What's the Contingency?

A Proposal for Bank Contingent Capital Triggered By Systemic Risk

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Abstract

Contingent capital (coco) can automatically recapitalize the banking system during financial crises if the trigger mechanism is properly designed. We propose a dual trigger mechanism that is a function of: (1) aggregate systemic risk in the banking system, measured using *CATFIN*, and (2) individual bank contribution to overall systemic risk, measured using delta *CoVaR*. The dual trigger is highly correlated with system-wide insolvency risk. We set different triggers for banks, insurance companies and broker-dealers. Using the 99^{th} percentile cut-off, we find that coco issued by Lehman and Bear Stearns would have been triggered in November 2007. Moreover, if cocos had comprised 19% of bank capital, automatic capital infusions in 2008 (2009) would have exceeded \$120 (\$185) billion.

Keywords: contingent capital, callable put option, dual trigger exercise price, systemic risk

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Proposals to introduce new subordinated debt and/or contingent capital instruments are periodically revived in the wake of banking crises. It is no accident that the original subordinated debt literature flourished in the years following the 1980s banking crisis in the U.S. Proposals requiring the issuance of subordinated debt focused on a market indicator of the insolvency risk of the individual bank. In contrast, current contingent capital proposals are a response to the 2007-2009 global financial crisis and therefore, are designed to address systemic crises and the contagion effects associated with fire sales of assets. Despite this objective, however, many of the more recent financial engineering proposals are based entirely on the financial condition of the individual firm.[1] That is, the trigger that automatically converts debt to equity is determined by some formulation based only on an individual bank's financial or accounting measures (e.g., bank capital ratio (market or regulatory), stock price, etc.). These approaches, while potentially beneficial from a capital structure point of view, do not address the systemic consequences of banking crises. That is, the fundamental objective of contingent capital instruments (coco) should be that they automatically increase capital cushions when ***the risk of system-wide banking crises increases***.

The motivation for a bank coco requirement is to reduce the incidence of regulatory interventions and bailouts precipitated by system-wide banking crises that have detrimental macroeconomic implications. During crises, financial markets shut down, prices fall to fire sale

[1] For example, the Call Option Enhanced Reverse Convertible, COERC, discussed in Pennacchi et al. (2012) can potentially mitigate agency problems inherent in the bank capital structure, but does not address systemic crises. An exception is McDonald (2011) which uses a dual trigger including the banking stock index. However, this measure is not tied to systemic crises and does not forecast banking crises that lead to macroeconomic downturns. The Squam Lake Working Group (2009) proposal calls for a dual trigger that is conditional on regulatory declaration of a systemic financial crisis, but is subject to regulatory risk associated with lags in the designation of a systemic crisis.

levels, and bank recapitalization is either extremely costly or not possible at any price. Coco instruments automatically inject capital into the banking system in the event of system-wide breakdowns that can lead to macroeconomic downturns, thereby mitigating the need for fire sales of assets and/or government bailouts. As a tool of bank regulators, coco is not a bank insolvency prevention mechanism, but rather a method of system-wide crisis mitigation or prevention. A properly calibrated coco requirement may reduce the moral hazard incentives that induce banks to take on excessive risk that induces systemic crises and macroeconomic downturns. In this paper, we propose a "systemic coco" that is designed to automatically take effect when macroeconomic downturns are imminent, thereby reducing their likelihood.

A critical design feature of any coco is the trigger mechanism that determines the conditions under which debt will be automatically converted to equity. The objective of the coco mechanism is not to prevent isolated bank insolvencies, but rather to intervene when system-wide increases in bank distress have negative externalities that potentially threaten the entire banking system. It is during these crisis periods that governments are called upon to bail out systemically important financial institutions in order to prevent asset fire sales and contagious financial market meltdowns. Coco can recapitalize the banking system without the moral hazard concerns and inefficiencies associated with too-big-to-fail government bailouts. Therefore, coco triggers should be contingent on both individual bank and systemic measures, and therefore require a dual trigger construction.

The first condition in our dual trigger coco conversion proposal is that an aggregate banking sector signal forecasts imminent macroeconomic downturns. Allen, Bali and Tang (2012) use publicly available data to devise a time-consistent measure of aggregate banking sector systemic risk (denoted *CATFIN*) that provides real-time forecasts of macroeconomic downturns approximately six months in advance throughout the world. *CATFIN* is a cross-sectional tail risk measure based on equity returns for all financial firms. To the extent that the measure is broad-based and robust to methodological estimation approaches, *CATFIN* is resistant to possible manipulation concerns. One can estimate an early warning threshold level of *CATFIN* that prevails during months of macroeconomic recessions. If *CATFIN* is higher than those thresholds, there is a high likelihood of macroeconomic downturns within the next six months.[2] In this paper, we estimate a different early warning threshold for banks, non-bank financial firms and insurance companies. Thus, coco can be used to address the systemic risk of the shadow banking system and non-banks, as well as banks.

Once the systemic risk trigger signals possible macroeconomic declines, the second condition in our dual trigger coco conversion proposal is a micro-level systemic risk measure such as delta CoVar (Adrian and Brunnermeier (2011)). The most systemically interconnected banks (i.e., high delta CoVar) would be subject to coco conversion, thereby structuring the second component of the coco trigger as a relative ranking of bank exposures conditional on high levels of aggregate systemic risk. Bank shareholders can avoid a coco trigger by reducing the bank's systemic risk taking (i.e., reducing their bank's delta CoVar) during high *CATFIN* periods, thereby reducing the overall systemic risk and potentially reducing the risk of systemic crisis. Thus, systemic coco reduces the risk shifting agency problem engendered as the bank approaches the trigger threshold by incentivizing bank shareholders to reduce systemic risk taking in periods of high aggregate systemic risk exposure. This approach could reverse the

[2] Allen, Bali and Tang (2012) show that *CATFIN* is more prone to Type II than Type I errors. Thus, it signals false warnings (i.e., high *CATFIN* even though no recession occurs), but no false positives over the 1973-2012 estimation period, therefore qualifying as a conservative regulatory policy tool. However, it is possible that its predictive power can be eroded over time as agents incorporate *CATFIN* into their behavior and find ways to circumvent it. Although this Lucas critique can be applied to any policy measure, the aggregate nature of *CATFIN* makes it somewhat resistant to non-collusive circumvention tactics.

incentives famously expressed by Charles Prince, CEO of Citibank in 2007, "As long as the music is playing, you've got to get up and dance. We're still dancing."[3] Facing a relative ranking dual trigger, systemically important financial institutions (SIFIs) would have incentives to reduce their individual bank's exposure, potentially reducing the system-wide *CATFIN* measure below the warning level and preventing trigger for all banks. Even if overall trigger is not prevented (i.e., aggregate *CATFIN* is not reduced sufficiently below the early warning level), each individual institution can take measures to try to improve their relative risk ranking in order to prevent their bank's coco from triggering, thereby reversing equity holders' moral hazard risk taking incentives.

The Squam Lake Working Group (2009) proposes a dual trigger mechanism similar to our proposal in that it is conditional on systemic crises. In the Squam Lake proposal, coco conversion would be triggered only if bank regulators declare a systemic crisis. However, this requirement introduces regulatory risk as it is not clear how regulators will make such a declaration, and whether they could be accurate predictors of future economic downturns. Our proposal makes the Squam Lake proposal operational by reducing uncertainty about regulatory actions. Our systemic coco trigger is automatic, transparent and easily replicable using publicly available data and well-specified empirical models.[4]

In contrast to other coco trigger proposals, systemic coco's trigger is based on market values rather than stale accounting or regulatory values that can be manipulated. The systemic coco trigger is based on a model of the tail risk properties of the cross section of forward-looking stock prices. Nonlinearities in the model avoid the multiple equilibria inconsistency problems

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[3] Interview with the *Financial Times* in Japan on July 10, 2007.
http://business.time.com/2007/07/10/citigroups_chuck_prince_wants/

[4] There are elements in this dual trigger mechanism similar to the "prediction market" conversion regime of Davis, Korenok and Prescott (2011). However, whereas their "prediction market" is based on participants' beliefs however formed, the systemic coco trigger uses econometric measures shown to forecast macroeconomic downturns.

documented by Bond et al. (2010) and Sundaresan and Wang (2010) when the simple bank stock price is used as a coco trigger. Moreover, coco triggers based on the market value of capital of the individual bank (as in Flannery (2009)) can be used to manipulate the bankruptcy process without necessarily impacting overall system-wide effects. Since these balance sheet market value triggers are essentially insolvency triggers, they exacerbate the moral hazard incentives of bank shareholders. That is, as the bank approaches insolvency, equity holders may increase risk taking when facing imminent triggering of the bank's coco.

Avoiding the use of bank stock price triggers also relaxes the condition prohibiting wealth transfers between debt and equity holders upon trigger. Indeed, the conversion ratio on systemic coco would redistribute value from stockholders by diluting equity upon conversion, thereby discouraging equity holders from undertaking excessive levels of systemic risk. Since systemic risk imposes an externality on other banks in the system, it is not priced in current macroprudential bank regulations.[5] Systemic coco could partially remedy this by internalizing the systemic risk externality via the imposition of costs (equity losses upon coco trigger) that increase as both the aggregate level and the individual bank levels of systemic risk increase. That is, the greater the aggregate level of systemic risk in the banking sector and the greater the relative systemic risk externality imposed by the individual bank on the economy, the greater the likelihood of systemic coco conversion resulting in wealth transfers from equity holders to debt holders.[6]

[5] Although recent bank regulations designate systemically important financial institutions (SIFIs), there are no proposals to impose regulatory penalties or taxes in an actuarially fair manner. Moreover, Allen, Bali and Tang (2012) show that systemic risk exposure can emanate even from small banks that would lie outside of regulators' SIFI designation.

[6] However, an imminent systemic coco trigger could incentivize bank equity holders to increase non-systemic risk even as they decrease the bank's systemic risk exposure (see, for example, Koziol and Lawrenz (2012)). Thus, systemic coco may increase the risk of individual bank insolvency even as the systemic implications are lessened. However, this may be viewed as a reversal of the incentive to shift from priced bank-specific non-systemic risk to currently unpriced systemic risk.

Regulators can utilize systemic coco in order to set the level of acceptable risk tolerance in the banking system. In this paper, we show how the trigger can be set to either tighten or loosen regulatory control over systemic risk. It should be clear that tighter systemic risk controls are not without costs as the triggering of contingent capital intentionally destroys shareholder value. Thus, the regulator must weigh the social benefits of reduced risk of systemic financial crises against the costs of redistribution of value from equity holders to bond holders, thereby exacerbating the debt overhang problem. The mechanism we develop in this paper allows an explicit analysis of the benefits and costs of systemic risk regulation.

Coco debt can be modeled as a callable put option on the bank's assets (see Allen and Saunders (1993) for application to deposit insurance). Straight debt can be viewed as a short put option on the bank's assets, such that bank equity holders are long both the put option and the bank's assets (equivalent through put-call parity to a call option on the bank's assets), enabling bank stockholders to "sell" the bank's assets to the debt holders when the market value of assets is less than the face value of debt (i.e., insolvency and default). However, coco bond holders are required to buy the bank's stock (an embedded call option) if the coco trigger is activated. Thus, coco debt can be viewed as a compound option consisting of the standard debt put option (since insolvency is still possible if coco conversion does not occur) plus a call option held by the coco bond holders when the coco trigger calls the debt put option.

Exercise of the call option is specified in the coco covenants as the coco trigger. Since coco is not designed to prevent an individual bank's insolvency, the coco trigger is not identical to the put option insolvency exercise point (asset value equals debt). Rather the dual nature of the systemic coco trigger proposed in this paper makes the call option's exercise dependent upon both the aggregate level and the bank's contribution to systemic risk. That is, as stockholders increase the bank's systemic risk exposure, the likelihood of systemic coco conversion increases, thereby exercising the call option in the callable put (i.e., coco conversion). Equity holders, therefore, lose the ability to put the bank's assets to the bondholders (i.e., default) and must issue equity in place of the debt. The difference between the non-callable put value and the callable put value measures the cost to shareholders of coco conversion.

The paper is organized as follows. Section 2 briefly describes the relevant literature on systemic risk in the banking sector. Section 3 describes the callable put model and simulates the proposed coco conversion trigger. We calibrate the systemic coco trigger using bank data over the period of 1990-2012 in Section 4. Moreover, we estimate the coco trigger for banks, insurance companies and securities firms separately, and find a higher trigger for non-banks than for banks. Finally, Section 5 concludes.

2. A Brief Review of the Literature

One need look no further than the ongoing aftershocks of the financial crisis of 2007 to see the impact of systemic risk on macroeconomic conditions. Indeed, the justification for macroprudential regulation of the banking industry hinges, in large part, on the potential negative and positive externalities imposed by bank risk taking on the broader economy. Allen, Bali and Tang (2012) show that macroeconomic downturns are linked to high levels of aggregate risk in the banking sector. They propose a measure, *CATFIN*, that can be used to forecast macroeconomic declines around six months into the future. Using out of sample estimation, they derive an early warning threshold such that *CATFIN* levels above this threshold (denoted $\overline{CATFIN}$) signal imminent financial crisis and recession.

The *CATFIN* measure is an aggregate macro-level estimate of systemic risk in the banking sector. However, it does not measure the contribution of each individual bank to the overall level of systemic risk. There have been many proposed micro-level estimates of systemic risk that can accomplish this. In this paper, we concentrate on Adrian and Brunnermeir's (2011) delta CoVaR (denoted c$CoVaR_{it}$) which measures the marginal contribution of an individual bank *i* to overall systemic risk at time period *t*. Delta CoVaR is defined as the difference between the VaR of the financial system conditional on the distress of bank *i* minus the VaR of the banking system conditional on bank *i*'s median financial condition. That is, $CoVaR_{it}$ measures the impact on the VaR of the entire financial system of an event at bank *i*, whereas c$CoVaR_{it}$ measures the difference between *CoVaR* if bank *i* is in distress compared to non-distress (median) conditions at bank *i*.[7] Adrian and Brunnermeier (2011) express c$CoVaR_{it}$ as:

$$cCoVaR_q^{j|i} = CoVaR_q^{j|X^i=VaR_q^i} - CoVaR_q^{j|X^i=Median^i} \tag{1}$$

It should be apparent that both *CATFIN* and delta *CoVaR* are required to structure the rule determining whether to exercise the coco option. That is, if contingent capital is designed to mitigate systemic financial crises, then coco should be triggered when financial crisis is imminent for individual banks that have substantial systemic risk exposure. If the trigger was conditioned only on high levels of insolvency risk at individual banks (as in the Flannery (2009) proposal), then coco conversion could take place if isolated bank failure was imminent. However, this would preempt the intact bank distress mechanism as well as the bankruptcy system and not address systemic risk at all. What coco is designed to do is to prevent systemic bank risk taking that imposes an externality on the financial system. Therefore, coco conversion must be conditional on the likelihood of a financial crisis that transcends an individual bank. Therefore, *CATFIN* and delta *CoVaR* are useful mechanisms to quantify that likelihood.

[7] Adrian and Brunnermeier (2011) do not follow the convention of converting VaR figures from negative to positive values. To be consistent with *CATFIN*, however, we perform the conversion for the use of c*CoVaR* in the calculation of the coco trigger.

2.1 Other Coco Proposals

Although not meant as a comprehensive review of the literature on coco instruments, we classify several coco proposals into those triggered by individual bank conditions as opposed to those with system-wide, aggregate trigger mechanisms. Banks have issued $70 billion of coco securities between June 2009 and June 2013 (see Avdjiev, Kartasheva and Bogdanova (2013)). For example, coco has been issued by Lloyd's (November 2009), Rabobank (March 2010) and Credit Suisse (February 2011). These coco instruments contain triggers based on the issuing bank's regulatory capital falling below a predetermined level. This design is problematic since regulatory capital ratios can be manipulated by the bank. Further, many banks had adequate levels of regulatory capital even though they were technically insolvent during the 2007-2009 financial crisis (e.g., Dexia at the time of its 2008 bailout). Indeed, Hart and Zingales (2010) contend that Lloyd's coco would not have triggered at any time during the 2007-2009 financial crisis. Duffie (2009) suggests the use of tangible common equity as a percent of tangible assets to focus only on the assets that could be liquidated in a systemic crisis.

Bank stock price has been used as the coco trigger in proposals by Flannery (2009), Coffee (2010) and Sundaresan and Wang (2010). Pennacchi (2010) triggers coco when the market value of equity as a fraction of the face value of debt falls below a threshold level. Hart and Zingales (2010) suggest the use of CDS prices that act to trigger a "margin call" when bank stock prices are low. However, approaches based on bank stock or CDS prices could subject coco conversion to price manipulation, potentially resulting in a "death spiral" as short sellers behave opportunistically (see Duffie (2009)). To address this concern, Calomiris and Herring (2011) propose a market value trigger defined using a moving average of "quasi market value of equity ratio." More fundamentally, however, these market-based trigger proposals convert coco from debt into equity when the financial condition of an individual bank deteriorates, not when systemic crises are imminent.

Coco proposals that rely on the regulator to trigger conversion are found in Huertas (2009) and the Squam Lake Proposal (2009). However, these rely on regulators to identify impending systemic crises and act expeditiously. McDonald (2011) and Pennacchi (2010) use banking industry distress measures in order to construct a dual trigger. That is, coco converts if both the bank's stock price and the banking index are below the trigger values. Rajan (2009) suggests a dual trigger based on: (1) aggregate bank losses that signal that a systemic crisis and (2) declines in a bank's capital ratio. Although these proposals are closer to our dual trigger mechanism, the conversion takes place after the banking sector is already in crisis (i.e., experiencing large stock price declines and/or aggregate losses) rather than using our predictive trigger mechanism which forecasts future macroeconomic downturns. That is, our trigger is designed to satisfy the condition that, "The trigger that converts the debt to equity should be set so as eliminate the debt claims before a liquidity crisis is likely to begin, and hopefully with a sufficiently strong impact on the balance sheet to forestall a self-fulfilling presumption of a liquidity crisis." (Duffie (2009)).

3. Coco as a Callable Put Option

The payoff to debt holders is equivalent to a short put option written on the underlying firm assets. Thus, unsecured, subordinated bank debt can be viewed by equity holders as a put option on the bank's assets, where the bank's shareholders "sell" the bank's assets to bondholders if the market value of assets is less than the face value of debt (i.e., default takes place). Coco instruments contain an embedded call option that forces the bondholders to "buy" back the straight debt put option when the coco trigger is breached and the debt is converted into equity. That is, the bank's stockholders lose their ability to walk away from debt obligations (put the bank's assets to bondholders) if the coco trigger converts the debt into equity. The difference between the non-callable put value and the callable put value represents the cost to equity holders of coco conversion.

Merton (1973) evaluates the perpetual American put option as:

$$p(a, \infty; 1) = \frac{1}{1+\gamma}\left[\frac{(1+\gamma)a}{\gamma}\right]^{-\gamma} \tag{2}$$

Where $a \equiv A/D$ such that A is the bank asset market value and D is the face value of bank debt; $\gamma = 2r/\sigma^2$ where r is the interest rate and σ is bank asset volatility (standard deviation). The non-callable put option exercise price is $a=1$, i.e., when the market value of assets equals the face value of debt (the insolvency point).[8] However, coco debt specifies conversion at a trigger value represented by $a>1$, (i.e., forced exercise when the option is out of the money).[9] That is, bank regulators retain a call option on the subordinated debt put option that enables the bank regulators to automatically call the bonds and replace them with equity. Thus, coco debt can be viewed as a callable put.

Allen and Saunders (1993) show that the callable put value is:

$$i(a, \infty; 1) = (1 - \bar{a})\left(\frac{\bar{a}}{a}\right)^{\gamma} \tag{3}$$

where $\bar{a}$ is the coco trigger function or exercise price. In this paper, we propose a trigger $\bar{a}$ that is a function of *CoVaR* and *CATFIN*.

Figure 1, Panel A shows the loss to equity holders of coco conversion as the shift from the non-callable put option value to the callable put option. The non-callable put value shows the standard moral hazard result: i.e., bank equity holders have an incentive to increase the

[8] For simplicity, we consider only the coco debt although the bank will have other sources of both insured and uninsured debt.
[9] Regulatory forbearance is modeled in Allen and Saunders (1993) so their call option exercise price is less than one. In this paper, we are concerned with forced early exercise (the opposite of forbearance) and so the call option exercise price is greater than one. Pennacchi (2010) uses this specification as the sole coco trigger in his model.

bank's asset risk since their put option value increases as asset volatility increases. However, the callable put option (coco) removes that incentive as the put option value turns negative. Figure 1, Panel A shows that the stricter the coco trigger (higher the value of $\bar{\alpha}$), the greater the loss (more negative the callable put option value). However, Panel A of Figure 1 shows that when the coco trigger value $\bar{\alpha}$ is fixed at any level, then the callable put value becomes less negative as the bank's asset risk increases. That is, the bank can circumvent the discipline imposed by coco debt by increasing its asset volatility, thereby exacerbating moral hazard concerns. Thus, coco with a fixed trigger value does not resolve the moral hazard problem associated with excessive bank risk taking.

Panel B of Figure 1 shows a coco trigger $\bar{\alpha}$, that is a function of bank risk exposure. This formulation of the coco trigger does reduce bank risk taking incentives since the callable put option value gets more negative as the bank's asset risk increases. Indeed, the more risk sensitive the coco trigger $\bar{\alpha}$, the more negative the callable put value becomes as bank asset risk increases, thereby reducing the bank's moral hazard incentives. Thus, coco with a risk-based trigger can mitigate the bank's risk taking incentives.

This approach focuses on individual bank risk taking. However, coco is designed to mitigate systemic risk taking incentives. To be effective, therefore, the coco must have a trigger that is sensitive to systemic risk rather than individual bank asset risk. Hence, our proposal is to tie coco triggers to systemic risk using c*CoVaR* and *CATFIN* (rather than σ^2 as shown in Panel B of Figure 1). c*CoVaR* is used to measure the contribution of each individual bank to overall systemic risk. *CATFIN* measures the aggregate level of systemic risk in the financial system. Thus, an individual bank's coco will trigger if both aggregate systemic risk is high (high *CATFIN*) and the bank's contribution to systemic risk is high (high c*CoVaR*). Both *CATFIN* and c*CoVaR* are important in designing the coco trigger.[10] Using both measures conditions the coco trigger on both the likelihood of a financial crisis and the impact of each bank on outcomes conditional on the crisis taking place.

Consider a function for the coco trigger $\bar{a}$ for bank *i* at time *t* that is a function of *CATFIN* and *CoVaR* as follows:

$$\bar{a} = 1 + CATFIN_t * cCoVaR_{it} \qquad \text{if } CATFIN_t \geq \overline{CATFIN} \tag{4}$$

$$= 1 \qquad \text{if } CATFIN_t < \overline{CATFIN}$$

where $\overline{CATFIN}$ is defined to be the early warning threshold value of *CATFIN* that signals recession within around six months (see Allen, Bali and Tang (2012)). Coco conversion takes place only in those months when *CATFIN* crosses the early warning threshold. Otherwise, the coco reverts to a straight debt put option.

Figure 2 simulates the callable put value using *CATFIN* data estimated for January 1973 through December 2013. The early warning threshold for that period $\overline{CATFIN}$ is estimated at 35.1855%. We used the mean c*CoVaR*, estimated by Adrian and Brunnermeier (2011) to be 1.16 to simulate $\bar{a}$ for each month, although in the next section each coco trigger is calibrated to the individual bank's measure of c*CoVaR.*[11] When coco conversion is triggered, the equity holders lose the value of the debt put option, and therefore, the callable put value is negative, representing the loss to shareholders associated with automatic coco conversion.

[10] One might consider the use of Adrian and Brunnermeir's (2011) delta *CoVaR* in place of *CATFIN*. However, delta *CoVaR* measures the cross-sectional deviation of an individual bank's increase in VaR in the event of a financial crisis. In contrast, the early warning threshold of *CATFIN* measures the likelihood that a financial crisis (i.e., a macroeconomic decline) will occur within the next six months.

[11] We convert the mean shown in Table 2 of Adrian and Brunnermeier (2011) from -1.16 to 1.16 to conform with the convention that VaR measures are typically converted from negative to positive values.

4. Calibrating the Coco Trigger

Coco is designed to trigger when the risk of either fire-sale asset liquidations or bailouts is high. This will occur when many financial intermediaries are approaching insolvency. Thus, we calibrate coco to trigger automatically when the financial sector's aggregate risk of default is high. To determine this, we create a market-capitalization-weighted average of default probabilities using Kamakura's Jarrow-Chava monthly default risk measure (see Chava and Jarrow (2004)) denoted *PD,* which measures the expected probability of default (in percentage terms) one year into the future for all financial firms. Table 1 shows descriptive statistics for the *PD*, *CATFIN*, *cCoVaR* and *CATFIN*cCoVaR* variables. The average (median) one-year ahead aggregate default probability for the financial system over the period from January 1990 through April 2012 period was 0.2126% (0.0924%). *cCoVaR* is an equally-weighted average of the delta *CoVaR* systemic risk variable (from Adrian and Brunnermeier (2011)) calculated monthly for all publicly traded financial firms.

Table 2 presents the results of a monthly time-series regression of *PD* on *CATFIN*, *cCoVaR* and *CATFIN*cCoVaR* variables over the period from January 1990 through April 2012 (268 months). The coefficients on *CATFIN* and *cCoVaR* are positive and statistically significant at the 1% level. However, the greatest statistical explanatory power (in terms of both R^2 and t-statistic) is realized when the *CATFIN*cCoVaR* variable is used. This is consistent with the coco trigger specification in equation (4). That is, the aggregate *CATFIN*cCoVaR* is highly correlated to system-wide insolvency risk in the banking sector over the 1990 through 2012 period.

To operationalize the aggregate relationship shown in Table 2, we devise a coco trigger for individual financial firms. Using the 99th percentile[12] of fitted values of PD, we set the coco trigger to:

$$99th\ percentile\ of\ the\ fitted\ PD = 1.6491 = -0.2227 + 0.0029 \times (CATFIN \times cCoVaR) \Longrightarrow CATFIN \times cCoVaR = 643.50 \qquad (5)$$

Thus, coco conversion occurs for any financial firm that has a *CATFIN**cCoVaR* measure over 643.50 for months in which the *CATFIN* measure exceeds the early warning threshold $\overline{CATFIN}$ of 35.1855%.[13] To smooth the stock-level systemic coco trigger measure, for each month *t*, we calculate the lagging 12-month exponential moving average of $CATFIN \times cCoVaR$ of a stock i (denoted $EMA_{i,t}$); specifically: $EMA_{i,t} = c\ CATFIN \times cCoVaR_{i,t} + (1 - w)EMA_t$, with $w = 2/(12 + 1)$.

Figure 3 presents the results of this analysis for the entire sample over the 1990 through 2012 period. Most of the coco triggers occur around NBER recession periods (shaded regions). However, using the EMA 99th percentile cut-off, there are seven coco triggers during the period from September 1998 through May 1999 period that corresponded to the Russian default and the LTCM debacle during the summer of 1998, but which did not result in a macroeconomic downturn.[14] These Type II errors are minimal since more than 97% of the coco trigger conversions occur during a period extending from six months prior to the start of each NBER-designated recession until six months after the end of each NBER recession during the 1990-

[12] In Section 4.2, we perform comparative statics on alternative cutoff points in order to test the social costs of tighter regulatory controls on systemic risk.
[13] We utilize the early warning threshold value of *CATFIN* estimated over the 1973-2013 as a long-term, out-of-sample forecast of macroeconomic recessions.
[14] Using the 99th percentile non-adjusted cut-off, there are 289 observations that trigger coco conversion during September 1998 through May 1999.

2012 period.[15] Moreover, there do not appear to be Type I errors of failure to convert around the three recession periods that occurred during the 1990-2012 sample period. However, the percentile cut-off can be adjusted by regulators to reduce Type I errors at the expense of increasing Type II errors (see discussion in Section 4.2).

Different financial firms have different exposures to financial crises. For example, whereas the 2007-2009 crisis had its roots in the banking industry, the 2000-2001 bursting of the high tech bubble predominantly impacted broker-dealers and securities firms. Thus, in the next section, we compute coco conversion triggers for different sectors of financial intermediaries.

4.1 Conversion Triggers for Banks and Non-Banks

In this section, we re-estimate the early warning thresholds for banks and non-banks separately.[16] A stock is included in the banking sector if its SIC code is 6000-6099, 6600-6699 or 6712; insurance if the SIC code is 6300-6399 or 6400-6499; and securities firms (broker-dealers) for all remaining financial firms (in the 6000 SIC code category). Following Allen, Bali and Tang (2012), we estimate the early warning threshold as the average value of *CATFIN* in months when the three month moving average of the CFNAI index is less than -0.7, consistent with the Federal Reserve Bank of Chicago recession designation.

Estimating the *CATFIN* model for the period from January 1973 to December 2013, we find that the early warning threshold for banks alone is set at a *CATFIN* equal to 32%. In contrast, the early warning thresholds for insurance companies and non-bank securities firms are 34% and 42%, respectively. Since the threshold is set at a lower level for banks than for non-banks, our trigger design incorporates the greater impact of banks on macroeconomic conditions.

[15] This was computed using the EMA trigger. Analogously, more than 77% of the coco conversions using the non-smoothed systemic trigger took place during the period from six month periods prior to extending to six months after the end of NBER recessions.
[16] Because segmenting the sample reduces the number of observations, we define *CATFIN* as the average of 1% VaR of the monthly cross-section of firms estimated using the SGED and non-parametric approaches only.

However, inclusion of non-bank systemic risk allows consideration of heretofore overlooked sources of systemic risk.

Figure 4 shows the results of the systemic coco trigger analysis for banks (Panel A), insurance companies (Panel B) and broker-dealer firms (Panel C). Interestingly, no triggers occurred for either banks or insurance companies during the 2000-2001 recession driven by the bursting of the high tech bubble that disproportionately impacted broker-dealers and other financial institutions. Similarly, banks were the predominant triggering financial firms during the 2007-2009 period, consistent with the banking origins of the systemic crisis.

Using the sector triggers, Table 3 lists the banks with systemic coco that would have been triggered during the 2007-2009 crisis. Table 4 lists the insurance companies and other financial firms with triggered cocos during this period. Bear Stearns and Lehman would both have triggered their coco conversion in November 2007, months prior to their actual demise. Coco issued by most major (SIFI) banks would not have converted until November 2008, after Lehman's collapse and around the time of the capital infusions from the initial TARP bailouts. The range of sizes of companies with coco conversions demonstrates that systemic risk is not limited to large financial firms only (as found in Allen, Bali and Tang (2012) with regard to aggregate systemic risk). Further, AIG's coco never triggers at all.

The total number of coco conversions during the 1990 through 2012 period is 1,452, representing 218 distinct financial stocks out of a total of 2,024 financial firms that were publicly traded over the period.[17] Table 5 shows the number of distinct firms triggering at any time during each year from 1990-2012 (omitted years had negligible triggers during the year). During 2008 (2009), 18.73% (23.37%) of all financial firms would have experienced at least one coco trigger during the year. However, this does not indicate the amount of capital held by coco

[17] Many financial firms experienced multiple triggers of their coco issues.

triggering firms. Therefore, Table 5 also shows that during 2008, 48.98% (43.71%) of the year-end book (market) value of total capital held by publicly traded financial firms was in triggering firms. As of the end of 2009, triggering firms held 51.08% (54.47%) of the financial system's book (market) value of capital. Thus, if coco instruments would have been issued before the 2007-2009 financial crisis, conversion during the crisis would have impacted firms holding a large portion of the capital in the banking system.

As an indication of the potential capital infusion as a result of coco conversion, we choose three possible regulatory mandated coco levels: 5% of capital must be held as coco, 9% held as coco (corresponding to the proposal by the Swiss State Secretariat for International Financial Matters) and 19% (corresponding to the Swiss requirement for both common equity and coco). Table 5 shows that if 19% of book (market) value of capital had been held in the form of cocos, there would have been an automatic capital infusion of $132.5 billion ($121.2 billion) during 2008 and $185.9 billion ($189.6 billion) during 2009. Moreover, these capital infusions would have targeted the most systemically interconnected financial firms. In contrast, the October 2008 $250 billion in TARP bailouts were given only to the largest banks, not necessarily to the institutions with the greatest amount of systemic risk exposure.

4.2 Measuring Social Benefits and Costs

We have used the 99th percentile cut-off of the coco trigger. However, if regulators choose more ex ante protection against systemic risk, they could mandate the 97th percentile or 95th percentile cut-offs. The lower the cut-off, the greater the likelihood of coco conversion that automatically infuses capital into the financial system, thereby reducing leverage during systemic crises. Figure 5 demonstrates that effect for the 97th percentile (Panel A) and the 95th percentile (Panel B). During the entire 1990-2012 time period, there were 8, 143 triggers using the 97th

percentile and 10,997 triggers using the 95th percentile, as compared to 1,452 conversions using the 99th percentile.

However, the lower the threshold for coco conversion, the greater the Type II error of unnecessary conversion, as shown in Figure 5 by the large number of conversions that are not connected to NBER-designated recessions. Using the 97th (95th) percentile, the percentage of triggers taking place during the period extending from six months before to six months after each NBER recession is 82.59% (78.69%) as compared to 97.66% for the 99th percentile cut-off trigger. To the extent that coco conversion destroys shareholder value, regulators must weigh the benefits of reduced systemic risk against the costs to shareholders in financial firms.

5. Conclusion

We propose a dual trigger mechanism for contingent capital that focuses on systemic risk exposure. Conversion only takes place if a macroeconomic decline is imminent, as forecast using Allen, Bali and Tang's (2012) *CATFIN* measure of aggregate systemic risk in the banking sector. Banks with a large contribution to overall systemic risk, as measured by Adrian and Brunnermeier's (2011) delta *CoVaR*, experience automatic contingent capital conversion during periods of high aggregate systemic risk. The loss to equity holders upon conversion is simulated using a callable put construction.

Equity holders will not voluntarily issue contingent capital, but regulators can require it as a component of capital requirements. Our coco trigger proposal can be calibrated to systemic risk emanating from banks as well as non-bank financial firms. Moreover, the regulator can explicitly weigh the ex ante benefits of greater protection against systemic crises against the cost of shareholder value destruction.

References

Adrian, T., and M. K. Brunnermeier, 2011, "*CoVaR*," *Federal Reserve Bank of New York Staff Reports*, No. 348, August 2009, revised September 15, 2011.

Allen, L., T. Bali and Y. Tang, 2012, "Does Systemic Risk in the Financial Sector Predict Future Economic Downturns?" *Review of Financial Studies*, October 2012, vol. 25, 10, pp. 3000-3036.

Allen, L. and A. Saunders, 1993, "Forbearance and Valuation of Deposit Insurance as a Callable Put," *Journal of Banking and Finance*, 17, 1993, pp. 629-643.

Avdjiev, S., A. Kartasheva and B. Bogdanova, 2013, "Cocos: A Primer," *BIS Quarterly Review*, September, pp. 43-56.

Bond, P., I. Goldstein and E. Prescott, 2010, "Market-Based Corrective Actions," *Review of Financial Studies* 23, 781-820.

Calomiris, C. and R. Herring, 2011, "Why and How to Design a Contingent Convertible Debt Requirement," April.

Chava, S. and R. Jarrow, 2004, "Bankruptcy Prediction with Industry Effects," *Review of Finance*, vol. 8, pp. 537-569.

Coffee, J., 2010, "Bail-Ins Versus Bail-Outs: Using Contingent Capital to Mitigate Systemic Risk," Columbia Law School Working Paper No. 380, October 22.

Davis, D., O. Korenok, and E. Prescott, 2011, "An Experimental Analysis of Contingent Capital Triggering Mechanisms," Federal Reserve Bank of Richmond Working Paper No. 11-01R.

Duffie, Darrell, 2009, "Contractual Methods for Out-of-Court Restructuring of Systemically Important Financial Institutions," Submission Requested by the U.S. Treasury Working Group on Bank Capital.

Flannery, M., 2009, "Market value triggers will work for contingent capital investments," working paper, University of Florida.

Hart, Oliver and Luigi Zingales, 2010, "How to Make a Bank Raise Equity," Financial *Times*, February 7.

Huertas, Thomas, 2009, "Too Big to Fail, Too Complex to Contemplate: What to Do about Systemically Important Firms," paper presented at the Financial Markets Group, London School of Economics, September 15.

Koziol, C. and J. Lawrenz, 2012, "Contingent Convertibles: Solving of Seeding the Next Banking Crisis?" *Journal of Banking and Finance*, vol. 36, pp. 90-104.

McDonald, R., 2011, "Contingent Capital with a Dual-Priced Trigger," April 11, 2011 Working Paper.

Pennacchi, George, 2010, "A Structural Model of Contingent Bank Capital," Working Paper, University of Illinois College of Business, April 23.

Pennacchi, G., T. Vermaelen, and C. Wolff, 2012, "Contingent Capital: The Case of COERCs," February Working Paper.

Squam Lake Working Group, 2009, "An Expedited Resolution Mechanism for Distressed Financial Firms: Regulatory Hybrid Securities," Council on Foreign Relations.

Sundaresan, S. and Wang, Z., 2010, "Design of Contingent Capital with Stock Price Trigger for Conversion," Unpublished, Federal Reserve Bank of New York.

Figure 1 Panel A
Fixed Coco Trigger

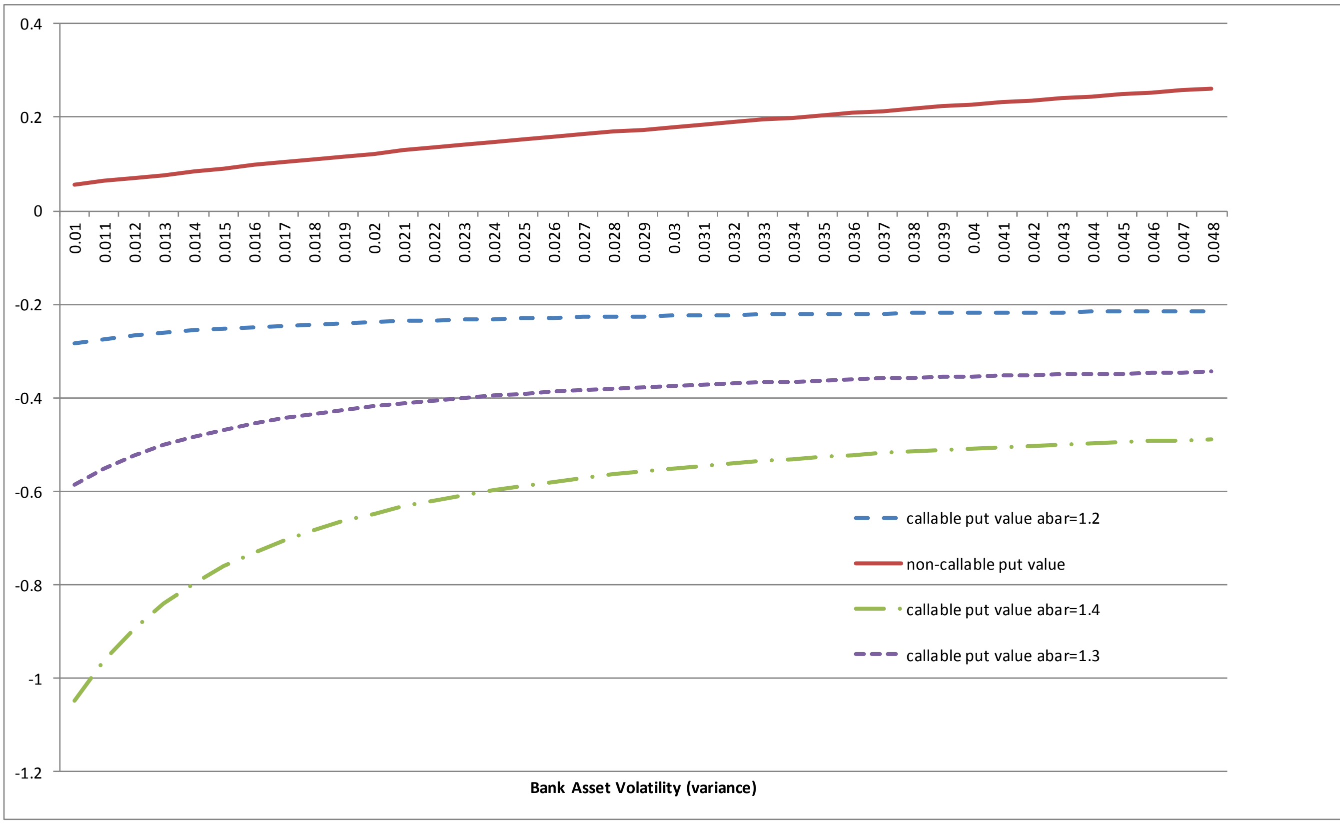

Figure 1, Panel B
Risk Sensitive Coco Trigger The coco trigger for the less risk sensitive simulation is set at $\bar{a} = 1 + \sigma^2$, whereas the more risk sensitive coco trigger is $\bar{a} = 1 + 2\sigma^2$.

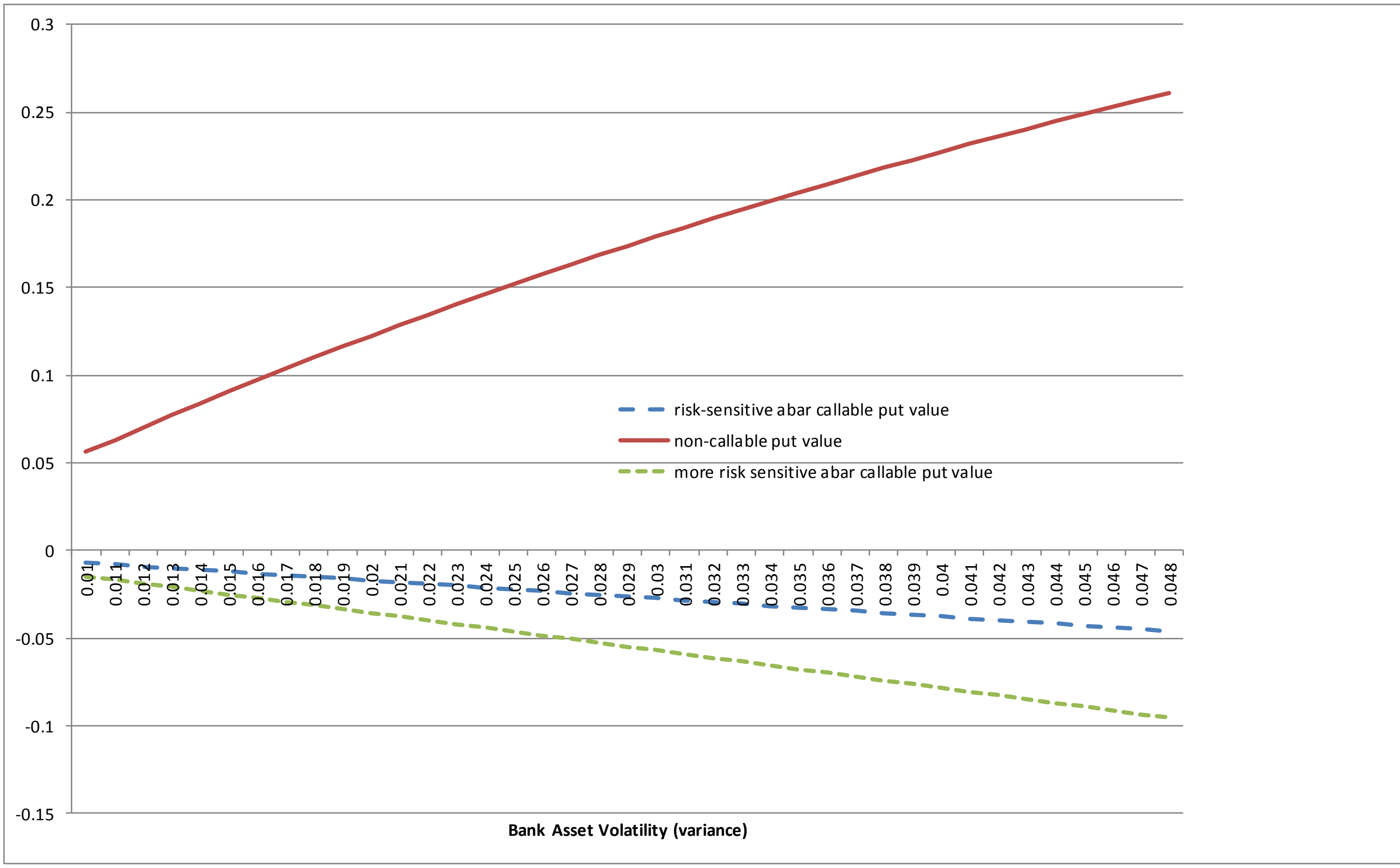

Figure 2

Proposed Coco Trigger Simulation Using Equation (3):

$\bar{a} = 1 + (CATFIN_t - \overline{CATFIN})$*c$CoVaR_{it}$ if $CATFIN_t > \overline{CATFIN}$; and $\bar{a} = 1$ if $CATFIN_t \leq \overline{CATFIN}$. Monthly simulated values of $\bar{a}$ are determined using estimates of *CATFIN* updated from Allen, Bali and Tang (2012) for the period January 1973-December 2013. The early warning threshold $\overline{CATFIN}$ is estimated at 0.351855. The mean c*CoVaR* of 1.16 from Adrian and Brunnermeier (2011) is used.

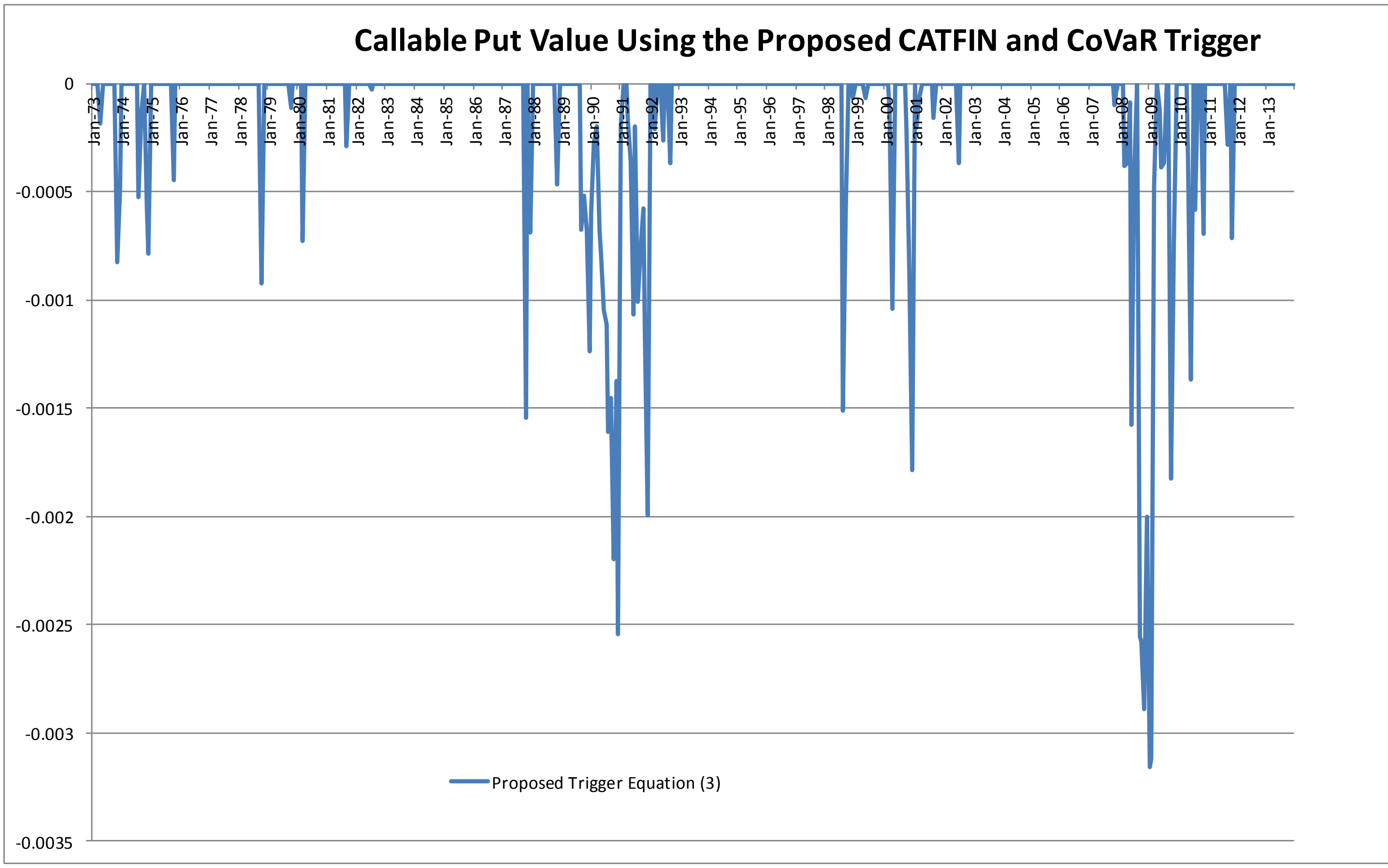

Figure 3: The Calibrated Systemic Coco Trigger using Financial Firm Data
The number of publicly traded financial firms converting under the systemic coco trigger using 99th percentile fitted values calculated from equation (5) and input into trigger equation (4). The shaded regions correspond to NBER recession periods.

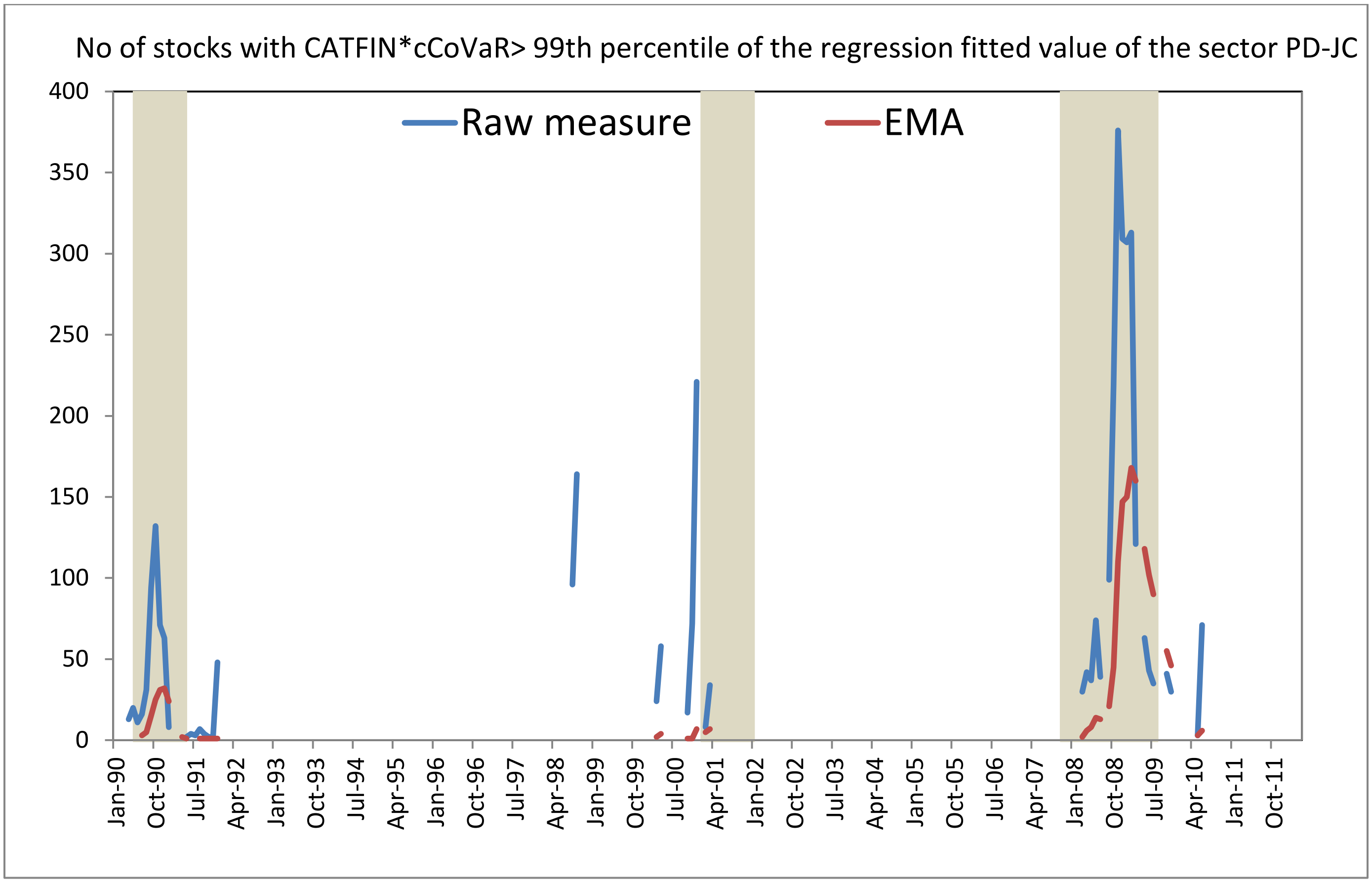

Figure 4, Panel A: The Systemic Coco Trigger for Banks Only

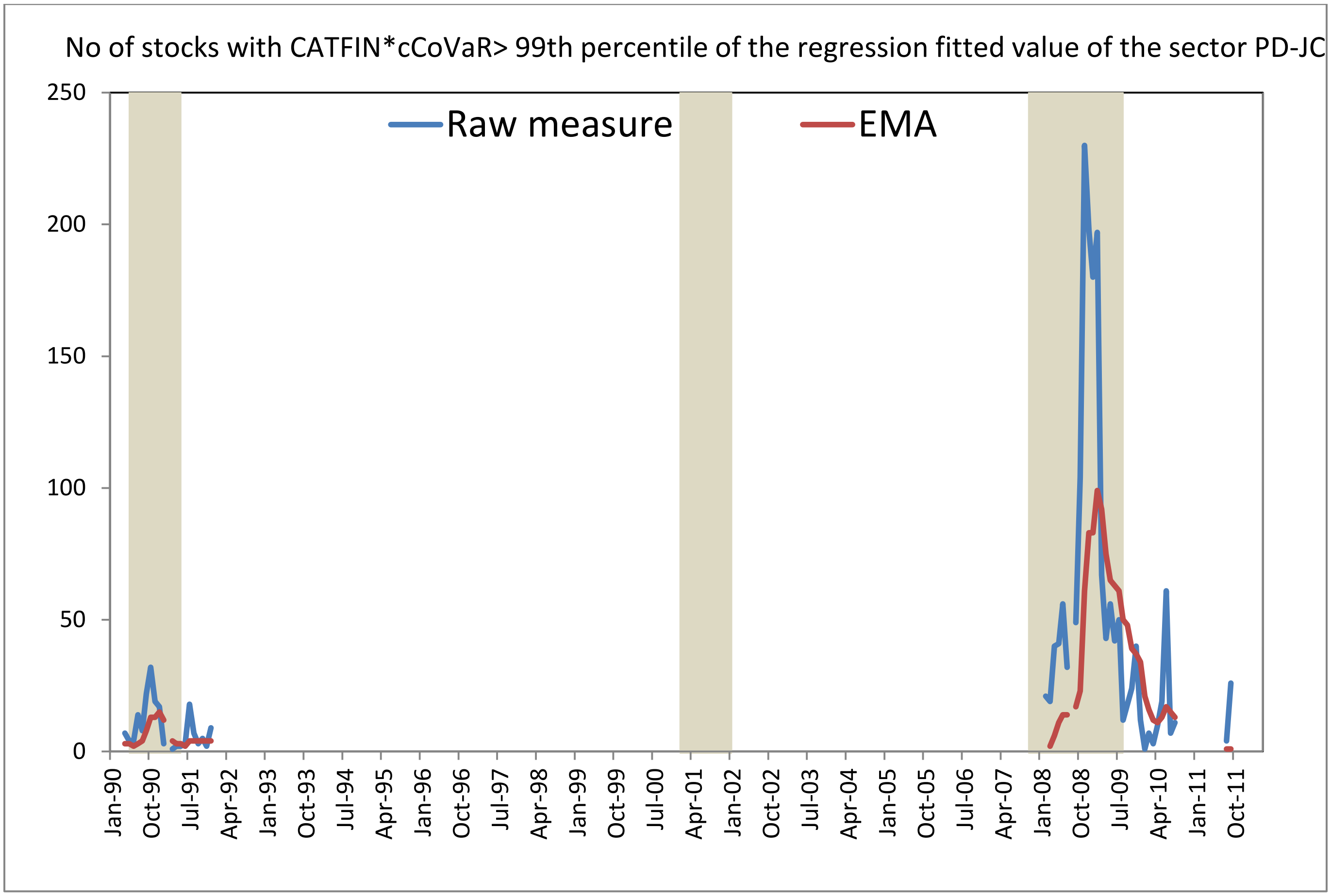

Figure 4, Panel B: The Systemic Coco Trigger for Insurance Companies Only

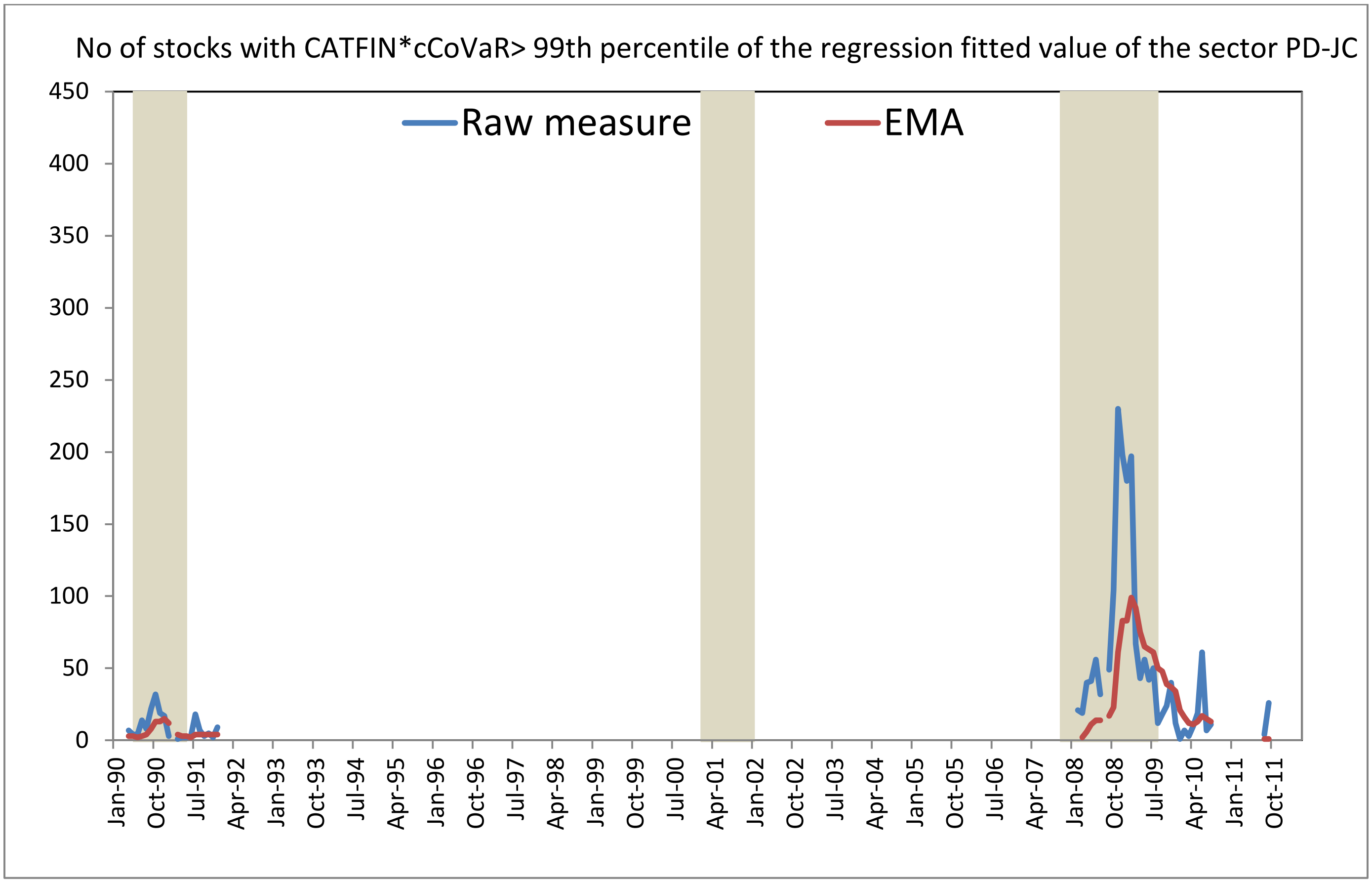

Figure 4, Panel C: The Systemic Coco Trigger for Broker-Dealers and Other Financial Firms

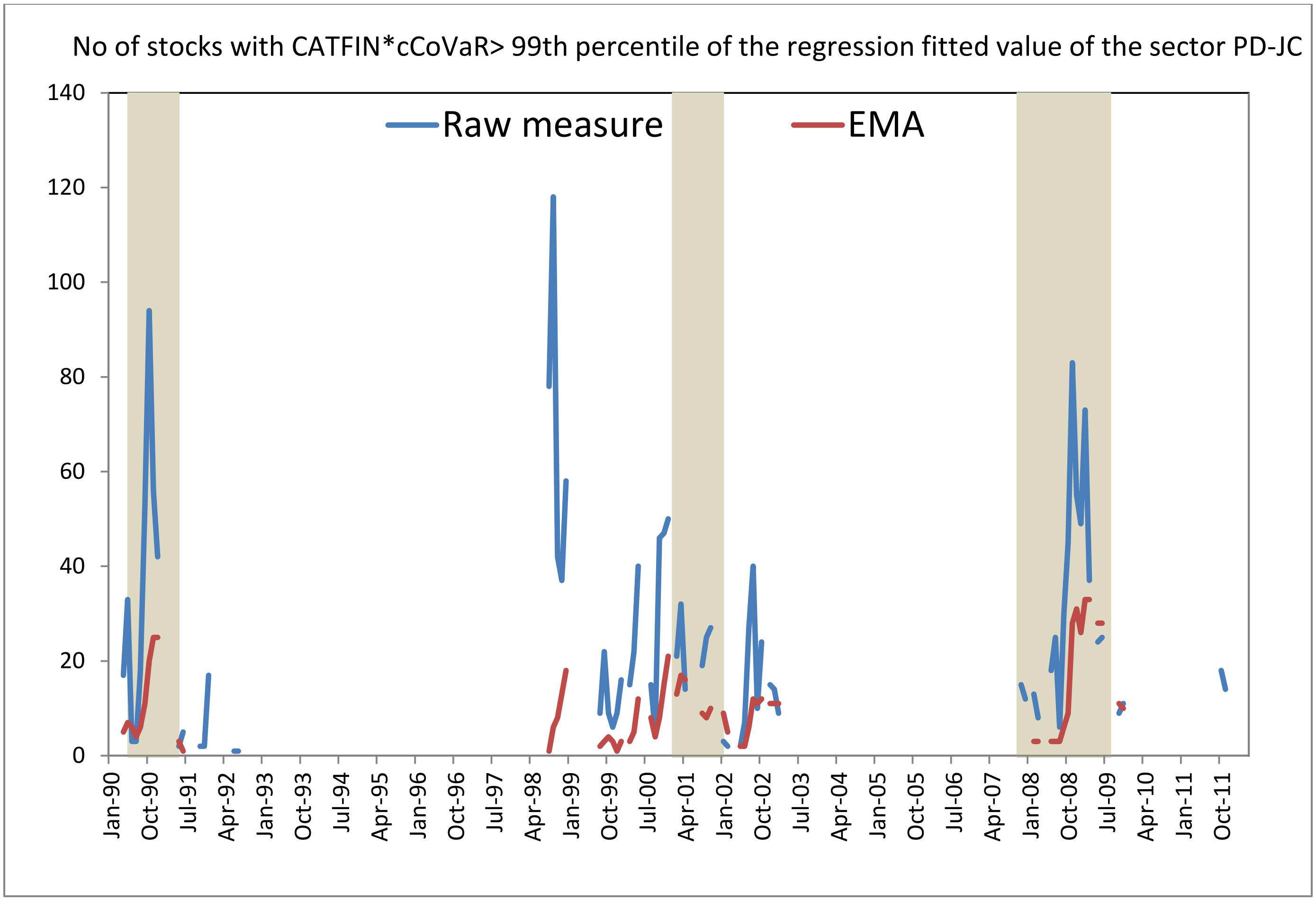

Figure 5, Panel A: Systemic Coco Trigger Using the 97th Percentile

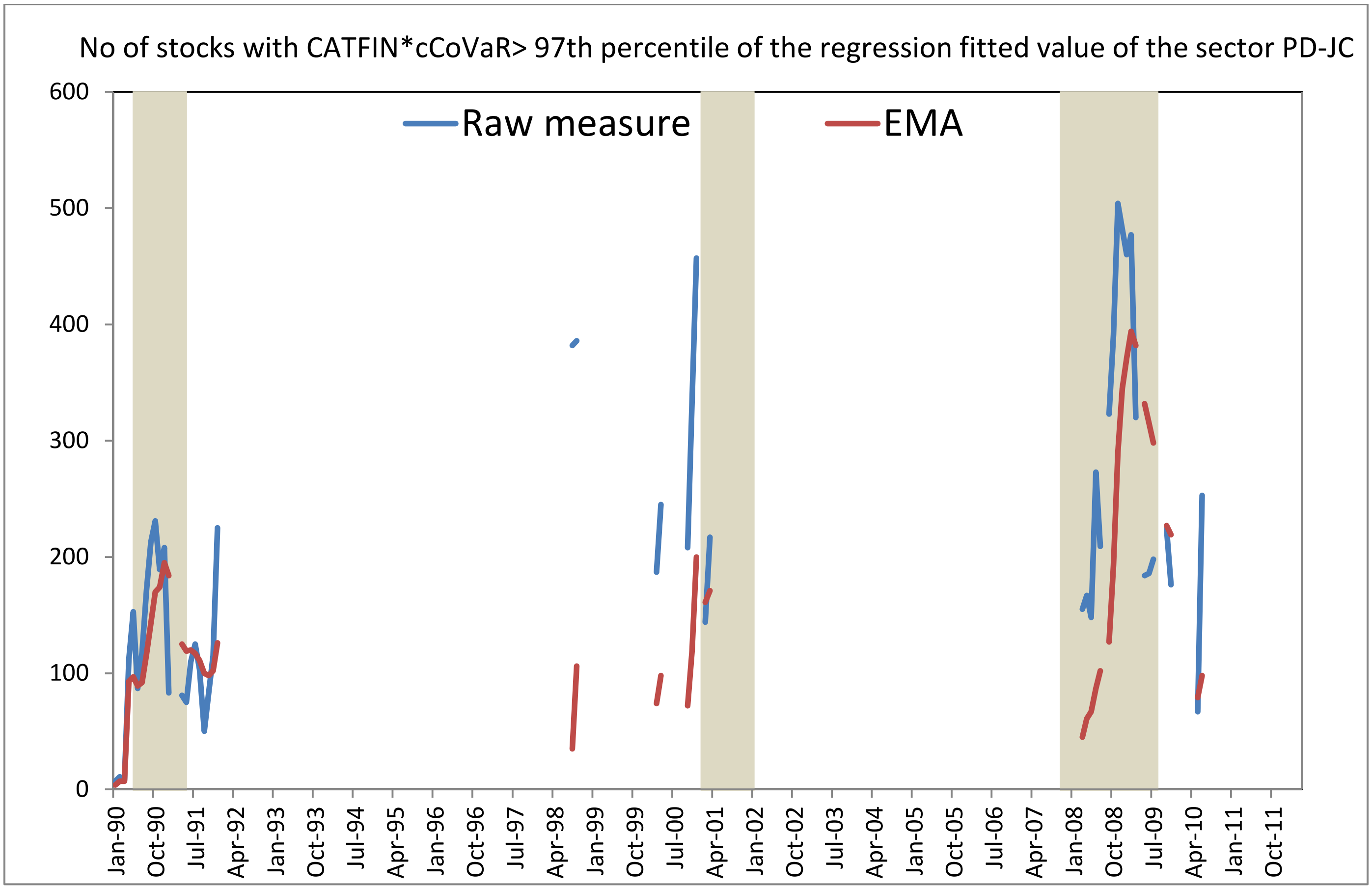

Figure 5, Panel B: Systemic Coco Trigger Using the 95th Percentile

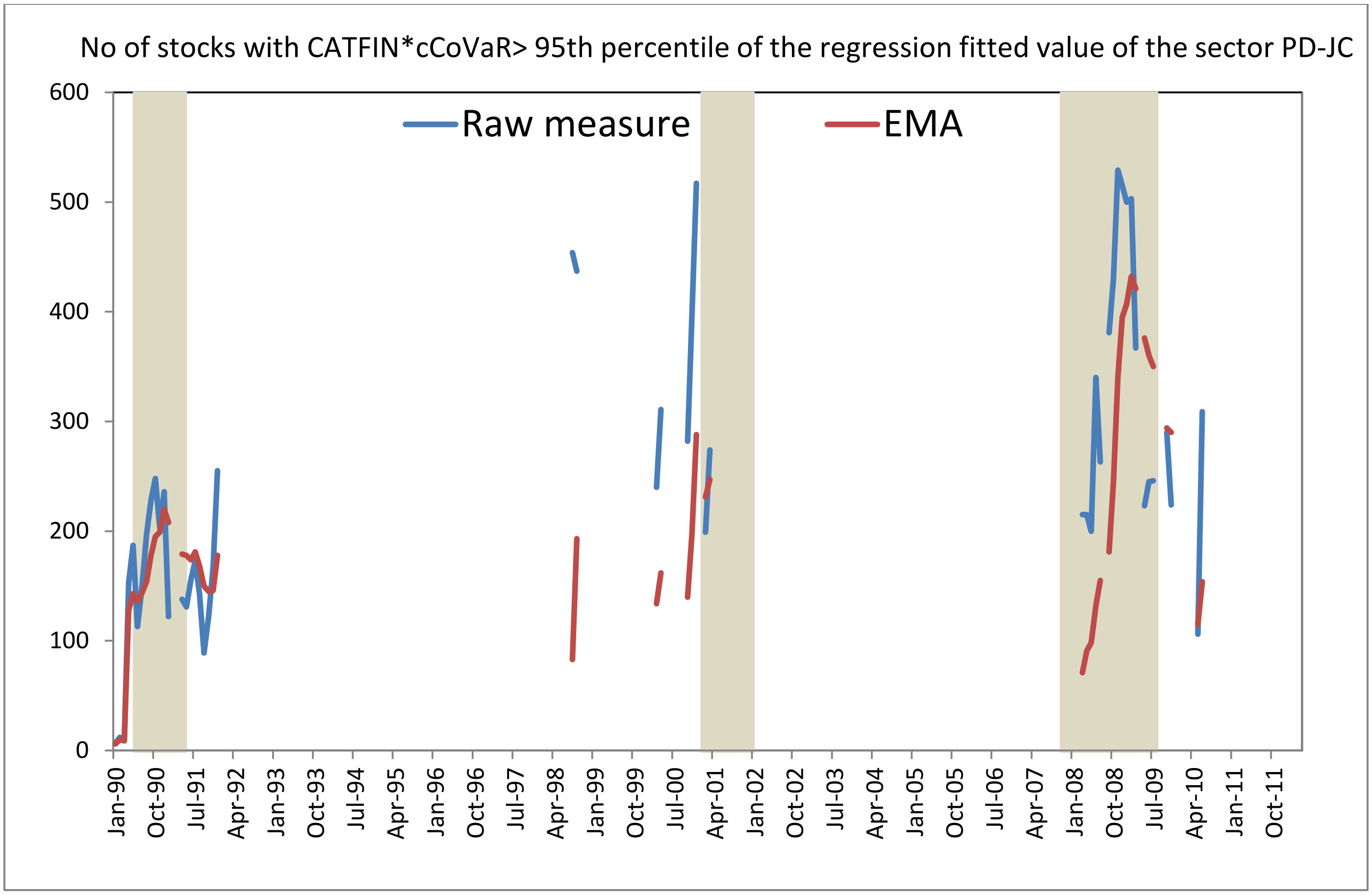

Table 1. Summary statistics of PD of the financial sector, CATFIN, cCoVaR, and the interaction term of CATFIN and cCoVaR

PD denotes the one-year-ahead default probability of the financial sector, defined as the value-weighted default probability across all financial firms estimated from the Chava and Jarrow (2004) model. CATFIN is the aggregate systemic risk measure from Allen, Bali and Tang (2012). cCoVaR is delta CoVar from Adrian and Brunnermeier (2011). The sample period is from January 1990 to April 2012.

Statistics	PD	CATFIN	cCoVaR	CATFIN*cCoVaR
Mean	0.2126	28.1045	5.0741	149.66
Median	0.0924	25.3440	4.8396	125.93
Std dev	0.3710	12.7000	1.0680	100.56
Min	0.0177	9.9534	3.3213	40.63
Max	2.6707	74.3523	11.8302	841.04
Skew	4.2728	1.2087	2.1687	2.95
Kurt	21.5272	1.6105	8.8172	13.64
5th percentile	0.0247	12.7770	3.9123	56.48
95th percentile	0.8240	54.1311	6.8500	313.46

Table 2. Time-series regression of PD of the financial sector on CATFIN and cCoVaR

The dependent variable is PD calculated as the value-weighted one-year-ahead Kamakura PD of all financial firms, where PD is estimated from the Chava and Jarrow (2004) model.

Intercept	CATFIN	cCoVaR	CATFIN*cCoVaR	Adj. R2	No of obs
-0.3357	**0.0195**			44.41%	268
-8.17	*14.64*				
-0.9030		**0.2199**		39.85%	268
-10.56		*13.34*			
-0.8572	**0.0136**	**0.1358**		55.40%	268
-11.62	*9.68*	*8.16*			
-0.2227			**0.0029**	62.03%	268
-8.88			*20.91*		

Table 3: Bank Coco Triggers During 2007-2009

Month Coco First Triggered	Permno	Name
200803	84108	UNITED WESTERN BANCORP INC
200803	83030	WILMINGTON TRUST CORP
200804	39766	FIRST REGIONAL BANCORP
200804	85829	HOPFED BANCORP INC
200804	64995	KEYCORP NEW
200804	10825	SOUTH FINL GROUP INC
200805	24628	COLONIAL BANCGROUP INC
200805	67046	CORUS BANKSHARES INC
200805	85865	COWLITZ BANCORPORATION
200805	35044	REGIONS FINANCIAL CORP NEW
200805	68144	SUNTRUST BANKS INC
200806	10563	HORIZON FINANCIAL CORP WASH
200806	83551	PACIFIC CAPITAL BANCORP NEW
200806	93105	W HOLDING CO INC
200807	35917	FIRST MIDWEST BANCORP DE
200809	85978	FRONTIER FINANCIAL CORP WA
200809	11056	STERLING FINANCIAL CORP WASH
200810	80223	BOSTON PRIVATE FINL HLDGS INC
200810	77898	CASCADE FINANCIAL CORP
200810	25081	COMERICA INC
200810	42906	HUNTINGTON BANCSHARES INC
200810	69032	MORGAN STANLEY DEAN WITTER & CO
200810	75509	SUFFOLK BANCORP

Table 3 Continued:		
200811	36346	1ST SOURCE CORP
200811	85789	BANCORPSOUTH INC
200811	59408	BANK OF AMERICA CORP
200811	84058	BRITTON & KOONTZ CAPITAL CORP
200811	80112	CASCADE BANCORP
200811	70519	CITIGROUP INC
200811	88943	CITIZENS FIRST BANCORP INC
200811	86685	CITIZENS REPUBLIC BANCORP INC
200811	35503	FIRST FINANCIAL HOLDINGS INC
200811	11513	FIRST FINANCIAL SERVICE CORP
200811	86574	FIRST PLACE FINANCIAL CORP NM
200811	84749	FIRST SOUTH BANCORP INC
200811	81298	FIRST WEST VIRGINIA BANCORP INC
200811	75162	FIRSTFED FINANCIAL CORP
200811	84734	FLAGSTAR BANCORP INC
200811	82573	FLUSHING FINANCIAL CORP
200811	88197	FULTON FINANCIAL CORP PA
200811	76684	HANCOCK HOLDING CO
200811	87070	HUDSON CITY BANCORP INC
200811	89237	IRWIN FINANCIAL CORP
200811	47896	JPMORGAN CHASE & CO
200811	77256	MAINSOURCE FINANCIAL GROUP INC
200811	51706	MARSHALL & ILSLEY CORP NEW
200811	89440	NEWBRIDGE BANCORP
200811	78903	PEOPLES BANCORP INC
200811	90983	PEOPLES BANCORP NC INC NEW
200811	87801	PEOPLES COMMUNITY BANCORP INC
200811	69586	SEACOAST BANKING CORP FLA
200811	85714	SECURITY BANK CORP NEW
200811	72726	STATE STREET CORP
200811	83903	SUN BANCORP INC NJ
200811	73809	SUSQUEHANNA BANCSHARES INC PA
200811	85751	TIMBERLAND BANCORP INC
200811	78829	U M B FINANCIAL CORP
200811	79747	UNION BANKSHARES CORP
200811	86199	WASHINGTON BANKING COMPANY
200811	10932	WEBSTER FINL CORP WATERBURY CONN
200811	76331	WEST COAST BANCORP ORE NEW
200812	79796	ASTORIA FINANCIAL CORP
200812	82251	AUBURN NATIONAL BANCORP
200812	85198	BANK OF THE OZARKS INC
200812	82575	BANNER CORP
200812	86253	C F S BANCORP INC
200812	84516	CAPITAL CITY BANK GROUP
200812	76037	CAPITOL BANCORP LTD
200812	86157	COBIZ FINANCIAL INC
200812	85728	EASTERN VIRGINIA BANKSHARES INC
200812	10913	FARMERS CAPITAL BANK CORP
200812	87488	FAUQUIER BANKSHARES INC
200812	11018	FIRST BANCORP P R
200812	79382	FIRST DEFIANCE FINANCIAL CORP
200812	58246	NORTHERN TRUST CORP
200812	78195	P V F CAPITAL CORP
200812	83414	SANDY SPRING BANCORP INC
200812	85798	SUSSEX BANCORP
200812	20053	SYNOVUS FINANCIAL CORP
200812	79116	TRICO BANCSHARES
200812	86437	U C B H HOLDINGS INC
200812	81577	WASHINGTON FEDERAL INC
200812	38703	WELLS FARGO & CO NEW

Table 3 Continued:		
200901	80498	AMERIS BANCORP
200901	86250	CARDINAL FINANCIAL CORP
200901	80517	CARROLLTON BANCORP
200901	87067	FIRST BANCORP INC ME
200901	77889	FIRST UNITED CORP
200901	79851	OLD SECOND BANCORP INC
200901	80808	PENNSYLVANIA COMMERCE BANCORP IN
200901	86287	REPUBLIC BANCORP INC KY
200901	11397	WASHINGTON TRUST BANCORP INC
200902	86384	C N B FINANCIAL CORP PA
200902	11992	CHEMICAL FINANCIAL CORP
200902	23916	CITY NATIONAL CORP
200902	83641	COMMERCIAL NATIONAL FINL CORP
200902	86896	COMMUNITY BANK SYSTEM INC
200902	10777	FIRST CITIZENS BANCSHARES INC NC
200902	86868	GOLDMAN SACHS GROUP INC
200902	85875	INTERNATIONAL BANCSHARES CORP
200902	80336	LANDMARK BANCORP INC
200902	79859	NEW YORK COMMUNITY BANCORP INC
200902	83774	OCEANFIRST FINANCIAL CORP
200902	60442	P N C FINANCIAL SERVICES GRP INC
200902	88343	PACWEST BANCORP DE
200902	84389	S C B T FINANCIAL CORP
200902	77519	TRUSTCO BANK CORP NY
200902	77053	WHITNEY HOLDING CORP
200902	86793	YADKIN VALLEY FINANCIAL CORP
200903	35554	M & T BANK CORP

Table 4: Non-Bank Cocos Triggered During 2007-2009

Month Coco First Triggered	Permno	Name	Designation
200711	68304	BEAR STEARNS COMPANIES INC	BrokerDealer
200711	80599	LEHMAN BROTHERS HOLDINGS INC	BrokerDealer
200712	79956	COMMERCE GROUP INC MASS	Insurance
200712	64486	PROTECTIVE LIFE CORP	Insurance
200712	86809	STANCORP FINANCIAL GROUP INC	Insurance
200802	34746	FIFTH THIRD BANCORP	BrokerDealer
200802	69032	MORGAN STANLEY DEAN WITTER & CO	BrokerDealer
200802	77114	WORLD ACCEPTANCE CORP	BrokerDealer
200803	79323	ALLSTATE CORP	Insurance
200806	57904	A F L A C INC	Insurance
200806	23473	CINCINNATI FINANCIAL CORP	Insurance
200806	82775	HARTFORD FINANCIAL SVCS GRP INC	Insurance
200809	15318	ASSOCIATED BANC CORP	BrokerDealer
200809	85840	P M A CAPITAL CORP	Insurance
200809	89258	PRUDENTIAL FINANCIAL INC	Insurance
200809	66325	S L M CORP	BrokerDealer
200809	85931	WADDELL & REED FINANCIAL INC	BrokerDealer
200810	90880	AMERIPRISE FINANCIAL INC	BrokerDealer
200810	16030	AVATAR HOLDINGS INC	BrokerDealer
200810	92090	BLACKROCK KELSO CAPITAL CORP	BrokerDealer
200810	64186	C I G N A CORP	Insurance
200810	91688	EMPLOYERS HOLDINGS INC	Insurance
200810	77120	HORACE MANN EDUCATORS CORP NEW	Insurance
200810	88313	JANUS CAP GROUP INC	BrokerDealer
200810	49015	LINCOLN NATIONAL CORP IN	Insurance
200810	79210	REINSURANCE GROUP OF AMERICA INC	Insurance
200810	79740	TRIAD GUARANTY INC	Insurance
200810	71175	UNUM GROUP	Insurance
200811	92284	ADVANTA CORP	BrokerDealer
200811	85593	AFFILIATED MANAGERS GROUP INC	BrokerDealer
200811	71271	ALLEGHANY CORP DE	Insurance
200811	85271	AMERICAN CAPITAL LTD	BrokerDealer
200811	59176	AMERICAN EXPRESS CO	BrokerDealer
200811	60687	AMERICAN FINANCIAL GROUP INC NEW	Insurance
200811	13507	AMERICAN NATIONAL INS CO	Insurance
200811	90038	ASSURANT INC	Insurance
200811	25487	AVIS BUDGET GROUP INC	BrokerDealer
200811	89463	C I T GROUP INC NEW	BrokerDealer
200811	47626	C N A FINANCIAL CORP	Insurance
200811	25129	COMMERCE BANCSHARES INC	BrokerDealer
200811	92121	DISCOVER FINANCIAL SERVICES	BrokerDealer
200811	31500	EATON VANCE CORP	BrokerDealer
200811	31974	FOREST CITY ENTERPRISES INC	BrokerDealer
200811	65584	FOREST CITY ENTERPRISES INC	BrokerDealer
200811	90162	GENWORTH FINANCIAL INC	Insurance
200811	91692	H F F INC	BrokerDealer
200811	82292	HANOVER INSURANCE GROUP INC	Insurance
200811	76697	HEALTH NET INC	Insurance
200811	85246	JONES LANG LASALLE INC	BrokerDealer
200811	65330	LEGG MASON INC	BrokerDealer
200811	76804	M G I C INVESTMENT CORP WIS	Insurance
200811	87842	METLIFE INC	Insurance
200811	89781	MOLINA HEALTHCARE INC	Insurance
200811	57446	N Y M A G I C INC	Insurance
200811	59396	OLD REPUBLIC INTERNATIONAL CORP	Insurance
200811	81530	P M I GROUP INC	Insurance
200811	16505	POPULAR INC	BrokerDealer
200811	63977	PRESIDENTIAL LIFE CORP	Insurance
200811	89195	PRINCIPAL FINANCIAL GROUP INC	Insurance
200811	78038	RADIAN GROUP INC	Insurance
200811	69649	RAYMOND JAMES FINANCIAL INC	BrokerDealer
200811	68292	SELECTIVE INSURANCE GROUP INC	Insurance
200811	10138	T ROWE PRICE GROUP INC	BrokerDealer
200811	62308	TORCHMARK CORP	Insurance
200811	88746	UTEK CORP	BrokerDealer
200811	85763	W P CAREY & CO LLC	BrokerDealer
200812	77576	ADVANTA CORP	BrokerDealer
200812	46392	INVESTMENT TECHNOLOGY GP INC NEW	BrokerDealer
200812	52919	MERRILL LYNCH & CO INC	BrokerDealer
200812	88820	PEAPACK GLADSTONE FINANCIAL CORP	BrokerDealer

Table 4 Continued:			
200902	75858	AMERICREDIT CORP	BrokerDealer
200902	63467	BROWN & BROWN INC	Insurance
200902	76099	DELPHI FINANCIAL GROUP INC	Insurance
200902	31238	E M C INSURANCE GROUP INC	Insurance
200902	83720	F B L FINANCIAL GROUP INC	Insurance
200902	80168	FEDERAL AGRICULTURAL MORT CORP	BrokerDealer
200902	37584	FRANKLIN RESOURCES INC	BrokerDealer
200902	90536	G F I GROUP INC	BrokerDealer
200902	78033	H C C INSURANCE HOLDINGS INC	Insurance
200902	92043	INTERACTIVE BROKERS GROUP INC	BrokerDealer
200902	89008	PHOENIX COS INC	Insurance
200902	68196	S E I INVESTMENTS COMPANY	BrokerDealer
200902	72996	STIFEL FINANCIAL CORP	BrokerDealer
200903	82571	FIRSTCITY FINANCIAL CORP	BrokerDealer
200903	91113	HEALTHSPRING INC	Insurance
200903	76722	STATE AUTO FINANCIAL CORP	Insurance
200903	84073	ZENITH NATIONAL INSURANCE CORP	Insurance
200905	90916	BLUEGREEN CORP	BrokerDealer
200910	89841	CONSECO INC	Insurance

Table 5: Capital at Triggering and Non-Triggering Financial Firms: 1990-2012

	No. distinct firm triggers	No. non-triggering firms	% of triggering firms	% of triggering capital over total		Coco Conversion ($m): BV			Coco Conversion ($m): MV		
Year	Using EMA 99% cutoff	at any time within year	out of total ea. Yr.	Book Value	Market Value	5%	9%	19%	5%	9%	19%
1990	37	409	8.30%	27.59%	29.54%	4,250.1	7,650.1	16,150.2	4,802.9	8,645.2	18,251.0
1991	25	454	5.22%	20.66%	20.07%	3,513.5	6,324.3	13,351.2	4,681.7	8,427.1	17,790.4
1998	4	1,004	0.40%	0.50%	0.40%	231.1	416.0	878.3	428.6	771.5	1,628.8
1999	2	924	0.22%	0.03%	0.01%	11.7	21.0	44.4	11.8	21.3	45.0
2000	10	997	0.99%	3.25%	2.73%	1,764.8	3,176.6	6,706.1	3,702.7	6,664.9	14,070.3
2001	7	936	0.74%	2.57%	1.80%	1,396.5	2,513.8	5,306.9	2,154.7	3,878.4	8,187.7
2007	1	795	0.13%	1.06%	1.20%	1,069.8	1,925.6	4,065.1	1,740.4	3,132.7	6,613.4
2008	147	638	18.73%	48.98%	43.71%	34,868.9	62,763.9	132,501.6	31,892.0	57,405.5	121,189.5
2009	176	577	23.37%	51.08%	54.47%	48,924.5	88,064.0	185,912.9	49,891.0	89,803.8	189,585.8
2010	6	706	0.84%	1.89%	1.60%	2,063.1	3,713.7	7,839.9	1,719.7	3,095.5	6,534.9