

HONG KONG INSTITUTE FOR MONETARY RESEARCH

CONCOCTING MARKETABLE COCOS

George M. von Furstenberg

HKIMR Working Paper No.22/2011

July 2011



Hong Kong Institute for Monetary Research
(a company incorporated with limited liability)

All rights reserved.

Reproduction for educational and non-commercial purposes is permitted provided that the source is acknowledged.

Concocting Marketable Cocos*

George M. von Furstenberg

Indiana University

Hong Kong Institute for Monetary Research

July 2011

Abstract

Adding contingently convertible debt securities, cocos, in an amount equal to about 3% of tangible assets to the financing mix of financial institutions is a promising reform idea. It would also be inexpensive for these institutions to issue cocos and thus to be prepared to recapitalize and to avert failure by rebuilding common equity and reducing leverage and debt overhang in a crisis. For cocos to become readily marketable, much work is needed on their standardization and optimal design. That basic design should include a trigger couched in a regulatory capital ratio referenced in Basel III. It should also include conversion terms setting the rate of increase in the number of shares equal to the rate of growth of the book value of common equity through conversion. This would prevent redistribution from existing to new shareholders, guarantee their equality of treatment, and protect the subordination hierarchy with non-cocos debt.

Keywords: Contingent Convertibles, Cocos Design, Capital Ratios, Financial Reform, Basel III

JEL Classification: G13, G18, G21, G33, G38

* Comments and helpful information provided by Arthur Yuen, Dong He, and Rose Luk of the HKMA, Eli Remolona of the BIS, Xiaodong Zhu of the University of Toronto, and an anonymous referee are gratefully acknowledged, but responsibility for remaining errors is solely my own.

Corresponding address:

J.H. Rudy Professor of Economics emeritus, Indiana University. Address: Department of Economics, Wylie Hall, Indiana University, Bloomington IN 47405, USA. Phone: +1 812 856 1382, Fax: +1 812 855 3736, E-mail: vonfurst@indiana.edu.

The views expressed in this paper are those of the author, and do not necessarily reflect those of the Hong Kong Institute for Monetary Research, its Council of Advisers, or the Board of Directors.

1. Introduction

At the “Stamp” lecture of January 2009, which came just one month after the federal-funds rate target had been set to its historical low of 0 to 25 basis points, Chairman Bernanke detailed the Federal Reserve’s remaining responses to the financial and economic crisis.¹ Among the newer policy tools deployed he distinguished *credit easing* by means of changing the composition of the Federal Reserve’s assets from *quantitative easing* through expanding its balance sheet. The goal of these operations was to reduce longer-term interest rates on private debt by lowering risk premiums as well as the risk-free level taken from the Treasuries market. Other important quantitative policy measures designed to strengthen the financial system’s own defenses after the recent crisis are being coordinated by the Basel Committee on Banking Supervision on which central bankers and national bank regulators are represented. These measures relate to raising capital ratios and possibly setting liquidity ratios for internationally active financial institutions, thereby affecting the composition of both their liabilities and risk-weighted assets. The goal of these measures -- to be fully phased in by the end of the decade -- is to make the financial sector more robust, to steadily reduce its leverage, and to make it do more for its self-insurance by holding more common equity and issuing debt that is contingently convertible into such equity.

Contingent capital that can be called upon to recapitalize a company in distress can take many forms. Among them are Rights Issues, Capital Calls, Mandatory Convertible Bonds and Notes, and Reverse Convertible Securities and Debentures. The only subspecies here considered is going-concern cocos whose conversion is triggered when a level, no lower than the minimum specified for one of the capital ratios referenced in regulatory accounting, has been breached. After the first such issue in the United Kingdom in late 2009, by Spring 2011 cocos had been issued in two other European countries, the Netherlands and Switzerland, and in Cyprus. Two smaller issues, both involving debt-forgiveness with write-back (reinstatement under certain conditions), by Unicredit and Intesa Sanpaolo in July and September of 2010, are not considered. They are described and reviewed in Goldman Sachs (2011, pp. 9, 17). A small late-2009 issue by the Yorkshire Building Society also involving a reversibility feature is ignored as well.

Voluntary issuance of cocos is likely to remain spotty as long as the extent and degree to which cocos are to supplement common equity in meeting regulatory requirements has not been settled. Lack of standardization, economies of scale, and liquidity are other issues troubling cocos in their infancy. Bolton and Samama (2011, pp. 56-57) list untested-innovation risk, regulatory uncertainty, and the “free” provision of an implied put option by government to institutions treated as too big to fail as among the factors that have held back cocos. To help reduce valuation uncertainty arising from unfamiliarity and idiosyncrasy like that of the few cocos issues that have occurred so far, this paper investigates how to appropriately design such a, still non-standard, instrument. It also offers tentative recommendations on

¹ The speech is available from <http://www.federalreserve.gov/newsevents/speech/bernanke20090113a.htm> .

how much of it to issue and at what cost. Goldman Sachs (2011, p. 3) has estimated that if cocos had been a mere 1% to 2% of the size of total (unweighted) assets, or exactly 4% of the risk-weighted assets (RWA) of the 50 largest banks globally, the amount outstanding with data for yearend 2010 would have been \$926 billion. Some other commentators have envisaged a global stock of cocos of \$1 trillion or more by the end of this decade. Thus this instrument may make a major contribution to financial and economic stability in the not-too-distant future and merits close study already in its design phase.

1.1 The Research Outline According to Dodd-Frank

As I have detailed elsewhere (2011, pp. 13-18), there has been much *official* support for cocos and cocos mandates. Unfortunately, outside Switzerland, that support has remained mainly rhetorical. In the U.S., the Dodd Frank Wall Street Reform and Consumer Protection Act of 2010 calls on the “independent” Financial Stability Oversight Council it has instituted to make recommendations to the Fed “concerning the establishment and refinement of prudential standards” (Sec. 115(a)(1)). The Council is also to “conduct a study of the feasibility, benefits, costs, and structure of a contingent capital requirement” for bank holding companies and nonbank financial companies (now) supervised by the Fed. It is to submit this study to the Congress within *two* years and then make recommendations on whether these institutions are “to maintain a minimum amount of contingent capital that is convertible to [common] equity in times of financial distress” (Sec. 115(b)(1) and Sec. 115(c)(1),(2), and (3)). Six issues are listed in the Dodd-Frank Act which the two-year study should include. Following these helps organize this introduction and shows where they are tackled both in what follows and in earlier work.

1. *An evaluation of the degree to which a cocos requirement would enhance the safety and soundness of companies subject to it.* Shedding light on this subject by subjecting an initially very well capitalized financial institution to a binomial expansion process causing diffusion in the gross rate of return and, eventually, a chance of bankruptcy was the main subject of my earlier study. It showed that cocos conversion gives the company a second life so that two low-probability series of decapitalizing events would have to occur in succession for the firm eventually to fail. It also estimated that cocos should have an original maturity of no less than 30-years to be most effective in reducing the probability of eventual bankruptcy and its expected cost.

2. *An evaluation of the characteristics and amounts of contingent capital that should be required.* This issue is addressed in Sections 4 (amounts) and 5 (desirable characteristics of cocos) of the present paper. Section 4 uses several approaches to gauge how big cocos issues might have to be in percent of the tangible assets of US-based Systemically Important Financial Institutions (SIFIs) if they are to be sufficient to provide what help is needed to recapitalize these banks in a crisis like that of 2007-2010 expeditiously and by their own means. Section 5 focuses on the specification of the conversion trigger, the conversion terms, and the reduction in debt overhang.

3. *An analysis of the standards that should be used to determine whether the cocos of a company should be converted to equity in times of financial distress.* This question relates in part again to the choice of trigger and conversion terms for cocos discussed in Section 5. Discretionary regulatory triggers for cocos conversion in view of macroprudential concerns are discussed in Section 3.

4. *An evaluation of the effect of cocos requirements on the international competitiveness of companies and the prospects for international coordination in establishing such a requirement.* Allowing cocos to meet a modest portion of the minimum capital requirement and a much larger portion of the buffer-capital or progressive-capital requirements or actually introducing a cocos mandate for supplementing regulatory capital of all major internationally active banks is continuing to be under active consideration under Basel III (see BIS, 2010a; BIS, 2010b). The contentious issue of international regulatory neutrality raised in the Dodd-Frank Act (Sec. 174(b)(3)) is not taken up here. Instead Section 2 documents fresh official support for cocos, and Section 3 examines macroprudential reasons for issuing them. Both sections also introduce and discuss the most prominent criticisms of cocos and the extent to which they subsume or promote a flawed design.

5. *An evaluation of the extent to which adding cocos to the financing mix is likely to affect the cost of capital.* What is called for in this evaluation is first an estimate of the interest rate on cocos relative to the riskless benchmark yield curve, i.e., a pricing of the conversion feature, and secondly an evaluation of how the cost of capital as a whole is affected by adding this feature. This complex question has been investigated by Glasserman and Nouri (2010) and Pennachi (2010) and in my earlier study (2011, pp. 46-56). That study estimated expected deadweight losses from bankruptcy to be borne by all equity holders and to a lesser extent by holders of senior non-cocos debt either without or with cocos in the financing mix. It concluded that with cocos equal to 4% of assets and with maturities ranging from 10 to 50 years, the overall cost of capital would be lowered by between 0.4 and 1.5 percentage point on account of the reduction in expected bankruptcy costs. While the conversion feature makes cocos more expensive than otherwise comparable noncocos debt, having the extra self-insurance on the books lowers the rate of return required on both equity and non-cocos debt, and these cost-reducing effects win out. The reason is that not just the social, but even the private, costs of bankruptcy are extremely high.

6. *An evaluation of what interest rate premium over the rate on Treasuries of comparable maturity may be required on cocos.* J.P.Morgan (2011) and my own effort in the present paper deal only with this narrow question of the yield required on cocos, and not on capital as a whole, by providing pricing formulas for cocos. I estimate the loss premium required for adding the conversion-trigger feature using characteristics of the first cocos issue shown in Tables 1 and 2, for Lloyds Banking Group (LBG), in a model framework fully laid out in Appendix B. That framework requires specification of a process for generating the cumulative conversion probabilities over the years to maturity of cocos, option-based derivation of the recovery value of the shares of common issued if conversion occurs, and the CDS spread that can then be calculated.

2. Private Doubts and Official Support for Cocos

As detailed in my earlier paper (2011, pp. 13-19), cocos mandates, at least for SIFIs, have received official support from central bankers and regulators of financial markets and institutions in North America and Europe, particularly in Canada, Switzerland, the United Kingdom and, with the exception most notably of Geithner (2011), in the United States. Since then, the UK's Independent Commission on Banking (ICB) has presented an interim consultation report on reform options. Annex 6 (ICB, 2011, pp. 180-183) discusses contingent capital instruments in some depth and offers propositions which will here be discussed in turn.

The ICB's specification for cocos instruments requires that conversion should be triggered while the institution still is a viable going. Cocos thus "provide pre-resolution loss-absorbing capacity and aim to reduce both the probability and impact of bank failure". The ICB notes correctly (p. 180) that cocos help address the debt overhang problem but then goes on to stipulate (p. 182) that, on conversion, the aim should be to engineer a transfer of (some) value from shareholders to (the former cocos?) bondholders. I will argue instead in Section 5 that cocos conversion that lifts or at least defers the threat of bankruptcy and reduces the expected present value of the attendant deadweight losses should be comforting for existing shareholders along with other stakeholders. This is the group of shareholders who would have stood to lose everything in a liquidation. Senior non-cocos debt holders, if otherwise facing haircuts, would benefit as well from the firm's reaching the conversion trigger long before the liquidation trigger. Expected future debt overhang then would be reduced by conversion, and future equity issues would be facilitated.

The ICB also calls for providing clarity and predictability around both triggers and loss distribution if a broad market for cocos is to have a chance to develop (p. 181). Uncertainty about the consequences of a given risk event would make rating and pricing cocos difficult so that issuing them would remain expensive. Nevertheless the ICB then leaves open whether rules-based capital-ratio triggers driven either by a market indicator or based on book values used in regulatory accounting should be preferred to triggers set off at regulators' discretion (p. 182).

Marking to market assets not held to maturity is part of regular (US GAAP and IFRS) book-value accounting. It is meaningful to compare this adjusted asset value, or the expected future value of assets used in "distance to default" estimates, with the face value of debt conditional on survival to see how far the firm is from insolvency. Any negative book value of equity so derived, in contrast to its market value which is constrained to be non-negative under limited liability, also has useful information on how much debt liabilities will need to be written down, or how much debt overhang there is to discourage new equity issues.

If the utility of accounting or book value triggers is indeed undermined by their allegedly lagging real time events (ICB, 2011, p. 182), this lag should not be taken as given. Accelerated regulatory examinations and forward-looking accounting and stress tests can seek to combat the tendency of management to hide losses. Kane, Bennett and Oshinsky (2008) have shown that the FDICIA (U.S. Federal Deposit Insurance Corporation Improvement Act of 1991) legislation has been beneficial in this respect. It has empowered regulators to wind up the affairs of troubled institutions before their accounting net worth is exhausted. Moreover, examining them more frequently the closer they get to the liquidation trigger has produced more accurate and effective accounting, provisioning, and intervention. It has also incentivized managers to take timely corrective actions or solicit mergers on their own and has made troubled banks respond more promptly to examiner criticism while lessening their incentives to go for broke.

Clearly “the market” and its rigging, such as accounting firms and rating agencies, have not been adept and quick at penetrating the wool over hidden losses (see the late Arthur Andersen, Enron, Global Crossing and Lehman Brothers). Hence supervision and re-enforcement of regulatory accounting standards remain necessary to inform the investing public correctly. It is difficult for all but adherents of the strongest version of the efficient-markets hypothesis to see how financial markets could function well otherwise. In the words of Goldman Sachs research (2011, pp. 4-5), “[a]s the experience of the crisis shows all too well, markets cannot find problems that have not been disclosed” or “assess what they cannot possibly know.”

As explained further in Section 5 of this paper, I do not agree with the claim that an “important advantage” (ICB, 2011, p. 182), and “socially best” feature (Goodhart, 2011, p. 117) of properly constructed cocos is that their conversion would impose such a large dilution on existing shareholders as to ensure that the bank remains well capitalized – and so keeps clear of the trigger – at all times. Seemingly approving of contingent capital that “holds out the prospect of death by dilution,” Calomiris and Herring (2011, p. 18) offer a version of cocos which would “almost never actually convert into equity” because they would promote timely equity offerings so that *next time is different*. Flannery and Perotti (2011, p. 4) also welcome the fact that “conversion at par [in shares valued at the time of conversion as under what is later described as the first method] ensures maximum dilution” as if threatening existing shareholders, rather than management and its deferred compensation, were the main disciplining objective. Milder versions of this destructive recommendation that relate also to the size of the cocos issue and the desirability of converting the cocos of a firm all at once to produce “severe” dilution have been presented by the Shadow Financial Regulatory Committee (SFRC, 2010). Shareholders realistically believe that crises can happen so that cocos are not “safe” from ever having to be converted if they are to serve any insurance, rather than illusive nuclear deterrence, purpose. If threatened with near-wipeout through extreme dilution in the event of cocos conversion to save the company, existing shareholders would strongly oppose any issuance of cocos in the first place. Otherwise upon conversion they might end up with next to nothing, while the new shareholders could get full compensation, equal to the face value of cocos, in shares. Of course new shareholders, or those to whom they sell, could meet the same fate later as existing

shareholders face now should there be such ill-designed cocos to convert in a future crisis. When existing shareholders are threatened with extinction if cocos are ever triggered they will be less inclined to inject equity that would also be exposed to such a standing threat in firms with cocos.

The ICB (2011) rightly shows concern about enhancing the marketability of cocos on one page (p. 181) but then fails to note on the next page that the conversion terms it favors make cocos needlessly unattractive for existing shareholders and management who would have to approve their issuance. In addition, having ill-designed cocos on the balance sheet that carry the threat of confiscatory conversion could discourage raising equity capital through new stock issues *prior* to cocos conversion. These multiple dysfunctions, and worries about a death spiral (p. 182) if conversion of cocos should ever appear imminent, are due to the crippling and arbitrarily redistributive conversion terms. Sceptics find cocos “in some cases positively dangerous” (Goodhart, 2011, p. 117) or simply “a very dangerous instrument” that would wreak havoc and contagion if ever triggered (Grübel, 2011). These dangers do not stem from cocos per se but from inappropriate design of their terms of conversion. As explained in Section 5, under a much preferred method, existing shareholders are not harmed by conversion on terms that make their share of the common equity held proportional to the share of the book value of equity capital they brought to the recapitalized firm. Instead, the loss from the dilution of their original stake is fully compensated by their pro rata share of the benefits from the cocos debt being cancelled when the preferred conversion method is applied, so that book value per share does not change.

Glasserman and Nouri (2010, p. 26) have pointed out that those who are obliged to accept the stock of financial institutions at the worst of times under this, not value-diluting, conversion method, will appreciate that the conversion has increased the probability of survival of the firm. Then “conditional on survival, the contingent capital investors can benefit substantially from an increase in equity value.” Bolton and Samama (2011, p. 30) similarly have lauded a scheme that would have long-term investors acquire bank equity automatically when equity prices are presumed to be “abnormally” low. Existing shareholders would stand to benefit equally from share-price recovery to which cocos conversion would contribute. Hence they might welcome adding cocos to the financing mix once the threat of confiscatory conversion has been lifted, but caution is in order: Although killings have been made when financial crises ebb and risk premiums plummet as confidence returns, I am not comfortable with excess returns being expected from shares obtained by cocos conversion and will not use this expectation in subsequent modeling. J.P.Morgan’s (2011, p. 3) research also speculates that “CoCo bondholders [may] have attractive upside optionality by [receiving] equity at distressed valuations in the event that the institution does not subsequently fail.” However, their research also notes helpfully that “the performance of equity valuations for banks experiencing financial distress may well change due to the presence of CoCos in the capital structure.”

2.1 Are There Superior Substitutes for Cocos Mandates?

Cocos are best viewed as a desirable supplement to higher common equity requirements. Should cocos mandates become part of regulatory capital-adequacy requirements under Basel III, the common equity component of these requirements will still be raised. If some choice will be allowed between common equity and cocos under Basel III, substitution of cocos for common equity will be capped and/or involve substitution at more than a 1:1 rate to limit such use. However, precluding any trade-off between common equity and cocos in setting or meeting regulatory requirements would actively discourage use of this potentially valuable instrument.

If banks are to be recapitalized in a crisis, how else could it be done? One alternative to cocos mandates that has been proposed to augment common equity when a financial institution has encountered a loss of capital sufficient to make its debt risky is to rely on compulsory common equity issuance. The reason is that for such an institution the “so-called ‘debt overhang’ problem is a strong deterrent against raising new equity” on its own (Admati *et al.*, 2010, p. 35 see also pp. iii, 51-52). These authors claim that the advantage of imposing the mandate to raise new equity on all (systemically important?)² banks on a pre-specified schedule when there is information asymmetry is that “investors will no longer be justified in making negative inferences about any particular bank based on the fact that it is issuing equity” (p. 52).

Compared with this tentative proposal by Admati *et al.* (2010), cocos are a succor to capitalization that is pre-positioned and to be used, not erected, in a financial crisis. Reducing banks’ discretion (p. 32) while raising that of the regulatory authorities by subjecting the banks -- to the risk, if they are sound and well-managed, or comfort, if they are not -- of collective decrees is not likely to improve either management or financial soundness prospectively. No matter how signals are muffled by collective action, the strongest banks will flaunt their superior qualities while investors are put on notice to scrutinize equity issues by the weakest banks very carefully when the authorities have declared a financial crisis. If appropriate, they should let such issues fail. The crisis declaration would then require all banks to issue new equity *en masse* regardless of their individual needs and merits and to stop all dividend payouts and stock buybacks (pp. iii, 35, 51) until the financial state of emergency has been lifted.³ Compared with such unsettling interventions which the authorities might well be reluctant to initiate, a further advantage of having cocos on the balance sheet is that they are triggered individually and automatically after a well-defined and auditable balance-sheet deterioration in regulatory capital ratios which are already closely monitored and prominently reported. To the extent trigger events bunch up in a financial crisis, cocos

² Imposing additional capital requirements on SIFIs by way of a “systemic surcharge” is favored by Geithner (2011).

³ It may be helpful for regulators to issue standing rules that would have financial institutions halt dividend payout and stock buybacks if the institutions trigger such a prohibition under standing rules. However, having such a rule would not be nearly sufficient or kick in in time to meet needs of the kind that could be addressed by cocos.

conversions are also countercyclically active without requiring official intervention. To the extent they are perceived to be due to bad management, equity investors can hold existing management accountable.

Depending on the method of conversion, one of the benefits of cocos noted by J.P.Morgan (2011, p. 4) could be that “shareholders’ interests are more aligned with a more conservative corporate strategy which minimises (sic) the probability of the instruments triggering.” Having cocos on the balance sheet could thus give existing shareholders an incentive to act more like bondholders by imposing some needed discipline to curb excessive risk taking. This is “something which remains beyond the realm of bondholders for now.” Calomiris and Herring (2011, p. 19) further support this point. As stated earlier in this section, I do not favor using conversion terms that could make cocos a neutron bomb whose triggering could all but wipe out existing shareholders of a going concern in favor of the new shareholders through cocos conversion. Nevertheless, the fact that such terms have been used in some recent cocos issues indicates that cocos, depending on their design, may indeed alleviate inherent frictions in corporate governance, although Admati *et al.* (2010, pp. 46-48) give them no credit for that.

The second alternative to pre-positioned cocos that is here considered for shoring up financial firms in a crisis are Bolton and Samama’s (2011) capital access bonds described as follows (p. 11): A bank would issue a bond of specified maturity with redemption at maturity in the form of either a given amount of common shares or cash. Up to expiration, the bank can choose to exercise the option at any time by paying back the bond in full with shares. Hence it becomes profitable to deliver shares when the market price per share falls below the strike price given by the ratio of the face value of the bond to the pre-specified number of shares to be delivered. This scheme shares with cocos the advantages of being pre-positioned and focused on the circumstances of individual companies. Unlike compulsory rights issues or mandates to issue new equity, it does not require discretionary action by regulators. It also allows control of a company and its management to be challenged by new groups of shareholders created in a financial crisis. This type of scheme comes closest to the second (“LBG”) method of conversion rather than the third method here favored, detailed in Section 5.2, which does not reference a market price either at the time of issue or of conversion of the instrument. It lacks the automaticity of conversion provided by a capital-based trigger and leaves the decision to convert up to management and vicissitudes of the market price per share in a crisis relative to a strike price which may become unsuitable because it is constant for the entire duration of the cocos.

This limited review of just two alternatives to cocos conversion in a crisis suggests that while permanently higher common equity requirements are welcome, well-designed cocos are well-positioned to provide prompt and effective help in shoring up capital and deleveraging in a crisis. They do so when such help is most needed and the private costs of issuing new equity in markets are forbiddingly high on account of debt overhang, information asymmetries, and other factors.

3. Macro-Prudential Reasons for Adding Cocos but Not a Dual Trigger

In emerging-market countries and in some other, small countries borrowing internationally to conduct some form of carry trade, currency and sovereign-debt crises have often led to banking crises. A sovereign debt crisis that starts in a particular country may affect foreign banks hosted by it as well as banks lending cross-border to that country. Even if the sovereign debt and underwater mortgages of a country were all held by its own domestic banks, interconnections with foreign banks through the interbank market and a network of cross-border lending and collateral arrangements could cause first the banking crisis, and then the sovereign debt crisis, to spread to more countries. Throughout this process, counterparty risk would rise while liquidity and asset values decline. In the disorderly deleveraging process that follows, the capacity and efficiency of the intermediation system shrinks, often with disastrous effects on economic growth. Failure rates and their consequences for credit supply, investment and employment become highly correlated across firms, industry sectors, and even countries.

The combination of surging bailout costs with declining economic activity may explain why, on average, the real stock of government debt rises by 86 percent during the three years following a banking crisis (Reinhart and Rogoff, 2009, p. 170). The United States has stayed close to that average experience in the latest crisis as the federal debt held by the public grew by 79% from fiscal year 2007 (ending September 30, 2007) to the end of fiscal 2010. The same rate of growth was experienced in U.K. general government debt from the end of the year 2007 to that of 2010. Bailing out home-country banks that were considered too big to fail worsened the fiscal and economic outlook and intensified the debt crisis of affected countries, most conspicuously Ireland. An April 2011 estimate, reported by Finfacts Ireland (2011), puts net Irish bank bailout costs at an amount equal to about 40% of its 2010 GDP.

Imposing cocos going-concern mandates, at least on SIFIs, is designed to make banking crises less likely and to reduce fiscal exposure should they still happen. Thus the value of the government's uncompensated guarantee of survival could be reduced for the SIFIs, thereby lowering the moral hazard with which they are operating. Rescue costs to be borne by taxpayers would shrink accordingly. SIFIs would still have to be bailed out if they threaten to go under, but they would have to invest in more financial survival gear to keep themselves afloat by their own means. Adapting advice given by Rajan (2010), if leading banks cannot be prevented from remaining too big to fail and if they continue to be heavily exposed to each other, at least their private-sector capital buffers should be strengthened.

Cocos are an innovative financial buffer instrument that should find a market without the need for mandates once it has outgrown the "infant instrument" stage. An attempt to drive their issuance initially may be made by introducing regulatory cocos mandates under Basel III in coming years and by even higher mandates already set by the Swiss Financial Market Supervisory Authority, FINMA. Guided by a

Too-Big-To-Fail (TBTF) Commission of Experts, FINMA has imposed a cocos buffer consisting of two instruments with different triggers and issue sizes. One has a “high” trigger of 7% common equity to Risk-Weighted Tangible Assets (RWA), and this buffer must be equal to 3% of RWA. The other has a “low” trigger of 5% common equity to RWA and this “progressive component” must amount to 6% of RWA. Giving more weight to the low-trigger than the high-trigger cocos is advisable if low-trigger cocos would otherwise be viewed as “gone-concern contingent capital.” “Such cocos would likely need to be issued in large size in order to be effective [in restoring capitalization to about the same going-concern level as the conversion of high-trigger cocos]” (Goldman Sachs, 2011, p. 2).

By themselves, low-trigger cocos are likely to be converted at a larger loss than high-trigger cocos particularly if jump processes are involved that can reduce the value of assets, and hence of equity, discretely, as modeled in Pennacchi (2010). However, if they have high-trigger cocos ahead of them, they will be less likely to convert since high-trigger cocos would always have to convert before low-trigger cocos could possibly be triggered later on. Hence it is impossible to gauge how the interest rates required on high- and low-trigger cocos might compare without knowing how much there is of each class. To avoid windfalls for existing holders of low-trigger cocos, cocos with the highest trigger should be phased in before any cocos with lower triggers, and financial institutions should announce the trigger-mix of cocos they then aim to maintain.⁴

In line with this, Credit Suisse is already committed to issuing, or has issued, a total of about \$8 billion (partly in CHF) of Tier 1 and Tier 2 cocos, both with the high trigger (see Tables 1 and 2). Of the total supply of cocos equal to 9% of RWA, which sits on top of a 10% of RWA tangible common equity requirement, FIMA made an amount not to exceed 3.5% of RWA creditable toward the 8% minimum capital requirement together with 4.5% in common equity. The 5.5% Conservation Buffer to be provided in common equity would be an additional requirement for Swiss SIFIs (Raaflaub, 2011) bringing the total equity requirement up to 10%. As one expression of the “Swiss finish,” this would well exceed the 7% common equity requirement proposed under Basel III. As another expression of that desire to display extra strength and self-reliance, cocos would become an intentionally rich part of the buffer capital of SIFIs in Switzerland. Cocos equal to 9% of RWA, as defined under Basel III rules, would have amounted to \$36 billion for UBS and \$19 billion for CS at the end of 2010 and to more by 2019 when these cocos mandates are to be met in full.

Rajan’s (2010) recommendation to keep SIFIs from failing by creating additional private-sector buffers which should include cocos is very welcome. However, the dual-trigger arrangement he proposed for cocos to achieve both micro- and macro-prudential objectives is unworkable and counterproductive. The

⁴ Rabobank’s unexpected issuance of cocos with an 8% common-equity trigger after cocos with a 7% trigger were already outstanding for almost a year created such a windfall. However, since Rabobank is a cooperative institution and the earlier issue had been sold mainly to its own members, the windfall remained “in the family.” Terms on both issues are given in Tables 1 and 2.

two events he required for triggering conversion would be (i) that the bank's designated regulatory capital ratio falls below a value that is set at or somewhat above the regulatory minimum. This I would support. However he would also install a second lock (ii) that could only be opened by regulators based on "objective indicators" such as aggregate bank losses (Rajan, 2010, p. 28). McDonald (2010) similarly proposes a second lock, also considered by Pennacchi (2010, pp. 12, 14), that would open automatically when a designated stock price index for financial institutions falls to or below a specified trigger level. In these cases, conversion of cocos could occur only when there are widespread and pronounced falls in earnings, and presumably in the share prices, of financial firms. Conversion would not occur when problems that would lead to bankruptcy of individual institutions remain isolated. Pennacchi thus views cocos with a dual price trigger as a blend of standard, single-price-trigger cocos and non-convertible subordinated debt.

There are several reasons to dispense with this second lock and trigger. The least of these is that there would be an element of redundancy because a financial crisis is marked by idiosyncratic risk being overshadowed by systemic (highly correlated) risk. The likelihood that cocos with just a single bank-specific trigger will be converted is, of course, much greater during a financial crisis than in normal and more profitable times. Hence their conversion has some automatic countercyclical effect and should not have to wait for an official determination or ETF (Exchange-Traded Sector Fund) signal that the banking system as a whole is under stress. Indeed, requiring conversions to wait until the entire banking system is in deep trouble causes dangerous delay and makes the pent-up torrent of conversions, when their second trigger is released, even greater. In addition, the failure of even a single SIFI, like Lehman Brothers, would likely not remain an isolated event as its adverse consequences would ripple through the financial system. When the authorities finally decide to pull the second trigger that lets all first-triggered conversions for still going institutions be carried out, there is a bunching of mandatory conversions and a flood of bank stock issues that could depress their prices further while raising volatility. Prolonged price deviations from fundamentals could follow unless markets show extraordinary resilience even in a crisis.

From a marketing standpoint, valuing cocos would become more difficult under the dual-trigger arrangement. It would involve speculations about the behavior of the economy *and* the responses of regulators. Regulators are unlikely to submit to any indicator-based automatic macroeconomic trigger without building in broad exceptions that would allow them to invoke "unusual and exigent circumstances" to regain freedom of action as under Section 13(3) of the Federal Reserve Act. Hence their actions might not be conditionally well predicted.

The same objections apply to adding the proposed non-viability trigger (see BIS, 2010a) which the authorities would pull when an institution has reached the point of non-viability in their view. Admati (2010) offers a devastating general critique of this proposed trigger. In the present context, it would either preempt the cocos trigger or be preempted by it, depending on how trigger-happy the authorities would care to be in different circumstances. In any event, the existence of such a possible override would add

uncertainty to valuing cocos, threaten their marketability, and deprive them of a separate rationale. The BIS (2010a, p. 5) has put forward for discussion, that all components of regulatory capital that are not already common equity “must have a clause in their terms and conditions that requires them to be written-off on the occurrence of the [non-viability] trigger event,” with any compensation “paid immediately in common stock.” This laudable objective is already substantially achieved by making cocos the only component other than common equity that qualifies as regulatory capital, as FINMA has proposed. Cocos convert in a crisis to forestall bankruptcy or the need for a bailout of the institution. They do so with their own objective trigger mechanism which the authorities should not override, but help to enforce.

Rajan’s (2010, p. 29) desire to preserve “debt discipline” over the management of individual institutions by preventing cocos conversion except when the entire banking system is distressed is troubling also. Denying cocos conversion to any SIFI, or to a group or local cluster of interconnected or similarly-positioned financial institutions, as in Hong Kong and Singapore, that together reach the heft of a SIFI, could bring on the very bankruptcies (and negative externalities) against which cocos are meant to guard. Admati *et al.* (2010, pp. 22-31) refute the notion that subordinated debt has provided an important disciplining force on management, but their preference for common-equity over cocos mandates is less well articulated (pp. 45-48). They do not concede the point later made in Goldman Sachs (2011, p. 11) that “[w]hile more equity would certainly increase banks’ capital cushion, it lacks a key feature of robust going-concern contingent capital: namely the incentives it creates for management to de-risk during the early stages of financial distress.” Calomiris and Herring (2011, pp. 12-13) explain why “[e]quity is costlier to raise than debt for fundamental reasons associated with asymmetric information, and with managerial agency costs” and that higher equity capital requirements, unlike cocos, “do not eliminate the information costs, and attendant adverse selection risks, that make equity offerings costly.” They also explain why cocos are superior to straight subordinated debt (p. 20) and assume casually, but correctly,⁵ that interest paid on cocos would be deductible for tax purposes in the United States. Admati *et al.* (2011) do not address the issue of whether adding cocos to the financing mix would lower the cost of equity capital. If one were to follow their invitation to “think of equity as contingent capital that is converted *ab initio*” (p. 48), the rate of return required on existing equity would fall because cocos would be viewed as a precursor to additional equity capital in the financing mix. However, if cocos conversion were set to burden existing shareholders disproportionately, the call could go the other way.

⁵ I have been unable to find evidence corroborating Goodhart’s (2010, p. 33) assertion that “CoCos would most likely not be considered debt for U.S. tax purposes, given the conversion feature” and that the absence of this tax advantage “could finally derail the CoCo bandwagon” as he wishes. While interest on certain forms of cocos, such as perpetuals, could be ruled non-deductible, an expert survey of the issue by Humphreys (2007) convinces me that most forms of cocos should have no difficulty with interest deductibility because conversion to equity is not mandatory but contingent and prospectively rare, interest payments are however mandatory and non-deferrable, etc. In addition, an IRS ruling is ultimately a policy matter that is going to be decided with an eye to maintaining international competitiveness and on whether or not cocos need to be issued, or should otherwise be encouraged in the view of the U.S. Treasury. Hence if cocos mandates are included in Basle III even though Geithner (2011) does not like them, the interest rates on them will be deductible for federal income tax purposes in the United States. To remind: IRS rulings have already proven extremely stretchable to accommodate the Treasury’s policy interests during the financial crisis, for instance in ruling that Citigroup should be allowed full and unexpiring loss carryover even after an ownership change. See the U.S. Internal Revenue Service Notice 2008-83 on Application of Section 382(h) to Banks. Hence it appears incorrect to cite an IRS Revenue Ruling as an independent cause in any matter whose resolution is of keen policy interest to the U.S. Treasury.

Cocos are likely to be light in covenants. However, their covenants might provide for regulatory verification of a low-rated company's capital ratio in relation to its cocos conversion trigger through a timely special audit if requested by the firm's Board or other qualified groups of stakeholders. Regulators could also initiate such a special audit on their own and declare a contingency event triggering cocos if their re-estimation of the actual level of the capital ratio referenced in the trigger so warrants. Under properly configured terms of conversion, existing shareholders may well press for careful monitoring and timely conversion. But management may be opposed and stall because such an event could require it to resign or at least to relinquish all deferred compensation under rules agreed in advance. Upon conversion the company could be placed under ongoing regulatory review until it had recovered sufficiently for the cocos shield to have been rebuilt. Either at the insistence of regulators or the firm's Board of Directors, or because the former cocos holders have gained a controlling interest in the firm upon conversion, existing management could be replaced. For these reasons it is hard to see how making cocos less likely to convert by adding a second lock could better serve to discipline management.

On the other hand, single-trigger countercyclical buffer requirements, such as the 0-2.5% of RWA countercyclical buffer proposed under Basel III, could make it less likely that a financial institution's single-lock cocos conversion would be triggered, but not because tripping that individual trigger is insufficient to cause conversion. The countercyclical buffer requirement now envisioned would be triggered and calibrated by national regulators for all banks, foreign and domestic, in their jurisdiction (BIS, 2010c). Regulators would mostly be looking out for significant positive deviations from trend of national credit to GDP ratios and assess how much to lean against any deviations judged to be excessive and dangerous. A countercyclical buffer requirement thus may be helpful to protect a company and its cocos: It would reduce the bunching of conversions in a downturn if it lowered the procyclicality of the financial system.

Actual capital-ratio targets chosen by financial institutions have properly been regarded as the result of optimization subject to constraints, such as the regulatory minima set for such ratios, and the penalties for violating them. In this case, violation of a countercyclical capital requirement, after the period allowed for implementation of any regulatory changes therein, is punishable by restrictions on the percentage of earnings that may be used to pay for dividends or stock buybacks. These restrictions are to be graduated with the extent of joint violation of conservation and any countercyclical capital-buffer requirements under Basel III.

4. How Big is the Hole from Banking Crises that Had to be Filled?

The capital infusions needed to tide over and restore normal functioning for those financial institutions that are too big to fail are surprisingly small when compared with the losses incurred by sudden collapse. Lehman Brothers crashed in September 2008 and its going-concern value was destroyed almost instantly. Having booked gains from the declining market value of its own debt liabilities through mark-to-market

accounting, Lehman reported total stockholders' equity of \$66 billion for September 14, 2008, just before the weekend on which its fate was sealed; it reported -\$54 billion for March 31, 2010, the next time it could report at all. Its reported capital ratio went from 10.5% of total reported assets of \$626 billion to -21.4% on \$253 billion of assets remaining on the latter date. Taking the \$120 billion loss of equity from September 14, 2008 to March 31, 2010 over average assets of \$440 billion yields a loss equal to 27% of total assets for the first 18 months of bankruptcy alone. Taking only the negative equity in percent of total assets on the more recent date yields a 21% shortfall. By mid-2011, these losses most likely already had matched the Federal Deposit Insurance Corporation's experience of a mean discounted total resolution cost to asset ratio of 33.6% (see von Furstenberg, 2011, p. 41, for the documentation).

Judging by the U.S. experience which may be similar to that of other advanced countries, such a percentage appears to be about 10 times as high as the funds required to recapitalize banks that are too big to fail in a financial crisis. Conceptually the desired estimate is of that amount of common equity which is missing and not quickly or readily made up through the institutions' own efforts to let them resume normal lending operations. Because this definition of the gap is qualitative and thus judgmental, it is best to try to measure it in several different ways, to see where the estimates point. The four estimates presented below, of how much capital is missing, center on about 3% of total assets for the required recapitalizations rather than over 30%, as for the bankruptcy loss estimates given just before.

1. The International Monetary Fund's *Global Financial Stability Report* (IMF, 2009, p. 36) estimates that by the end of 2008 the first two years of the 2007-2009 financial crisis had reduced the ratio of tangible common equity (TCE) to total tangible assets (TA) to 3.7% in the United States. TCE is defined as total equity less preferred shares, intangible assets, and good will, or as core tier-1 capital. Reported write-downs of \$510 billion exceeded capital of \$391 billion raised during 2007-2008 by \$119 billion. For 2009-2010, the IMF expected write-downs of \$550 billion to exceed net retained earnings of \$300 billion by \$250 billion. To both raise the leverage ratio, TCE/TA, from 3.7% to 4% and to keep it at 4% would require an equity infusion of \$275 billion in 2009-2010 according to this April 2009 estimate. The TA value for the U.S. banks covered that is implicit in these calculations is \$11,250 billion. All these and subsequent estimates for the U.S. do not include the GSEs. These are Government Sponsored (now owned) Enterprises engaged in (mostly) residential mortgage securitization and finance.

2. To raise the leverage ratio to the "well-capitalized" level of 6%, the "approximate leverage of U.S. banks in the mid-1990s, prior to the buildup in leverage in the banking system that contributed to the crisis," would require a total equity infusion of \$500 billion according to a companion estimate. *These two IMF estimates combined imply that the financial crisis required an additional equity cushion of at least 275/11250 or 2.4%, and at most 500/11250 or 4.4% for the capital shortage to be overcome by the end of 2010.*

3. Funding under the U.S. Treasury's misnamed Troubled Asset Relief Program (TARP), that actually provided only capital injections, amounted to barely 2% of the 2008:Q4 assets of the three largest U.S. financial institutions. At the time they were in order of total assets JPMorgan Chase, Citigroup, and Bank of America, with the latter having overtaken the two others since. These three largest banks held over half of the assets of the 19 banks regarded, on the basis of their inclusion in the Federal Reserve's stress tests, as too big or interconnected to fail. They received \$115 billion, or about two-thirds of all the TARP funds invested by the Treasury from 10/28/2008 to 09/30/2010 in these 19 largest institutions under its Capital Purchase Program and Targeted Investment Program combined. *Yet their TARP funding was equal to only 1.9% of their combined assets of \$5,931 billion at the end of 2008.*

4. The Federal Reserve, in a March 18, 2011 press release announcing completion of its Comprehensive Capital Analysis and Review of the capital plans of the 19 largest U.S. bank holding companies reported that from the end of 2008 through 2010, "common equity increased by more than 300 billion" at these 19 companies. The Fed appears to have been satisfied that most of the 19 largest banks tested (one significant exception was Bank of America) had reached a level of capitalization sufficient to allow a resumption of, initially still modest, dividend payments and stock buybacks. The common equity raised had been sufficient to allow TARP funding to be repaid by the end of 2010 by all of the 19 banks, except Ally Bank, General Motors Acceptance Corporation's troubled successor. With the assets of these 19 banks at the end of 2010 at \$12,065 billion, *a capital increase equal to 2.5% of these assets appeared to have been all that was needed to restore banks to normal operating conditions.*

In sum, it appears that the recent financial crisis left a hole of 1.9% to 4.4% of total assets for the private parties which they were unable to fill quickly by themselves. Additional indications pointed to 3% as the most representative round estimate within this range. Because long-term debt amounts only to about 12% of the assets of large banks, cocos would account for about a quarter of long-term debt, or to one fifth when added to, rather than substituted for, non-cocos long-term debt. This indicates that had cocos in the amount of 3% of tangible assets, or about 6% of RWA which in the United States are just about half as large, been outstanding at the start of the 2007-2010 financial crisis, their conversion might have been sufficient to recapitalize the banking system quickly during that crisis. Strongin, Hindlian, and Lawson (2009) had recommended these same percentages earlier on comparable grounds. At yearend 2010, 3% of the tangible assets of the 19 largest U.S. financial institutions would have been \$360 billion.

This central estimate of recapitalization needs in the 2007-2010 financial crisis may fit not only the United States. The BIS (2009, p. 12) states that "among banks that have received capital injections, the average amount was close to 30% of the book value of shareholder equity." Now if shareholder equity was equal to at most 10% of tangible assets in 2009, capital injections would have amounted to at most 3% of such assets for the SIFIs of the 11 advanced countries, 4 from outside Europe, covered in the BIS study. Of course, what is enough on average may fall well short in individual cases if the loss experiences of different SIFI's are quite diverse and concentrating aid on just those who need it most is politically difficult

and fraught with moral hazard. Furthermore, the government helped in more ways than just through direct capital injections. A federal funds rate target that was kept near zero for three years running transferred income from savers to banks. There were also liquidity facilities, troubled asset purchases and public-private investment partnerships, and investment and debt guarantees among other government programs. These lowered the cost of funds and the losses from the sale of distressed and illiquid assets by financial institutions. By reducing write-offs and charges against retained earnings, these programs provided government capital injections by other means, i.e., by a variety of implicit and explicit subsidies to shore up retained earnings and to facilitate a return to normal financing operations. Hence, if cocos are greatly to reduce reliance on the government safety net, more than just the past amounts of direct government capital injections would need to be replaced through self-insurance to be well-prepared for a future crisis of comparable severity.

Nevertheless the SFRC's (2010, p.2) recommendation that U.S. SIFIs should issue an amount of cocos equal to 10% of a bank's assets, which the SFRC defined as the market value of equity plus the face value of its debt, is far too high. Goldman Sachs (2010, p. 1) has reported that average risk weights which stood at 27% for European investment banks were twice as high, 54%, for such banks in the United States. Hence assuming that the SFRC's measure of assets does not differ systematically from the book value of tangible assets, its recommendation would imply a cocos ratio equal to 18.5% of RWA, whereas the total long-term debt of financial institutions had tended to be only about 22% of RWA by the same calculation. If one adds to the SFRC's 18.5% of RWA cocos mandate the 7% of RWA proposed under Basel III as the minimum common equity requirement including the conservation buffer, the total reserve requirement would be 25.5% of RWA. If one added instead the common equity requirement equal to (at least) 10% of unweighted assets, and hence equal to another 18.5% of RWA, recommended by Admati et al. (2010, p. 51) one would end up with a combined capital plus contingent capital requirement of 37%. This is almost twice the Swiss maximum for SIFIs of 19%, about half of which (47%) is also in cocos. Imposing such a high insurance requirement could be seen as an attempt to completely privatize insuring against the risk of being TBTF to those who cause it because it could absorb even Lehman Brothers' loss proportions.

Switzerland's two SIFI's are 5 times larger, in relation to the country's GDP, than the 19 largest banks specially stress-tested in the United States are in relation to U.S. GDP. FINMA (2011, p. 62) thus expresses concern that the Swiss government in the future (like the Irish government recently) may have a problem rescuing its largest institutions at a cost that is "bearable." More generally, the biggest banks may be too big to save at affordable fiscal cost in some countries, particularly if they are already government-debt constrained, but not in others. The former set of countries, which could include the United Kingdom, Ireland, and the Benelux countries, but not as yet the United States, would be prudent to exceed the Basel III standard by a substantial margin as Switzerland has endeavored to do. The only justification the SFRC (2010, p. 2) gave for its outsized recommendation for the United States was that the amount of cocos should be "sufficient to cause significant dilution to shareholders if the conversion is

triggered.” As previously noted, this is a self-defeating objective and not a guide for the size of cocos issues.

5. Designing Cocos

5.1 The Trigger Choices

Having already rejected a dual trigger or double lock for cocos conversion, it is still necessary to confront the directive, found in Goodhart (2010, p. 30) and others, including Flannery (2009, pp. 10, 16), that “CoCo convertibility must be triggered by falls in market, not in accounting valuations.” This presumption is unjustified but often treated as self-evident and thus not in need of justification for reasons well explained by Goodstadt (2011, pp. 18-33). I hold instead that trigger levels should be specified in terms of the capital ratios referenced in regulatory accounting and reject market-based triggers for the following reasons:

(i) Market pricing errors relative to normal valuations are not random in a major financial and market-illiquidity crisis. Rather they are positively correlated across financial firms and time on account of a surge in counterparty risk and growing illiquidity. In a systemic crisis, market-based triggers thus would tend to be pulled in large numbers and almost simultaneously through cocos conversion thereby releasing a flood of new equity issues by financial institutions just when market liquidity has plummeted.

(ii) Capital ratios based on regulatory book-value accounting do not necessarily lag behind market-based measures particularly since accounting measures have become more forward-looking, for instance in stress tests and in the recognition of impairment and reserve set-asides to cover anticipated future losses. J.P.Morgan (2011, pp. 6-7) contains empirical evidence that would “suggest a relationship between the erosion of the solvency trigger variable and the deterioration in the issuer’s share price” that is approximately linear and simultaneous after smoothing the core tier-1 ratios reported for end of quarters to distribute them continuously.

(iii) Indeed, market valuations react strongly to quarterly earnings announcements and reports of a firm’s end-of-quarter regulatory capital ratios, even if they do not deviate from the average forecast. Because priors become highly diffuse and tentative in a financial crisis, reassurance matters. Hence market valuations are informed by the results of book-value accounting.

(iv) Regulatory capital ratios are routinely monitored and reported at least quarterly under standing rules which accounting departments, outside auditors and government regulators can apply with a high degree of legal certainty and (official) assurance. If the discipline of accounting has been so corrupted that “[f]or large banks, major accounting issues are to a large extent at the discretion of regulators”

(Flannery and Perotti, 2011, p. 7) and regulators are time-inconsistent in using that discretion even for going concerns, then it is difficult to see how market discipline could have solid information to do better. Goldman Sachs research (2011, pp. 2-3) notes that while regulators typically have significant discretion to decide whether and when to use *gone-concern* contingent capital to recapitalize a firm, *going-concern* conversions are triggered “through a more objective process with far less scope for regulatory discretion.”

(v) If true that “CoCo conversion triggered by accounting numbers would be subject to regulatory discretion,” the key risk would remain regulatory-based, as Flannery and Perotti (2011, p. 7) have claimed. Official meddling could then invalidate triggers linked to the capital ratio used in regulatory accounting. The national authorities thus would thwart the intention to set international capitalization standards that are measurable and applied with a high degree of consistency over time and country within the current Basel process. However, it is unclear that the national regulators of the key countries are guilty as charged, and if guilty, why they would stop short of suspending or subverting any other type of built-in conversion trigger when it suits them.

(vi) Constructing a financial firm’s balance-sheet entries for non-par items simply, or even largely, by use of an uninterrupted and “thick” flow of auction-market prices is rarely an option, least of all in a financial crisis.

(vii) Whether or not assets, and, more controversially, liabilities, are marked to market, stockholders’ equity for most purposes is best treated as the respective residual. It cannot be independently marked to market *and* be consistent with the rich information, transparency and completeness provided by *any* internally-consistent method of balance-sheet accounting.

(viii) Finally, under limited liability, stock prices have a lower bound of zero and become highly volatile and uninformative when that boundary is approached by what may have become “penny” stocks. A firm’s accounting value of equity by contrast may become negative in a financial crisis and inform on the haircuts to be applied to debt holders.

Myers (1977, p. 150) adds the point that while book values refer to assets already in place, a significant part of many firms’ market value is accounted for by the present value of future growth opportunities. While Myers had nonfinancial firms in mind, investments in reputation, customer good will, franchise value, product development, trading and clearing platforms, and ICT networks present valuable growth opportunities for financial firms as well. However, the market value of these opportunities, and with it the market value of the entire firm, become highly volatile and poorly aligned with fundamentals when market liquidity and short-term funding shrink in a serious financial crisis. Such a crisis clouds the business outlook thereby adding large amounts of noise to stock price movements. Sharply higher volatility can be encountered not only in flash-crash minutes but persist over months, though probably not years. Stock

prices thus tend to lose their usefulness for accurately measuring net worth, which may be positive or negative, just when such an accurate measurement is most needed to assess solvency.

If market-based triggers are bad, regulatory capital-ratio based triggers could be even worse. Assume, for instance, that in a financial crisis under proper accounting 50 “bad” banks, 50B, would appear undercapitalized and likely to fail unassisted while 50 “good” banks, 50G, would be likely to survive judging by the capital ratios derived with regulatory accounting. In both cases the forecast based on *bona fide* accounting would turn out to be, say, 70% correct so that the 50B would divide into 35BB and 15BG. Likewise, the 50G would turn out to be 35GG and 15GB. Now assume 80% of the 50B become “liar” (investment) banks, like Lehman Brothers, when in difficulties. They pass themselves off as good banks for lack of appropriate accounting, audit, and supervisory oversight. Then the lineup is 90G and 10B, with 40 liar banks, 40BG*, contained in the reported 90G. Now 7 of the truthful 10B would in fact go bad and so would 43 (15GB and 28BG*B) of the 90G, almost half of them. Since the forecast identifying 90G and 10B banks based on creative accounting is so poor, it may be easy to beat it with market-based measures.⁶ There is another source of bias favoring rejection of accounting-based data which may be described as “many against one”. At least partly market-based measures and the length of the rolling-average periods which researchers use to construct them are many, but a firm’s regulatory capital ratios come just one at a time, being reported quarterly. This makes such accounting-based measures sitting ducks for multiple attempts to best their poor performance as early-warning signals in past samples of firms by freely experimenting with market-based data.

Instead of using the outcome of such an uneven fight to push for market-based triggers that have rightly been spurned in all existing cocos issues so far, regulators should find it disturbing and feel challenged to identify what is wrong with the regulatory measures and how they should be fixed. They should inquire why the accounting, whose application they are supposed to oversee for financial institutions, has been left so dysfunctional that “regulatory capital ratios offer, on average, little if any advance warning of impending problems” (Haldane, p. 6). They should not just dismiss regulatory accounting, to whose reliability they are supposed to contribute, as simply too complex to be meaningful because corporate window-dressers appear to understand it quite well. When Calomiris and Herring (2011, pp. 4-5) asked themselves, “Why did the regulatory system perform so badly?” they answered that, under existing rules, banks and rating agencies, which suffer conflicts of interest that make them understate risk, control the

⁶ Strongin, Hindlian and Lawson (2009, p. 10) hint that to the extent stock prices react faster and more strongly to the release of adverse information than capital-adequacy based measures, a stock-price based trigger could create even stronger incentives than an accounting based trigger to conceal problems. Calomiris and Herring (2011, pp. 24-25) recommend employing as trigger a 90-day moving average of the ratio of the market value of equity relative to the market value of equity plus the face value of debt to smooth fluctuations in share prices and to provide time to react to the signals contained in this trigger measure. They recognize (fn. 20, p. 36) that as this measure approaches the trigger point, there could be a downward spiral because existing shareholders anticipate that they may soon suffer high losses from dilution (under the first method of conversion) when cocos convert to equity. However, this spiral could be arrested through timely new equity issues which would beg the question unless they are mandated in a crisis. In their view (pp. 31-34), such new issues would also overcome the problem of multiple equilibria or of indeterminacy of outcomes with cocos which has been raised by Sundaresan and Wang (2011).

measurement of risk used by regulators. But such existing rules can be challenged and are not beyond fixing.

5.2 Three Possible Methods of Conversion Defined

At least three methods are available which normally differ with respect to the dilution they impose on existing shareholders. Calomiris and Herring (2011, p. 17) define a cocos conversion as dilutive if it leaves the holders of cocos with no less value in new equity as the principal of the bonds they surrender. I prefer to define a cocos conversion as dilutive if it gives cocos holders a larger fraction of the total number of shares outstanding after conversion than corresponds to their contribution to (book) equity through conversion.⁷ By the latter definition, method 3 below is necessarily neutral, being neither dilutive nor its opposite. Method 2 is anti-dilutive if the book value per share at conversion is less than the market price per share at the time of cocos issue. Finally, application of the first conversion method is dilutive if the market price per share is less than the book value per share at conversion. Total book equity after conversion is equal to the book value of common equity at the trigger point⁸ plus the gain, booked at face value, from cocos debt cancellation. With this background, the three methods are specified in turn.

(a) The first method has a pre-assigned market-value target to determine the number of shares to be issued and valued at conversion. If the target is equal to the principal amount of the cocos (**PA**), then the number of shares to be newly issued (**NS**) is $NS = PA/PC$, where **PC** is the market price of reference just prior to conversion. Hence the lower $PC > 0$ turns out to be, the higher **NS** and the greater the dilution and expropriation of existing shareholders relative to their contribution to the book value of common equity at the time of conversion. If the market price inferred at the time of conversion, **PC**, can actually be realized around that time because the firm's shares have a deep market, cocos holders would get their principal back in full, and sooner than originally scheduled. Senior non-cocos debt holders and existing shareholders on the other hand could suffer substantial losses. Hence the subordination hierarchy would be disrespected when conversion has been triggered under the first method. So would equality of treatment for new and existing shareholders which is here represented by a distribution of shares that conforms to the book value of common equity contributed by each group,

⁷ Application of the two definitions would often, but not under all circumstances, lead to the same classification.

⁸ The book value of common equity at the trigger point is equal to a specified percentage of either unweighted or risk-weighted assets, such as 5%. If a notice of conversion, with a near-term date at which the conversion is to be effected, is issued promptly as soon as there is accounting evidence that the trigger has been breached, the book value of equity would simply be taken to be 5% of the referenced assets of the firm. If either the notice of conversion or the actual conversion date are delayed for any reason such as stays resulting from litigation, the determination of the book value of common equity minus the, say, 3% of assets contributed by the cancellation of cocos, would have to be updated, most likely to the detriment of existing shareholders. For instance, if it were found later that the value of the equity of existing shareholders has fallen from the trigger level of 5% to 2% of assets, the former cocos holders would get not 60% as many shares as were outstanding prior to conversion but 150% as many under method 3. Hence existing shareholders would have an incentive to seek conversion promptly when triggered lest their ownership share shrink from 62.5% to 40% in the above example in a delayed conversion.

(b) The second method fixes the number of shares to be obtained in the conversion, except for any anti-dilution provisions that may apply, already at the time cocos are issued. It solves for that number by means of the equation $NS = PA/PI$, where PI is the market price of reference around the time of cocos issue. For example, that reference price may be a volume-weighted average daily market closing price which may be only slightly trailing or leading from the date of issue. The value (and hence number) of shares obtained at conversion but determined at the time the cocos are issued could also be required to be a little more, such as 105% of the principal amount or face value of cocos, so that $NS = (1.05PA)/PI$. This recommendation, not further supported, was put forward in a casual proposal by the SFRC (2010, p. 3) to give cocos more “upside.” J.P.Morgan (2011) has offered what they regard as a superior combination of the first two methods in that conditions at the time of issue would be used mechanically to project the market price at conversion which would then become the conversion price specified in the cocos issue. If, for instance, the minimum capital requirement were 10% and the trigger level 7%, the conversion price would be set equal to 70% of the market price at time of issue.

(c) The third method makes sure that book value per share is the same on the day before as on the day after conversion so that conversion does not cause a devaluation of existing shares. It achieves this by having the number of shares outstanding grow at the same rate as the book value of equity upon conversion. It assumes that the book value of the existing number of shares (ES) in a firm is equal to what the conversion trigger implies. If that trigger level is set at 7% of tangible assets, A , which may be risk-weighted as in the 2011 Credit Suisse issues, then, at the trigger point, that book value, $b_0(ES)$, must be taken to be equal to tA . In this example, t is 7% and b_0 is book value per existing share equal to tA/ES which is to be left unchanged by conversion. If conversion applies to a principal amount of cocos whose book value, not marked to market, is equal to $c = 3\%$ of the same assets, then $b_1(NS) = cA$. Thus the book value of cocos per share contributed to common equity by conversion, b_1 , is cA/NS . Now under the third method of conversion the number of shares newly issued, NS , would be equal to 30% of the total number of shares outstanding after conversion in this example, i.e., to $NS/(NS+ES) = cA/(c+t)A = c/(c+t) = 0.3$. The remaining 70% or $t/(c+t)$ would still be held by the existing shareholders. The increase in the total number of shares would be by $3/7$ to $10/7$ of ES , the same as the gross rate of increase in the book value of equity. Hence b would be unchanged from just before to just after the act of conversion and $b_0 = b_1$. A general proof of this result, if one is needed, is given in Appendix A. The former cocos holders would have lost their seniority over the existing shareholders whom they have joined on equal terms without redistribution.

5.3 The Three Methods of Conversion Illustrated

Having specified and explained the three different methods of conversion and some of their consequences, their applications are described in the same order as before.

(a) Under the first and worst method, the number of shares obtained in the conversion is determined so that their value at a recent average price would be equal, at that price, to the face value of the cocos being converted. Use of the “recent average price” may be qualified by the phrase, “but not less than \$x per share,” where x is a floor price. This price sets a limit on the maximum number of new shares that may be issued in the conversion and thus on the resulting dilution of the stake of existing shareholders. Except when the floor price is firmly expected to be binding, the number of shares obtained from the conversion is not known until the “recent average price,” PC, has been recorded. Cocos then are converted at full face value as if they were called at par, thereby violating the subordination hierarchy of pre-existing debt. If the floor-price constraint is binding, the violation of seniority in favor of cocos holders would be less as their claims could be subject to a substantial haircut when evaluated at market price PC rather than PC_{floor} , and $PC < PC_{\text{floor}}$. A recent Swiss cocos issue illustrates application of the first method with a stopping point on dilution. The tier 2 Buffer Capital Notes (BCNs), when to be converted, “convert into Credit Suisse Group ordinary shares at their prevailing market price over a 30-day period preceding the notice of conversion, subject to a minimum price of USD 20” (Credit Suisse, 2011, p. 1). On May 17, 2011, CS (as an ADR representing one share of CSGN, Credit Suisse Group) was trading in the \$41-\$42 range in New York. Here is some background on this cocos issue: Credit Suisse announced in February 2011 that it had agreements with some of its strategic investors, Qatar Holding and the Olayan Group, to swap \$6.2 billion worth of certain hybrids, which soon will no longer qualify as tier 1 capital, for cocos. Interest rates on the cocos are lower than on the hybrid capital they will replace. Announcement of this agreement with strategic investors was to help generate interest in its \$2 billion Capital Buffer Note (BCN) offering of cocos. That issue turned out to be oversubscribed by a factor of 11. The BCNs have a final maturity of 30 years but are callable at par at any time from August 2016. They were issued at par with a coupon of 7.875%. This was 322 basis points above the yield on 30-year U.S. Treasuries on the BCNs’ issue date of February 17, 2011 and about 200 basis points above the yield required on long-term corporates that were rated A by S&P with a “stable” outlook like Credit Suisse Group. The initial yield of 7.875% fell to 7.35% within a week after issue and then further to about 7% as the price of the issue continued to climb in the secondary market. Tables 1 and 2 provide details on the basic and conversion-related characteristics of the cocos issued through the first quarter of 2011.

(b) The second method has been used in the first cocos issue pioneered by Lloyds Banking Group (LBG). To determine how many shares would match the face value of cocos at the time of issue, its exchange offer of November 3, 2009 of certain hybrid securities for cocos specified the following price: the volume-weighted average price of ordinary shares of LBG for each of the five consecutive trading days included in the period November 11-17, 2009. The number of shares determined by use of this price was raised soon afterwards to compensate for the decline in their theoretical value produced by a massive rights offering later that month.

(c) The third, and preferred, method has not yet been used. As already explained, it focuses on the fair share of new (NS) versus existing (ES) shares of common, in the total number of such shares

outstanding after conversion, $NS + ES$, and uses book-value accounting. By making the number of shares issued independent of their market value at conversion, downward stock-price spirals through conversion can be avoided. Furthermore, existing shareholders and new shareholders by conversion are treated exactly the same, with the share of the combined equity retained by, or issued to, each of the two groups equal to the share of the book value of capital which they brought into the recapitalized firm. If instead of following this rules-based calibration, cocos holders were arbitrarily accorded a larger pre-determined share of common equity in the event of conversion than would be proportional to the book value of common equity which they had contributed, cocos holders could benefit greatly from conversion and from gaining the valuable control rights it would confer. The result would be similar to what would happen under the first method if PC declined toward 0 and existing shareholders are expropriated by the former cocos holders through extreme dilution for lack of a stop price. Dealing with an (almost) gone-concern to be recapitalized with a similar result, Aghion *et al.* (1992, p. 535, ftnt. 30) describe a pre-arranged scheme where junior creditors -- think cocos holders -- end up with all the new shares, senior creditors are paid off in full, and the old -- here "existing" -- shares are cancelled since the expected net worth of the bank is already negative. At least formally, absolute seniority is preserved in their scheme that can be applied by prior agreement outside bankruptcy. It involves granting out-of-the-money, in their case finally worthless, subscription rights to existing shareholders and in-the-money rights to junior creditors. This makes the "benefits" of bankruptcy, wiping out existing shareholders, and those of recapitalization, finding new shareholders, coincide.

Under any of the inferior methods or with incorrect calibrations of the preferred method of conversion based on ownership shares, the prospect of partial or total expropriation of existing shareholders for the benefit of the new shareholders would destabilize the stock price as "conversion risk" grows. Micro-prudentially at least, any such systematic risk can, however, be avoided, as already shown, by keeping book value and theoretical price per share before and after conversion the same. Of course macro-prudentially a rash of decapitalization in a financial crisis that causes bunching of cocos conversions would lower the outstanding stock of long-term bank debt and raise its quality, while at the same time greatly increasing the number of banks' common shares outstanding. Depending on the liquidity and depth of markets and the elasticity of portfolio substitution toward equity, there could be price effects: During the portfolio-adjustment process, stock prices would fall while the value of bonds would rise. The economywide reduction in leverage would reduce both the actual and the required rate of return on equity along Modigliani-Miller lines microeconomically. At the same time, the aggregate portfolio rebalancing toward equity would involve a partly offsetting rise in the required rate of return on equity over debt to the extent the volume of bank equity may have exceeded the capacity of its preferred habitat. Without cocos in the financing mix the same crisis conditions would be triggering receivership or regulatory bankruptcy and prompt corrective action by bank supervisors. Hence the market stresses from bunched crisis conversions should not deter issuing cocos in view of these vastly more costly and unsettling alternatives.

If having cocos on the liability side of the balance sheet is compared with having raised that much more common equity instead, unlike cocos conversion, using up common equity in a crisis does not provide for deleveraging or arrest the shrinkage of the balance sheets of financial institutions. Hence even this comparison need not be disadvantageous for cocos. However, it would be prudent to let the stock of cocos outstanding grow only gradually as a market for them is developed with long-term investors. Among these desirable investors are pension funds, life insurance companies, private-asset managers, and sovereign wealth funds that are not significant loan clients of banks or money markets and able to hold equity obtained from conversion at least temporarily. The reason for this caution is that banks should be minimally exposed to some of the non-bank financial institutions qualified to hold the cocos issued principally by SIFIs. Otherwise, when these qualified financial institutions suffer concentrated losses from cocos conversion more or less at the same time in a crisis, there could be adverse spillback to the banks and to the smooth functioning of financial markets.

5.4 Debt Overhang

The debt overhang problem arises when informed investors choose not to inject additional equity since some of the proceeds of the tangible investment would go to existing holders of the company's risky debts rather than to the equity holders. FINMA (2011, p. 71) cites debt overhang as a reason why equity capital is privately more expensive than debt even ignoring differences in the tax (deductibility) treatment of interest versus dividends paid. To explain briefly, consider first an investment in a fundamental risk class of assets requiring and providing an 8% rate of return regardless of how these assets are financed. Consider what happens if these assets are 75% debt financed initially and leverage is then reduced to 50%. In Case A the riskless rate of return is 4% but the interest rate on debt is initially 6% because the debt is risky so that there is debt overhang. In Case B the riskless rate of return is 6% and so is the interest rate on the debt initially and subsequently because there is no risky-debt overhang. Then initially the rate of return required and obtained on equity is 14% in either case, with debt initially bearing part of the total risk premium of $(8-4)\% = 4\%$ per annum in Case A. But when leverage (debt to assets) is reduced from 75% to 50%, the holders of the (most senior) debt that previously would not have been paid in full in the event of bankruptcy would be first to benefit as the required rate of return on that debt would fall from 6% to the riskless rate of 4%. Thus the rate of return on equity would fall from 14% only to 12% in Case A. In Case B, the interest rate on debt would stay at the alternative riskless level of 6% and the required rate of return on equity would fall from 14% with an 8% equity premium to 10% with a 4% equity premium over the riskless rate. Hence equity holders would get the full benefit of sharing the total risk premium on safer assets, now of $(8-6)\% = 2\%$ per annum, twice as widely between them as leverage is reduced to 50% because there was no debt overhang to start with. Myers (1977) has developed the concept and Occhino (2010) has provided an accessible introduction to the kinds of questions it can address.

(i) If the outstanding debt is already risky, does taking on cocos debt increase the debt overhang problem and discourage equity finance of future investments which are profitable overall, but not profitable for shareholders? The answer here is that cocos are normally issued in times when default risk is low and necessarily converted to equity when default risk is high and conversion is triggered. Cocos debt that is issued in good times may not be viewed as risky, but it may become risky in bad times prior to conversion and add to debt overhang which conversion itself may later relieve. Hence any debt overhang problem with cocos comes with its own cure, with conversion capable of reducing the riskiness of the remaining debt just as in Case A before.

(ii) The second question is whether the design of cocos militates against the development of debt overhang in the first place. Part of the answer is that the trigger for cocos should be set at or somewhat above the minimum level of the regulatory capital ratio referenced in its covenant. As this minimum is raised further during implementation of Basel III, any prospect of bankruptcy, or the fear that conversion might come too late to save the company, would be diminished.

(iii) It is further worth noting that the debt overhang problem, as in Myers (1977, p. 148) and the literature cited therein, is usually represented as if bankruptcy of financial institutions did not in itself represent a value-destroying activity, producing average losses equal to about one third of the total assets of the institution being resolved as already noted. But to the extent having cocos on the balance sheet greatly diminishes prospects of bankruptcy, there is value added for all stakeholders in the company who are exposed to the risk that it may fail. Common shareholders, who could lose everything in a bankruptcy, would benefit most.

6. Conclusions

While it is true that the only immediate cash-flow benefit which the conversion of cocos brings is the cessation of their interest payments, as Goodhart (2010, p. 30) emphasized before calling for a ban on dividend payments under distressed conditions instead, this is by no means the only benefit of conversion. Deleveraging through debt write-off outside bankruptcy or regulatory insolvency proceedings confers advantages beyond bringing regulatory capital back up to adequate, or well-capitalized, levels, depending on the strength of the cocos shield. For instance, cocos conversion can reduce collateral requirements imposed for repos, loans and other liabilities of a financial institution, improve the rating of its remaining debt, and increase borrowing capacity, for instance on trade credit and commercial paper, which could bring in cash. The counterparty risk of dealing with such an institution would be reduced. Debt overhang would also be lessened prospectively as the larger equity base from conversion reduces the riskiness of the debt remaining thereafter and lowers the extent to which the returns on profitable investments would have to be diverted to make risky debt whole. Hence more equity financing of profitable future

investments would now become feasible, and the mere emergence of this prospect could add value to the equity currently outstanding.

While promising in principle, cocos have been held back by insufficient functionality and lack of standardization in their design. Using data from the most recent financial crisis as a guide, this paper tried to analyze first how large the cocos buffer should be. It concluded that this buffer need not be any greater than 3% of tangible assets, and not nearly as high as 10% of a similar total recommended by the SFRC (2010, p. 2) and by two of its members (Calomiris and Herring, 2011, p. 29) separately. It then showed why the trigger should be based on regulatory accounting measures of the type referenced in Basel III, preferably a leverage ratio with core tier-1 capital, also known as tangible common equity, TCET1, in the numerator and total tangible assets in the denominator. The latter may have to be risk-weighted as under Basel III although harmonizing the risk-weighting process conceptually and in its application across jurisdictions of national regulators is frustrating, and the weights are prone to manipulation (Haldane, 2011).

Finally it explained that many problems attributed to cocos can be attributed to poor design of their terms of conversion, like most of those used so far. There should be nothing discretionary or intentionally redistributive in these terms, and nothing that disrespects pre-specified seniority rules or treats new and existing shareholders differently by changing book value per share in the process of issuing new shares by conversion. Accordingly the preferred method of conversion is distributionally neutral and in principle neither dilutive nor its opposite for existing shareholders. This does not mean that existing shareholders may not have other good reasons to agree to new equity issues to forestall triggering conversion. Calculability and marketability of cocos would benefit if the design of successive issues would conform to the basic specifications here laid out. Once dominant forms of cocos have crystallized in the market, they could gain a substantial primary market and an active secondary market without relying solely on regulatory mandates.

Investing in cocos requires a loss premium under risk neutrality over the rate of return required on otherwise comparable long-term debt without the cocos conversion feature. Because the market price per share at the time of conversion is likely to be below the level that would deliver par value for cocos under the second method, so that $PC \leq PI$, the immediate value of the shares received by conversion is expected to be less than the principal amount of the cocos converted. This conversion loss is priced by the put option with strike price equal to the conversion price, in which cocos holders would have to invest to ensure receiving the face value of cocos in full, but at the cost of that option. As laid out in Appendix B, the addition to the required rate of return on non-cocos debt turns out to be a little over 1/2 percentage point with LBG's conversion terms and a remaining maturity of 9 years. Keeping the debt write-off but dropping the conversion feature, as in the Rabobank issues listed in Tables 1 and 2, would add another 1 percentage point for a full loss premium of 1-1/2 percentage point. This means that adding a debt-write-off trigger but dropping the conversion feature -- which is equivalent to setting the recovery value of cocos to

zero in calculations of the CDS swap rate under given conversion risk -- would cause the extra cost of issuing cocos to be three times as high on that account. These estimates are specific not so much to LBG but to the time structure and size of the conversion probabilities generated with equation (1) in Appendix B and thus not easy to generalize. Yet even if the extra private costs from cocos conversion with some other calibration were to turn out twice as high as here deduced because the firm is weaker than implicitly assumed, they would still pale in comparison with the social costs of receivership or bankruptcy which they help to avoid or at least to defer and reduce.

To end with a simple analogy to the usefulness of cocos mandates: Requiring installation of automatic sprinkler systems reduces the probability that a building will burn to the ground, but does not eliminate that possibility. Having these systems, like having cocos on the liability side of the balance sheet of big financial institutions, also lowers the cost of fire insurance, or the taxpayer cost of the government's implicit too-big-to-fail guarantee. FINMA (2011, p. 64) has provided a survey of estimates suggesting that the funding advantage provided by this uncompensated guarantee to big banks in the years just prior to the most recent financial crisis was around 30 basis points annually. The crisis then showed that the social costs of this guarantee and of the excessive leverage and risk taking it induced were many times higher. Hence lowering its future social cost is an urgent matter with which properly designed cocos, with a defined role in supplementing and contributing to regulatory capital, could help.

References

- Admati, Anat (2010), "Comments on Proposal to Ensure the Loss Absorbency of Regulatory Capital at the Point of Non-Viability," Stanford University, 1 October
<http://www.gsb.stanford.edu/news/docs/AdmaticommentsforBaselCommitteeOct12010.pdf>.
- Admati, Anat R., Peter M. DeMarzo, Martin F. Hellwig and Paul Pfleiderer (2010), "Fallacies, Irrelevant Facts, and Myths in the Discussion of Capital Regulation: Why Bank Equity is *Not* Expensive," Stanford University and (for Hellwig) Max Planck Institute for Research on Collective Goods, Bonn, draft dated 30 September.
- Aghion, Philippe, Oliver Hart and John Moore (1992), "The Economics of Bankruptcy Reform," *Journal of Law, Economics, and Organization*, 8(3)(October): 523-46.
- Bank for International Settlements (cited as BIS) (2009), "An Assessment of Financial Sector Rescue Programmes," *BIS Papers* No.48.
- BIS (2010a), "Proposal to Ensure the Loss Absorbency of Regulatory Capital at the Point of Non-Viability," Basel Committee on Banking Supervision (BCBS) Consultative Document, August
<http://www.bis.org/publ/bcbs74.pdf>.
- BIS (2010b), "An Assessment of the Long-Term Economic Impact of Stronger Capital and Liquidity Requirements," BCBS, August.
- BIS (2010c), "Guidance for National Authorities Operating the Countercyclical Capital Buffer," BCBS, December.
- Bolton, Patrick and Frederic Samama (2011), "Capital Access Bonds: Securities Implementing Countercyclical Strategies," Columbia University (for Bolton), rev. April.
- Calomiris, Charles W. and Richard J. Herring (2011), "Why and How to Design a Contingent Convertible Debt Requirement," April
<http://ssrn.com/abstract=1815406> .
- Coughlin, Paul (2010), "Standard and Poor's Credit Ratings Performance and Initiatives," Standard and Poor's Financial Services, June
http://siteresources.worldbank.org/FINANCIALSECTOR/Resources/Session5_PaulCoughlin_presentation.pdf.

Credit Suisse Group AG. (2011), "Credit Suisse Group Places 7.875% Tier 2 Buffer Capital Notes," Form 6-K: Report of Foreign Issuer filed 02/18/11 for the period ending 02/18/11.

Eidgenössische Finanzmarktaufsicht in conjunction with other Swiss government agencies and departments (cited as FINMA) (2011), "Regulierungsfolgenabschätzung zur Änderung des Bankengesetzes (too big to fail)," Bern, 31 March. (Unofficial translation: Assessment of the Consequences of Regulations Leading to Changes in the Banking Law).

<http://www.efd.admin.ch/dokumentation/zahlen/00578/02267/index.html?lang=de> .

Finfacts Ireland (2011), "Market News Friday: Net Irish bailout costs at €65 bn - - 43% of GDP," 1 April, last updated 4 April

http://www.finfacts.ie/irishfinancenews/article_1021982.shtml.

Note: On March 24, 2011 the Central Statistics Office Ireland published €165 billion as its preliminary GDP estimate for 2010. With that, the costs would amount to 39% of GDP.

Flannery, Mark J. (2009), "Stabilizing Financial Institutions with Contingent Capital Certificates," Warrington College of Business Administration, University of Florida

<http://ssrn.com/abstract=1485689>.

Flannery, Mark and Enrico Perotti (2011), "CoCo Design as a Risk Preventive Tool," Vox, 9 February.

<http://www.voxeu.org/index.php?q=node/6089> .

Geithner, Tim (2011), "Remarks by Treasury Secretary Tim Geithner to the International Monetary Conference," Atlanta, 6 June

<http://www.treasury.gov/press-center/press-releases/Pages/tg1202.aspx>.

Glasserman, Paul and Behzad Nouri (2010), "Contingent Capital with a Capital-Ratio Trigger," Columbia Business School and Columbia University, 31 August

<http://ssrn.com/abstract=1669686>.

Goldman Sachs. Global Investment Research (2010), "Still Not a Level Playing Field; Regulatory Differences Drive Relative Returns," Europe: Banks, 9 December.

Goldman Sachs. Global Investment Research (2011), "Contingent Capital: Possibilities, Problems, and Opportunities," Banks: Multinational. Investment Grade / High Yield, 16 February.

Goodhart, Charles A. E. (2010), "Are CoCos from Cloud Cuckoo-Land?" *Central Banking*, 21(1)(August): 29-33.

- Goodhart, Charles A. E. (2011), "The Squam Lake Report: A Commentary," *Journal of Economic Literature*, 49(1)(March): 114-9.
- Goodstadt, Leo F. (2011), *Reluctant Regulators: How the West Created and China Survived the Global Financial Crisis*, Hong Kong: Hong Kong University Press.
- Grübel, Oswald (2011), "UBS Sticks to CoCos Work Despite Chief's Danger Warning," *Financial News*, 3 March
<http://www.efinancialnews.com/story/2011-03-03/ubs-committed-to-cocos-despite-oswald-grubel-warnings>.
- Haldane, Andrew G. (2011), "Capital Discipline," Remarks by Andrew G. Haldane, Executive Director, Financial Stability, avail. from
www.bankofengland.co.uk/publications/speeches.
- Humphreys, Thomas A. (2007), "Appendix: Tax Deductible Equity and Other Hybrids in the US - A Brief History and Current Developments,"
<http://www.mofo.com/docs/pdf/TaxDeductibleHybrid.pdf>.
- Independent Commission on Banking (cited as ICB) (2011), "Interim Report: Consultation on Reform Options," April
<http://bankingcommission.independent.gov.uk/bankingcommission>.
Note: The final report of the Commission is scheduled to be released in September 2011.
- International Monetary Fund (cited as IMF) (2009), "Responding to the Financial Crisis and Measuring Systemic Risk," *Financial Stability Report*, World Economic and Financial Surveys, April.
- J. P. Morgan (2011), "Making CoCos Work," Europe Credit Research, 15 February.
- Kane, Edward J., Rosalind L. Bennett and Robert C. Oshinsky (2008), "Evidence of Improved Monitoring and Insolvency Resolution after FDICIA," Boston College and FDIC, 8 December
<http://ssrn.com/abstract=1396770>.
- McDonald, Robert L. (2010), "Contingent Capital with a Dual Price Trigger," Finance Department, Kellogg School, Northwestern University.
- Moody's Investors Service, Global Credit Research (2002), "Understanding Moody's Corporate Bond Ratings and Rating Process," May
<http://www.moodys.com/sites/products/ProductAttachments/eeSpecialComment.pdf>.

- Myers, Stewart C. (1977), "Determinants of Corporate Borrowing," *Journal of Financial Economics*, 5(2)(November): 147-75.
- Occhino, Filippo (2010), "Is Debt Overhang Causing Firms to Underinvest?" Federal Reserve Bank of Cleveland, Economic Commentary, 20 July
<http://www.clevelandfed.org/research/commentary/2010/2010-7.cfm>.
- Pennacchi, George (2010), "A Structural Model of Contingent Bank Capital," Federal Reserve Bank of Cleveland Working Paper No.10-04.
<http://ssrn.com/abstract=1595080>.
- Raaflaub, Patrick (CEO FINMA) (2011), "Basel III and the Swiss SIFI Policy," Presentation at the Asian Financial Forum 2011, Hongkong, 18 January
http://www.asianfinancialforum.com/PDF/Speakers2011/AFF2011_PatrickRaaflaub_Powerpoint_en.pdf.
- Rajan, Raghuram G. (2010), "Too Systemic to Fail: Consequences, Causes, and Potential Remedies," BIS Working Papers No.305.
- Reinhart, Carmen M. and Kenneth S. Rogoff (2009), *This Time is Different: Eight Centuries of Financial Folly*, Princeton, NJ: Princeton University Press.
- Shadow Financial Regulatory Committee (cited as SFRC) (2010), "The Case for a Properly Structured Contingent Capital Requirement," Statement No.303.
- Strongin, Steve, Amanda Hindlian and Sandra Lawson (2009), "Effective Regulation: Part 5 – Ending 'Too Big to Fail'," Goldman Sachs, Global Markets Institute, December.
- Sundaresan, Suresh and Zhenyu Wang (2011), "On the Design of Contingent Capital with Market Trigger," Federal Reserve Bank of New York Staff Report No.448, rev. June.
- von Furstenberg, George M. (2011), "Contingent Capital to Strengthen the Private Safety Net for Financial Institutions: Cocos to the Rescue?" Discussion Paper Series 2: Banking and Financial Studies, No. 01/2011, Deutsche Bundesbank, Frankfurt, Germany.
http://www.bundesbank.de/download/bankenaufsicht/dkp/201101dkp_b_.pdf.

Table 1. Key *Non-Conversion* Terms of Cocos Bonds (to be) Issued

Issuer, Bond	Amount, Issue Date, Seniority	Coupon	Interest Deferral, Maturity	First Call
Bank of Cyprus, Convertible Enhanced Capital Securities (CECS) announced	EUR 1.342bn partly in USD, authorized 03/23/2011, T1	EUR: 6.5% until 6/30/2016, then 6m Euribor + 300bp USD: 6% until 6/30/2016, then 6m Libor + 300bp	Optional Noncumulative, Perpetual	6/30/2016, redemption subject to replacement with T1 capital/same or better quality
Credit Suisse (CS), 7-7/8 02/24/41 CoCo Bonds	USD 2bn 02/24/2011, T2	7.875% until 08/24/16 then resets every 5 years at USD 5-yr. swap rate + 522bp	No deferral, 02/24/2041 (30Y)	08/24/2016
CS, Tier 1 Buffer Capital Notes (BCN)	USD 3.5bn+CHF 2.5bn BCN to be issued in exchange 10/2013, T1	USD bonds: 9.5% CHF bonds: 9% reset after first call date	Noncumulative, Perpetual	No earlier than 2018
LBG, Enhanced Capital Notes (ECN)	GBP, EUR, USD, JPY totalling end 2009 GBP8.78bn, 12/01/2009, LT2	Fixed rates, with some fixed-to- (from redem.date) floating perpetuals	No deferral, 2019-2032 (10-23Y) or perpetual	First optional redemption date in 2020 or later for undtd. ECN
Rabobank, 6-7/8 19/03/20	EUR 1.25bn, 03/19/2010, senior	Fixed at 6.875%	No deferral, 03/19/2020 (10Y)	Not callable
Rabobank, 8-3/8 Perpet. Contingent Capital Bonds	USD 2bn, 01/26/2011, T1	8.375% until 07/26/16 then reset every 5 years at 5 year U.S. Treas.+ 642.5bp	Noncumulative, Perpetual, option to redeem / must replace from 01/26/2041	07/26/2016

Source: Based on "DB-A look at the European bank CoCos market," Figure 1, 04/26/2011, but with corrections and completions based on company reports and news releases. See: <http://7marketspot.com/archives/1567>.

Table 2. Key *Conversion* Terms of Cocos Bonds and No. of Shares to be Issued

Issuer, Bond	Conversion Trigger(s)	Trigger Event(s)	Details of Conversion: No. of Shares Issued or Write-downs
Bank of Cyprus, BOCY T1 Convertible Enhanced Capital Securities (CECS) announced	Core Tier 1 <5% or Central Bank (CB) finds noncompliance w. capital requirements (<i>Contingency Event</i>) or that conversion is needed to avoid (the need for public sector support to prevent) insolvency (<i>Viability Event</i>).	Issuer delivers a notice or CB determines noncompliance with core capital ratio (<i>Contingency Event</i>). CB may also activate the trigger at any time (<i>Viability Event</i>).	Bonds are convertible into common at investors' option during specified periods until 05/31/16 at EUR3.30 per share. If <i>Contingency</i> or <i>Viability Event</i> occurs, conversion into common is mandatory at share price equal to 80% of 5-day average market price before <i>Event</i> notice with max. price of EUR3.30 and min. of EUR1.
Credit Suisse (CS), 7-7/8 02/24/41 CoCo Bonds	Core T1 or Common Equity T1, as app., <7% <i>Contingency Event</i> , <i>CE</i> or <i>Viability Event</i> , <i>VE</i> .	Quarterly Financial Report (<i>CE</i>) or regulatory declaration anytime (<i>VE</i>).	Common stock with share price based on the 30-day avg. price prior to the conversion. Min. share price used is USD20.
CS, Tier 1 Buffer Capital Notes (BCN)	Same as immediately above.	Same as immediately above.	See above but with 5-day avg. price and min. of USD20 or CHF20 dep. on bond currency.
LBG, Enhanced Capital Notes (ECN)	Core T1 capital ratio <5%	(Semi)annual reports. Issuer may publish trigger ratio anytime.	Common stock at 59.2093 pence per share, applied also to principal values converted to GBP at time of conversion
Rabobank, 6-7/8 19/03/20 Cont.Senior Bond	Common equity capital ratio <7%	Issuer delivers cert. signed by 2 Board members that <7%.	Cash equal to 25% of principal with 75% of principal write-down.
Rabobank, 8-3/8 Perpetual Contingent Capital Bonds	Common equity capital ratio <8%	Issuer reports ratio is below trigger level or regulators expect ratio to fall below trigger level.	Principal may be written down successively to 0 and never up. Partial write-down amount equals what is needed to restore equity capital to trigger level.

Source: See Table 1.

Note: The number of shares issued in a conversion of cocos, is equal to the face (or principal) value of cocos divided by the reference price. This price may be established from market price data around the time of issue (LBG) or around the time of conversion (CS). To the extent the reference price is below market rather than at market, as in the Bank of Cyprus issue, more new shares, 25% more in that case, are issued in the conversion. The result is a more severe dilution of the stake of existing shareholders.

Appendix A.

Cocos Conversion with Third Method does not Change Book Value per Share

The proof starts with the balance-sheet identity at the time of cocos issue (subscript 0):

$$A_0 = D_0 + C_0 + E_0. \quad (1A)$$

A is the book value of assets, D and C are the face values of senior debt and of cocos, and E is the book value of equity. At the trigger point (subscript T),

$$E_T = tA_T = x_T S_T. \quad (2A)$$

Here the fraction t is the designated level of the capital ratio triggering cocos conversion, and x_T is the book value per share for the S_T number of shares outstanding at the trigger point just prior to conversion. When conversion is implemented (subscript C), E rises by C_0 from E_T on account of cocos being cancelled. At the same time the number of shares outstanding increases from S_T to $S_T + S_C$, where S_C represents the number of shares issued in the conversion. Hence the book value of equity immediately after conversion can be expressed as:

$$E_T + C_0 = x_C (S_T + S_C). \quad (3A)$$

New (S_C) and existing (S_T) shares are identical so that they must have the same book value per share, x_C . However, under the first two methods of conversion, x_C normally differs from x_T .

This is different under the third conversion method. Applying that method requires the ratio of S_C to S_T to be equal to the ratio of the book values of common equity associated with each of these share issues so that:

$$S_C = (C_0/E_T) S_T. \quad (4A)$$

Substituting from equation (4A) for S_C in equation (3A) then yields:

$$E_T + C_0 = x_C (E_T + C_0)(S_T/E_T). \quad (5A)$$

Dividing through by $E_T + C_0$, solving for x_C , and comparing the result with the solution of equation (2A) for x_T then shows that book value per share is unchanged by the accounting process of conversion under the third method:

$$x_C = E_T/S_T = x_T. \quad (6A)$$

Q.E.D.

Appendix B.

The Loss Premium on Cocos with Assumed Conversion-Trigger Risk

Table 2 shows that if the common shares of LBG obtained in cocos conversion are valued at 59.21 pence (p) per share, their total value would be equal to the principal amount of the cocos converted. This appendix deduces what conversion loss premium would have to be included in the interest rate on cocos under risk neutrality. This premium would have to cover the expected loss from conversion that arises from the stock price of LBG falling short of 59.21 p at the time of conversion. With that premium on top of what would be required on comparable long-term non-cocos debt, the cocos would then be valued at 59.21 p times the number of shares obtained in conversion. Normalizing by using the adopted conversion price per share as reference, the principal amount invested in cocos, and hence their par value, is simply taken to be 59.21 p to work with the easiest common scale of one share's worth of cocos valued at conversion price.

It is assumed that conversion will *not* be triggered when the share price is *above* the conversion price. However, this is a possibility particularly since the share price at conversion will already reflect the anticipated benefits of conversion for shareholders. Still we assume conservatively that there will be no instant capital gain for cocos holders from conversion so that $PI \geq PC$. In other words, cocos holders will not be able to realize prices over 59.21 p per share upon conversion, but they may see that price or less: If conversion occurs, only the parts of the expanding stock price distributions, projected by the diffusion process into the future, from 59.21 p on down are taken to be relevant for cocos holders as they look ahead to evaluate the value of the share they will obtain in any future conversion.

With this assumption, the loss premium is calculated by representing conversion as a dual-trigger option:

- (i) The company has the option to put the predetermined number of shares for its outstanding cocos debt. Exercising this put would have value for shareholders, and cause losses to cocos holders, if the market price per share is below the conversion price.
- (ii) However, for the put to be exercised, the capital ratio referenced in the cocos covenant must have fallen to the level that triggers mandatory conversion.

Hence inputs for the Black-Scholes theorem must be specified as well as the probability of setting off the trigger under (ii) over the 9 years of the remaining life of the LBG cocos bonds many of whose dozens of series are due in 2020.

For the theorem, the market price (for LLOY-L) used was 54.54 p, adjusted for dividends and splits, but not rights issues, from Yahoo Finance at the close of 05/11/2011. This market price is somewhat below the 59.21 p strike price which is equal to the conversion price set at the time of cocos issue with subsequent adjustment for dilution. The riskless rate on that date was 3.3% for the 9-year U.K. government benchmark yield. Due to the assumption of risk neutrality, this rate also is the discount rate used in subsequent calculations. Because of the company's near-death experience and massive bail-outs in 2008-2009, to estimate prospective volatility, the rate of stock price change between successive trading-day prices at the close, $\ln(P_t/P_{t-1})$, from 05/11/2011 back only to the ex-rights date of 11/27/2009 appeared fit for use. The resulting volatility measure was 0.43 after annualizing the standard deviation of trading-day rates of change by multiplying by $252^{0.5}$. With these inputs and assuming no future dividends, the theoretical put value of the European options whose maturity varied from 1 to 9 years, depending on when conversion would be triggered, was obtained with ERI's Black-Scholes calculator easily found online.

To specify the probability that these put options are exercised in any year, we start with the probabilities, p_i , that the company, if still around at the beginning of the respective year, will experience a conversion-trigger shock in any of the next $i=1, \dots, 9$ years by using the formula

$$p_i = 1 - 1.001333^{-1.5^i}, \quad i = 1, \dots, 9. \quad (1B)$$

With this hyper-exponential specification, in eq. (1B) the value of the conversion probability for cocos outstanding at the beginning of the year, p_i , rises from 0.2% in year 1 and 0.4% in year 2 to 1% in year 5 and then to 5% in year 9. For comparison, an innovative model for evaluating and updating the default probabilities of companies developed at the Risk Management Institute (RMI) of the National University of Singapore has the default probability for LBG at 0.1% within 1 year of June 30, 2011 and at 0.3% within 2 years of that date. Public access is provided through <http://www.rmi.nus.edu.sg> →Research→Credit Rating Initiative→Company Forecast. Although the cumulative probabilities implied by formula (1B) are twice as high as those estimated for LBG by RMI in mid-2011, the RMI estimates have varied sensitively, ranging -- for instance at the 1-year horizon -- from a high of 1.29% for the year from February 28, 2009 to a low of 0.03% for the year from March 31, 2010 as LBG emerged from a perilous experience. This shows that the default rates implied by formula (1B) are not outlandish. After these rates have been made additive by being conditioned on conversion not having been triggered earlier, the cumulative probability of conversion having occurred by the end of year 5 is 2.6%, and it grows to 13.9% by the end of year 9.

Although this calibration is only illustrative, it preserves features familiar from Moody's and S&P's records of what happens to corporate bonds with given initial ratings over the years. The time structure of the cumulative conversion rate was informed by that of the default rate on Baa/BBB rated corporate bonds tracked by Moody's (2002) and Standard and Poor's (see Coughlin, 2010) because cocos issues, if rated, tend to get just barely investment-grade ratings. Only the second of two Rabobank issues, stood out for

being rated more highly. (The first issue by this cooperative bank was largely sold to its bank members and not rated or priced competitively in the open market, thus offering an abnormally low yield.) These agency records show that annual corporate bankruptcy rates are at first very small but then start to rise strongly, reaching a cumulative level of around 0.2% after 1 year, 2.4% after 5 years and 4.6% after 9 years for the lowest investment grade issues of Baa and BBB, respectively. Moody's (2002, p. 8) and S&P (see Coughlin, 2010, p. 10) appear broadly in agreement on this. Conversion trigger events should happen more frequently than the bankruptcies they are aiming to prevent through prompt recapitalization. Accordingly, our cumulative probabilities of conversion, later represented as $pcsum_i$, while close to the cumulative default rates reported by the agencies for the first five years from the time of issue, rise faster with i thereafter and reach double digits already by $i=9$. Such a level is reached by cumulative default rates in Moody's 1979 Baa cohort only in the 13th year out.

To estimate the actual conversion rates, the probabilities of conversion of existing cocos must still be conditioned on conversion not having occurred in any year before i . The *probability of cocos surviving* through year $i-1$ is:

$$ps_i = \prod_j (1-p_j), \quad i = 1, \dots, 10; \quad j = 0, \dots, i-1; \quad p_0 = 0. \quad (2B)$$

That probability here still is over 99% at $i=4$, but it falls to 93.8% at $i=8$ and to 86.1%, at $i=10$ ($j=9$) so that only 86.1% of cocos are paid off in full at maturity. Annual coupon payments are made in year i with probability ps_i that cocos have not been converted through year $i-1$, while repayment of principal after 9 years is made with probability $ps_{i=10}$ that cocos have not been converted through year 9.

Therefore the actual *probability of conversion* in any year i , taking account of the probability of cocos's survival declining with the number of years prior to i in which conversion-trigger shocks can occur, is:

$$pc_i = p_i (ps_i), \quad i = 1, \dots, 9. \quad (3B)$$

While $pc_1 = p_1$, for the highest values of i pc_i is appreciably less than p_i .

The probabilities pc_i can be added to yield the *cumulative conversion probability* of cocos through year i :

$$pcsum_i = \sum_j pc_j, \quad i = 1, \dots, 9. \quad (4B)$$

Its complement is the declining *probability of cocos remaining outstanding* through year i :

$$po_i = 1 - pcsum_i = ps_k, \quad i = 1, \dots, 9; \quad k = 2, \dots, i+1. \quad (5B)$$

Having defined the requisite components, the present values of the annual interest payments and of the cocos principal per share equal to 59.21 p is calculated next.

The calculation of present value is for the beginning of year 1. We assume that interest is still paid on cocos at the end of the year at which conversion occurs and their principal is cancelled. Interest will thus be paid in any year conditional on cocos remaining outstanding at the end of the previous year or, equivalently, the beginning of the current year. The present value of the annual coupon payments, each conditional on the cocos surviving up to the beginning of that year, is calculated as a multiple of the unknown annual *coupon* rate, r . This is the rate that is to be determined to make the present value of the stream of payments expected on cocos per share equal to 59.21 p.

The expected present value of receiving the annual coupon payments at the rate r for up to 9 years is the sum:

$$\text{Coupons} = \sum_i (ps_i 59.21r)/1.033^i, i = 1, \dots, 9. \quad (6B)$$

The present value of the principal per share of 59.21 p will only be paid if the company survives to the end of the 9th year. The *principal* will thus be paid in cash only if the cocos remain outstanding through their final year. Its expected present value is:

$$\text{Principal Repayment} = ps_{10}(59.21)/1.033^9. \quad (7B)$$

Should conversion be triggered at the end of any year, the cocos holders obtain a common share whose market price is no more than 59.21 p. Given the probability of conversion pc_i for each of the 9 years, the per-share value of a European put option at that strike price maturing in i years indicates the size of the loss per share confronting the former cocos holders. After discounting 59.21 to the present for each i , the corresponding put values for maturities ranging from 1 to 9 years are therefore subtracted and each difference is multiplied by pc_i and then summed over all i to estimate the expected *stock value* of the common shares obtained by conversion:

$$\text{StockValue} = \sum_i (pc_i (59.21/1.033^i - \text{PUT}(54.54, 59.21, i, 0.033, 0.43))), \\ i = 1, \dots, 9. \quad (8B)$$

Because the strike price is fixed while the expected future spot price and book value per share must be assumed to grow to afford the return required in the absence of dividend payments, the put option becomes less valuable over time on this account. However, this effect need not be decisive because giving the diffusion process more time to unfold has the opposite, and (up to $i=11$) more important, effect. Hence the value of the PUT function rises with maturity i from 10.95 p at $t=1$ to 15.25 p at $i=3$ and 18.71 p at $i=9$. It would rise to a maximum of 18.82 p at $i=11$ and then decline, all beyond the remaining term to

maturity here considered. This indicates that lengthening the maturity of cocos would not continue to be increasingly expensive beyond a certain point and hence not discourage long, e.g., 30-year or 50-year, issues.

For the calibration here explored, the values of these last three components in equations (6B) through (8B) appear in order on the RHS of the equation below.

$$59.21 = 442.78r + 38.06 + 4.04. \quad (9B)$$

The result is $r = 3.86\%$, so that 56 basis points are to be added for the conversion loss premium to the riskless U.K. government bond rate of 3.3% in mid-May 2011 besides all the other risk and liquidity premiums specific to a financial firm's long-term debt.

Had that institution entered a free fall just prior to triggering conversion, or conversion had been triggered with excessive delay, the shares received by the cocos holders could turn out to be worthless instead of having a present value of 4.04 as in equation (9B). Then re-solving equation (9B) without its last term, r would have to rise by an additional 92 bps (to 4.78% compared with 3.86%) for a total of almost 1-1/2 percentage point to allow cocos to be issued at par if zero recovery value from shares had been expected ex ante. The add-on for cocos conversion thus rises by a factor of 3 if the conversion feature is removed, (or made worthless by the threat of highly dilutive terms of conversion) and only debt forgiveness can be triggered. Adjusting the CDS spread of 83.25 bps, published in <http://firestone.princeton.edu/econlib/blr/docs/cds.pdf> (p. 14) for a cumulative default probability of 14.2% after 10 years, from 40% to 0% recovery yields a CDS spread of 139 bps ($83.25(100/60)$) over the risk-free benchmark yield curve. This estimate compares with the 148 (56+92) bps found above for a cumulative conversion probability of 13.9% after 9 years. Hence our results remain informative as transparent ballpark estimates.

With the specifications in this appendix, cocos convert to common shares which have been shown to have substantial recovery value in regard to the (discounted) face value of cocos converted. Setting aside discounting momentarily – that value is over 80%, $(59.21-10.95)/59.21$, when considering the possibility of conversion one year ahead though less than 70%, $(59.21-18.71)/59.21$, farthest out at $i=9$. Discounting 59.21 at 3.3% per annum, as equation (8B) requires, leaves the former percentage still above 80% but reduces the latter to 58%. Assuming therefore that the recovery rate, weighted by conversion probability, averages about two-thirds rather than 40% would yield an adjusted CDS spread of 46 bps ($83.25(33.33/60)$), again not radically different from the spread of 56 bps previously reported.

What is needed even for the elementary estimates laid out in this appendix is:

- (i) the curve of cumulative default probabilities that is linked to the curve of conversion probabilities over the remaining life of cocos,
- (ii) a weighted average recovery rate derived from put-option pricing of the risk of achieving less than 100% recovery,
- (iii) a standard CDS model to calculate the CDS spread that would price the expected losses as an add-on to the risk-free benchmark yield curve based on inputs from (i) and (ii).