gain from investing in CABs. For these long-term investors CABs should be an especially attractive investment. By charging an insurance premium, these investors would be able to monetize their long-term commitment toward a counter-cyclical investment strategy.

To determine investors' expected return, we begin by calculating at each time node *t*, what we define as the *no-loss stock price* for the investor, should the issuer decide

to convert. The no-loss stock price is the strike price minus the sum of coupons received up to time *t*. The evolution of the *no-loss stock price* is plotted in Figure 4.

The reason why we focus on this no-loss price is that the investor only incurs a loss if the issuer triggers conversion *and* the stock price is below the no-loss stock price. Note that from time 0 to time 5, the conversion frontier is below the no-loss stock price, meaning that when conversion occurs the CAB investor actually incurs a loss, while from time 6 to 10 the no-loss stock price is below the conversion price, so that the CAB investor only incurs a loss if following conversion the stock price continues to fall below the no-loss stock price (see Figure 4).

The loss probabilities for a CAB investor from time 1 to 10 are given in Figure 5. This is an inverted V-shaped curve because the probability of conversion is very low in early years (see Figure 2) and the probability of a loss conditional on conversion is also low in the years close to maturity. By these estimates, an investor gets a 54% bigger coupon by purchasing the contingent capital security than from a regular bond (in our example 6.28% compared to 4% for the regular bond) for a probability of incurring a loss at any time until maturity that is less than 3.5%.
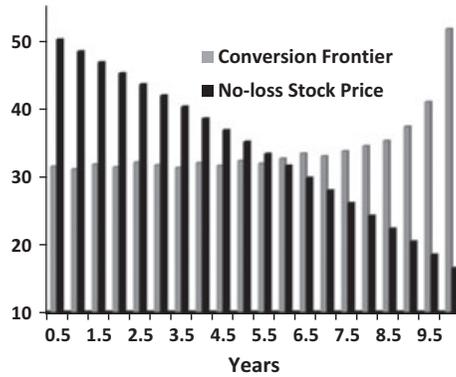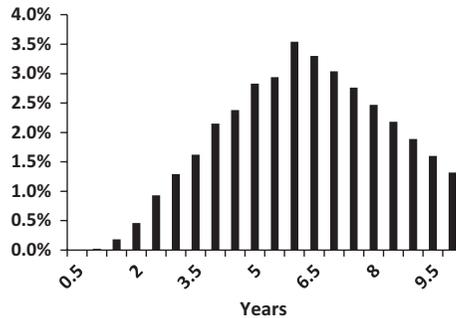

Figure 4. No-loss stock price

Figure 5. Loss probabilities for the investor

Sovereign wealth funds (SWF) in particular ought to be a natural clientele for CABs, as they currently are overweight in cash and short-term liquid securities. Moreover, SWF due to their long-term horizon, their low redemption risk, and their lack of explicit liabilities, are ideally placed to implement counter-cyclical investment strategies, selling stocks when their price is above trend and buying stocks in downturns. As the Norwegian government has notably argued in its Government Pension Fund Global Annual Report of 2008 (p. 19):

> The financial crisis has revealed that many institutions have based long-term investments on short-term funding. When this funding is no longer available, the time horizon for investments quickly becomes very short. Owners and investors have therefore incurred heavy realized losses.

> The situation for savings in the Government Pension Fund-Global is different. Its investments are not funded by borrowing, and the institutional framework provides a real assurance of a long-term strategy. Growing risk in the markets will not force us to make changes that result in realized losses for our owners. This long-term approach provides the basis for investment choices that safeguard the fund's long-term returns.

> The strategy for the fund means that more equities are purchased when equity prices fall, and fewer when they rise.

Investing in CABs is a simple way of executing such a counter-cyclical strategy, as ultimate equity ownership is contingent on conversion by the issuer in a downturn. A SWF would then not only earn a high return as long as the bond is not converted, but also be automatically set up to buy bank equity when equity prices are low. In particular, the fund would thus be able to monetize this equity investment strategy by charging an insurance premium for its commitment to purchase bank equity in downturns.[31] Additionally, as the owners of a significant part of global financial assets (which is expected to grow), SWF are particularly exposed to systemic financial crises. If contingent capital mechanisms were widely implemented by financial institutions, this could mitigate systemic risk while rewarding SWF investors. Interestingly the CAB also replicates the counter-cyclical strategies pursued by the governments sponsoring the SWFs.

Other CoCo instruments also have the property that they allow long-term investors to monetize a commitment to a counter-cyclical investment strategy. They also set investors up to increase their equity holdings in downturns. However, the challenge in valuing these instruments inevitably makes them less liquid than CABs, especially around the trigger point. Also, the exogenous noise introduced around the automatic conversion trigger inevitably results in a noisier implementation of a

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[31] By this analysis it is not entirely surprising that the main investors in contingent capital issued by Credit Suisse were Sovereign Wealth Funds.

counter-cyclical investment strategy. In particular, CoCo instruments with an automatic trigger do not generally replicate a dynamic counter-cyclical investment strategy. Note finally that CoCo instruments with an automatic trigger are a somewhat awkward way of attracting a more loyal long-term investor base, since investors in those instruments face the greatest uncertainty regarding the value of these instruments precisely at the times when their loyalty is most valuable to the firm.

4.3. Benefits for regulators

It is not really feasible to accurately quantify the benefits of contingent capital for regulators in a numerical example. Accordingly, we limit ourselves to a qualitative analysis of the benefits of contingent capital for regulators. The first point to recognize is that if banks were to raise a significant fraction of their capital in the form of contingent capital commitments, this would substantially reduce the need for regulators to step in by providing emergency lending or by recapitalizing banks. One might argue along the lines of Admati *et al.* (2011), that the reliance on bail-outs and lender-of-last-resort interventions can also be reduced by simply raising capital requirements. But to the extent that the higher costs of building and maintaining a high capital buffer relative to relying on contingent capital cut into banks' bottom line, banks would either be more fragile or would shrink their operations to avoid the high external costs of equity.

The second point is that there are other advantages of contingent capital commitments besides reducing the need for bail-outs in a crisis. We have already mentioned the advantages of contingent capital in terms of helping smooth bank lending over the business cycle. Another useful role of CABs for regulators is that, by observing the premiums banks are paying in the market on their capital access bonds, they would be able to learn both what the market's perception of the underlying risk is for an individual bank and what the capital insurance is worth to the bank. This information is best provided by CABs, which are easily priced and therefore more likely to be traded in a liquid secondary market than other CoCo instruments. The secondary market price of CABs in particular would, just as CDS spreads, provide valuable information to regulators as to the market's perception of the risk of a crisis.[32]

Given all these advantages of CABs, how could the Basel III regulatory framework accommodate contingent capital? Some of the main changes under Basel III concern the first Pillar, regulatory capital requirements and definitions.[33] The Basel Committee on Banking Supervision (BCBS) has also recently released a consultative document defining another set of rules which only concern SIFI (Systemically

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[32] Moreover, the observation of the 'volatility smile', which is the difference between the implied volatilities of the at-the-money option and the out-of-the-money option, would provide a measure of the probability of a crisis.

[33] The documents which form Basel III have been published since July 2010 and can be found on the webpage of the Bank for International Settlements (BIS).

Important Financial Institutions).[34] Perhaps the main change under Basel III is a significant increase in common equity Tier 1 capital requirements. In addition, the new definitions of regulatory capital are more stringent. For instance, Tier 2 regulatory capital must now include a write-down clause, or conversion into common equity, if the bank is deemed to be a *gone-concern*, that is, if the bank is *insolvent* or if the responsible authority has declared the bank non-viable without a capital injection or a write-down.

An unresolved question remains whether an additional contingent capital (CoCo) buffer should be added to current capital requirements, at least for SIFIs. This issue has been extensively debated among bank regulators, but so far only the Swiss bank regulatory authorities (FINMA) have chosen to pursue this approach, and have imposed substantial CoCo requirements on Credit Suisse, which has already complied with these regulations, and UBS. The BCBS has argued that contingent capital is an untested instrument that could come in many different forms, and concluded that SIFIs should be required to hold additional loss absorbency capital in the form of common equity Tier 1 capital only, with additional requirements ranging from 1% to 2.5% (far below the buffers recommended by Admati *et al.*, 2011 and Greenspan, 2010, and also far below the CoCo requirements of FINMA).[35] Still, the BCBS promises to continue to 'review contingent capital, and support the use of contingent capital to meet higher national loss absorbency requirements than the global requirement, as high-trigger contingent capital could help absorb losses on a going concern basis'. Similarly, the European Banking Authority (EBA) has required banks in Europe to meet a 9% core Tier 1 capital ratio by June 2012, and noted that 'newly issued private contingent instruments will be accepted if in line with strict criteria defined in a common European term-sheet to be finalised by the EBA'.

How will CABs be classified under Basel III? Currently a CAB will probably be classified as Tier 2 before conversion due to the 'non-perpetual' nature of the instrument. This is already the case for the Lloyds and the Rabobank CoCos. However, since the CAB is designed with a conversion ratio such that conversion will be triggered before the bank becomes a gone-concern (that is, before the Tier 2 holders incur losses) it would be more logical to have CABs ranked as higher quality capital than Tier 2. To comply with the spirit of Tier 1 classification, CABs could easily be modified to be perpetuities, but with an option for the bank to call (and repay in cash) the CAB after a fixed period (say, 10 years).

Note finally that, as far as CABs and CoCos are concerned, bail-ins (or gone-concern contingent capital) are a complementary regulation, a form of last resort resolution once all other measures, including conversion of CoCos or CABs have failed.

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[34] As A. Haldane (2011), a member of the Basel Committee has mentioned, Basel III will not make crises disappear. However, it should aim at smoothening them and make sure it is not the taxpayers who pay for the financial system's mistakes.

[35] More precisely, the indicator-based approach comprises five broad categories: size, interconnectedness, lack of substitutability, global cross-jurisdictional activity and complexity. Banks are then split into five buckets with respect to their obtained score which measures their global systemic importance.

5. PROS AND CONS OF OTHER FORMS OF CONTINGENT CAPITAL

In this section we further compare our CAB instrument to the other contingent capital instruments and proposals, and discuss their pros and cons.

5.1. Tier 1-based CoCos

Two first examples of contingent capital issues by banks have emanated from the UK. In November 2009, two banks issued different forms of contingent capital. First, the UK Treasury[36] put in place a contingent capital commitment of £8 billion with the Royal Bank of Scotland (RBS) under its *Bank Asset Protection Scheme*, to be exercised in the event that RBS' Core Tier 1 Capital Ratio falls below 5%. In return for this commitment RBS is paying the UK Treasury a 4% annual premium. This is really the simplest possible form of contingent capital: when RBS's Tier 1 capital ratio hits a lower bound, it gets automatically recapitalized with an injection of public money of £8 billion. Such a simple scheme, with in particular no arrangement to address possible counterparty risk, is only possible given that the counterparty is the UK government. As such, it is therefore not replicable when private (long-term) investors are the counterparties to the bank. Second, and more germane to our purposes, Lloyds has issued £7.5 billion against *Enhanced Convertible Notes*,[37] a form of subordinated debt (lower Tier 2 capital) with fixed maturities ranging from 10 to 15 years, convertible into common stock if Lloyds' core Tier 1 capital ratio falls below 5%. Since investors in these *Enhanced Convertible Notes* effectively agreed to exchange a more senior for a more subordinated claim, Lloyds' also agreed to pay a 1.5% to 2.5% coupon on top of the one that applies to the existing securities for as long as these notes are not converted into common stock.

These two forms of contingent capital share the feature that the conversion trigger is automatic and is linked to an accounting measure of the bank's Tier 1 capital ratio. This feature is also present in other proposals on contingent capital (see, e.g., Duffie, 2009). This particular feature has the drawback that the instrument is more difficult to value. Another concern with Lloyds' scheme is that the conversion trigger may have been set too low; so low that it is unlikely to be reached without a prior intervention by bank regulators to force the bank to recapitalize. Thus, investors have so far perceived and priced the Enhanced Convertible Notes as if the conversion probability was negligible.

In recent months contingent capital or CoCos have gained momentum with two other important issues. First, Rabobank, a Dutch cooperative bank, was the first to

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[36] RBS website: http://files.shareholder.com/downloads/RBS/613513065x0x328836/10a144e0-27ea-4c6c-98f3-f276aabfb460/031109.pdf

[37] Culp (2009).

issue a type of CoCo without 'forcing' investors to take them. Due to the particular shareholder structure of the bank (it remains a cooperative), the *Senior Contingent Notes* (SCN) Rabobank issued on 12 March 2010 have the specific feature that instead of transforming into shares, they face a 75% write-down and the remaining 25% are paid out in cash in the event the bank's equity ratio falls below 7%. However, since Rabobank is considered as one of the most conservative banks in Europe with an equity ratio of around 15%, this is considered to be a very unlikely event. As they put it in their press release[38] it is designed mainly to hedge against tail risk. Accordingly, the bank has been able to raise €1.25 billion at a yield of 6.875% and the issue was more than twice over-subscribed. Given that Rabobank is considered to be one of the safest banks in the market (triple-A rating) it is not clear whether other less secure banks would face demand for similar products.

The latest and probably most significant CoCo issue is the one by Credit Suisse. As the *Financial Times* has reported[39]: 'That makes the Credit Suisse deal all the more significant as the next step in the evolution of the market. Rabobank and Lloyds Banking Group have already issued forms of contingent capital but since Rabobank is a mutual, and the Lloyds deal was part of an exchange in stressed circumstances, unlike the planned Credit Suisse CoCo, the deals were not true tests of the market'. Credit Suisse has issued $2 billion of *Buffer Capital Notes* (BCN) on 17 February 2011 with a coupon rate of 7.875% per annum. The bonds convert into equity if the risk-based capital ratio falls below 7% at any of the calendar quarters and they have a 30-year maturity.

The $2 billion public issue was more than ten times oversubscribed although most bank analysts were saying that there would not be enough interest from market participants for this type of product. This last point shows that interest for contingent capital does indeed exist in the market. However, it has also been pointed out that the missing player in the order book was insurance money. The lack of a credit rating from the Credit Rating Agencies is probably one of the reasons some investors could not take part in this first real CoCo issue. Nevertheless, due to the strong interest for these products from market participants, it is probable that the Rating Agencies will find a way to assess CoCos in the near future.[40]

Despite the recent enthusiasm for Tier 1 triggered CoCos, they raise seven recognized concerns. First, their complexity: Tier 1 ratios are variables that are very difficult to compute and monitor under existing risk-weighted-asset (RWA) bank regulations. As Haldane (2011) has stressed, over 200 million calculations could be necessary to determine whether a bank is within its regulatory capital ratio. This is

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[38] http://www.rabobank.com/content/investor_relations/investor_news/Rabobank_succesfully.jsp

[39] http://www.ft.com/cms/s/0/87ce09e2-3867-11e0-959c-00144feabdc0.html#axzz1GFvlIXqQ

[40] At the same time Credit Suisse arrived at an agreement with strategic investors, Qatar Holding LLC and The Olayan Group, to exchange Tier 1 capital notes issued in 2008 against $6 billion of newly issued BCNs. According to the CEO of Credit Suisse Group this amount will allow them to satisfy 50% of their high trigger requirements imposed by the Swiss Regulator (https://mobile.credit-suisse.com/index.cfm?fuseaction=mOpenArticle&coid=293544&aoid=300208&lang=EN).

obviously time-consuming and banks can only compute this ratio every quarter. This leads to the second concern: Tier 1 triggered CoCos are subject to model risk. As shown in Appendix 4, model risk often plays a big role when a bank faces default. For instance from the graph of Appendix 4 we can see that RBS had provisioned four times too little capital to face trading losses due to model risk. This example points to the importance of model risk which is also present when computing RWAs for the Tier 1 ratio. Third, these CoCos lack *reactivity*: the conversion of such CoCos can only be triggered every 3 months at fixed dates, and, as recent events have amply demonstrated, three months can be a very long time. A fourth concern is the difficulty in pricing these instruments. The trigger is based on an accounting ratio and currently there are no models for the stochastic evolution of such a ratio. In normal times it might seem reasonable to approximate the trigger with a share price threshold since the option is out of the money and hence is not too sensitive to this approximation. However, in times of crisis, the option becomes very sensitive to parameter values and this approximation does not hold any more, so that the option cannot be priced with any degree of confidence.[41] Fifth, as Haldane (2011) shows in the graph in Appendix 4, the Tier 1 ratio is not a good predictor of an impending default event. Indeed, the banks that ended up in trouble in 2008 did not have Tier 1 ratios that would have triggered the CoCos. Sixth, this instrument could face a 'death-spiral' problem if stock markets, anticipating a conversion, drive down the stock price.[42] Seventh, the bank may choose to engage in costly fire-sales of assets to avoid conversion, which is too dilutive. In contrast, the CAB addresses all of these problems by simply giving the right of conversion to the issuer. This contingent capital instrument is simple, hence easy to price, liquid during crisis times, reactive and flexible and hence serves best its purpose to prevent a bank from defaulting.

5.2. Other recent contingent capital proposals

Contingent capital for banks has been actively debated by regulators, policy makers and academics in the aftermath of the crisis.[43] One simple early proposal similar to Lloyds' *Enhanced Convertible Notes*, was to have banks issue subordinated debt that is entirely and automatically converted into common equity if the ratio of *tangible* common equity to *tangible* assets falls below a pre-specified threshold (see Duffie, 2009). As Duffie argues, the focus on tangible assets would have the advantage of

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[41] A possible approach to pricing this product could be to formulate it as a *binary* option that would have a premium equivalent to the necessary discount to sell shares. Nevertheless, the strike of that option would be unknown and only estimated. Note that mispricing is likely to be less of an issue at the time of issuance since the probability of conversion at that time is low, whereas close to conversion, uncertainty around the product valuation would be maximal.

[42] Note that Ervin (2011) implemented a cap on the potential shares issued to limit the effect of a death spiral.

[43] The Basel Committee on Banking Supervision (2010) has studied various approaches of contingent capital and contingent capital has also been advocated by the Squam Lake Working Group (2010).

reducing accounting uncertainty on how capital is measured. He also suggests intro-
ducing a regulation requiring banks to undertake an automatic rights offering when
they approach the point where their holdings of cash and other liquid assets are
dangerously low. Although this scheme would ensure that banks are not over-lev-
ered in a crisis there are some potential concerns with the implementation of this
form of contingent capital. One problem with the automatic rights offering is that
banks would be left exposed to market risk. Also, even if accounting uncertainty is
reduced by focusing on tangible assets and common equity it is not entirely elimi-
nated. Moreover, these ratios are not continuously updated, and in particular, they
would not respond in time to a rapidly unfolding crisis.[44]

   This is why Flannery (2009) has proposed issuing contingent capital securities for
which the automatic conversion would be based on the stock price and take place if
the issuer's common equity *market value* falls below 4% of total assets. Flannery names
these securities *Contingent Capital Certificates* and argues that conversion would be more
sensitive to (rapidly unfolding) future adverse shocks and would be subject to less
accounting manipulation. Unfortunately, however, using the stock price as an auto-
matic trigger could give rise to other problems, as Sundaresan and Wang (2010) have
shown. In particular, valuing the Contingent Capital Certificates could be problem-
atic. To address some of these concerns they suggest amending the Contingent Capi-
tal Certificates by specifying a coupon indexed so that the Certificates always sell at
par. This, however, would substantially increase the complexity of the design of the
contingent capital instrument and would not reward the risk taken by investors.

   Another variant of Flannery's *Contingent Capital Certificates* proposed by McDonald
(2009) is to have two price triggers for conversion: one is the bank's own stock price
and the other is a financial stock index. As McDonald explains, the added benefit
of the second trigger is that conversion would only take place if the entire banking
sector is in trouble and not if only one individual bank is in trouble. This has the
merit of addressing moral hazard concerns, but, as we have argued, it also comes
at the cost of substantially increasing the difficulty of pricing and hedging these
contingent capital instruments. Moreover, there remains the potential difficulty in
pricing highlighted by Sundaresan and Wang (2010).

   Yet another alternative of Flannery's *Contingent Capital Certificates* proposed by Pen-
nacchi *et al.* (2010) would specify a (substantially) lower *conversion price* from the auto-
matic *trigger price* and also give equity holders an option to repurchase the converted
equity from the contingent capital holders, to reduce the risk of equity dilution post
conversion. Under this formulation, however, old shareholders need to find fresh
capital to fund their buyback of newly issued shares at a moment of financial
distress. This would probably come at some cost which could be of the same order
as the cost for a classic recapitalization.

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[44] To address this problem Glasserman and Nouri (2010) propose modifying Duffie's approach by only allowing for a partial
and ongoing conversion process as the bank's capital ratio deteriorates.

Other proposals for bank contingent capital focus less on security design and on implementation of contingent capital via marketable securities. Thus, Acharya *et al.* (2010) recommend that banks build up a special capital account through deferred dividend payouts. This capital would be invested in safe assets and would serve as a buffer in case of financial distress. Alternatively, Hart and Zingales (2009) propose that banks be required to raise equity when their CDS spreads rise above a given threshold. Also, under their scheme the prudential bank regulator would intervene if the CDS price does not move back to normal levels within a predetermined period following the equity capital injection.

6. REFINEMENTS AND OTHER ISSUES

There may be concerns with contingent capital about issuer incentives (moral hazard), stock-price manipulation, and possibly 'death spiral' risks. We briefly discuss in this section how the CAB can be tweaked to reduce or even eliminate these potential problems. We also briefly touch on some inevitable implementation complexities relating to the tax, accounting and regulatory treatments of contingent capital.

6.1. Moral hazard

How is moral hazard affected by the issuance of CABs? The answer depends on whose and what form of moral hazard one has in mind. First, concerning *moral hazard in lending*, an investor in CABs as opposed to bonds with an explicit or implicit *too-big-to-fail* (TBTF) guarantee is more likely to engage in due diligence, monitoring and prudent investing in a bank. As we have shown in Section 4, the coupon of the CAB must reflect the risk of conversion by the bank. Therefore, CAB investors will try to determine what that risk is and price it. This is in contrast to bond-holders, who will do little due diligence in a TBTF-bank, as they rationally expect that they will be repaid in full no matter what. Also, once CABs are issued and traded any increase in the underlying risk of conversion, due to mismanagement at the bank, will be priced in the secondary market. This information, in turn, can be a valuable tool to discipline management.

Second, concerning moral hazard of the issuer, one worry may be that CABs effectively 'soften' a *hard budget constraint* imposed on the bank in the form of debt financing. Any form of insurance (which is what CABs offer) may potentially come at the expense of incentives to maximize earnings. That is not to say, however, that any form of insurance is inefficient. There is generally a trade-off between risk-sharing and incentives. It is also worth emphasizing that as much as the disciplining effect of debt is well grounded in theory, it has not turned out to be a panacea in practice. The basic reason is that the price of debt and ratings agencies are slow to pick up the first signs of future poor performance due to bad investment decisions, and in the mean time the incentives for management to *gamble for resurrection* or invest in high beta

assets are huge. These incentives are somewhat mitigated by CABs, so that a mix of CABs and debt may well offer an optimal incentive structure for management.

Third, some of the negative incentive effects of CABs can be alleviated through more high-powered incentive schemes for bank managers and traders. For example, Barclay's has suggested that it might use CoCos instead of cash bonuses to reward its traders and executives.[45]

Fourth, in a dynamic setting the conversion of a CAB into equity is far from a pure incentive gift to bank shareholders. Indeed, post conversion the 'upside' of higher earnings for initial shareholders is lower, which creates incentives to avoid conversion.

Fifth, managers stand to lose their job after conversion, if the expanded shareholder base results in a change of control of the bank after conversion.[46] On balance, therefore, it is not obvious that the introduction of CABs will significantly worsen bankers' incentives to perform.

Relative to other CoCo instruments, the trade-off in terms of moral hazard with CABs is likely to be qualitatively similar to the trade-off between debt and CABs. To the extent that other CoCo instruments lead to dilution of equity holders upon conversion, they give the same qualitative incentives for management to avoid this outcome (or to gamble for resurrection) as debt. Thus, other CoCo instruments could have a benefit over CABs in terms of providing stronger incentives to increase mean earnings, but this benefit is likely to be small.

6.2. Price manipulation

A point that has been the source of a lot of criticism and confusion with CoCos is price manipulation. This is not so much a concern with CABs, as conversion is an optimal decision for the issuer, which therefore does not give rise to equity dilution and the potential of multiple equilibria in conversion. As Sundaresan and Wang (2010) have shown, this problem is present with other forms of contingent capital with fixed stock price triggers. Another way of seeing why this is not an issue with CABs is to observe that since conversion is an optimal decision to maximize the long-term value of bank equity, any short-term deviation of the stock price due to a liquidity shock, a freak 'flash crash', or possibly strategic shorting of the stock by bondholders hoping to force a conversion of the CAB will have little impact on CAB conversion. Therefore, share price manipulation is much less of a risk when the bank issues CABs.

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[45] See Cox (2010).

[46] See Himmelberg *et al.* (2011).

6.3. Strike price ladders

One concern raised by Von Furstenberg (2011) is that a CAB with a single strike price may be too rigid an instrument to deal with all the contingencies that could arise in a crisis. This is a well taken point, which can be addressed by having the bank issue multiple CABs with multiple strike prices, in effect offering a strike price ladder through which issuers can convert as a crisis deepens.[47]

6.4. Credit rating implications

The rating of CABs with an embedded put option is very likely to have an impact on their price, and in all expectation the rating agencies will err on the side of caution in rating these new products. Worse still, Moody's is likely not going to rate securities where conversion is either at the bank's option or tied to the activation of pre-specified triggers that are unrelated to the financial health of the bank. Indeed, a recent report by Moody's indicates that 'the unpredictable and non-credit linked elements surrounding these triggering events make the instruments unsuitable for a fixed income rating' (Moody's, 2010).

As for Standard & Poor's, it considers that conversion features based on regulatory capital increase the risk of loss to investors.[48] Therefore, CABs with such triggers would be rated by S&P 'at least one notch below a similar issue without the contingent capital trigger'. Also, S&P recommends the frequent tracking of the triggering capital ratio to protect more senior bond holders: 'If the issuer moves closer to the trigger point, we could lower the rating further to reflect the increased risk relative to other junior instruments in the issuer's capital structure.'

However, Fitch has moved forward and has rated the Credit Suisse CoCo BBB+. The other two agencies will now probably follow especially since the Credit Suisse issuance has faced so much demand. No rating agency wants to miss out on such a huge potential market. Note finally that as much as there may be a greater risk of loss for the holders of CABs, other (more senior) debt instruments receive greater protection with the conversion feature, as it provides an additional equity cushion to absorb potential losses. Therefore, these other debt instruments should logically receive a more favourable treatment by the rating agencies.

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[47] Similarly to what is sometimes done for classic convertible bonds, some banks already issued different tranches of contingent capital with different trigger levels. For example, Rabobank issued €1.25 billion of Senior Contingent Notes and $2 billion of Tier 1 perpetual capital securities with respective triggers of 7% and 8% for the equity capital ratio. Different tranches (coupled with a roll-over before maturity of the CAB) would also limit the potential pro-cyclical impact of delta neutral CAB holders.

[48] Standard & Poor's Ratings Services (2009).

6.5. Taxation of CABs

A full deductibility of coupon payments from corporate taxation would provide a powerful incentive to issue CABs. The most likely and already implemented tax treatment is for the CAB to be considered as debt. Indeed both Rabobank's Notes, Lloyd's and Credit Suisse's CoCo's are tax deductible. And, as Pennacchi *et al.* (2010) argue: 'it would be ironic if the government would discriminate against debt' a product 'that reduces the likelihood of a financial crisis' and does not have the unlimited upside of equity.

A client briefing by the law firm Clifford Chance (2009) suggests a second possibility: that the portion of the coupon payment attributable to the payment of the option premium would probably not to be treated as interest and thus, would not be tax-deductible. Also, the issuer may be taxed on an income basis in order to account for the fair value movements on the embedded derivative (recorded on the balance sheet as a derivative asset), as is the case in the UK. However, the complexity of this solution makes this treatment unlikely. The last possibility could be that governments treat CABs more like equity than debt for tax purposes. This scenario is the likeliest in the US according to Barclay's Capital Credit Research (2011). However, as they argue, the rules are not that clear and some exceptions already exist for insurance companies.

6.6. Accounting treatment

According to a report by Ernst & Young (2009), the accounting treatment of contingently convertible debt is as follows:

1. Under US GAAP, 'Potentially issuable shares are included in diluted Earnings per Share (EPS) using the 'if-converted' method if one or more contingencies relate to the entity's share price'.
2. Under international standards (IFRS), 'Potentially issuable shares are considered "contingently issuable" and are included in diluted EPS using the if-converted method only if the contingencies are satisfied at the end of the reporting period.'

Also, the *Enhanced Capital Notes* issued by Lloyds Banking Group (2009), have received the following accounting treatment: the bond part of the security has been classified as a subordinated liability and is reported at fair value, while the embedded put option is recorded as a derivative asset, carried at fair value. Thus, in particular, changes in the fair value of the derivatives are recognized as unrealized gains or losses each reporting period: if the stock price decreases, then there is a positive impact on the put valuation.

6.7. Takeovers, governance and CABs

In our analysis so far we have not addressed any issues relating to the separation of ownership and control in banks. We have simplified the analysis by assuming that

bank CEOs always act in the best interest of shareholders. But, this is clearly not always the case in practice, especially when it comes to takeovers. To the extent that there might be a potential conflict between management and shareholders we believe that the decision to convert the CAB should be in the hands of the board of the issuing bank. This would be a protection against management strategically choosing to convert CABs against the interests of shareholders purely as an attempt to fend off a hostile takeover. Another concern voiced by regulators is that CABs, and more generally all contingent capital instruments, could be a backdoor way to bank ownership by some investors, who could thus gain control of a bank without prior regulatory approval. This problem could also easily be solved by taking the conservative standpoint of including CoCos in all statutory shareholding threshold crossings. It goes without saying that when the bank is facing a situation where it needs an additional capital buffer to continue business, the regulator may well prefer an undesired new shareholder to a bank failure which puts the economy at risk.

6.8. Death spirals and contagion

What is likely to happen with the stock price when conversion occurs? One of the concerns is that new shareholders will be selling their shares, putting further pressure on stock price and possibly triggering further conversion. In short, that the bank will be sucked into a 'death spiral'. This concern is particularly relevant for CoCos with automatic price triggers. However, for CABs the likely effect of conversion is to lead to an increase in price, as conversion means that new equity has been purchased at above market value, thus leading to a net increase in market capitalization. Note also that if the risk of a sell-out still remains a concern, banks could counter this risk by introducing special rewards to 'loyal' shareholders (see e.g. Bolton and Samama, 2010 and Coffee, 2010).

Another concern besides 'death spirals' is contagion. If CABs are held by other financial institutions conversion may affect their bottom line and raise concerns about systemic risk. To avoid this contagion fear the simplest response is to make sure that CABs are not held by other banks. Financial institutions can be discouraged to invest in other banks' CABs simply by applying an onerous risk weighting to these assets. As we have argued above, SWFs would be ideal investors in CABs. Interestingly, the Credit Suisse CoCo issue has revealed that these investors are indeed interested in these high premium products.

6.9. Catalyzing CABs

To induce banks to issue CABs regulators have powerful tools at their disposal. First, they can make CABs entirely tax deductible as it is the case with debt. Second, the regulator could add these forms of liabilities to the new regulatory capital framework as is the case in Switzerland. Third, as Haldane (2011) argues, banks

could be enticed to pay bonuses to employees[49] in the form of contingent capital. This would create a first market for such products and help catalyze the launch. Fourth, as stressed by Himmelberg *et al.* (2011), the inclusion of contingent capital securities in credit indices will also be an important factor, perhaps even more important than obtaining a rating. Furthermore, some regulators, especially in Europe are in the process of setting up support funds for banks. It would make sense for these funds to invest in such products. Finally, as stressed in Ervin (2011), the pull for contingent capital is likely to come from investors rather than regulators. Indeed, in the new perspective of Basel III, efforts are made to avoid bail-outs by governments and impose private bail-ins. Increasing investor demand for bail-in protection is thus likely to pull the demand for contingent capital, as it provides an additional layer of protection and decreases the likelihood of a bail-in of more senior investors.

6.10. Communication around CAB issues

Finally, one last word of caution: issuers and the associated syndicates should be careful to describe appropriately the risks associated with this type of product. In particular, in case there is any doubt, it should be clearly mentioned that the risk is different from the risk of a classic or a subordinated bond. Furthermore, it is essential that banks enhance and standardize disclosure. As stressed in Himmelberg *et al.* (2011), whatever the structure of contingent capital, banks need more horizontally comparable, comprehensive and consolidated reporting, along with more robust marks to allow markets to have enough information to actually impose discipline on financial firms.

7. CONCLUSION

We believe the economic case for a contingent capital solution to foster greater stability of the banking system is compelling. At the very least, contingent capital is a superior investment in banks for long-term investors than equity investments at the onset of a recession, 'when equity prices fall', as it lets long-term investors charge an insurance premium for the 'capital-line commitment' they provide, and also protects long-term investors against the risk of investing in 'lemons' in a crisis.

The performance of sovereign wealth fund investments in bank equity in the summer of 2007 has been disappointing to say the least. It would be highly regrettable if the lesson sovereign wealth funds take from this experience is to simply stay out of bank equity investments. The way forward instead, ought to be to pursue a similar long-term investment strategy as *Berkshire Hathaway* and to sell long-term

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[49] The CEO and all members of the board who decide whether to trigger the CAB should for evident conflicts of interest, be excluded from the employees receiving CABs.

puts on bank equity. This would both let long-term investors reap a compensating return on their investments, and provide banks with a lower cost of meeting an adequate equity capital target in a downturn.

If the case for contingent capital is so compelling, this naturally raises the question why banks have not made greater use of this financing instrument before the crisis. Why did we have to wait for a nearly cataclysmic crisis to occur to start thinking about contingent capital? There are a number of answers one can offer to this question.

As with any successful financial innovation, a first reason may be simply a lack of imagination before the innovation has been introduced and tested. A second reason may be linked to bank regulatory barriers and regulatory conservatism: if the regulatory classification of contingent capital was too conservative it could have made sense for issuers to concentrate instead on other securities, which received a more favourable treatment under Basel II. Perhaps more importantly, if banks were able to circumvent regulatory equity capital requirements through off balance-sheet, 'shadow banking' operations or by manipulating the risk weightings on their assets, they would not have perceived the need to secure more equity capital through contingent capital commitments. This may be the reason why, unlike monoline insurers, we have not seen banks use this form of financing before the crisis.

Another related reason may be that banks never perceived a need for a 'capital-line commitment', as they could count on contingent public liquidity provision through various liquidity backstops including quantitative easing, and possibly even on 'bail-outs'. Indeed as we have seen during the crisis, a lot of banks were conscious they were 'too big to fail' and hence believed that the government had sold them a put option on a capital issuance for free. It therefore did not make any sense to buy this put option or insurance from a private investor when the state provided the same for free with no counterparty risk.

However, as we have seen recently with Ireland in particular, some countries will not have the financial power to rescue every bank, hence reintroducing counterparty risk of sovereigns. Furthermore, public opinion is pushing for less support of the banking system going forward. This will definitely encourage more banks to consider contingent capital issuances in the near future. In addition, banks are aware that the more precarious state of public finances makes another bail-out infeasible in the short and medium run, thus increasing the benefits of securing a 'capital line of credit' from long-term investors.

The main uncertainty at this point concerning the development of contingent capital financing is likely to be regulatory uncertainty. How will CoCos or CABs be treated under bank regulatory capital rules? Will their use be penalized or encouraged? So far the regulatory response towards contingent capital outside of Switzerland has been one of timid scepticism. This is partly due to early concerns about design flaws of CoCos and complexity. The other reason seems to be that bank regulators felt that a more urgent and more effective approach to crisis mitigation was to simply focus on raising capital requirements. But this narrow focus on raising straight equity capital

requirements appears to come, by all the existing evidence, at the substantial risk of inducing a credit-crunch. We believe that the costs of pushing for higher straight equity-capital requirements have been substantially underestimated, and that insufficient attention has been placed on the potentially large benefits from implementing a counter-cyclical bank capital regulation through contingent capital. Indeed, while higher straight equity buffers allow for more loss absorption in recessions they do not reduce the pro-cyclical effects of bank capital regulation. Even if regulations were in place that would allow banks to dip into their loan-loss provisions and equity capital buffers in recessions, banks would be extremely reluctant to do so for fear of increasing leverage at the wrong time. In contrast, CABs would allow banks to *replenish* their capital buffer in recessions, which is the economically appropriate response.

In sum, there are thus a number of important benefits for regulators from reorienting bank capital regulation towards contingent capital and CABs, the main one being a more counter-cyclical approach and a lower risk of inducing a credit crunch in recessions. The other benefits are a lower regulatory cost imposed on the banking system, a greater reliance on private investors for loss absorption in recessions, a better warning system for approaching crises, and a better pricing of the value for banks of public liquidity backstops and bail-outs. What is more, our analysis in this paper highlights that CABs are not that complex – certainly not more complex than widely used other convertible instruments and options. In addition, CABs do not suffer from the design flaws of early CoCo instruments.

Discussion

Wolf Wagner
Tilburg University

The experience of the recent crisis has spurred a renewed debate on how to deal with bank failures and how to avoid such failures. One popular type of proposal – which has gained some traction – is the idea of contingent capital (CoCos). The details of the CoCos proposals vary but the common denominator is that banks issue a special form of debenture that has an automatic trigger embedded. Once the value of the bank (measured either in book values or market values) falls below a certain threshold, the debt is (automatically) converted into equity at a pre-specified rate.

Contingent capital seems to give us the best of both worlds. On the one hand, the fact that leverage is automatically reduced when the bank faces difficulties reduces the risk of bankruptcy and the substantial cost associated with bankruptcies (which are particularly pronounced for failures of financial institutions). On the other hand, it allows banks to finance themselves with debt under 'normal' circumstances. This provides benefits through various channels, such as the disciplining role of debt, the potential for leverage to create a higher ROE, and the tax deductibility of debt.

However, contingent capital itself also comes with some problems. One key issue – which has been pointed out by several commentators – is the automatic nature of the conversion trigger. For instance, speculators may aim to depress the price of bank equity in order to trigger the conversion and profit by taking simultaneous derivative positions in bank equity. Another issue is the potential for multiple equilibria: one equilibrium with high share prices and no conversion and one equilibrium with low priced (and diluted) equity and conversion. This may create an additional source of instability – particularly for banks close to failure.

The proposal by Bolton and Samama gets at the core of this problem. They put forward a clever idea. If automatic triggers are the issue, why don't we design convertible capital such that the trigger is no longer automatic but becomes an option? In essence their idea is to let banks issue *Capital Access Bonds* (CABs) which give banks *the right* to convert the bonds into equity at a pre-specified exchange ratio.

In my view, this proposal should be taken seriously. CABs address a key shortcoming of standard CoCos. As the authors argue, they also provide a new investment vehicle for investors that allows them to pursue countercyclical investment strategies. However, CABs inherit some other issues with CoCos and also create problems themselves.

Let me focus on the latter ones in my discussion.

The most important issue is the moral hazard CABs create. CABs are akin to banks buying put-options on their own equity. It amounts to insurance against situations where bank equity falls below a certain threshold. This has the potential to cause textbook-style moral hazard of a CAB issuer as the cost of bad performance will no longer be fully borne by him. In addition, it creates incentives for banks to engage in tail-risk shifting. Banks will perceive higher gains from engaging in tail-risk strategies which produce abnormal profits in normal times but expose banks to catastrophic risks in the event of a large negative shock. The potential for such risk-shifting is particularly pronounced in the financial system and has been a key cause of the crisis of 2007–2008.

Another challenge is the valuation of the option-feature of CABs. Bolton and Samama value the CAB-option using standard techniques which take the perspective of an outside investor that holds the option. This is potentially problematic since the option holder here is the firm underlying the option. One issue this creates is strategic incentives of firm managers to exercise the option, such as in order to affect short-term performance. Another issue is that due to limited liability, banks have insufficient incentives to purchase insurance against bad states. This makes the value of exercising the option (which would remove the insurance) a different one than for an investor. The valuation problem is hence not the same. My guess is that the option price will ultimately also depend on the bank's liability structure as this determines the risk-shifting incentives of the bank. A final, more technical, point on this issue is that exercising the option will change the threshold at which a bank defaults (the threshold is lower after conversion because the bank then has less

debt). This reduces the standard option value of equity and makes the bank's share price endogenous to exercising the option. This seems to create a circular problem as the incentive to exercise option itself also depends on share price.

There is also the issue of liquidity of CABs. In order to become successful, capital access bonds have to be reasonably liquid in order to make them attractive for investors. One can get a clue about the likely liquidity of such bonds (if introduced) by looking at bank put-options. Unfortunately, deep out-of-the money put options (to which CABs can be likened) are fairly illiquid for bank sector indices and even more illiquid for individual banks. CABs thus have to be marketed well in order to ensure that their trading will be sufficiently liquid. It may also be a good idea to issue right away a large amount of CABs (rather than testing the ground with a small amount first) in order to get the attention of the investor community and to immediately create a large market.

The authors argue that CABs will reduce banks' cost of capital as it allows them to raise (expensive) equity only when they need it (that is, close to bankruptcy). This argument needs to be pushed further in my mind in order to be fully convincing. With a CAB the bank effectively buys insurance against tail risk. To the extent that banks are correlated, this amounts to purchasing insurance against severe market downturns. Such insurance will be expensive since in these states of the world investors' marginal utilities are high. Evidence from option prices indicates that this effect can be significant since the price of deep-out-of-the money put options can be substantially higher than the one implied by standard option pricing models. One would need a comprehensive analysis to compare the gains from issuing capital as pointed out by Bolton and Samama against the cost of purchasing tail-risk insurance.

Let me finish by saying that the proposal by Bolton and Samama is a neat one. It is based on the clever insight that by making a small modification to the process that triggers conversion of debt in equity, we can avoid automatic triggers. As such, it constitutes a significant improvement over standard CoCos. The downside is that it has the potential to cause issuer moral hazard as CABs effectively amount to banks buying tail-risk insurance. If these bonds were to be introduced, additional measures would need to be taken to limit this moral hazard.

Panel discussion

Refet Gürkaynak and Nicola Fuchs-Schündeln wondered why the capital access bond (CAB) is not already available in the market if it is such a good idea. Gürkaynak also asked who should have the right to decide when to exercise this option: the equity holders or the management? He contended that if management has this right, then a variety of intra-bank problems are created. Specifically, if managers do not get along well with equity holders then they may fear the possibility of dismissals. Consequently, management may wish to dilute (the power of) equity holders by exercising this instru-

ment. Georges de Ménil argued that besides sovereign wealth funds there are other examples of long-term investors such as life insurance companies which in principle last a very long time.

In response to Wagner's remarks on moral hazard, Frédéric Samama argued that new market discipline is introduced with CABs as the holders of these bonds do not wish to see any conversions occur. In comparison to the classic bond holders that can benefit from an implicit or explicit 'too big to fail' guarantee, this new class of investors will monitor the conversion when the company reaches a crisis situation. In relation to the issue of circularity, Samama pointed out that similar situations arise with classic convertible bonds. On the issue of asymmetric information surrounding equity versus options, Samama indicated that if the company has inside information then greater value is derived from issuing shares as the sensitivity to this information is extremely high.

Patrick Bolton agreed that the moral hazard issue warranted more attention. He contended that the limitation of any CoCo product is that it eradicates the discipline imposed on the debt holder by replacing a hard budget constraint with a soft one. Accordingly, if one is wedded to the view that banks have a lot of leverage because of the need to discipline bankers, then CoCos may not be a good idea. However, Bolton indicated that there are good reasons why banks are highly levered, with the most important being that debt is a less information sensitive claim. Conversely, convertible debt is somewhat more information sensitive while the most sensitive claim is equity. As Bolton notes, pecking order theory suggests that equity will be used as a last resort. Ultimately, a contingent capital instrument will always be cheaper than equity.

APPENDIX 1: BUILDING THE TRINOMIAL TREE

We assume that the stock pays a semi-annual dividend of 2%. At each node, u and d are the respective sizes of the up and down jumps, with probabilities p_u and p_d. With probability p_m the stock price S_n remains unchanged:
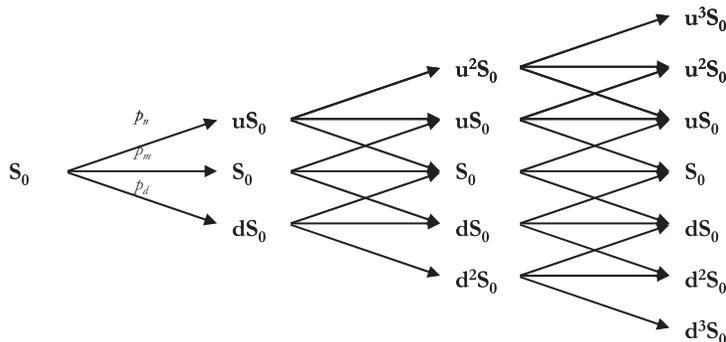
Figure A1.   Trinomial tree

$$u = e^{\sigma\sqrt{2\Delta t}} \text{ and } d = e^{-\sigma\sqrt{2\Delta t}}$$

$$p_u = \left(\frac{e^{\frac{r\Delta t}{2}} - e^{\frac{-\sigma\sqrt{\Delta t}}{2}}}{e^{\frac{\sigma\sqrt{\Delta t}}{2}} - e^{\frac{-\sigma\sqrt{\Delta t}}{2}}}\right)^2 \quad p_d = \left(\frac{e^{\frac{\sigma\Delta t}{2}} - e^{\frac{r\sqrt{\Delta t}}{2}}}{e^{\frac{\sigma\sqrt{\Delta t}}{2}} - e^{\frac{-\sigma\sqrt{\Delta t}}{2}}}\right)^2$$

$$\text{and } p_m = 1 - p_u - p_d$$

This is one of the possible parameterizations for a risk-neutral recombining trinomial tree with the following constraints to match the first two moments of the stock price model distribution:

$$E[S_{n+1}|S_n] = e^{r\Delta t}S_n$$

$$V[S_{n+1}|S_n] = \sigma^2\Delta S_t$$

We then add the discrete dividend payment using the Hull approximation (see Hull, 2010). At each node we now compute the price of the CAB by reverse induction using the following equality:

$$CAB_n = Max\left(e^{-r\Delta t}E[CAB_{n+1}|S_n], Y_n = B_n - 2S_n + RP_n\right) = Max(X_n, Y_n)$$

where $RP_n = CAB_0 - \sum_{i=1}^{n} PR_i$ and $Y_n = B_n - 2S_n + RP_n$

The terminal value at maturity being: $Y_{final} = B_{final} - 2S_{final}$ where:

B_n is the par value of the bond plus accrued coupon. This relies on the assumptions that interest rates are constant and that the CAB always converts before the issuer defaults. This assumption is equivalent to ignoring the instant default risk (we later relax this assumption);

S_n is the value of the stock price at time t_n;

RP_n is the value of remaining principal to be paid via an additional spread on the coupon of the CABs;

r is the risk free rate;

Δt is the time step between two nodes in the trinomial tree.

We compute the value of the CAB at each node as follows: We first assume that the remaining principal is 0 at each node, and that the bond pays the riskless rate. By backward induction we then compute the price at inception of the CAB. Let CAB_0 be this price. We also compute our risk-neutral conversion frontier and conversion probability. The conversion frontier is simply the highest value of S for a given time t where $Xn \leq Y_n$ (i.e. when the expected value of not converting the CAB at time t is less than the value after conversion). Note that the only times when it is more advantageous to convert rather than wait is just before the coupon payments. Hence there are only 20 dates in our case where the issuer is likely to convert. We denote by C the column vector denoting the

conversion frontier with each C_i corresponding to the date just prior to the coupon payment. Similarly, we use this conversion frontier to compute the conversion probability, which is the probability that a node is attained in our tree without previously crossing the conversion frontier. Let P be the column vector representing the conversion probabilities at each of the 20 dates prior to the coupon payments.

Next, we distribute this value in additional equal coupon payments (*AECP*) on the bond. We can separate the *AECP* into two parts: the interest payment (*IP_i*) and the principal repayment (*PR_i*). The remaining principal is simply:

$$RP_n = CAB_0 - \sum_{i=1}^{n} PR_i$$

where n is the number of coupons which have already been paid.

We also have to take into account the probability that the coupon payments are suspended due to the positive probability of conversion. Accordingly, we use the riskless probability of conversion and make sure that the expected present value of the AECP is equal to CAB_0. If we denote by D the discount vector with elements D_i the discount factors at each coupon payment i, we are looking for AECP such that:

$$AECP = (1/CAB_0).D^T \cdot P$$

We next plug in the remaining principal in each node of our tree, which will restart the loop, and we get the AECP once the loop has converged.

## APPENDIX 2: VALUATION PERFORMED BY ITÔ33

A rigorous state-of-the-art approach to valuing the CAB takes into account both the volatility of the underlying and the issuer's default hazard rate modelled as a Poisson process.[50] If we use the same parameters as in the main text and assume a zero recovery on the CAB in the event of bankruptcy, the corresponding annual coupons under this more rigorous approach are shown in the table below. Note that the values of the options are affected by both the Brownian volatility (fixed at 35% in our model) and the default Poisson process which sends the spot price to zero.

Default rate (%)	CDS 10Y 40% recovery (BPS)	Implicit volatility put 50 10Y (%)	Coupon (%)
1.50	90	41.32	6.15
6.00	361	58.87	10.00
9.00	541	69.82	12.79

[50] We are thankful to the company Itô33 for carrying out this pricing simulation and sharing their results.

Using this more rigorous approach we can also determine the *conversion price* at any point in time at which the issuer should exercise the option. As we have already noted, at maturity this conversion price is simply the strike price of $50. Before the expiration of the options, however, the conversion price will be strictly lower than $50, as early conversion involves an opportunity cost in the form of lost future put and call options. Roughly speaking, the conversion price before maturity is given by the price at which the two newly issued shares have the same value as the fair value of the redeemed security. Or, in options parlance, the conversion price is given by the price at which the *delta* of the product is equal to 100%. In other words, at conversion the change in value of the combined options with a $1 change in the underlying stock price is equal to one.[51]

APPENDIX 3: TRINOMIAL TREE MODEL SENSITIVITY TO PARAMETER VALUES
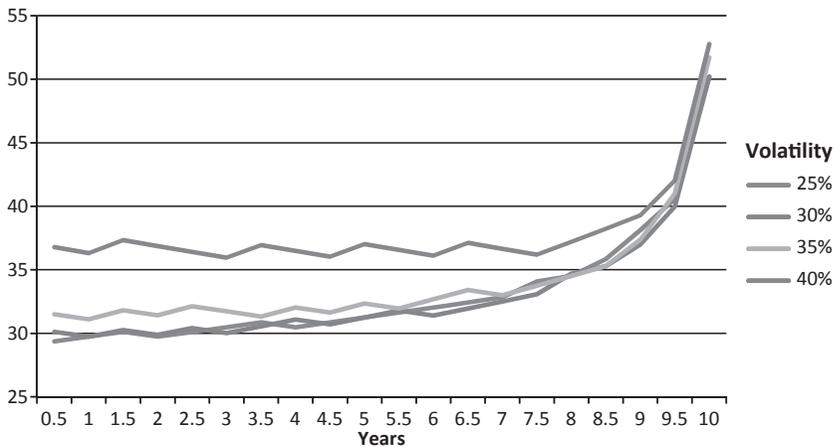
Figure A2. Conversion frontier for different volatiles.

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[51] Since conversion times are discrete, Bermudan options ought to be considered instead of American options. To smooth out these effects driven by the discrete timing of coupon payments the CAB could be structured to allow for a quarterly rather than a semi-annual coupon payment.

APPENDIX 4
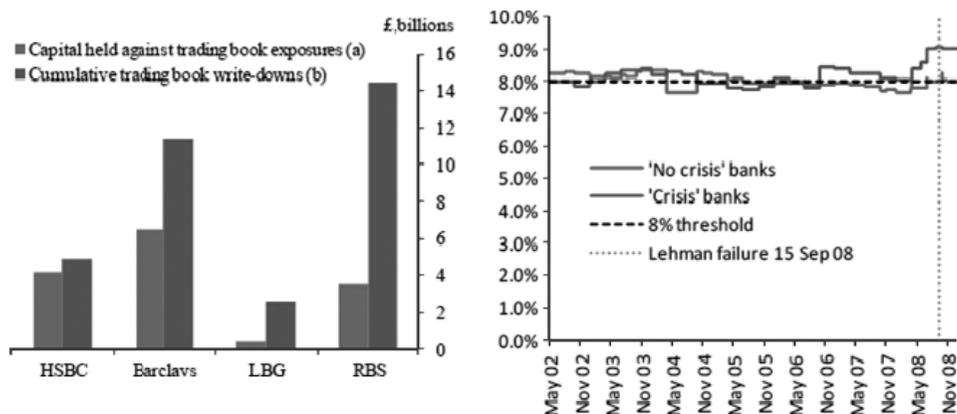
Figure A3. Cumulative losses relative to capital requirements for four major banks (left) and capital ratios for 'crisis' and 'no crisis' banks (right)

Source: Haldane (2011), Bank of England.

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