Contingent Convertible Bonds And Public Policy: A New Approach

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Table of Contents

Section 1 – Rationale

1.1 Introduction

My thesis investigates alternatives to the government provision of funds to banks during financial crises, an increasingly controversial process known as "bailouts". If effective, the alternative will reduce the likelihood and size of government intervention should it become necessary. My proposed alternative is a public policy mandating issuance of contingent convertible bonds (CoCos) by banks. Contingent convertible bonds are debt instruments that convert from debt to equity under specific, pre-defined conditions. They are designed to reduce the liabilities of a bank following an unexpected decline in asset value, thereby preventing the bank from falling in to insolvency (McDonald 2009 pg 5).

Section 1.2 details the justification for external intervention in financial firms during crises. Section 1.3 gives an overview of the characteristics of CoCos. Section 2 gives detailed explanation of the specific attributes I propose for CoCos, including their structure, as well as numerical examples of each attribute. Section 3 proposes a pricing model for CoCos with the attributes described in Section 2. I also discuss the possible size of the CoCo market, investor behavior with regards to CoCos, and the impact CoCo issuance may have on banks' balance sheets and funding mix. Section 4 summarizes my findings and recommends whether CoCos should be used as a policy alternative.

Section 1.2 Financial Crises and Bailouts

Why are financial firms "special" in requiring bailouts during crises? Why is this proposal being written about banks rather than farms or industrial firms? Diamond and Dybvig note that failure of banks can cause "the recall of loans and the termination of productive investment" (1983 pg 402). Banks facilitate investment and control the money supply. When they fail, the credit they extend and deposits they hold are liquidated, lowering the supply of money and therefore the price level in the economy. This can lead to deflation and economic contraction. No other firms occupy such a central and critical position as banks. But the impact is not limited to credit extension and money supply. Bernanke documents the effects of bank failures on markets for financial instruments: not only do bank failures reduce the money supply and wealth of bank shareholders, they also make financial assets less liquid (1983). When a bank fails, it can no longer supply liquidity in financial markets. Brunnermeier defines liquidity as "the relative ease of finding someone to take the other side of [your] trade" (Brunnermeir 2008 pg 22). Bank failures make it harder to trade in financial assets.

When markets for financial assets become less liquid, there can be positive feedback effects; the original problem can create compounding new problems. Again referencing Brunnermeir, "loss spirals" can occur when leveraged investors (like banks) suffer losses in their portfolio of assets or lose funding; they are then forced to sell assets at a loss (2008 pg 22). Forced selling of assets increases volatility, which increase "haircuts" or the equity stake the market requires an investor to have in each instrument they hold. These effects further depress the market price of assets. A bank can be forced in to this "loss spiral" either by suffering large, sudden losses on its assets, or by losing funding for those assets. In a financial crisis, one bank's sudden decrease in asset values could become the next bank's loss of funding, via the disruption of liquidity in financial markets.

The perfect example of these effects is the case of British mortgage lender Northern Rock, as detailed in "Reflections on Northern Rock: The Bank Run That Heralded the Global Financial Crisis" by Hyun Song Shin (2009). Starting in the summer of 2007, declines in housing prices in the United States created losses in securities derived from loans made to US mortgage borrowers. Investors – including banks – suffered a sudden decline in asset values or lost the ability to accurately price the securities, which amounted to an asset value decline. Investors who were uncertain of the present value of future cash flows were willing to pay less for them. British mortgage bank Northern Rock was heavily dependent on short-term debt issued to the capital markets to fund itself. On August 9th 2007 BNP Paribas announced problems with three vehicles that invested in the US mortgage market. These vehicles were funded using short-term debt similar to Northern Rock. The market for short-term debt that funded both the investment vehicles of BNP and Northern Rock lost liquidity due to uncertainty over the asset values of borrowers in the market. When liquidity disappeared from the short-term funding market because of BNP Paribas' announcement, Northern Rock was unable to renew its short-term debt. Without the ability to renew short-term debt funding, the bank became insolvent. It was eventually taken in to state ownership in February of 2008.

In order to avoid bank failures, governments or the financial industry itself occasionally engage in "bailouts": infusions of capital in to financial firms to prevent bankruptcy, such as those performed by the UK government in the case of Northern Rock. Since the beginnings of financial sector deregulation in the 1970s, a trend of accelerated financial innovation and expansions in the size of the financial sector has been broken by periodic crises, usually ending in a government bailout of some kind (Crotty 2009 pg 564). Sudden decreases in asset values and the resulting decrease in the liquidity of capital markets can make a bank insolvent, requiring an external party to reinforce the bank. My goal is to design an instrument that shifts that role from the government to the private sector.

The literature discussing government support of the financial sector broadly supports the idea that intervention in support of banks is occasionally necessary. However, drawbacks to the idea of government support remain. Opponents such as Crotty point to the problem of "moral hazard". Moral hazard refers to a situation where an individual chooses how much risk to take, but does not have to suffer the cost of a loss resulting from the risk. Dembe and Boden's research on the topic indicates that the term has been in use since the development of modern insurance companies in eighteenth century England (2000 pg 258). An example of moral hazard is the behavior of people with medical insurance. Since they bear a lower cost of treatment, they can consume more services than they would if the cost of the services was not reduced by insurance. By insuring banks do not fail governments create incentives for banks to take higher risks (Crotty 2009 pg 565). More risk taking for banks means greater likelihood of bailouts at the expense of the government. This is the argument against bailouts for the financial sector of any kind.

In late 2009 and early 2010 several nations proposed a universal "bank tax" as a method of insuring society – as represented by national governments – is compensated *ex ante* for bearing the risk of being required to bail out banks. At the request of G-20 leaders, the International Monetary Fund developed a report detailing various proposals for uniform bank taxation (IMF Staff 2010). Several countries such as Japan, Canada and Australia, whose banks did not require bailouts during the crisis, objected to a uniform international tax on grounds of fairness (CBC News 2010). The proposal was ultimately rejected.

Since a bailout of some kind will almost certainly be necessary again at some point in the future, Canadian Minister of Finance Jim Flaherty proposed banks be mandated to issue contingent convertible bonds instead of depending on government bailouts (Carmicheal 2010). Contingent convertibles (CoCos) are debt instruments designed to convert into equity during financial crises. In place of government infusions of cash, CoCos would be held by the private sector and would increase equity when banks encountered asset value declines or problems in obtaining funding due to market illiquidity. They would bear the same risks as a government commitment to bail out banks, but would be held by private sector investors. If designed appropriately, they would effectively be a tax on the risk that banks must be bailed out. Risk-averse investors would require a higher rate of return to hold CoCos issued by banks they deemed to be more likely to suffer a conversion event. Safer banks would have an advantage over banks perceived to be risky. From a national interest perspective, Canadian banks would probably have to pay lower interest rates on their CoCos than American or UK banks; no Canadian bank was bailed out during the financial crisis of 2008 and the World Economic Forum rated Canada's financial system the most sound in the world four years in a row (WEF 2011 pg 141). Canadian policymakers therefore wished to avoid a bank tax penalizing their stable banks with a rate designed to insure riskier banks in other countries. CoCos would allow a spectrum of "tax" rates; the proposal would make Canadian banks more competitive rather than punishing them.

In the United States, Obama administration policy makers initially supported a global bank levy (Austen 2010). Their support may have been misguided. A bank tax based purely on assets – or assets weighted by risk as defined by prudential regulator – is not dynamic enough to efficiently charge banks for the *ex ante* risk of government bailout. Changes to risk-weightings often lag market assessments of the value and/or riskiness of assets banks hold. The Financial Services Authority (FSA) – the main banking regulator in the UK – did not require banks to hold equity capital against Eurozone sovereign debt before November of 2011, despite a collapse of market confidence in the ability of several Eurozone countries to repay that debt in the year preceding the decision (Burger 2011). Banks whose assets were comprised largely of Eurozone sovereign debt issued by risky countries such as Greece would represent a much higher risk of requiring a government bailout than banks with no positions in that debt. A flat tax based on assets would therefore be inefficient: riskier banks would pay the same rate as less risky banks.

CoCos would reduce this inefficiency. Investors in CoCos would charge higher rates of interest to banks with riskier investments, giving a cost of funding advantage to less risky banks. Markets are able to adapt faster than regulators, and market prices could adjust with less time lag than prudential regulation. A full discussion of the advantages of market measures of risk versus regulatory measures of risk can be found in Section 2.2.

1.3 Policy Goal

The policy goal of CoCos is to reduce the likelihood of a requirement for government-financed recapitalization of banks. To facilitate accurate pricing of investors risk for holding CoCos, the terms of conversion from debt to equity must be rigid and transparent, while being sensitive to rapidly moving market assessments of banks' asset values. The instruments must not be open to intentional manipulation by bank management, holders of CoCos, or holders of bank common equity.

Section 2 - Characteristics

2.1 Introduction to Characteristics

Section 2 provides details on the specific attributes of my CoCo proposal. There is no consensus structure for CoCos. Various authors have proposed diverse trigger mechanisms, levels, and issuance requirements. Section 2 proposes specific attributes with which to accomplish those goals. I will also note alternatives for each attribute. The general intention of the rules I propose is to wherever possible remove regulator discretion from decision-making regarding CoCos; my goal is that they perform automatically.

2.2 Market Trigger

The mandatory conversion of a CoCo from debt to equity occurs when a predefined trigger event takes place. According to Buergi's survey of existing literature on CoCos, three types of trigger events have been proposed: a regulatory trigger, an accounting trigger, or a market trigger (2012 pg 4,5).

The most common form of trigger is an accounting-based trigger. An accounting trigger converts bonds based on audited, publically disclosed accounting ratios. For instance, a bond may convert when the ratio of its retained earnings plus common equity to its assets falls below 7%. An alternative measure could be a bank's equity capital ratio (value of equity capital divided by value of assets) or quick ratio (value of cash and equivalents, marketable securities and accounts receivable divided by short-term liabilities). All CoCo issuance that has taken place thus far has been dependent on an accounting trigger. Major European banks including Credit Suisse, UBS, and Lloyds Banking Group have issued CoCo bonds based on their respective Tier-1 capital ratios (Buergi 2012 pg 11). Tier-1 Capital is defined by the Bank of International Settlements as the sum of common stock, retained earnings, and several other small line items (Basel Committee 2011 pg 13).

While the accounting trigger is the most straightforward trigger in terms of calculation and the ability to select a transparent, predictable level of conversion, it has the following drawbacks:

1. It lags behind the market
2. Accounting information updates are infrequent (once every three months)
3. There exists significant possibility for manipulation

Updates to a bank's audited financial condition occur only once every three months through Securities and Exchange Commission (SEC) mandated disclosures. A crisis that sets in rapidly (e.g. over the course of a month or two) may drive banks in to insolvency faster than new information can be released to trigger CoCos. As noted by Flannery accounting variables are also dependent on generally accepted accounting practice (GAAP) measures that are based on historical cost (2009 pg 11). They may not reflect an accurate, forward-looking representation of the value of assets. Flannery also points out that GAAP practices are not rigid; they allow management leeway to value assets how they see fit. This gives management an opportunity to manipulate a trigger and potentially reduce its efficacy by creating a trigger event or preventing one through legal changes in accounting practices. Buergi models an accounting trigger through the path of the stock price, assuming it has a linear relationship with his selected accounting trigger (Buergi 2012 pg 17).

The second major type of trigger is a regulatory trigger. These conversion events take place at the discretion of regulators. For example, a CoCo with a regulatory trigger might convert at the discretion of the Federal Reserve, Federal Deposit Insurance Corporation (FDIC), or another prudential regulator. While the regulatory trigger lends the greatest amount of flexibility to regulators to manage a crisis, it also has drawbacks. McDonald (2010 pg 12) theorizes that political pressure to trigger or not trigger CoCos could result in a trigger decision driven by politics rather than the goal of maximizing financial system stability, or be delayed by the complicated political machinations within the regulatory architecture.

The third and final trigger method proposed by the literature is the market trigger. Market triggers convert CoCos when a financial instrument related to the bank exhibits a predefined behavior; for example when shares drop below a pre-defined common stock price. Buergi notes possible variables include stock price (the price of 1 unit of the bank's common equity), credit spreads (interest rate spread between a bank's senior bonds and the risk free rate), or credit-default swap spreads (CDS; spread between the cost of insuring a bank's debt against default and the cost of insuring an index or alternative low-risk counterparty). The most common market trigger mechanism proposed is an absolute level of the bank's stock price.

I favor a market trigger for the following reasons:

1. Accuracy
2. Forward outlook
3. Implications for current financial conditions

Market triggers are inherently forward-looking. Any market variable is dependent on buyers and sellers independently valuing an asset related to the financial health of a bank. In the case of equity, market capitalization reflects a discounted present value of the bank's future earnings, which are equal to the market value of its assets minus liabilities. Credit spreads represent the increased default risk of a bank relative to benchmark interest rates. CDS spreads are securities analogous to insurance premiums reflecting default risk. Of these three indicators, the common stock price has the most liquid market. McDonald notes the low likelihood of a disruption in stock trading (2009 page 11). At the height of the crisis equities traded smoothly while other markets such as those for CDS were accused of being manipulated (Stulz 2009 pg 35). The common stock price therefore provides the most continuous and reliable information set reflecting a bank's financial condition, because it accounts for all components of the balance sheet, is forward looking, and is difficult to manipulate.

As described in Section 1, bank stocks are also reflective of overall financial system strain. While other metrics exist, I select equity value because it represents the market expectation of the assets minus liabilities of banks. When banks suffer a shock to asset values, it is the market expectation of those values that matters, rather than the value of those assets held to maturity or book value. Imagine a bank has market-valued assets of $100, liabilities of $90, and equity in the form of common stock of $10. Then imagine a sudden shock – for instance, the economy grinds to a halt because oil prices have jumped to $250 per barrel over night. Now the market believes assets are worth $91. This fact will be instantly observable in the equity price, which the market will price at $1, since it will value the stock as assets minus liabilities. The goal of my proposal is to keep banks from being viewed as insolvent by the market, so they can continue their role as providers of credit for investment and liquidity providers in a number of financial asset classes. The market view of their solvency is instantly recognizable in the share price. Fischer and Merton call the stock market "the single most important market in finance" because "stock prices are seen as providing the key price signals to managers regarding corporate investment choices." (1984 pg 6). For this reason, I select the common stock price as my trigger

Choosing a share-price trigger is not a new proposal; McDonald (2010), Buergi (2012), and Flannery (2009) all advocate this sort of approach. As previously mentioned, Buergi models a regulatory trigger, but due to specific assumptions regarding the behavior of the stock price relative to regulatory measures, he models his trigger as a market price. However, their approaches are all based on some absolute share price level. A CoCo issued under their approach would include in its covenants a static stock price that if breached would trigger a conversion of the CoCo in to common stock. For instance, a CoCo would be issued with a conversion level of $10 per share. If the stock traded below that level, the CoCo would convert. Instead of a static price level, I prefer an alternative method that creates a conversion based only on recent price movements. Short-term price movements are key indicators for death spirals, the positive feedback loop experienced by leveraged investors when "a decline in asset values erodes…net worth faster than…gross worth" (Brunnermeier 2008 pg 22). In other words, leverage exacerbates the effects of a decrease in market asset values. I propose tracking only accelerated declines that signal sudden shifts in liquidity or asset values at a bank. Long-term declines give managers and counterparties time to adjust to new funding conditions for a bank; short-term declines do not, and are key contributors to financial market volatility that can create a crisis.

My proposal is designed to target the "loss spirals" described by Brunnermeir, where leveraged investors become stuck in a positive feedback-loop (2008 pg 23). Leveraged investors such as banks, hedge funds, or dealers can be forced to sell assets when they lose funding for exogenous reasons; for instance, because short-term debt markets are no longer functioning, as occurred in 2008. The forced asset selling leads to further price declines, putting further pressure on the investor to reduce its positions. A parallel process occurs where "haircuts" or the amount of equity required for each type of position by market participants increase. This process generally occurs when price movements in those assets increase. This implies the assets are riskier, and therefore require higher equity stakes from investors. Higher haircuts force further asset selling. Combined, the losses and higher haircuts brought on by a lack of funding force the investor into bankruptcy. These spirals are not long-term (for example, taking place over the course of a year) in nature, because they are driven by the removal of short-term funding (e.g. overnight or term funding for periods of one month or less). Equity movements would capture a death spiral since they are updated second-to-second during trading days.

The specific equity decline and window I choose is a 40% loss over 5 trading days, or one week. The time itself is somewhat arbitrary, as is the loss factor; however, both are designed to capture a loss spiral. The key attribute I wish to capture is large short-term market capitalization declines. These variables best highlight that attribute. I also note that the price selected for the purposes of a trigger event is always the day's closing price, in order to facilitate orderly conversion during the overnight hours following the trigger event.

2.3 Dual Trigger

A dual trigger CoCo refers to a trigger mechanism that depends on two discrete variables. **Both** must trigger for a CoCo to convert from debt to equity. The Squam Lake Group (Plosser 2010 pg 3) proposed that CoCos convert under both an accounting trigger and a regulatory trigger. My view focuses on a dual market trigger, as proposed by McDonald (2010). McDonald uses both a bank's common stock price and a financial index representative of common stock prices across the financial industry to determine whether a CoCo should convert. As he states:

> This structure reduces the debt load for poorly performing institutions in times of crisis, but permits individual banks to fail in good times. (McDonald 2009 pg 2)

Policymakers are not concerned with the performance of individual firms if that performance does not reflect the health of the system as a whole. If a firm encounters difficulty, but the broader financial markets are not affected, the social benefit of intervention to insure stability and liquidity in the broader financial markets is much lower, because the costs of not intervening are restricted only to the firm's employees, its debt holders and its equity holders. There are no externalities forced on society as whole by the firm's collapse. On the other hand, if a firm's collapse removes confidence in the rest of the financial system, there are negative effects for all of society due to lower credit extension, disrupted financial asset markets, and a loss of financial intermediation. Therefore the second trigger should be designed to allow only a conversion when the whole financial system is struggling, rather than one single firm.

McDonald (2009 pg 2) points out that setting a high enough level of the index for conversion "would effectively depend only on the bank's own stock price" rather than the combination of the index and the bank's stock price. Since my stock trigger is dynamic (dependent only on recent price movements), I would apply the same methodology to the index. Furthermore, since individual stock price movements tend to exhibit higher volatility than indices, I set the observation window to the same time as the single stock trigger, but decrease the required drop in the index to 20% over that five-day time span. This creates two variables for conversion that are discrete. The variables are not independent, and in fact may exhibit high correlations. I discuss correlation between a selection of bank stock prices and my chosen reference index in Section 3.2.

The index I have chosen to represent the financial sector as a whole is the Financials Sector of the S&P 500 Index. The Index tracks all financial firms with market capitalization in the top 500 of US listed companies. It represents a market capitalization weighted value of total market capitalization of all constituents divided by outstanding shares of the companies (Standard & Poors Indices 2012 pg 8).

2.4 Numerical Trigger Example

Given the above-described trigger levels, Table 2.1 illustrates two hypothetical scenarios for five-day price movements of two bank stocks and the financial system index.

Table 2.1 – Dual Trigger Example

		5 Day Stock Change	5 Day Index Change	CoCos Trigger?
Scenario 1	Bank 1	25%	5%	No
	Bank 2	-50%	5%	No
Scenario 2	Bank 1	-10%	-26%	No
	Bank 2	-41%	-26%	Yes

2.5 Conversion Behavior

When a CoCo breaches its trigger level, the instrument stops behaving like a bond, and becomes equity. Bonds are fixed streams of cash flows, with a predetermined interest rate. Equity has no fixed cash flows. Rather, it gives the holder a claim to a firm's assets after liabilities. CoCos can convert from debt to equity at some predetermined rate. The rate is either based on a share price or a number of shares. A CoCo holder could receive a predetermined number of shares for each unit of bond they hold, or a number of shares equal to the face value of their bond divided by some price. The issuing institution's balance sheet would reflect a reduction in liabilities and an increase in owner's equity equal to the face value of converted CoCos. Table 2.2 gives numerical examples of various types of conversion. The column "Cost per share" represents the amount of bond face value that is exchanged for each share.

Table 2.2 – Conversion Examples

Conversion Terms	Face Value of Bond	Market Value of Stock	Shares Received	Cost Per Share
Fixed Number of Shares (100)	$1,000	$15	100	$10.00
Fixed Price per Shares ($5)	$1,000	$15	200	$5.00
100% of Market Price	$1,000	$15	67	$15.00
150% of Market Price	$1,000	$15	44	$22.50
50% of Market Price	$1,000	$15	33	$30.00

Conversion ratios have important implications for incentives to investors. If a conversion ratio leads to a value per share cost above the market price for the share, investors will have a greater risk of losing money relative to the payment of principal because they will have to sell the shares they receive below the value received on conversion. Conversely, conversions that lead to a cost per share below the market price give investors a chance to realize a gain immediately by selling shares in to the market at a price above that they received during conversion. Furthermore, conversion prices impact the dilution on bank stockholders at the time of issuance, in a manner inverse to CoCo investors. Section 3.6 discusses the full impacts of dilution.

In my proposal, I select a conversion level at 100% of market price. When a bank's stock breaches the -40% five-day return barrier at the close of a trading day, and the index trigger also activates, the number of shares received by CoCo holders will be the face value of their bonds divided by that day's closing price. I select this value because it offers the most straightforward incentives to the holders of CoCos, and creates the smallest possible opportunity for market manipulation. CoCo holders will receive shares at a market price, and while they may be able to sell them for a profit, there will be no designed incentive to sell at the market price for an immediate profit, thereby putting further downward pressure on the market capitalization of a bank.

2.6 Issuing Institutions

Banks required to issue CoCos will include any bank holding company (BHC) with book value assets of over $50 billion. This definition is one of several used by the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 (H.R. 4173) to define systemically important financial institutions. I operate under this definition as a means to make my policy proposal conform to existing policy of financial sector regulation.

2.7 Required Issuance Level

Since CoCos present incremental risk to investors relative to alternative investments due to their possibility of conversion, I expect their cost in terms of an annual interest rate to be higher than conventional funding sources such as long-term debt, securitizations, or deposits. The incremental cost of issuance will therefore weigh on both bank profitability and bank lending. I discuss more detailed analysis of the costs of a pro-CoCo policy in Section 3.7. Incremental cost of issuance will have a linear relationship to the size of required issuance.

Swiss authorities have already enacted a pro-CoCo policy, with banks mandated to hold a minimum 9% capital buffer in CoCos (Jenkins and Simonian 2010). This regulation forces major Swiss banks such as UBS and Credit Suisse to issue CoCos equal to 9% of their asset's book values, a baseline for the level of required issuance in my proposal. Current minimum Tier-1 capital levels in the United States are 4% (Basel Committee 2004 pg 12). Tier-1 Capital represents the ratio of common stock plus retained earnings to total book value of assets. This level is set to increase to 7% due to the non-binding Basel III framework, a guideline issued by the Bank of International Settlements (Basel Committee 2011 pg 13). I therefore select an issuance level of 5% of total assets that represents a significant addition to Tier-1 capital, but is more moderate than Swiss regulation. Table 2.3 offers a numerical example of required issuance.

Table 2.3 – Required Issuance of CoCos Numerical Example

	Assets	Required Face Value of CoCo Issuance
Bank A	$1,000,654,633,000.00	$50,032,731,650.00
Bank B	$567,632,189,900.00	$28,381,609,495.00
Bank C	$45,867,110,000.00	$0

2.8 Maturity Requirements

Maturity requirements will create a stock of CoCo issuance that spreads maturities over time, insuring that each issuer's portfolio of Cocos does not mature in a concentrated fashion. In other words, I wish to avoid a regulatory regime that would allow a bank to issue a portfolio of bonds that matured simultaneously or was extremely long or short dated. A bank faced with a large volume of maturing CoCo debt would be forced to issue large volumes of new CoCos to replace the maturing batch and stay above the regulatory minimum issuance level. Doing so could oversupply the market for CoCos, forcing up yields demanded by investors to buy the instruments. Furthermore, creating a range of maturities for investors offers an increased spectrum of conversion risks. Shorter-dated CoCos would be less likely to convert over their life than long-dated CoCos, allowing investors to optimize their risk-return profile along the spectrum of CoCo maturities offered by a given bank. The resulting "conversion curve" would be similar to the range of interest rates by maturity referred to as the "yield curve". Regulators could analyze the conversion curve of various banks to detect market pricing of risk; sudden spikes in yields demanded by investors could give regulators clues to investigate bank behavior and assets. CoCos would be a canary in the coalmine for prudential regulation in addition to existing measures such as stock prices, financial market volatility, credit spreads or other market data.

I propose that the portfolio of any given bank's CoCo issuance have a minimum weighted average maturity (WAM; average time to maturity of the portfolio weighted by face value of each time to maturity) of two years. Furthermore, I propose the maturity-at-issuance of any given bond cannot be more than five years and cannot be less than 3 years. This scheme allows some degree of flexibility for banks to optimize the maturity of their CoCo portfolio, but still ensures that a range of maturities will exist for any bank in the market at any one time. Tables 2.4 and 2.5 present two example portfolios – Table 2.4 conforming to my proposal and Table 2.5 non-conforming. Bank A has issued CoCos equal to 5.52% of assets, and the portfolio has an average maturity of 3.04 years. It is therefore in compliance with regulations proposed in Section 2.8. Bank B, while issuing CoCos with face value greater than 5% of the book value of its assets, does not have a portfolio with a high enough average maturity. In this case, the bank would be mandated to either issue more longer-dated CoCos, or buy back shorter-dated CoCos while issuing longer dated CoCos in order to bring the portfolio WAM up to the minimum three years.

Table 2.4 – Example Conforming CoCo Portfolio with Maturities and WAM

	Bank A		
	Assets	$2,265,792,000,000.00	
	Minimum Issuance	$113,289,600,000.00	
	Assumed Issuance	$125,000,000,000.00	
Issuance Maturities (Years)	Face Value	WAM	% of Assets
1	$20,000,000,000.00	0.16	0.88%
2	$30,000,000,000.00	0.48	1.32%
3	$20,000,000,000.00	0.48	0.88%
4	$35,000,000,000.00	1.12	1.54%
5	$20,000,000,000.00	0.80	0.88%
Portfolio Total	$125,000,000,000.00	3.04	5.52%

Table 2.5 – Example Non-Conforming CoCo Portfolio with Maturities and WAM

Bank B	
Assets	$1,760,764,000,000.00
Minimum Issuance	$88,038,200,000.00
Assumed Issuance	$95,000,000,000.00

Issuance Maturities (Years)	Face Value	WAM	% of Assets
1	$22,000,000,000.00	0.23	1.25%
2	$30,000,000,000.00	0.63	1.70%
3	$10,000,000,000.00	0.32	0.57%
4	$13,000,000,000.00	0.55	0.74%
5	$20,000,000,000.00	1.05	1.14%
Portfolio Total	$95,000,000,000.00	2.78	5.40%

2.9 Conversion Limits

Given that all CoCos issued by a bank will have the same trigger conditions, they would all convert simultaneously to equity without a final condition. Simultaneous conversion is not an inherently negative outcome. But if CoCos are to be an effective regulatory tool, it makes little sense for them to be a single-shot weapon. Rather, I propose that the CoCos convert through reverse maturity until a face value equal to 25% of the market capitalization at time of conversion has been converted into equity. CoCos closest to maturity will convert first, followed by the next closest to maturity, etc., until the face value of converted CoCos is equal to 25% of the market capitalization of the issuing bank at the time conversion began. I describe the minimum amount of face converted as the "conversion floor." Any single issue of CoCos would convert simultaneously. Table 2.6 shows an example of this process. Since CoCos represent a direct transfer from liabilities to owner's equity, and owner's equity is the value of assets minus liabilities, the conversion floor should represent a 25% increase in the spread between market value of assets and liabilities.

Table 2.6 – Reverse Order of Conversion Example

Market Capitalization at Conversion	$45,000,000,000.00
Conversion Floor	$11,250,000,000.00

CoCo Issue	Converts?	Time to Maturity (Years)	Face	% of Conversion Floor	% of Conversion Floor Running Total
1	Yes	0.5	$1,500,000,000.00	13%	13%
2	Yes	0.75	$750,000,000.00	7%	20%
3	Yes	1.25	$825,000,000.00	7%	27%
4	No	1.4	$1,237,500,000.00	11%	
5	No	1.6	$1,500,000,000.00	13%	

In practice the effects of dilution and forced selling of converted equity by CoCo holders could cause the market capitalization of the bank to increase by less than 25% of its pre-conversion value following a round of conversion. New rounds of conversions would continue on subsequent days if market capitalization continued to drop following the initial conversion event. Conversions would continue until the portfolio of CoCos issued by any one bank was fully exhausted, or trigger conditions no longer existed. Table 2.7 provides an example of multiple rounds of conversion. On the first day, an initial conversion identical to Table 2.6 takes place. On the second day, market capitalization falls again, leading to a second conversion. Note that CoCo Issues 4 and 5 are available for conversion on both days. Since Issues 4 and 5 did not convert on the first day, they remain available for conversion the following day, or until they mature in 1.4 and 1.6 years respectively. Since they have the lowest maturities, they are first in line for conversion on Day 2. Issue 6 also converts in order to bring the total conversion for the day over the conversion floor.

Table 2.7 – Multi-Conversion Event Example

Day 1		First Round			
Market Capitalization at Conversion		$45,000,000,000.00			
Conversion Floor		$11,250,000,000.00			
CoCo Issue	Converts?	Time to Maturity (Years)	Face	% of Conversion Floor	% of Conversion Floor Running Total
1	Yes	0.5	$1,500,000,000.00	13%	13%
2	Yes	0.75	$750,000,000.00	7%	20%
3	Yes	1.25	$825,000,000.00	7%	27%
4	No	1.4	$1,237,500,000.00	11%	
5	No	1.6	$1,500,000,000.00	13%	

Day 2		Second Round			
Market Capitalization at Conversion		$30,000,000,000.00			
Conversion Floor		$7,500,000,000.00			
CoCo Issue	Converts?	Time to Maturity (Years)	Face	% of Conversion Floor	% of Conversion Floor Running Total
4	Yes	1.4	$1,237,500,000.00	11%	11%
5	Yes	1.6	$1,500,000,000.00	13%	24%
6	Yes	1.85	$1,050,000,000.00	9%	34%
7	No	2.5	$1,260,000,000.00	11%	
8	No	3	$742,500,000.00	7%	

2.10 Full Numerical Example

In order to demonstrate the full impact of a CoCo conversion event, I apply the characteristics of a CoCo to the balance sheet of J.P. Morgan as of Dec 31 2011 in Appendices 1.1 – 1.6. Some items on the balance sheet have been introduced to illustrate the hypothetical issuance of CoCos by the firm. These are highlighted in yellow. All balance sheet and contingent convertible figures are quoted in US dollars.

Appendix 1.1 displays J.P. Morgan's balance sheet as disclosed to the Securities and Exchange Commission on Dec 31 2011. No alterations have been made; this balance sheet is provided for reference.

Appendix 1.2 details the required issuance J.P. Morgan would have as described in Sections 2.7 and 2.8. I assume the bank optimizes its issuance above the minimum face value and WAM, although close to the lower boundary of what is mandatory. The specific face values for each of the issued maturities are hypothetical.

In Appendix 1.3 I denote the inclusion of CoCos on J.P. Morgan's balance sheet in two areas. A new entry entitled "Contingent Convertibles" reflects the face value of the contingent convertible securities, while long-term debt has been reduced to hold liabilities constant. Section 3.6 engages in a more complete discussion of the impact CoCo issuance may have on bank balance sheets.

Appendix 1.4 gives numeric examples of a hypothetical price movement scenario that would create a CoCo trigger event, and the consequential conversion of an issue of CoCos into equity, including share price and number of shares. These events are recorded in Appendix 1.5 as a decrease in the liability account for Contingent Convertibles and an increase in the book value of shares issued by the company. The book value of the shares is described in two categories: "Common Stock" and "Capital Surplus". These two categories together represent the book value of common stock at the time of issuance. Common stock represents the "par" values of the shares. I have assumed a par value of $1 per share. Therefore "Common Stock" increases in value by the number of shares issued times $1, while "Capital Surplus" increases by the total value of common shares created by conversion less the number of shares issued multiplied by $1. The total increase to book value of common stock is the sum of changes to "Common Stock" and "Capital Surplus", which is equal to the face value of CoCos converted.

Finally, Appendix 1.6 illustrates the need for new issuance of CoCos to make up for the issue that was consumed through conversion.

2.11 Reissuance Following a Crisis

The design strategy I pursue in selecting terms for CoCos is to remove discretion wherever possible. I acknowledge that this could create unintended consequences for regulators, bank management, or bank shareholders by removing the flexibility of regulatory discretion; however, I prefer this alternative to the possibility that political pressure could interfere with regulator actions during a crisis. In one area, however, regulatory discretion is important. When banks lose CoCos to conversion, the decision over how long to give banks before requiring new

CoCo issuance to replenish their portfolios of issuance should remain at the discretion of issuers. I would make the single non-discretionary requirement be that banks could not increase dividends until CoCo issuance had returned to the mandatory 5% of assets minimum.

Section 3 – Feasibility

3.1 Introduction to the Pricing Model

I begin my discussion of my pricing model by noting the significant academic investigation that has already taken place in the field of CoCo price modeling. Buergi (2012) offers an exhaustive summary of current research in the field. All the models discussed are based upon Black-Scholes options pricing. Integral to their methodology is the type of trigger causing a conversion event. All previous attempts at pricing models are dependent on either a static regulatory trigger based on capital ratios, or a static stock price trigger. For example, conversion takes place at a stock price of $10, or when a bank's ratio of equity and retained earnings to liabilities falls below 7%. Various authors have developed a coefficient to convert that capital ratio into a static stock price that is equivalent to the trigger price explicitly defined. However, my trigger is dynamic. It depends on prices over the five previous days in the index and individual stocks, not over any relationship between the stock price and a pre-defined static price level. I have found no literature that would indicate that current pricing techniques using the methodology of Black-Scholes exist for that type of structure. In order to overcome this problem, I use a constant binomial probability of conversion derived from historical stock price trends and use it as one input for my pricing model.

Black-Scholes and other pricing models are a special case of the general valuation method based on the risk adjusted net present value. Given the difficulty of making specific assumptions regarding trigger values and conversion events, I revert to the basic risk-adjusted net present value. The method is based on the assumption that investors are risk averse. Risk aversion is defined as a situation where an individual would not be willing to pay the actuarially fair value of an uncertain situation. For example, a risk-averse individual would not be willing to pay $1.00 to flip a coin and receive $2.00 if heads occurs and 0 if tails occurs (Hanson and Menezes 1970 pg 482).

In finance, risk aversion implies that investors would not be willing to pay the same amount for an uncertain future cash flow with the same expected value of a perfectly certain cash flow. For instance, a zero coupon bond that pays $1,100 next year would command a higher price today relative to a bond that would pay $2,200 with a probability of .5 and 0 (default with no recovered value) with a probability of .5. Under certain conditions the differential amount of compensation required to make an individual indifferent between the purchase of the two instruments described above can be converted into an increase in the discount rate, sometimes called the required return (Arditti 1967 pg 20).

As stated, risk-averse investors will seek compensation for higher risk by demanding a higher return than the expected value of the investment would imply.

Using the work of Xu and Nencioni (2000), I model the required return for investors given a defined probability of trigger and expected recovery value as a percentage of the face value of the bond. Xu and Nencioni are able to model the impact of default risk on the interest rate compensation between a risk-free asset and an issuer at risk of defaulting on payments of a bond for a given an assumed probability of default and recovery value for the bonds. Defaulted bondholders receive compensation in the form of a recovery value relative to face. For instance, an investor holding a bond with a face value of $100 that defaults may end up receiving $50 after the issuer has restructured. This recovery value is described as a percentage of face value; 50% in the example. I will adapt this model by treating a trigger event of a CoCo as a default, and I value the stock received following the trigger event as a percentage of the original face value of the bond.

3.2 Credit Spread Model

Xu and Nencioni's model is based on the formula in equation (1).

$$S = \Lambda\ (\ 1 - R + r\ ) \approx \lambda\ (\ 1 - R + r\ ) \qquad (1)$$

Where: S is the annual interest rate spread over reference bonds
λ is the annualized probability of default
R is the recovery rate of the face value of the bond
r is the reference rate
and $\Lambda = e^{\lambda} - 1 \approx \lambda$

Xu and Nencioni approximate $\Lambda = e^{\lambda} - 1 \approx \lambda$ by modeling constant probability of default through a Poisson process with parameter λ. A Poisson process is a technique that counts the number of events and the time that they occur at over some defined period of time. Therefore probability of no default from time 0 until time t is $e^{-\lambda t}$ and annualized probability of default is $1 - e^{-\lambda t}$. This figure approximates λ when λ is "not too large" (Xu and Nencioni 2000 pg 8). Xu and Nencioni are modeling default. I model conversion risk. The two are indistinguishable for my purposes, because they both represent a material change to expected cash flows of a bond. While CoCo conversion is not a default, from an investor's perspective the two situations are the same.

In order to determine an appropriate value for r, I surveyed the historical probability of a trigger event occurring over 20 years of daily price data for six financial institutions and the trigger index. Historical data was obtained via Bloomberg. The result is a one-period binomial probability of conversion equal to 10%. For all banks in the sample, there were two years that included price movements in their stock price and the index that would qualify as a conversion event as described in Section 2. I assume the probability of conversion remains constant. Although CoCo conversion depends on two discrete events, there is a high correlation between most institutions' stock prices and those of the index. A sample of correlations is noted in Table 3.1, and the historical probability of a trigger event (given the defined criteria for CoCo conversion) is described in Table 3.2.

Table 3.1 – Bank stocks correlation with S&P 500 Financials Index

	Stock Correlation to Index:	
	Price	1 Day Price Change
BAC	0.9151	0.8379
JPM	0.7121	0.8368
GS	0.1871	0.7461
BONY	0.8218	0.7787
MS	0.8997	0.7429
C	0.9345	0.7966

Table 3.2 – Historical Probability of Conversion

Number of Years	Years With Trigger Event	Odds of Trigger Event in any given year
20	2	10.00%

Note that the probability of conversion in a given year is the same across all banks in the sample because all had conversion event price movements in two years out of the 20-year sample. My analysis of historical probabilities is an approximation for what might happen. I assume that conversion is predictable as a binomial, and that binomial is a constant over the life of a CoCo.

For the second component of my model, I must estimate a recovery value; this value represents the cash proceeds for investors may be able to receive following a conversion. While CoCos convert into common stock at a ratio that does not imply a loss, I assume CoCo holders will immediately attempt to sell the stock. This assumption is made in order to give the most pessimistic possible estimation of a CoCo conversion's impact on bank equity values. As described in Section 2, upon conversion CoCos will entitle the holder to units of common stock equal to the face value of their bond divided by the closing price of the stock on the day of conversion. For example, Table 3.3 shows the amount of stock an investor would receive if they held $100 million face value of CoCos issued by a bank whose stock closed at $15 on the day of conversion.

Table 3.3 – Conversion Example

Stock Price	$15
Face Value of CoCos	$100,000,000
Number of Shares Received	6,666,667

At the time of conversion, investors do not necessarily lose money on a CoCo conversion; in fact, depending on the interest rate environment, an investor may actually experience capital gains by holding a CoCo that triggers. If a CoCo is trading at a steep discount to face value due to an increase in prevailing interest rates since the bond was issued, the bond could convert at a value far above its purchased price. An example of a zero-coupon CoCo that illustrates this scenario is shown in Table 3.4.

Table 3.4 – Conversion of a CoCo Trading Below Par

Face Value	$100
CoCo Yield	7%
Purchase Price of CoCo	$93.24
Value of Stock At Conversion	$100
Profit At Conversion	$6.76

By design, CoCos will convert during a time when the issuer's stock price has been falling. Therefore, I assume that investors will not be able to sell the proceeds of conversion at the same price as the conversion factor. To assess a probable cash conversion value, I assume the investor will sell the stock 1 standard deviation below the mean 1-day return of bank stocks following historical price movements that would constitute conversion events (if CoCos had existed and been issued at that time). Table 3.5 documents the mean, standard deviation, and the assumed cash recovery value of conversion as a percentage of the face value of the bond. This recovery value is an approximation based on historical information. I assume that the market for the converted stock will be relatively illiquid and prices will be falling when investors attempt to monetize the shares they received in conversion. I note that predicting a path of stock prices following conversion could add accuracy to a CoCo pricing model, but is not required for this proof-of-concept.

Table 3.5 – Expected Recovery Value of a CoCo given historical price movements

Mean	-0.5469%
Standard Deviation	9.8754%
Assumed Recovery Value	89.58% of face value

3.3 Pricing Example

Having obtained an estimate for the binomial probability of a trigger event occurring in a given year, and for a probable conversion value for the investor, I can apply Xu and Nencioni's credit pricing model to a hypothetical zero-coupon CoCo issued by a bank. In order to determine a relative cost of capital between the bank's current debt and the CoCo, I will price the CoCo's risk of conversion relative to the rate of interest paid on a non-CoCo zero-coupon bond that matures on the same date as the CoCo. The spread between these two bonds will represent the incremental annual cost of capital for the bank to issue CoCos instead of standard long-term debt. It also represents the incremental compensation risk-averse CoCo investors would require to hold the bond instead of a non-CoCo bond issued by the same bank.

Both bonds illustrated in Table 3.6 have the same maturity of one year from today. The CoCo has a conversion risk of 10%. I expect investors to sell the stock they receive upon conversion for 89.58% of the face value of the bond. This assumption is based on assumed negative price movements following the conversion of the CoCo into stock, but before investors can sell the proceeds of the conversion. I assume a risk-free interest rate of 0.50%. The spread between the risk free rate and that of the non-CoCo reference bond is assumed to be 2.5%.

Table 3.6 – CoCo versus Reference Bond

Odds of Trigger Event Per Period	10.00%
Expected Return	-10.42%
Recovery Rate	89.58%
Real Risk Free Rate	0.50%
Interest rate spread Between Risk Free Rate and Reference Bond	2.50%
CoCo Spread	1.34%
Reference Bond Yield	3.00%
CoCo Yield	4.34%

	Reference	CoCo
Face	$100.00	$100.00
Maturity (Years)	1	1
Yield	3.00%	4.34%
Price	$97.04	$95.75

"Odds of Trigger Event Per Period" is derived from my historical analysis. "Recovery Rate" is 1 standard deviation below the mean 1 day returns following past price movements that would have constituted a conversion had CoCos been issued by those banks. "Risk Free Rate" and "Normal Spread" are assumed interest rates that would be computable using market data; they are hypothetical for the sake of simplicity. "CoCo Spread" is 0.1 * (1 - 0.8958 + (0.025 + 0.005)) = 1.34%. 1.34% is the premium per year that CoCos will cost banks relative to funding via long-term debt. I then derive prices for 1-year zero-coupon bonds by discounting the future cash flow of the bond ($100) to present value via the yield obtained above. In the case of the Reference Bond, the discount rate is the "Risk Free Rate" plus the "Normal Spread". In the case of the CoCo Bond, the discount rate is the reference rate plus the "CoCo Spread". Both rates are then used to discount the future cash flow to present value through the formula:

Present Value = Future Cashflow / (1+r)
Where: r is the yield or discount rate

The price of the CoCo bond represents the price the marginal risk-averse investor should be willing to pay for the reference bond and the CoCo bond given the assumed conditions.

To illustrate the sensitivity of my computation of CoCo Spreads to the probability of conversion and recovery value of a CoCo, Tables 3.7 and 3.8 present a sensitivity analysis that measures the extra compensation demanded by the marginal risk averse investor for a range of conversion risks and recovery values. For Table 3.7, I hold recovery value equal to 89.58%, risk free rate equal to 0.5%, and normal spread equal to 2.5%. For Table 3.8, I hold probability of conversion equal to 10%, risk-free rate equal to 0.5% and normal spread equal to 2.5%.

Table 3.7 – CoCo spread as a function of conversion risk

Probability of Conversion	CoCo Spread
2.500%	0.338%
5.000%	0.676%
7.500%	1.014%
10.000%	1.352%
12.500%	1.690%

Table 3.8 – CoCo spread as a function of recovery value

Recovery Value	CoCo Spread
79.58%	2.342%
84.58%	1.842%
89.58%	1.342%
94.58%	0.842%
99.58%	0.342%

As demonstrated by Figures 3.7 and 3.8, there is a linear relationship between CoCo spread with respect to changes in both conversion risk and recovery value.

3.4 Price Manipulation

Since the conversion behavior of CoCos is dependent on market price movements, it may be possible to manipulate prices to the advantage of CoCo holders. Both Flannery (2009) and McDonald (2011) discuss the possibility of share price manipulation resulting in conversion. Flannery asserts that the combination of high-market capitalization for CoCo issuers and a trailing conversion trigger such as that proposed in Section 2 would adequately protect CoCos from manipulation (page 20). However, assuming a market participant can deploy enough capital in the market to have some pricing power (i.e. change market prices due to the size of its trades), timed short selling of a bank's common stock could create cash flows to a market manipulator. Figure 3.9 is a step-by-step process of how this might be accomplished, while Figure 3.10 and Table 3.11 add hypothetical price movements to illustrate the scenario numerically. I assume the hypothetical stock trades are large enough to move the market. In practice, public equity markets are extremely liquid; short selling by one actor may not be enough to move the market. However, if a number of investors pursued this strategy (with or without coordination), the effect would be the same. While pricing power removes some risk for investors pursuing this type of strategy, it is not necessary for a conversion to take place because of short selling by CoCo holders.

Figure 3.9 – Market Manipulation Steps

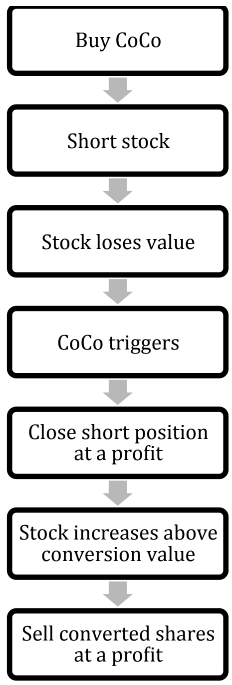

Figure 3.10 – Market Manipulation Graphic Example

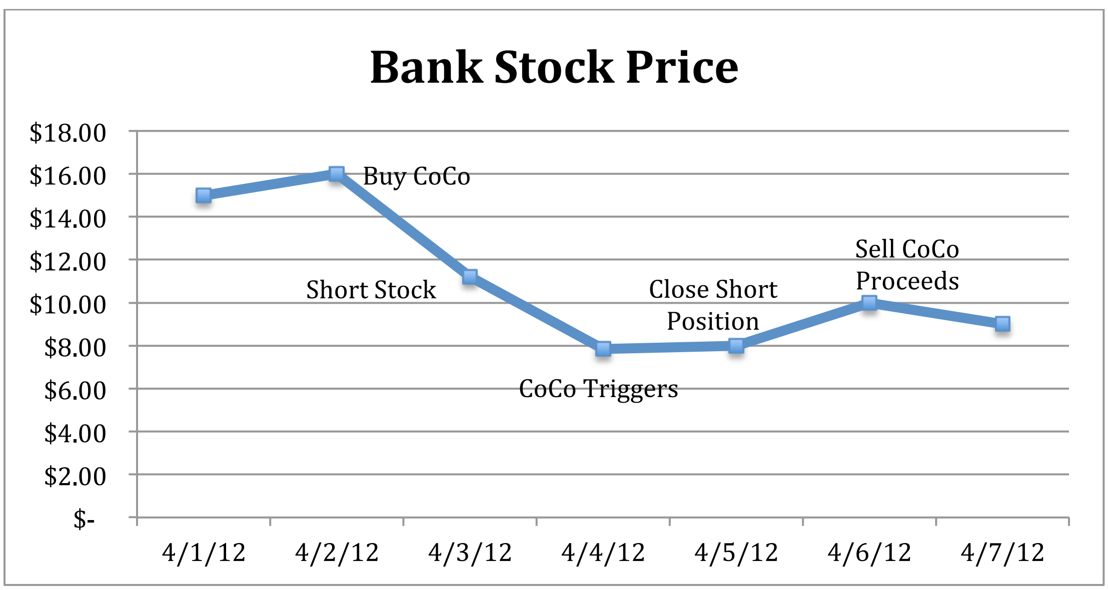

Table 3.11 – Market Manipulation Numerical Example

Date	Stock Price	Action	Cash Flows	Impact on stock price
4/1/12	$15.00			
4/2/12	$16.00	Buy CoCo	$(10,000,000.00)	None
4/3/12	$11.20	Short Stock	$112,000,000.00	Negative
4/4/12	$7.84	CoCo Triggers		Negative
4/5/12	$8.00	Close Short Position	$(80,000,000.00)	Positive
4/6/12	$10.00	Sell CoCo Proceeds	$12,755,102.04	Negative
4/7/12	$9.00			
		Total	$34,755,102.04	

An alternative solution to the problem of market manipulation proposed by Flannery is a ban on short positions for holders of CoCos (2009 page 20). This policy option would make conversion risk harder to hedge by shorting shares of the issuing bank. At the margin, such a policy would increase risk for an investor and therefore increase yields required in compensation. This would increase the costs to banks and society of this proposal.

3.5 CoCo Issuance Relative to Other Major Asset Classes

Dodd-Frank defines a Systemically Important Financial Institution (SIFI) as a bank holding company with assets of over $50 billion (H.R. 4173). Given an assumed minimum level of 5% for assets at the time of issue, Cocos would be a small component in financial markets relative to other asset classes. Table 3.12 compares the assets of these holding companies with those of other asset classes, namely: market capitalization of equities traded on US exchanges, government debt, municipal debt and other fixed-income markets.

Table 3.12 – Expected CoCo Issuance Relative to Other Existing Fixed Income Assets and Equities

Bank Holding Companies w/ Assets >$50bn, Total Assets	$14,308,644,616.00	
Required 5% Issuance	$715,432,230.80	
Asset Class	Market Size	% of Total (Total does not include CoCos)
Equities	$16,778,462,060,000.00	31.4329%
Treasury Debt	$9,928,440,000,000.00	18.6000%
Mortgage Related Securities	$8,423,521,500,000.00	15.7807%
Corporate Debt	$7,790,700,000,000.00	14.5951%
Municipal Debt	$3,743,300,000,000.00	7.0127%
Money Market Debt	$2,572,000,000,000.00	4.8184%
Agency Securities	$2,326,879,000,000.00	4.3592%
Asset-Backed Securities	$1,815,400,000,000.00	3.4010%
CoCos	*$715,432,230.80*	0.0013%

Sources: Federal Reserve, SIFMA, WFE

CoCos would therefore represent a very small segment of the market relative to other asset classes. Based on their small relative size to other asset classes, I do not view the proposed size of required issuance as major hindrance to issuing CoCos.

3.6 Dilutive Effects of CoCos

CoCos dilute existing common equity shares at the time of conversion. All other things being equal, conversion events would have no impact on the market capitalization of a bank, but would increase the divisor that gives a per-share price. An arithmetic example of this effect is provided in Table 3.13. The numbers are hypothetical.

Table 3.13 – Dilutive Effect of Conversion

Market Capitalization	$100,000,000,000.00
Pre-conversion Common Shares	5,000,000,000.00
Pre-conversion Common Share Price	$20.00
Post-conversion Common Shares	5,100,000,000.00
Post-conversion Common Share Price	$19.61
Dilutive Effect of Conversion Per Share	$0.39

Rational existing equity holders would therefore discount their current equity stake to reflect the possibility of dilutive conversion at some point in the future. Given the binomial annual probability of conversion stated in Section 3.2 of 10% and an expected level of conversion, an investor could calculate the dilutive cost of CoCos on their holding. Table 3.14 illustrates dilutive effects on a stock for an investor that expects a 10% probability of conversion occurring for 25% of outstanding CoCos.

Figure 3.14 – Probability-Adjusted Risk of Conversion Impact on Pre-Conversion Share Prices at 10% Probability of Conversion Event

Initial Market Capitalization of Common Stock	$150,000,000,000.00
Pre-conversion Common Shares	6,500,000,000.00
Pre-Conversion Share Price	$23.08
Assets	$1,500,000,000,000.00
CoCos (5% of Assets)	$75,000,000,000.00
Market Capitalization at Conversion	$82,500,000,000.00
Share Price At Conversion	$12.69
Conversion %	25%
New Shares	1,477,272,727.27
Post-conversion Share Price	$10.34
Dilutive Effect	$2.35
Adjusted for Probability of Conversion	$0.24
Pre-conversion Share Price adjusted for probability of dilution	$22.84

I assume that the current stock price already accounts for the risk of a decrease in market capitalization. I also assume that the only change in the risk profile of the common shares is the addition of dilution due to new CoCo issuance. Dilution effects would be sensitive to investor assumptions of conversion percentage and likelihood of conversion. Table 3.15 holds all variables equal except for probability of conversion, which I increase to 25%.

Table 3.15 – The Impact of a Probability-Adjusted Risk of Conversion on Pre-Conversion Share Prices (at 25% Probability of Conversion Event)

Initial Market Capitalization	$150,000,000,000.00
Pre-conversion Common Shares	6,500,000,000.00
Pre-Conversion Share Price	$23.08
Assets	$1,500,000,000,000.00
CoCos (5% of Assets)	$75,000,000,000.00
Market Capitalization at Conversion	$82,500,000,000.00
Share Price At Conversion	$12.69
Conversion %	25%
New Shares	1,477,272,727.27
Post-conversion Share Price	$10.34
Dilutive Effect	$2.35
Adjusted for Probability of Conversion	$0.59
Pre-conversion Share Price adjusted for dilution	$22.49
Difference Between Pre-conversion Share Price adjusted for dilution at 10% probability versus 25% probability	$0.35

The above exercise demonstrates that CoCos would depress per-share prices at the time of issuance by some magnitude that was dependent on the market's assumed likelihood of CoCo conversion events and size of conversions. The effect of the impact is unknown in terms of magnitude, but is certain in terms of direction: CoCos will be hinder equity performance at the time of issuance.

3.7 Impact of Issuance on Bank Balance Sheets & Funding

As shown in Section 3.8, CoCos will create a probability of dilution and thus decrease the market value of banks' equity. Other sections of banks' balance sheets and their funding may also be affected as banks shift their funding to reflect the mandatory 5% of assets issuance requirement. Table 3.16 is a simplified example of a bank's funding mix before and after issuance of CoCos. In order to illustrate the cost of issuing CoCos without re-optimizing the balance sheet and funding mix, I assume the bank holds total assets constant and minimizes funding cost while complying with the minimum issuance requirement. I assume equity represents 10% of assets and deposits, long-term debt and short-term debt comprise 30% each of the banks assets. Furthermore, annual funding costs are assumed as stated; with the exception of CoCos, which have a funding cost of long-term debt annual funding cost plus CoCo spread determined in Section 3.4. The higher cost of equity is driven by the tax deductibility of interest as described in Modigliani and Miller (1958). I also assume that the bank optimizes its CoCo issuance by retiring long-term debt upon issuance of CoCos. Since long-term debt has the highest funding cost, replacing it with CoCos will have the lowest impact on funding cost.

Table 3.16 – Impact of CoCo Issuance on Bank Funding Costs (Substituting CoCos for Long-Term Debt)

Assets	$100,000,000,000.00		Assets	$100,000,000,000.00	
No CoCos		Cost	CoCos Required		Cost
Equity	$10,000,000,000.00	15.00%	Equity	$10,000,000,000.00	15.00%
Long-Term Debt	$30,000,000,000.00	6.00%	Long-Term Debt	$25,000,000,000.00	6.00%
Short-Term Debt	$30,000,000,000.00	2.00%	Short-Term Debt	$30,000,000,000.00	2.00%
Deposits	$30,000,000,000.00	1.00%	Deposits	$30,000,000,000.00	1.00%
Total	$100,000,000,000.00	4.20%	CoCos	$5,000,000,000.00	7.34%
			Total	$100,000,000,000.00	4.27%

Increase In Funding Cost	0.0670%

Holding constant the above assumptions regarding funding and without variations in the market value of bank assets reductions or increases in bank assets will not impact the change in funding cost created by CoCo issuance. This is because I assume that equity, debt, deposit and CoCo funding are driven by fixed ratios of assets. However, if I assume instead that assets are reduced, and that long-term debt is reduced by the amount of CoCo issuance plus the reduction in assets, a bank could optimize its funding cost to the same value as if it had not been required to issue CoCos. Table 3.17 illustrates this process with a numeric example.

Table 3.17 – Impact of CoCo Issuance on Bank Funding Costs (With Funding Ratio Shifts and Asset Changes)

Assets	$100,000,000,000.00		Assets	$96,409,000,000.00	
No CoCos		Cost	**CoCos Required**		Cost
Equity	$10,000,000,000.00	15.00%	Equity	$10,000,000,000.00	15.00%
Long-Term Debt	$30,000,000,000.00	6.00%	Long-Term Debt	$21,588,550,000.00	6.00%
Short-Term Debt	$30,000,000,000.00	2.00%	Short-Term Debt	$30,000,000,000.00	2.00%
Deposits	$30,000,000,000.00	1.00%	Deposits	$30,000,000,000.00	1.00%
Total	$100,000,000,000.00	4.20%	CoCos	$4,820,450,000.00	7.34%
			Total	$96,409,000,000.00	4.20%

Increase In Funding Cost	0.0000%

By reducing assets, the bank can issue fewer CoCos. CoCo issuance will have a linear relationship to bank assets as described in Section 2.7. The bank illustrated in Figure 3.17 optimizes by reducing assets until the impact of higher cost CoCos can be offset by reductions in long-term debt.

My analysis of the effects of CoCo issuance indicates that banks wishing to hold their funding cost constant would shrink their asset levels in order to retire higher-cost debt, eliminating the impact of a CoCo's increased funding cost. Banks unwilling to do so would face a higher cost of funds relative to a regulatory regime that does not include CoCos. Slovik and Cournède show that increasing funding costs has a negative effect on GDP. For instance, the estimate the cost to annual GDP growth brought on by Basel III policy shifts to be -.05 to -.015 percentage points per year (2011 page 10). CoCo funding costs will therefore negatively impact GDP growth.

Section 4 – Conclusion

The policy goal of mandating CoCo issuance is to reduce the likelihood that the financial sector requires government-finance infusions of cash during financial crises. I recommend that prudential regulation in the US does not adopt a pro-CoCo policy in pursuit of this goal. While the instruments have theoretical merit, in practice they would not be effective. The effects of dilution on existing stockholders and possibility of manipulation would discount the magnitude of recapitalization CoCos could offer. Interest rates charged by CoCo investors to compensate them for high levels of risk would add cost to bank funding, at the expense of the non-financial economy. Furthermore, CoCos would not provide any new funding for banks during disruptions in short term debt markets. Cash out flows would not be materially affected, while the instruments would not increase cash inflows. Therefore while the book value of a bank may increase, its liquidity position would probably not be affected. If funding liquidity did not change, a bank would still fail even if its CoCos triggered. As noted by Professor Connel Fullenkamp (2010) of the Duke Economics Department: "…there has been no new infusion of cash, only a decrease in current obligations…the firm is no better able to absorb losses."

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