WORKING PAPER NO. 11-22
THE TRUST PREFERRED CDO MARKET:
FROM START TO (EXPECTED) FINISH

Larry Cordell
Federal Reserve Bank of Philadelphia

Michael Hopkins
Federal Reserve Bank of Philadelphia

Yilin Huang
Federal Reserve Bank of Philadelphia

June 2011

RESEARCH DEPARTMENT, FEDERAL RESERVE BANK OF PHILADELPHIA
Ten Independence Mall, Philadelphia, PA 19106-1574 • www.philadelphiafed.org/research-and-data/

The Trust Preferred CDO Market: From Start to (Expected) Finish

Larry Cordell

Michael Hopkins

Yilin Huang[1]

[1] Cordell is business lead and Hopkins and Huang are senior analysts in the Risk Assessment, Data Analysis, and Research (RADAR) Group of the Federal Reserve Bank of Philadelphia. The views expressed here are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Philadelphia or the Federal Reserve System. This paper is available free of charge at www.philadelphiafed.org/research-and-data/publications/working-papers. For helpful comments we wish to thank Jeremy Brizzi, Meredith Williams, Brian Gordon, Jennifer Dlugosz, and Joshua Siegel; Robert Dittmar for critical help with econometric modeling; members of the Supervision, Regulation and Credit Department at the Federal Reserve Bank of Philadelphia; the Structured Products Group at Moody's; and members of the Financial Sector Analysis and Structured Products groups at the Federal Reserve Bank of New York.

ABSTRACT

This paper investigates the development, issuance, structuring, and expected performance of the trust preferred securities collateralized debt obligation (TruPS CDO) market. Developed as a way to provide capital markets access to smaller banks, thrifts, insurance companies, and real estate investment trusts (REITs) by pooling the issuance of TruPS into marketable CDOs, the market grew to $60 billion of issuance from its inception in 2000 through its abrupt halt in 2007. As evidenced by rating agency downgrades, current performance, and estimates from our own model, TruPS CDOs are likely to perform poorly. Using data and valuation software from the leading provider of such information, we estimate that large numbers of the subordinated bonds and some senior bonds will be either fully or partially written down, even if no further defaults occur going forward. The primary reason for these losses is that the underlying collateral of TruPS CDOs is small, unrated banks whose primary asset is commercial real estate (CRE). During their years of greatest issuance from 2003 to 2007, the booming real estate market and record low number of bank failures masked the underlying risks that are now manifest. Another reason for the poor performance of bank TruPS CDOs is that smaller banks became a primary investor in the mezzanine tranches of bank TruPS CDOs, something that is also complicating regulators' resolutions of failed banks. To understand how this came about, we explore in detail the symbiotic relationship between dealers and rating agencies and how they modeled and sold TruPS CDOs. In our concluding comments, we provide several lessons learned for policymakers, regulators, and market participants.

The Trust Preferred CDO Market:
From Start to (Expected) Finish

I. Introduction

The recent financial crisis has led to monumental changes in everything from securities markets, to regulations, to accounting policy. Researchers have only just begun to investigate the determinants of the crisis and to propose appropriate policy responses. This paper investigates the development, issuance, structuring, and expected performance of the trust preferred securities collateralized debt obligation (TruPS CDO) market, as well as offering policy recommendations. While only a niche part of the structured finance CDO market at $60 billion of issuance, Fitch, the rating agency that rated all but one TruPS CDO, reports that over 1,800 banks have placed TruPS into TruPS CDOs. Experts have estimated that banks have purchased some $12 billion of TruPS CDOs, mostly in mezzanine classes of the CDOs, which means that banks became a primary investor in the debt of the banking industry.[2] Banking experts estimate that successfully resolving TruPS claims at failed banks could save taxpayers billions of dollars as well as substantially improve the valuations of existing TruPS CDOs.[3] This in-depth study of the TruPS CDO market provides important insights into how markets respond to regulations; how dealers and rating agencies interact to develop models; how ratings are developed and adjusted over time; and how accounting rules were changed to value untraded securities in response to the illiquidity of structured products during the crisis. This study is also one of the very first of its kind to conduct empirical analysis with Intex©, the primary source of data and valuation software for ABS/MBS markets.

This paper is organized as follows. In Section II, we examine the background and development of TruPS and the TruPS CDO market. Then we conduct a review of the literature, most importantly the development of rating agency models from published research reports from investment banks and Moody's, press releases, and discussions with analysts central to the development of the TruPS CDO market. Of particular importance is the symbiotic relationship between rating agencies and investment banks in the development of the research on TruPS CDOs that contributed to the development of rating agency models. In Section III, we examine the specifics of the TruPS CDO structure needed to generate our loss estimates and securities prices. In Section IV, we discuss our source data from Intex, the FDIC, and rating agencies. Our summary statistics include analysis of the TruPS CDO market by vintage, comparisons across subgroups, original and current rating agency ratings, and comparison of bank failure rates in TruPS CDOs against the broader market. In Section V, we describe our stylized benchmarking model used to estimate losses and securities prices. In Section VI, we present our results, where we describe several things. First, we validate our loss estimates out of sample and against

[2] See "Toxic CDOs Beset FDIC As Banks Fail," *Wall Street Journal,* May 18, 2010.
[3] See "Fewer Bank Failures? Chapter 11 Sale Offers a New Way," *Wall Street Journal,* January 6, 2011.

Moody's internal models. Second, we summarize our cumulative loss estimates for 785 active TruPS CDO securities, the preponderance of all securities in the market. Third, we estimate securities prices using 2009 Financial Accounting Standards Board (FASB) guidance to reflect losses for non-traded debt securities. Even if no further deferrals or defaults occur with TruPS, we estimate that substantial numbers of the subordinated bonds will be either fully or partially written down. In Section VII, we draw our conclusions and lessons learned.

II. Background on TruPS and TruPS CDOs and Review of the Literature

a. Background on TruPS and TruPS CDOs

The trust preferred securities (TruPS) market begins with the decision by the Federal Reserve System to approve for bank holding companies (BHCs) the use of up to 25% of TruPS for Tier 1 capital for regulatory accounting purposes, the very highest form of capital allowed for banks.[4] For banks and thrifts, TruPS are issued out of a special-purpose subsidiary that is wholly owned by the parent company (see left panel of Figure 1). To be eligible as Tier 1 capital, TruPS must provide for a minimum five-year consecutive deferral period on distributions to shareholders. In addition, the intercompany loan would need to be subordinated to all other forms of debt (i.e., just above preferred shares in the capital structure) and "have the longest feasible maturity,"[5] which in practice came to mean a non-amortizing 30-year term. TruPS also generally have call provisions giving issuers the option to pay off, typically set at 5 to 10 years, and thereafter.

The reason TruPS at insured depositories are held only at the BHC level is that the Federal Deposit Insurance Corporation (FDIC) opposed the Fed's decision to allow banks to count TruPS as Tier 1 capital for regulatory accounting purposes. This has resulted in TruPS being issued at the holding company level, which is regulated by the Federal Reserve, and not at the bank level, where the FDIC has its insurance. The FDIC had at least three major objections. First, TruPS are perpetual and have cumulative dividend structures and thus are more appropriately classified as debt, even though their deferral period can last as long as five years. Second, the FDIC argued that TruPS are treated as debt by rating agencies and under generally accepted accounting principles (GAAP)) starting in 2004 after issuance of FIN 46R.[6] Finally, their presence in the BHC puts stress on bank subsidiaries to upstream dividends to the BHC to service trust preferred investors. Partly in response to these concerns, the Federal Reserve would later exclude goodwill and tax-deferred assets as qualifying assets to count toward the 25% ratio. They also limited TruPS to a 15% maximum for "internationally active BHCs," which, critically

[4] See Federal Reserve press release, October 21, 1996.
[5] Ibid, p. 1.
[6] Under FIN 46R "[TruPS] may no longer be treated as minority interest in the equity accounts of a consolidated subsidiary on a BHC's consolidated balance sheet." See Federal Reserve System, Final Rule, "Risk-Based Capital Standards: Trust Preferred Securities and the Definition of Capital" (12 CFR Parts 208 and 225), p. 4.

for the TruPS CDO market, meant this limitation applied only to the very largest BHCs that could issue TruPS in public debt markets.[7]

A major benefit of TruPS that proved crucial for their growth is that, for tax purposes, their dividends are a tax-deductible interest expense, unlike dividends paid on directly issued preferred stock, and did not dilute existing shareholder value. By the first quarter of 2010, $150 billion of TruPS were on BHC balance sheets.

The growth of the TruPS market presented a special dilemma for banks that were both too small and unrated or not highly rated enough to access public debt or private placement markets. This problem was addressed in 2000 when a capital markets team at Salomon Smith Barney came up with the idea of pooling TruPS into CDOs. As depicted in the right panel of Figure 1, TruPS were pooled as assets into TruPS CDOs with a senior/subordinated liability structure with tranches, or slices, of equity and fixed income securities with ratings ranging from BB to AAA for the fixed-income securities. The first TruPS CDO was issued on March 31, 2000 and was underwritten and managed by Salomon Smith Barney.[8]

The introduction of TruPS CDOs "helped the market explode."[9] As shown in Table 1, between 2000 and 2007, TruPS CDO issuance reached $58.9 billion, with 108 separate deals comprising collateral mainly across banks, thrifts, insurance companies, and REITs.[10] These deals were issued under SEC 144A rules,[11] a status that allowed TruPS CDOs to be unregistered and gave CDO issuers and trustees the right to provide very limited disclosure.

One of the most important decisions made by dealers was to withhold the names of issuers of the underlying TruPS. According to one issuer, the nondisclosure practice evolved because dealers wanted to keep their customer base confidential, despite exhortations from rating agencies to disclose names. Critically, the limited disclosure, relatively small issuance volumes, and concentration in single industries helped ensure a concentrated base of dealers and collateral managers and, ultimately, a limited base of investors too. For the bank TruPS CDOs, this meant that banks became the primary investors in securities from the banking industry. As shown in Table 2, the top five dealers issued over 80% of TruPS CDOs. Some of these dealers also serve as collateral managers and consult with banks on valuations. While we do not have figures on

[7] Ibid.
[8] See Moody's (2004), p. 1.
[9] Onaran and Shenn (2010).
[10] The exact figure for total public deals is 109 TruPS CDOs. In our analysis we exclude one security, Non-Profit Preferred Funding Trust, because it was a "non-profit" deal made up mainly of municipal bond debt. For the record, the total TruPS CDO market comprised 109 deals, 821 individual bonds and notes for total issuance of $60.1 billion. Moody's (2010a) reports 113 total TruPS CDOs, which means that there are at least four pure private placements.
[11] Rule 144A of the Securities Act of 1933 allows private companies to sell unregistered securities (the Rule 144 securities) to qualified institutional buyers (QIB) through a broker-dealer. The rule also permits QIBs to trade these securities among themselves. To be a QIB, the institution must control a securities portfolio of $100 million or more.

who invested in TruPS CDOs, one estimate from Red Pines Advisors LLC, a consultancy that values illiquid assets, put the figure of bank purchases of TruPS CDOs at $12 billion. If this figure is correct and if it is also true that, as quoted below, banks mainly purchased the mezzanine tranches of these securities, this means that banks were a primary investor, if not the primary investor, in TruPS CDO mezzanine bonds.

What was also not known by investors until after banks started failing was that the same banks were issued into many CDOs. Fitch developed a practice of reporting names of defaulted banks in monthly research reports, but only after banks filed for bankruptcy or had been taken over by regulators. One example: Fitch (2010b) reports that Indy Mac, the second largest thrift failure, appears in 28 separate TruPS CDOs, more than a quarter of all TruPS CDOs issued! On average, failed banks and thrifts were included in 4.2 separate TruPS CDOs.

These interlocking relationships combined with limited disclosure proved advantageous to dealers and deal managers, but they raise issues about risk management practices at banks. The second largest dealer, Merrill Lynch, responsible for some of the most important research on TruPS CDOs, described the relationships this way:

> Early TruPS transactions were 'blind pools', where investors did not have access to collateral specifics. Although most TruPS CDO trustee reporting does not include specifics on the collateral, it is common for originators to provide collateral information and analysis to investors in their deals.[12]

In essence, early TruPS CDO investors were relying largely on rating agency ratings and surveillance from the dealers responsible for issuing TruPS CDOs. More recently, this lack of disclosure has been the subject of lawsuits against dealers and rating agencies.[13]

A review of the literature for this paper shows that, until the market experienced substantial stress, analysis of TruPS CDOs was almost exclusively done by analysts with a direct economic interest in the deals: dealers, rating agencies, collateral managers, and consulting firms for banks. This dominance of the analysis and control of information was recognized early on as an important contributor to the investor base of TruPS CDOs being concentrated within the issuing industries. Merrill Lynch (2004) described the primary reason for the very large spreads on AAA-rated bonds of TruPS CDOs relative to other sectors this way:

> Few investors are familiar with this collateral relative to most CDO subsectors as it was not possible to invest in the debt of mid-market banks and insurers prior to 2000. In fact, other banks and insurers were, not surprisingly, the first investors across the capital structure of TruPS.[14]

[12] See Merrill Lynch (2004), p. 10.
[13] See "Toxic CDOs Beset FDIC As Banks Fail," *Wall Street Journal,* May 18, 2010.
[14] Merrill Lynch (2004). Merrill cites three other reasons for the large spreads, but all are dismissed as overblown.

Merrill (2004) did identify the central risks of TruPS CDOs, namely, that they were investments in deeply subordinated debt of unrated banks whose principal investment was CRE. As they state, "One can view investing in TruPS as an indirect investment in CRE." Later they state, "Most TruPS issuers that pool securities into CDOs are small and unrated." [15]

The success of TruPS CDO issuance was undoubtedly influenced by existing market conditions, characterized by a booming real estate market and record low bank failures. In 2004, CRE was exhibiting superior performance at the height of the real estate boom, as were banks investing in CRE. As shown in Figure 2, bank and thrift failures or assists dropped off dramatically after 2002, when there were 11. From 2003 to 2007 bank failures/assists totaled 10, the lowest five-year total on record in the history of the FDIC. The only two-year period of no bank failures since 1934 was 2005-06, the period of the largest TruPS CDO issuance.

Missing from these research reports is a critical assessment of rating agency models, particularly around asset correlations and diversification benefits, which, as experience would show, were made much worse by banks issuing TruPS into multiple deals and banks being the primary investors in bank TruPS CDOs. It was only after the TruPS CDO market came under stress that analysts critically examined these inherent risks:

> Too many banks ended up buying the mezzanine tranches of the CDOs, which went bust faster than the highest-rated ones, according to Siegel, who left Citigroup to co-found New York-based Stone Castle Partners LLC, which manages about $3.1 billion, including TruPS CDOs. He said he didn't realize that was happening as the market grew and was "shocked" at disclosures about what banks had bought.
>
> "Smaller banks should not have been buying any kind of structured paper" except for simple government-guaranteed mortgage securities, Siegel said. "Unfortunately, too much of this paper has landed back at banks, which really wasn't what should have happened."

As the quote from Merrill (2004) above confirms, concentrated bank holdings of TruPS CDOs were publicly disclosed as early as 2004, yet rating agencies made few, if any, adjustments for this fact nor did we find evidence that issuers or other analysts expressed any concerns until after the TruPS CDO market came undone.

What the financial crisis did to end the TruPS CDO market, the U.S. Congress did to end issuance of future TruPS as equity capital for regulatory accounting purposes, although virtually all *existing* bank TruPS in TruPS CDOs are exempt from restrictions. The Collins Amendment to the Dodd-Frank Wall Street Reform and Consumer Protection Act (DFA) eliminated trust preferred securities issued after May 19, 2010 as an element of Tier 1 capital for all insured

[15] Ibid, pp. 22, 25.

depositories. For trust preferred securities issued before May 19, 2010, there will be a phase-in of exclusions in the Tier 1 capital incrementally from January 1, 2013 to January 1, 2016 for large BHCs (defined as more than $15 billion in assets as of December 31, 2009), whereas for medium-sized BHCs (less than $15 billion but more than $500 million in assets as of December 31, 2009), the inclusion in Tier 1 capital is grandfathered. Small BHCs with $500 million in assets or less, however, are exempt from exclusions of trust preferred securities as Tier 1 capital, as well as from risk-based capital and leverage capital requirements in the act and in the amendment.[16] Thus, because most banks issuing TruPS in TruPS CDOs are under $15 billion, the old regulatory accounting rules still apply.

b. Review of the Literature

A review of the literature begins by reviewing the symbiotic relationship between rating agencies research and that conducted by investment banks. Rating agencies' research is especially important, not only because their ratings were a critical element in making TruPS CDOs marketable, but because the three major rating agencies were the only entities that knew the issuers of TruPS assets in all TruPS CDOs. The three major rating agencies collectively rated all 108 TruPS CDOs. For the 681 bonds in the 108 CDOs, Fitch rated 678, all but three and all but one deal, Moody's rated 511 (75%) and S&P rated 362 (53%). We will explore these ratings in more detail below.

The rating agencies developed models independently, but their models had many similarities and were driven by at least three key inputs: recoveries; internally generated default models of the industries represented in the TruPS CDO (mostly banking, insurance, and REITs); and correlation coefficients across industries and within and across regions represented by groups of U.S. states. The correlation assumptions were most important for the initial rationale for single industry TruPS CDOs, even if later they were not central to downgrade decisions. As Moody's (2004, p. 1) put it, "The assumptions regarding pool diversity are particularly important because Trust Security CDOs are effectively single industry transactions." Overall, the rating agencies took similar approaches to rating TruPS CDOs and, when the market turned, also downgraded in similar ways and at similar times. To gain an understanding of how these models evolved, we will focus on Moody's research related to rating bank TruPS CDOs because they provided the most detailed descriptions of their ratings methodology, and model revisions.

The central challenge in rating bank TruPS CDOs was, as Moody's (2004, p. 3) put it, that "financial institutions that issue Trust Securities in a CDO typically have not accessed the capital markets and do not have a credit rating." For any TruPS CDO pool, the standard approach of Moody's was to assign a weighted average rating factor (WARF), which is effectively a 10-year pool-wide cumulative default probability from Moody's "Idealized Default Rate Table,"[17] and then extrapolate out 30 years to match the maturity of the TruPS. Because most banks did not

[16] See Davis Polk, pp. 47, 48, and 49.
[17] See Moody's 2010 (a), p. 4.

have ratings, Moody's approach from 2000 to 2007 was to assign, with certain restrictions on the banks, a WARF of 480, which corresponded to a Baa3 (or BBB) rating, consistent, they argued, with FDIC default data.[18] This rating was further augmented with additional restrictions from internal models.[19] Thus, on the unrated banks in a TruPS CDO, this 480 translated into a 10-year cumulative default rate of 4.8% (=480/10,000). Since the TruPS themselves were 30-year securities, Moody's Default Rate Tables extrapolated out 30 years. A TruPS CDO of 480 yielded for 30 years, by their calculations, a cumulative default rate of around 17.5%.[20]

Assignment of correlation assumptions were particularly difficult for TruPS CDOs because, as Moody's (2004, p. 5) put it, "CDOs of Trust Securities have broken new ground by being the first single-industry transactions." Moody's addressed this in two ways. First, it limited any TruPS from an unrated bank to 3% of the total pool balance, meaning that a TruPS CDO made up entirely of securities from unrated banks had to have at least 33 securities. (Rated credits were assigned a 5% limit.) Second, Moody's derived its correlation assumptions off its "alternative Diversity Score methodology," which assigns U.S. banks to one of five regions.[21] Each region is considered a separate *industry* for purposes of calculating of its diversity score. Based on its methodology, Moody's assumes default correlations of 20% within a region and zero correlation across different regions. [22]

The genesis of much of the underlying assumptions about choice of states included in bank regions and asset correlations came from research at Salomon Smith Barney (SSB) conducted in the late 1990s and published between 2000 and 2002. (See Salomon Smith Barney 2001, 2002.) It was SSB that came up with the concept of dividing banks into five distinct regions and considering them as uncorrelated separate industries for modeling purposes. Moody's five regions were divided up exactly the same as SSB's, save for one small state (Arkansas); SSB also adopted the zero interregional correlation assumption in its models. Fitch rated the first TruPS CDO and worked closely with SSB on this deal. While Fitch used six regions instead of five, it adopted zero intra- and inter-region correlation assumptions. In its influential 2001 paper, SSB took credit for the first TruPS CDO.[23]

[18] Restrictions include a $100 million minimum asset size, five years of operating history, and no regulatory actions against them.

[19] Additional weights were placed for "barreling" or mixing concentrations of very strong and very risky banks. See Moody's (2010a, pp. 3-4).

[20] See Moody's (2004, p. 3f). Moody's was kind enough to provide us with its ratings matrix, which summarizes its cumulative default rates out as long as 30 years.

[21] See Moody's (2004, p. 6) for a list of U.S. states within the five regions.

[22] See Moody's (2004), p. 6. The inclusion of thrifts in bank TruPS CDOs "tend[s] to provide less diversity benefit as would the inclusion of additional banks." Later revisions to their modeling treated them the same.

[23] As stated in Salomon Smith Barney (2001, p.1), "The conclusions herein served as a basis for the Regional Diversified Funding Ltd, (March 2000) the first 30-year Collateralized Debt Obligation transaction utilizing a pool of newly issued 30-year capital securities of mid-size commercial banks as collateral."

It is noteworthy that the theoretical foundations for the zero correlation inter-regional assumption in the SSB work was based on a model by Lucas (1995) developed for letters of credit-backed (LOC) debt that requires default of *both* debt holder and debt obligor, obviously not a condition for bank failures. According to SSB (2001, p. 11), this calculated "binomial event" correlation was 0.0024, while the alternative correlation coefficient for default rates across the five regions was a significantly higher 25%. Their rationale for the zero correlation assumption was stated this way:

> The most important feature [of bank failures] is the fact that while every region had a period of significant default activity, none of the peaks in default activity coincide with one another (SSB (2001), p. 11).

Moody's described its reasoning for the zero inter-regional correlation this way:

> Even though there have been spikes in defaults over the past 30 years, they have not occurred at the same time. Rather, the spikes have tended to occur at different times within the different regions…. It is assumed that banks are highly correlated within a region but are uncorrelated across the five specified regions. We currently assume that the default correlation within a region is 20% (Moody's (2004), p. 6).

It is beyond the scope of this paper to investigate analytically the effects of correlation assumptions on bond structures and pricing; we do not have asset detail on TruPS CDOs to conduct such an analysis in any case. That will have to wait until more information is disclosed. It is noteworthy nonetheless that the empirical justification for treating bank regions as separate industries with a zero inter-regional correlation assumption for TruPS CDOs in SSB 2001, and adopted by rating agencies, was based on a correlation approach developed for an unrelated class of securities.

Where the rating agencies did differ significantly from SSB was in their assumptions on the *level* of lifetime default rates used to calculate expected losses. SSB (2002) argued for use of the 1970-2001 period for calculating bank default rates; over this time period, 30-year default rates were just under 7%. The rating agencies chose to include much longer histories that included the Great Depression. As mentioned, Moody's adoption of a Baa3 implied default rate resulted in a 30-year expected default rate of 17.5%. So whatever the difficulties presented by correlation assumptions, default rates of 17.5% for banks during a period of record low bank failures and record low CRE losses must have seemed more than adequate by rating agencies.

Finally, assumptions on recovery values were complicated by the fact that TruPS were relatively new instruments, starting only in 1996, with no history of defaults. While banks had the option to defer on interest for up to five years, Moody's assumed that deferral of interest on TruPS "was tantamount to default" and assumed that all deferrals would ultimately default.[24] For this reason,

[24] This assumption was retained from Moody's first ratings through today. See Moody's (2010b).

TruPS deferring on non-defaulted institutions are treated the same as TruPS on institutions that have defaulted (i.e., filed for bankruptcy or been seized by regulators) for enhancement level test purposes.

The rating agencies' methodologies remained unchanged through 2007 because, as mentioned previously, bank failures were at all time lows through 2007. As late as March 11, 2008, Moody's had not changed a rating on a single bank TruPS CDO tranche and predicted that "ratings in 2008 should remain stable."[25] This had changed considerably by July 2008, when Moody's placed 182 tranches on 72 TruPS CDOs on review for possible downgrades, almost one-quarter of all TruPS CDO bonds, completing the downgrades of 77 tranches in August.[26] The actions were prompted by enhancement level tests, or "triggers," failing due to a sudden rise in deferrals among banks. When this happened, interest was deferred on the lower-rated tranches, prompting rating downgrades.

The November 12, 2008 Moody's press release proved a watershed event in the TruPS CDO market, as Moody's announced several significant changes to its TruPS CDO ratings methodology (see Moody's (2008d)). Moody's revamped its methodology for calculating the default probabilities on banks by augmenting them with two accounting-based risk ratios. If either of these ratios was above certain thresholds, Moody's assumed that these banks had defaulted with zero recovery; for lesser thresholds, they received a rating factor of 6500, consistent with a Caa2 (or CCC) rating.[27] For banks below the thresholds without public ratings, Moody's capped bank ratings at 360 (consistent with a Baa2 (or BBB-) default probability). Recall that initially, the convention was to assume a Baa3 rating for unrated banks; now Moody's was assuming a Baa2 *maximum*. Based on figures on ratings distributions from a 2009 report, this meant that around 37% of all TruPS were downgraded to Baa2, effectively truncating the grade distribution of commercial banks and thrifts at Baa2. Further, to account for deteriorating market conditions of the banking industry, pool-wide default probabilities were multiplied by 1.25. For asset correlations, Moody's increased the inter-regional correlation to 10% from zero; the intra-regional correlation had been increased to 45% from 20% in 2007. While the correlation assumptions were critical to the creation of a TruPS CDO market, Moody's noted that the changes it made to its correlation assumptions were not central to their downgrade decisions in 2008.

[25] See Moody's (2008a), p. 1. Moody's did, however, place 11 REIT TruPS CDOs on negative watch, primarily because they had been "largely limited to the mortgage REIT and homebuilder areas," which had come under severe stress due to the subprime mortgage crisis.

[26] See Moody's (2008b,c).

[27] See Moody's (2008d). The first ratio is calculated as follows: (non-current loans plus other real estate owned) divided by (tangible common equity plus allowance for loan losses) ("First Ratio"). The second ratio is calculated as follows: (non-current loans plus other real estate owned plus 20% of current construction and development loans) divided by (tangible common equity plus allowance for loan losses) ("Second Ratio"). If the First Ratio is above 150% or the Second Ratio is above 175%, for purposes of these rating actions, Moody's assumed that these banks had defaulted with a zero recovery. If the First Ratio is above 100% or the Second Ratio is above 130%, Moody's assumed that these banks had a WARF of 6500.

With these model adjustments, Moody's downgraded 180 tranches across 44 TruPS CDOs, over 20% of all bonds in the market. As a result of these "dramatic changes to rating agency methodology," Siegel (2009, p. 32) predicted that the "capital markets driven TPS market [was] unlikely to return,"[28] a forecast certain to be true.[29] Fitch and S&P took different approaches in their models, but by the end of 2008, downgrades were similar across all three rating agencies. Ratings downgrades are further analyzed below.

The very significant changes to rating agency models should also be placed in historical context. These ratings revisions were made at the same time as ratings revisions on the structured finance (SF) CDO market were being made, as the rating agencies came under attack for downgrades in the SF CDO market that contributed so significantly to the financial panic of 2007.[30] By the time of the changes to the rating agency models, issuance had completely dried up. After we examine features of TruPS CDO deal structures, we will examine current conditions in the market and then provide our loss estimates.

III. Features of TruPS CDO Deal Structures

Before presenting our model and empirical results, we describe the major features of TruPS CDO deal structures, unique for each deal, that are necessary for estimating losses. To start, the cash "waterfall" of a deal, displayed in the right panel of Figure 1, determines how the principal and interest, the revenue of a deal, are allocated among fixed income and residual claimants, as well as how losses and expenses are allocated. In addition to the waterfall, various other features of deals protect bondholders, particularly the senior bondholders, against unexpectedly high losses. As we will show, these additional features have significant effects on current and expected cash flows and must be accounted for to generate loss estimates and valuations. Some of the features described are standard for the typical senior/subordinated structure of structured finance CDOs, while some are unique to the TruPS CDO structure itself. We will describe only those features of structures that figure most prominently in our valuations.

a. Subordination

Subordination is the central feature of many private-label deals in ABS/MBS markets because it determines how revenues and losses get allocated to fixed and residual security holders, particularly when the deal is performing as expected. Subordination in the TruPS CDO tranche is the total amount of credit support provided by all junior bonds to a given tranche in the same deal and serves to absorb any losses before this subject tranche experiences any losses. The subordination share is therefore the share of the remaining balance of a deal that provides a cushion against losses. The higher the percentage share of subordination, the greater the

[28] In discussions with Joshua Siegel, he stated that these changes by Moody's were the most severe of the three rating agencies.
[29] The last TruPS CDO issued was Preferred Term Securities XXVIII, closed on 11/8/2007.
[30] See Gorton 2008.

protection the bond has against losses. Higher-rated bonds therefore have more subordination, while lower-rated bonds have much less. In Tables 3(a) and 3(b), we summarize the subordination shares and discount margins at issuance across vintages and on a weighted average basis for the 108 TruPS CDOs to gain insights into expected risks, since subordination levels and discount margins reflect investors *ex ante* views on risk. For comparison, we gathered a sample of mortgage-backed cash mezzanine structured finance CDOs (SF CDOs), which we also report in the tables.[31]

A somewhat unique feature for TruPS CDOs, at least relative to other SF CDOs, is the very high levels of subordination and discount margins for the senior-most classes, those originally rated AAA to AA. Subordination levels for the senior AAA bonds averaged 48.03%, although it did trend down some after 2002 as issuance climbed. Table 3(b) shows Senior AAA TruPS CDO floating rate notes have, on average, 10 basis points more in margin than Senior AAA structured finance CDOs, which is quite a substantial spread pick-up for investors, even as it trended down over time. Junior AAA bonds reflect, on average, 15% higher levels of subordination than SF CDOs, with almost identical spreads. This combination of spread and discount margins reflects the perceived riskiness of the TruPS CDO market to AAA investors.

Note that the pattern is quite different for the more junior-rated securities, which were the securities for which, as noted in reports above, the primary investors were the banks, thrifts, and insurance companies issuing TruPS. Lower-rated TruPS CDO tranches enjoy higher subordination levels than their SF CDO counterparts as well, although by lesser amounts. However, TruPS CDO floating rate notes originally rated AA to BB, have lower discount margins than their SF CDO counterparts. This is a pattern you would observe for securities for which risk is viewed as more comparable.[32] One possible explanation for these differences in perceived risks is that banks, thrifts, and insurance companies perceived much lower risk among these securities than did the broader market, which bought the AAA-rated bonds. While it is beyond the scope of this paper to investigate these differences in more detail, we make the point here and will discuss further in our lessons learned.

b. Excess spread

Since bonds are fixed income securities, the first line of protection against losses for the bondholders, and the sole revenue source for the equity tranches, is from the excess spread on the deal. Excess spread for TruPS CDOs is the interest cash-flow from the underlying collateral net of the CDO debt interest expenses and the deal senior administrative expenses, including

[31] Our sample of cash mezzanine CDOs was drawn again from Intex, which has all 144A CDOs. We selected all CDOs that had more than half of their collateral as RMBS. From the 740 SF CDOs, 248 cash mezzanine SF CDO deals with floating rate tranches were chosen, since these are the riskiest deals and most comparable to TruPS CDOs in structure. Aggregate subordination levels and coupon margins by original rating/seniority are weighted averages by original face of the constituent tranches.

[32] The same pattern also exists for coupons on the fixed-rate securities but is not included here because they constitute a small share of securities.

hedging costs. Excess spread provides the first layer of credit protection against the defaults and losses from the CDO collateral. TruPS CDOs often divert a portion of the excess spread to pay down debts even before the violation of any other tests meant to protect bondholders. Usually this amortization, also known as "turbo," occurs in reverse order of seniority to reduce the most costly debt tranches in the deal structure, or pro rata across the CDO debt tranches to maintain the deal leverage mechanism. Since these features are unique for each structure, we will need to account for these in each security when we estimate our losses.

c. Reserve Accounts (RAs)

RAs for the TruPS CDOs can either be set up at the initial deal closing from the proceeds of CDO issuance or built up from the excess spread until the reserve account reaches the target amount, which is usually 0.25 to 0.75% of the original deal balance. Funds in RAs can be drawn to pay senior administrative expenses or senior note interest as required and thus provide additional support to the TruPS CDOs. Any draws made from the account can be replenished from the excess spread if the collateral performance improves and the transaction generates enough cash flow.

d. Hedges/Swaps

Hedges and/or swaps are structured in most TruPS CDO transactions to mitigate the risks of interest rate mismatches between the very long-term 30-year fixed-rate TruPS debts in the collateral and the floating rate TruPS CDO liability. Owing to the growing percentage of deferring/defaulting collateral assets (the fixed-rate TruPS debt collateral, in particular) and the historically low current interest rate environment, some TruPS CDOs have been negatively affected by the large imbalances in the fixed-floating interest rate swaps, which require the deals to make significant payments to the hedge counterparties, even as these same deals are facing dwindling cash flows. Since hedge payments are senior to the interest payments to even the AAA-rated notes and non-payment of interest to the senior notes constitutes an event of default, TruPS CDOs lacking the ability to reduce the swap notional or unwind the hedge are at risk of experiencing cash shortfalls and triggering an event of default to the deals.

e. Overcollateralization (OC) Tests and Interest Coverage (IC) Tests

OC and IC "triggers" are features designed to protect bonds, particularly the more senior bonds, against higher than expected losses. The traditional OC tests operate in the same way in TruPS CDOs as in most deals, but with some twists. If defaults or deferrals rise above preset levels, first excess spread gets diverted, then subordinated bonds stop receiving principal and interest (P&I) payments. When triggers hit on subordinated bonds, they start to "PIK," an acronym that stands for payment in kind, which means that the bonds start diverting P&I payments and start accumulating interest arrears. (This is a result of the TruPS themselves being cumulative debt.) Typically, the mezzanine, or more junior bond, triggers trip first ("sub-tests"). If losses rise, then the senior, or AAA-rated bond, triggers fail ("sr. tests"). For purposes of the OC tests, a deferral

of interest is treated the same as a default, and deferrals are given a significant haircut in calculating OC ratios, with some CDOs giving deferrals of 10% of par as credit and some even zero credit. Interest coverage tests exist in some TruPS CDOs, and with more banks/insurance companies/REITs deferring interest on their TruPS debts, this usually less conservative test is failing at a greater rate and magnitude than the OC tests. The IC test failure affects the CDO waterfall mechanism in the same way as the OC test failure.

As shown in Table 4, only six deals (6% of all deals) pass all triggers. Significantly, all six are pure insurance TruPS CDOs. Another 18 deals (17%) are failing the sub-bond triggers but still passing the senior bond triggers. Over two-thirds (71%) of the deals are failing the senior-most trigger, which means only the senior class of bonds is receiving P&I payments. This level of trigger failure is extraordinary.

f. Event of Default (EOD) Tests

An EOD can occur in TruPS CDOs under certain circumstances, including but not limited to the following provisions: the non-payment of interest to the most senior notes outstanding, the non-payment of principal when due and payable, the failure of an EOD overcollateralization trigger, and the bankruptcy/insolvency/receivership/reorganization of the co-issuers, among others. When an event of default is triggered, the controlling class of the transaction, usually 66 2/3% of the most senior notes outstanding, can instruct the trustee to declare the principal of the notes immediately due and payable, which effectively puts the CDO deal into the acceleration stage. The liquidation of the deal due to an EOD and acceleration, however, is very unlikely at present, given the current status of the banking industry and the illiquidity of the underlying TruPS debt collateral.

While an extraordinary 94% of deals have failed OC and IC tests, only a small share (13%) have failed their EOD triggers. This is undoubtedly because few, if any, TruPS have actually defaulted. This is another unique aspect of TruPS in CDOs. While the banks have failed in many TruPS CDOs, until the holding company is fully liquidated, the TruPS themselves are technically still deferring, at least until the fifth year of deferral. Effectively, they are defaulted, and rating agencies track the defaulted institutions within the TruPS CDOs. But until the fifth year or liquidation of the TruPS themselves, they are still reported as active balances in deal structures. This is another unusual aspect of TruPS CDOs.

g. Auction Calls

TruPS CDOs usually have 30-year final maturities due to the fact that the underlying collateral, the TruPS debts issued by banks, insurance companies, and REITS, have 30-year terms. The rating agencies, however, generally assume a weighted average life of the CDO liabilities to be around 10 years due to the 5-10 call option of TruPS. They do, however, model TruPS CDOs to maturity to estimate the “extension risk” that the TruPS do not in fact prepay. Auction calls are structured in most TruPS CDOs that allow an auction of the collateral assets at some point in the

life of the transaction, usually at 10 years. If proceeds from the collateral auction would generate enough to retire the CDO debts, the auction sale can be consummated. If the expected proceeds are not enough to make the CDO debts whole, the auction will not take place but will be attempted at every following payment period until its success or until the collateral is completely amortized. Owing to the lack of trading and liquidity in the TruPS debt market and legislative changes, the success of auction calls by most TruPS CDOs is growing more remote, which probably indicates that the existing TruPS CDO bonds will experience a much longer expected weighted average life (WAL). We will discuss how we see the TruPS CDO market playing out in our concluding comments.

IV. Data and Summary Statistics

a. Data

Our primary data source is Intex, the source data and structuring software for all 144A structured finance CDOs. While 144A deals are unregistered, issuers provide Intex with the deal prospectuses that allow Intex to properly code in the deal "waterfall" and all other features of the deals discussed in the last section so that analysts can generate cash flows, estimate losses, and price the deals for sale. Intex also provides software to enter in assumptions about expected losses, prepayments, severities, and discount rates to project cash flows, estimate losses, and price the bonds. Intex also makes available to analysts critical information on the deal, including deal and bond balances, bond CUSIPs, rating agency ratings, pool factors, coupons, principal and interest payments to each bond in the deal, and performance information for the underlying collateral. Each reporting period, trustees provide Intex with updated performance information, which it makes available. Intex is therefore the primary source for all information on each deal for all 144A TruPS CDO deals.

Because of the 144A status of TruPS CDOs, however, trustees do not allow Intex to make all information available to analysts as they do with public deals. Most important, analysts not specifically investing in TruPS CDOs generally do not know the issuer of TruPS going into each pool. For performance, analysts observe only the *cumulative* default and deferral balances (and number of defaults/deferrals). Combining of defaults and deferrals in reporting makes estimation of defaults particularly difficult, since we cannot determine which institutions of the TruPS have defaulted and which are deferring. Likewise, cures merely lower the combined default/deferral balance.

To overcome these data limitations, we were able to obtain from FTN (2011), the largest issuer of TruPS CDOs, information on the timing of deferrals, defaults, and cures in each of its deals.[33] As shown in Table 2, FTN issues the preferred term securities shelf, one-third of the current market. From these we were able to track the timing of deferrals, defaults, and cures to calculate

[33] FTN (2011) maintains a website that it makes publicly available to potential investors at http://www.ftnfinancial.com/SitePages/home.aspx; last accessed on September 10, 2010.

our CDRs at the deal and issuer level for forecasting purposes. We use the FTN data to estimate our initial industry conditional default rates (CDRs) for the TruPS CDO market.

Other sources of data are the rating agencies, deal managers, and consultants who service the TruPS CDO market. From these sources, we are able to gather information that feed into our model assumptions on such factors as shares of deferrals that default, severity rates on TruPS defaults, and other data relevant to generating loss projections on existing balances, all of which we detail below.

Finally, we obtained data from bank call reports, SNL Securities, and the FDIC to obtain information on the TruPS and banking markets. These data allow us to compile data on TruPS issuance and compare failure rates between banks in TruPS CDOs and the overall market.

b. Summary Statistics

We begin our review of TruPS CDO performance by examining issuer data through Intex, rating agency ratings, and data from the FDIC. Issuers in this case refer to the legal entity that issues the TruPS CDOs; an issuer is also commonly referred to as a "shelf." As shown in Table 2, the TruPS CDO market is composed of 17 shelves, 108 separate deals totaling $58.9 billion of issuance, and a total of 790 separate securities, 109 equity notes and 681 bonds. Reflecting the fact that very few firms exercised call provisions and very few defaults have been liquidated through the holding companies, the current pool factors on all deals is a comparatively high 80%. As of March 2011, the default/deferral rate for the entire TruPS CDO market stood at 32% (27% as a share of original balance). While there is some variation among sub-groups we will explore below, poor performance exists across almost all the issuers. The analysis that follows will focus primarily on the 107 still-active deals and 787 securities.[34]

The first point of performance evaluation begins with a comparison of the original and current (as of June 2010) rating agency ratings, which is important since the rating agencies are the only entities with complete data on the universe of TruPS CDOs. To be consistent, where ratings differ among the rating agencies, we chose the lowest of the ratings, both at issuance and at June 2010. In Table 5, we show that of the 681 bonds initially rated,[35] only 13 of the bonds (2%) currently retain their initial ratings or have been upgraded. Ninety eight percent of the bonds have been downgraded; of those originally rated investment grade, 87% have been downgraded below investment grade.

One reason for the especially poor performance of the TruPS CDO market is that it coincides with the onset of the real estate and banking crises, with performance not nearly as correlated

[34] One deal composed of three securities from the preferred term securities shelf was called, and its remaining collateral was rolled into another deal (new issuance at time of the call) in the same shelf.

[35] Note that 109 bonds were unrated. These bonds were mainly the residual classes of the deals that are not bonds at all so do not receive ratings.

with seasoning or vintage as it was in the SF CDOs.[36] As shown in Figure 3, the onset of the real estate and financial crises in 2007-08 is when defaults and deferrals rise significantly in most TruPS CDO vintages. Early defaults and deferrals are often characterized by "cures" from deferrals, especially in the 2001 vintage. The current default/deferral rate for remaining vintages ranges from 28% to 42%. The 2002 book is the worst performing book of all, although this is partially explained by adverse selection from payoffs, as nearly 60% of the collateral is paid down. While the 2003 vintage paid down by $1 billion, not many other vintages have appreciable payoffs, and all have default/deferral rates that, if deferrals transition into defaults, will likely require the complete write-down of many of these the bonds.

In searching for potential sources of performance variation with the very limited information we have, the only reliable indicator of performance variation is whether a CDO has insurance industry TruPS. We classify the 107 active TruPS CDOs into five broad industry categories based on information gathered from Intex and various industry sources. As shown in Table 6, by far the best performing group is the pure insurance TruPS group, with a current default/deferral rate of 5%. The next best performing group is REIT TruPS CDOs at 26%, followed by the hybrid bank, thrift, and insurance TruPS CDOs at 33%. The two worst classes are the ones made up predominantly of insured depositories, the bank & thrift (38%) and bank (41%).

We say insurance TruPS concentration *appears* to be the one clear discriminator because, while we know which TruPS CDOs are pure insurance and which have insurance TruPS in them, we don't have figures on shares of insurance TruPS in the hybrid TruPS CDOs, nor do we have shares of any major asset classes in the hybrids. Another important point to make about these classifications is that, since they are CDOs, they frequently contain other types of securities, including sub-debts, surplus loans, middle market securities, commercial mortgage-backed securities (CMBS), CMBS CDOs, and, in one case, a TruPS CDO. Without better figures on asset shares in these hybrid deals we cannot draw more definitive conclusions about their contributions to variation in performance. But we can say that the pure insurance TruPS CDOs are significantly outperforming any other major group and that the groups dominated by insured depositories, bank and bank & thrift, are performing worst.

Another important factor of the poor performance that was not noted at the time was the significantly higher risk of the banks that issued TruPS into TruPS CDOs. One source of risk noted was that many of the banks in TruPS CDOs were unrated, unable to access capital markets or to engage in private placements. Rating agencies, of course, maintain their own ratings on companies and securities, and they had their own methods for assessing bank risks.[37] What further complicates analysis is that we don't know which banks that issued TruPS issued them

[36] Goodman et al (2008) contend that the 2006-2007 vintage explains some 91% of the variation in structured finance CDOs, with no other factor contributing significantly to performance.

[37] Moody's relied on a measure of non-performing assets taken off bank call reports. During the real estate boom, these measures were especially strong across almost all the banks.

into TruPS CDOs versus those that did not. Only the three rating agencies have the complete list of banks issuing TruPS into TruPS CDOs.

One way to assess relative risk among banks, at least on an ex post basis, is to compare directly the failure rates of banks and thrifts placed into TruPS CDOs against overall bank and thrift failure rates over the period. This is done in Table 7. Since we do not have TruPS CDO bank and thrift data, we rely on aggregates from Fitch (2010b), which reported that 176 bank and thrift holding companies had failed from 2007 through April 2011. Overall, 1,813 bank and thrift holding companies have been placed into TruPS CDOs, for a failure rate of 9.7%. This is nearly double the 4.7% failure rate of all FDIC-insured banks and thrifts that failed over the same 2007 to April 2011 time frame.[38]

Unfortunately, we do not have information to analyze the risk profile of small banks issuing TruPS into TruPS CDOs versus those that did not. A more thorough analysis of risks at these small banks will have to wait until more information is disclosed. But it is definitely an important area for future research.

V. The Model: Development of Industry and Deal-Specific Loss Curves

The challenge of forecasting expected losses for the 107 active TruPS CDOs was not only in dealing with limited data but also in making our models compatible with the valuation algorithms in the Intex software designed by dealers and trustees for investors. Intex provides all of our deal- and bond-level data, along with the coding of the deal-specific structures to generate cash flows. The user needs to input deal-level CDRs, CPRs, and severity rates. In this way the software is set up much like one is valuing an MBS pool. This is different from what the rating agencies do because they have information at the asset level and are able to estimate default rates of each institution issuing TruPS. We must work with information trustees make public to potential investors (or researchers like us).

One of the features of the reporting on TruPS CDOs is that trustees only make available *cumulative* deferrals plus defaults (DDs) to non-investors each reporting period. "Deferrals" in this case refers to TruPS of institutions that have suspended dividend payments on their TruPS but have not yet filed for bankruptcy or been seized by regulators. "Defaults" refers to institutions that have filed for bankruptcy or been seized by regulators. This is important because until the institutions issuing the TruPS are liquidated, TruPS balances on defaulted institutions are still reported as active in the TruPS CDOs, which almost all presently are.[39] In this sense defaults resemble real estate owned (REO) properties in MBS deals that are still reported in the pool because they have not yet been disposed of and written down. Deferrals are more

[38] These are not strictly comparable, since Fitch figures are for holding companies, which can include more than one depository, while FDIC figures are for individual banks and thrifts. The FDIC does not report its figures at the holding company level.

[39] Rating agency analysts explained to us that because a deferral is "tantamount to a default" they did not feel the need to distinguish between defaults and deferrals.

synonymous with delinquencies, since they represent TruPS balances at still active banks that have suspended dividends on their TruPS.

In terms of the deal triggers, defaults and deferrals are regarded the same. As mentioned above, on most TruPS CDOs, combined DDs have exceeded their trigger levels, meaning that interest from the junior bonds is being diverted to the senior bonds. Both deferrals and defaults count toward trigger calculations in exactly the same way; that's one reason why trustees report them as a combined amount. Subject to imbedded deal triggers, interest arrears accumulate in the junior bonds (i.e., they "PIK"). Cash is not available to the trust until deferring TruPS cure. Thus, while Intex reports only the combined DD balances, we needed to find a source to distinguish deferrals from defaults so that we can estimate our conditional default rates (CDRs) on our TruPS CDOs.[40]

As mentioned, to estimate conditional default rates (CDRs), we were able to use data from FTN (2011) to construct a net DD curve. FTN's deals are present in all major TruPS CDO groups mentioned in Table 6. As of June 2010, FTN's historical cumulative DD balance as a percent of current balance was 28% (this had risen to 32% by the end of March 2011). The industry average on the non-FTN TruPS was 27.7%. This gave us confidence that the FTN data were representative of the TruPS CDO market and could be used to estimate industry CDRs for all 107 TruPS CDOs. Finally, we augmented our model with assumptions from rating agency models, since they are the only entities that have full information on TruPS CDOs across all issuers.

Our deal-specific expected loss model is as follows:

$$EL_{i,t} = \sum_{j=1}^{n} CDR_{i,t+j} * LGD * PerfBal_{i,t+j-1} + DD_t * LGD \qquad (1)$$

where

$$CDR_{i,t} = (1 - (1 - MDR_t)^{12}) * Multiplier_i, \qquad (2)$$

$$MDR_t = \frac{1}{18} * \sum_{j=0}^{17} \left\{ \frac{DD_{t-j} - DD_{t-j-1}}{Perf\ Bal_{t-j-1}} \right\} , \qquad (3)$$

$$Perf\ Bal_{i,t-j-1} = Balance_{i,t=0} - PP_{i,t-j-1} - DD_{i,t-j-1} + \text{Cures}_{i,t-j-1} , \quad (4)$$

Cum $EL_{i,t}$ = cumulative expected loss on deal i at time t,
$CDR_{i,t+j}$ = conditional default rate on deal i at time t+j,
LGD = loss given default,
Perf $Bal_{i,t+j-1}$ = performing balance of deal i at time t+j-1,
$MDR_{i,t}$ = monthly default rate on deal i at time t,

[40] We also should point out that because we only have aggregated balances in Intex, we could not consider other modeling frameworks, such as a copula model, that would specifically incorporate asset correlation assumptions.

$Multiplier_i$ = deal-specific multiplier applied to deal i,
$DD_{i,t-j}$ = cumulative defaults plus deferrals on deal i at t-j,
$Balance_{t=0}$ = Balance on the deal at issuance (t=0),
$PP_{i,t-j-1}$ = cumulative prepayments on deal i at time t-j-1,
$DD_{i,t-j-1}$ = cumulative deferrals and defaults on deal i at time t-j-1 and
$Cures_{i,t-j-1}$ = cures on deal i at time t-j-1.

Several features of our model need elaboration. CDRs are annualized monthly default rates (MDRs), which are the default inputs required by Intex to project cash flows. Since historical DDs occur in a lumpy fashion (see Figure 4), for forecasting purposes the decision was made to use an 18-month moving average to smooth the noise. Eighteen months was chosen as the time period for smoothing, since TruPS CDOs report only quarterly or semi-annually, and the 18-month moving averages provided the smoothest curves, which proved advantageous when working with the Intex software.

Note that LGD is not denoted with subscripts because we first built an industry curve from the FTN deal-specific data. The MDR curve estimated from deal-level data is ultimately aggregated to the issuer level, which we use to represent the TruPS CDO industry. Because of the lack of data, the same LGD assumption is applied across all deals.

Another feature of the Intex modeling software is that CDRs are calculated only against *performing* balances, which nets out defaults, deferrals, cures, and prepayments. For the current stock of DD, an LGD is required

Cures are embedded in our estimated deferral curve, since the curve is net of cures. Since cures are netted out, we do not need to adjust our MDRs for a probability of default (PD), as we do with delinquent loans in MBS pools. In effect, the MDR is the share of non-cures forecasted over the remaining life of each deal. In the FTN data, as of June 2010 there were eight cures totaling $48.4 million, and 295 accounts in deferral status totaling $2.51B. Cures therefore represent 2.3% of all deferrals by balance. Thus, our model assumes a cure rate of 2.3%, or a PD adjustment to the MDR of 97.7%. On these we are in between the three rating agencies. Moody's, S&P, and Fitch have implied cure rates of 10%, 0%, and 5%, respectively, on all future deferrals or defaults.

Finally, for the CDR calculations, what generates deal-specific CDRs is the multiplier applied to each deal. $Multiplier_i$ represents the ratio of DDs of deal i at t=0 to the average DD on the FTN deals at t=0 ($DD_{FTN,t=0}$), with some adjustments described below. Each TruPS CDO receives a level adjustment to the MDR curve by Equation (5) below.

$$Multiplier_i = Max\left(20\%, {}^{DD_{i,t=0}}\Big/_{DD_{FTN,t=0}}\right) \quad (5)$$

A key adjustment we make is to place a floor of 20% on the multiplier. The deal-specific multipliers for these 107 deals ranged from 0 to 292%. The deals with the highest multipliers were seasoned deals with very low pool factors due to pool burnout. For the deals with zero or very low losses we placed a 20% floor on the multipliers, which gave lifetime default rates more comparable to Baa-rated firms based on Moody's idealized default probability tables.[41]

For the empirical estimation of the CDR curves, we investigated several model specifications, ultimately settling on a unit root specification. From FTN, we had the issuance date of each deal; the month of each deferral, default and cure; and the collateral type, as described in Table 6. It was initially hoped that more accurate forecasts could be formed from taking information about the CDOs' age into account. A matrix of DD rates was created from the asset data consisting of observations of these rates at a given calendar date across assets of different ages. Next a low rank approximation to this matrix was formed by minimizing the squared differences between the observed rates and those calculated as an outer product of two vectors.[42] Unfortunately, the age profile was found to be essentially nothing but noise, and the time-varying component was nearly identical to a simple average of monthly rates across all assets over calendar time. This is apparent from Figure 3 when observing how the time profile of DDs shot up in late 2007 as the financial crisis took hold, but did so for all vintages. Given this we concluded that there was very little in the age of a deal that would improve forecast accuracy, and it was fine to use a simple average over observed rates to form a base CDR forecast.

Limited historical performance for TruPS, particularly in a stress environment, also makes forecasting future DDs more an art than a science. Fortunately, we can draw on the Merton (1974) model of firm default to justify a forecast that is very plausible—at least in the near term. In Merton's model, a firm defaults if the market value of its assets falls below its liabilities. We argue that a similar process is driving defaults and deferrals among the firms' TruPS that make up a TruPS CDO. A firm is forced to defer interest payments or default outright as the value of its assets gets close to, or falls below, its liabilities. The typical Merton assumption is that the value of a firm's assets is driven by a geometric Brownian motion. Assuming that a firm's liabilities don't change, we reason that the probability of default at any time can be expressed by evaluating the cumulative density function (CDF) of a normal random variable at the difference between the log of its assets' value and the log of its liabilities. This difference evolves as a random walk unit root process as long as the firm's liabilities don't change. If we apply an inverse normal CDF to historical rates of default and deferral, we should extract a time series

[41] Since insurance TruPS perform so much better, we considered separate multipliers for them. The problem is that there are so few TruPS insurance deferrals that the curve was not stable. Doing the adjustments the way we did gave us results consistent with how Moody's rated unrated firms, as described in Section II. Also, the effect was to raise only slightly the lifetime losses on the non-insurance TruPS CDOs (around 1%).

[42] This is in the spirit of forming low-rank approximations to matrices with the first vector components of a singular value decomposition. The hope was to interpret the elements of one of the vectors as an aging profile and the entries of the other as a time-varying component. Forecasting would then have proceeded by forecasting the time series component and combining it with the age profile to get differential forecasts for TruPS of differing ages.

component that closely tracks the log asset process; we would expect this component to closely resemble a unit-root process. We have extracted this component and it certainly passes the standard tests for unit roots.[43] We argue therefore that the best short-term forecast of DD rates is the current DD rate.

Our historical information on defaults and deferrals from FTN and our forecasted base industry CDR curve is represented in Figure 4. Given the theoretical discussion above, our key assumption is that the current trend of defaults and deferrals will continue for the next 24 months (from June 2010), consistent with this process being modeled well in the short run as a unit root. The extension of the current 18-month average DD rate out 24 months is consistent with rating agency assumptions and the fact that the FDIC's list of problem banks continues to grow.[44]

At longer horizons, the assumptions of the simple Merton framework are less plausible. In particular, we expect firms' liabilities to change markedly as firms respond to the decline in the value of their assets. We also know that regulatory actions against banks require them to restructure their assets and liabilities to raise capital or face seizure, which rating agencies have noted is a source of the rise in deferrals (Fitch (2010b)). Consequently, we conjecture that bank defaults will peak in mid-2012 and taper off significantly after that. After mid-2012, we reduce our DD forecast to 3% for months 25-36, 1.5% for months 37-48, and .25% thereafter for the remaining lives of the deals. These step-level forecasts of 3%, 1.5% and 0.25% are blended in with the prior 17 months to produce our industry curve depicted by the dotted line in Figure 4, which starts after June 2012. The final step is to multiply this industry curve by Multiplier_i to generate deal-specific CDR curves.

Finally, our assumptions for CPRs and LGDs are calculated as follows. For CPRs, we were able to obtain historical prepayment rates directly from Intex. As of June 2010, the rolling 18-month average voluntary conditional prepayment rate (CPR) was 1.38% for all TruPS. A 1% CPR was used for model projections, which approximates the most recent empirically observed performance and takes into consideration that issuers will have more restricted opportunities to revolve the debt as a result of the Collins amendment that disallows all future TruPS to count as equity.

[43] The transformed deferral/default rate series is so highly auto-correlated that none of the standard unit root tests reject the null hypothesis of non-stationarity. The t-statistic from a Dickey-Fuller regression has the value 0.1637. All of the critical values for a Dickey-Fuller test are actually negative, so this test provides no reason to reject the unit root hypothesis. A Phillips-Peron test was also run and values of 0.1600 and 0.1522 were obtained for the Z_a and Z_t statistics, respectively. These correspond to p-values of 0.963 and 0.968 and clearly offer no reason to reject non-stationarity. Both of these tests were done using a constant in the regression and this constant proved insignificant in each case.

[44] The FDIC problem bank list grew from 700 in December 2009 to 775 in March 2010, then rose again to 824 in August. As stated in Fitch (2010c), "The worst of the downgrades have occurred for structured finance CDOs but other sectors, particularly bank TruPS CDOs, still face an extended decline." Our assumption is 24 months.

For LGDs, all three rating agencies assume no recoveries, at least for the existing TruPS in the CDOs, with assumptions of recoveries coming for future expected defaults. The deeply subordinated nature of the TruPS, just above perpetual preferred stock, suggests that recoveries should be zero or very small. Recent history suggests that investors have been able to extract some recoveries out of their TruPS and that banks merging with deferring banks have been curing some TruPS. Fitch (2011) reported for the first time that a deferring bank completed a tender offer for a TruPS in a TruPS CDO in January 2011 with a recovery of 21%. Six CDOs sold a defaulted bank's TruPS for an average recovery of 13% during December 2010 and January 2011. Furthermore, nine TruPS CDOs entered into agreements with a third party, essentially a sub-servicer, to work out recoveries from 32 defaulted banks, offering hope that additional recoveries are forthcoming. For these reasons, we apply Moody's 10% recovery figure to both existing TruPS and future TruPS.[45]

While FTN data give us additional information on performance not found in Intex, we must acknowledge that our highly stylized model is best understood as a benchmark model, reflective of average expected losses and prices across the TruPS CDO market rather than precise estimates for individual securities. Without specific information on the assets (i.e., the names of the firms that issued the TruPS in the CDOs) or even on which specific assets are deferring or have defaulted, we must work with the information we have, which is the cumulative DDs out of Intex. This is why an important part of our model validation is comparing our expected loss estimates against models that use the asset-level detail, namely, those from the rating agencies, which we do next.

VI. Results: Validation and Loss Forecasts

a. Validation

Our model assumptions are now tested by comparing our model forecasts, run through Intex, on a deal-by-deal basis to Moody's for the comparable time period over which the Moody's model was estimated, which was mid-2010. Rating agencies are the best source for validation, since, as mentioned, they are the only entities provided with collateral-level information across all major securities issuers. Moody's was chosen because, of the three major rating agencies, it provided deal-by-deal figures for most of the securities for which we could develop cumulative loss estimates to use for validation against our own model.

Moody's published an expected collateral loss table in a special report on CDOs (Moody's (2010a)). Moody's report estimated cumulative collateral losses for 87 deals, over 80% of the 107 active deals in the TruPS CDO market. Moody's expected default data table was matched

[45] Given these very recent developments, we expect that rating agencies will adjust recovery assumptions on their models as well.

up against our model's cumulative loss forecasts in mid-2010 for the same 87 deals to get a direct comparison.[46]

Our forecasted cumulative loss estimates came in as we had hoped, lower than Moody's on average, with outliers explained either by data errors or information on the underlying assets we could not observe because Moody's had access to the individual issuers of TruPS. As shown in Table 8, our cumulative loss forecasts were 4.4% lower, on average, than Moody's, with a lower median difference of 3.1% and a standard deviation of 6.7%. We had hoped for lower loss estimates because, as we discussed in Section 2 above, Moody's made some adjustments to its models, such as truncating the distributions on bank ratings at Baa2, which seemed overly conservative to us. The very high standard deviation was partly driven by outliers. We believe the two highest outliers (-28% and -23%) are data errors at Moody's. In the case of the outlier for which we were much higher, at +13%, Moody's had lifetime cumulative losses lower than *current* default and deferral rates. This is either an error or Moody's must have observed something in the underlying collateral that we could not observe. We also noticed that Moody's had much higher cumulative losses than we did on the insurance TruPS CDOs, by far the best-performing group, driven by Moody's much higher lifetime cumulative loss assumptions on the insurance sector. But overall, our model validated as we had hoped.

As part of our validation, we also analyze our out-of-sample results, which we depict in Figure 5. Note that our forecasted near-term DD assumption has been coming down as the new DDs have declined significantly, a self-correcting feature of our model. While our forecasted DD curve has been slightly higher than actual, it has performed reasonably well, on average. Over the nine-month out-of-sample period from July 2010 to March 2011, the root mean square error (RMSE) of the actual against the predicted lines in Figure 5 is 1.08%, which is around 9% off the actual average DD rate. Thus, we believe our model provides a reasonably conservative benchmark for estimating expected losses and performs reasonably well out of sample.

b. Expected Losses on Bonds

With forecasts from our benchmark model we gain a fairly complete picture of our ultimate expected losses for the TruPS CDO market. Results are summarized in Table 9. The first group of 327 securities represents those for which existing defaults and deferrals are high enough to result in a complete write-down of these securities. In other words, even if the TruPS in these deals suffer no additional defaults, if the existing DDs have a 10% recovery or less (standard baseline assumptions), these 327 securities will be fully written down, 42% of all TruPS CDO bonds and equity tranches. Because they are generally most junior in the capital structure, they constitute a smaller share of balances at 24%. The next group of 110 securities represents those

[46] As mentioned, we obtained from Moody's its Idealized Default Probability Tables (DPTs) for up to 30 years (with 20 different bands), which allowed us to match up Moody's DPTs against the remaining life of each deal and Moody's forecasts, which Moody's called its Assumed Default Amounts (ADAs). See Moody's 2010a, Table 1 for deal specifics.

that we estimate will be partially written down with existing DDs, fully written down when adding in our forecasted losses. The next group of 15 securities has enough existing subordination so that they will not suffer losses with existing DDs, but we expect them to be fully written down based on our forecasts. All told, we forecast 58% of all securities, 38% of total current balances, will be fully written down.

We forecast that a smaller subset of bonds will be partially written down. Again, in Table 9, we forecast 27 securities, totaling $2.7 billion, to suffer write-downs between 50 to 99%, while another 27 securities, totaling $3.5 billion, will suffer write-downs between 0 and 50%. Finally, we forecast 279 securities, 36% of total bonds, and 50% by current balance, to suffer no write-downs. Stated differently, we estimate that 77% of all TruPS CDO securities will suffer full or partial write-downs. All told, we estimate security losses will total $21.4 billion, 43% of April 2011 balances. By original issuance balance, $58.9 billion, we estimate 36% will be written down.

A more detailed cut by original bond ratings shows that losses are concentrated mostly in bonds originally rated A or lower, with the originally AAA-rated bonds mostly expected to have no write-downs. As shown in Table 10, for bonds originally rated senior AAA, we forecast that 84% (109 of 129) will suffer no losses. None are expected to be fully written down. This is not surprising, since most deals' triggers have already tripped, which means that cash is being diverted from lower-rated bonds to pay down the senior-most bonds. We do estimate that 16% of the senior AAA bonds will suffer some losses. For the junior AAA-rated bonds, 76% (90 of 118) are expected to suffer no write-downs, while 17% are forecasted to be fully written down (20 of 118). All told, we estimate that 81% of the AAA-rated bonds (199 of 247) will suffer no loss of principal, while 19% (48 of 247) will suffer some loss or be fully written down.

For AA-rated bonds, 43% are estimated to fully pay off, while 48% are expected to be fully written down. For bonds originally A-rated, we estimate 14% will suffer no write-downs, while 81% will be fully written down. For bonds originally rated BBB or BB, we estimate complete write-downs on 90% and 95%, respectively. The B-rated bonds expected to suffer no losses are mostly all from insurance TruPS CDOs. There is also no clear monotonic pattern to these full write-downs. For example, 95% of BB-rated bonds are expected to be fully written down, while 92% of the equity tranches are expected to be fully written down.[47]

We should emphasize again that these are benchmark figures estimated from industry averages. If recoveries are higher from defaulted banks, or if deferring banks cure in greater numbers than have occurred to date, our figures will come down. Our unit root assumption and the multipliers in our model adjust with the market, so if credit conditions at banks improve significantly in the near term, our loss estimates will come down as well.

[47] This is most likely because the insurance TruPS CDOs, the best performing group, had only one bond in the BB group. In contrast, equity tranches are in every deal, so strongly performing insurance TruPS CDOs are expected to suffer only partial write downs in their equity tranches.

With access to asset-level detail, analysts can look across the actual financial institutions themselves, which will result in potentially more accurate forecasts than our benchmarks. We caution that Moody's already has this detail, and their lifetime loss figures are higher than ours. While we have reason to believe Moody's figures may be too high based on its 2008 model adjustments discussed above,[48] we feel that our assumptions are not overly conservative, which is why our loss estimates represent good benchmarks. We would also close by pointing out that, with any model, the full write-down of the 327 securities that are forecasted to be fully written down with existing DDs appears most certain. These are dominated by the B-rated and equity tranches of the non-insurance TruPS CDOs.

c. Estimating Other Than Temporary Impairment (OTTI) Losses

In April 2009 the Financial Accounting Standards Board (FASB) issued revised guidance (FASB 2009) in part to address concerns that current market conditions caused temporary declines in value that do not reflect cash flows that will actually be collected for non-traded debt securities. In this section, we will describe how current guidance is used to calculate OTTI prices. Then we will value these securities based on our forecasted losses described above.

The new guidance changed the method for determining whether a debt security is OTTI and where the impairment loss is recognized in the financial statements. Under this guidance, firms are permitted to separate credit losses on debt securities from losses due to *temporary impairment* if the firm can assert that it does not intend to sell the security and it is "more likely than not" it will not be required to sell the security before recovery of its amortized cost basis. Temporary impairment reflects factors such as liquidity and market sentiment, factors that can be quite volatile and change over time. Owing to the highly illiquid nature of the TruPS CDO market, they certainly count as non-traded debt securities.

The decision sequence for both available for sale (AFS) and held to maturity (HTM) debt securities and the appropriate valuation method is depicted in Figure 6. If a firm intends to sell a security in an unrealized loss position, it recognizes an impairment loss equal to the full difference between the amortized cost basis and the fair value of those securities (the bottom left box in Figure 6). If the firm does not intend to sell the security and it is "more likely than not" that the firm will not be required to sell the security before recovery of its amortized cost basis, only the credit loss portion of OTTI is recognized in earnings, whereas the portion of OTTI due to other factors is included as a separate component of accumulated other comprehensive income (AOCI). The credit loss portion of OTTI is calculated as the difference between the present value of the security's expected cash flows and its amortized cost basis reported on the balance sheet, or the bottom right box.

[48] Recall that Moody's gave all banks a maximum WARF equivalent to a Baa2-rated security, significantly raising expected default rates on better performing banks and thrifts, an arbitrary assumption made at the height of the financial crisis.

We will describe and then represent FASB 2009 guidance for estimating OTTI prices for our 785 TruPS CDO securities. First, we use the losses estimated above as our OTTI losses. Each period the Intex software will generate cash flows that incorporate specific cash flows for each bond based on the priority of payment (or "waterfall" rules) stipulated in each deal prospectus and modeled in Intex. Also modeled in Intex are subordination rules, triggers, expenses, hedging costs, and other aspects of each deal described in Section 3 above.

The only remaining issue for estimation of our OTTI price is the choice of the appropriate discount rate. FASB 2009 guidance for OTTI calls for discounting expected losses at the purchase yield of the security. Since we do not know the purchase yield for each investor, we price each security as if it was purchased at its par values. Thus, for our discount rate, we use the par coupon rate for fixed-rate indexed securities or the spot rate of the index plus the discount margin for floating rate bonds. Within Intex, this can be done directly by generating cash flows for each time period, as done above, and discounting them by the appropriate discount rate. The discounted OTTI price is as follows:

$$Price_{i,OTTI} = \left\{ \sum_{j=1}^{n} \frac{\text{Cash Flows}_{i,t+j}}{\left(1+{}^{DR_{i,t+j}}/_{4}\right)^{j}} \middle| \text{Structure}_{i,t+j} \right\} \Big/ Balance_{i,t=0} \qquad (6)$$

where for floating rate securities

$$DR_{i,t+j} = r_{DM(i)} + z_{t,j} ,$$

for fixed-rate securities

$$DR_{i,t+j} = r_{coup(i)}$$

and for equity securities

$$DR_{i,t+j} = .15.^{49}$$

Also,

$Price_{i,OTTI}$ = Price of security i reflecting its OTTI price,
$Cash\ Flows_{j,t+i}$ = cash flows generated for security i at t+j,
$r_{DM(i)}$ = constant discount margin for security i,
$z_{,t,j}$ = j-period LIBOR spot rate at time t,
$r_{coup(i)}$ = the coupon rate for fixed-rate securities,
Structure = structural features of security i that affect cash flows at t+j, and

[49] We chose 15% as the appropriate discount rate for our equity securities as representative of what equity holders would require in a normal market.

$Balance_{i,t=0}$ = Balance of security i at t=0.

In Table 11, we summarize our OTTI price estimates. The center column at 100% represents our expected weighted average discounted prices as a percent of par value, i.e., the OTTI prices for each major tranche class. Senior bonds have OTTI prices of about 97 cents and about 93 cents for the junior AAA bonds. Because triggers are diverting cash flows to the AAA classes, prices drop off significantly after that, consistent with losses rising significantly as in the previous section. The AA class prices out at 56 cents on down to about 1 cent for the BB bonds, and about 4 cents for the equity tranches.

To show the sensitivity of our loss estimates, we also provide OTTI prices for ranges of our expected loss curves, from 0 to 200%. Of great interest is the zero percent loss column because it represents prices that we can expect if TruPS CDO securities experience no future losses above losses generated from current defaults and deferrals. In this case, AAA bonds will recover full value, with AA bonds recovering around 98 cents. But again, lower rated bonds suffer substantial deterioration in values, even in these close-to-best-case scenarios, with prices ranging from 7 to 89 cents.

At the other extreme, at twice our estimated loss curve, weighted average prices are still positive for the A-rated bonds and the B-rated insurance TruPS CDOs. At what we consider a worst case for our benchmark model, the senior AAA-rated bonds still retain about 90% of their value, the junior AAA-rated bonds 78%, falling off significantly after that.[50] The positive values for the B-rated tranches are driven mainly by the insurance TruPS CDOs, whose current DDs are low enough so that they retain value even in the 200% scenario.

VII. Conclusions and Lessons Learned

This paper investigates the development and performance of the TruPS CDO market. While a niche part of the structured finance CDO market at $60 billion of issuance, the large number of banks issuing TruPS into TruPS CDOs and the effects of TruPS on bank resolutions has had significant impacts on the small to medium-sized banking industry in the U.S. and also on the FDIC insurance fund through resolution of failed banks. More broadly, this in-depth study of the TruPS CDO market is another example of issues that occurred in the broader structured products market. This in-depth study of the TruPS CDO market provides important insights into how markets respond to regulations; the symbiotic relationship between investment banks and rating agencies in developing models and ratings; how ratings are adjusted over time; and, most recently, how accounting rules have changed with the crisis and have been applied to valuing

[50] We should note that this stress scenario would get worse if we factor in another major credit downturn at banks over the remaining lives of the bonds. So this is a true stress scenario only in the context of our benchmark model.

untraded securities. Thus, this study provides insights and lessons learned not just for the TruPS CDO market but for all structured products markets.

Before engaging in a lessons learned, we need to acknowledge that the TruPS CDO market represented a positive market response to a real need. Small, unrated banks were often not able to place their debt except for the TruPS CDO. Without this structure, many small banks lacked the ability to issue TruPS. The TruPS CDO was thus a positive capital markets response to that need.

The poor performance of TruPS CDOs is first and foremost a direct, and largely unanticipated, result of the financial crisis and the broad-based nature of the real estate downturn. Record low numbers of bank failures over the 2003-2007 period as well as the booming real estate market also help explain the concentrations of issuance volume in these years. The very favorable market conditions combined with good returns relative to other structured finance products also may explain why banks became primary investors in securities in their own market.

Having said this, the very favorable market conditions masked underlying risks. Since bank TruPS CDOs were made up mainly of debt of banks too small to be rated, and since these banks largely invested in commercial real estate (CRE), these deals were, in effect, indirect investments in unrated and deeply subordinated CRE bonds. By comparison, even the riskiest of the synthetic mezzanine subprime CDOs were composed of bonds at least *initially* rated investment grade.

But having banks both issue TruPS and hold each other's debt greatly increased those risks, as did the tendency to include the same TruPS issuers in many different CDOs. Banks turned out to be *the* primary customer for the lower-rated tranches of TruPS CDOs, many of which all models estimate are likely to be fully written down. The rationale for such holdings appeared to be that banks were investing in their own industry, which they ostensibly knew the risks of better than others. While this may not be uncommon for such a niche class of securities, it undoubtedly increased these risks once the downturn commenced. We show that banks' being the primary investors of the TruPS CDOs in their own industry was publicly reported in the investment banking literature as early as 2004, but none of the major players, dealers or rating agencies, expressed any concerns or made significant model adjustments until after the TruPS CDO market came undone. Since ratings do not take into account the investor base of a deal, nor do rating agencies keep track of who investors are, this would have to fall to the dealers to police. These agents are conflicted when a primary motive is to generate business. The Dodd-Frank Act addresses this in part by establishing a new Office of Financial Research (OFR)[51] that could monitor these instruments better. Regulators also need to do more by proactively monitoring new—and existing—markets.

The failure of banks' internal risk management practices is also a factor in these purchases. As mentioned in Merrill Lynch (2004), many of the early deals were "blind pools." In these cases,

[51] For a description of the new OFR, see *Wall Street Journal*, "How a Street Watchdog Got Its Bite," September 15, 2010.

banks appeared to be largely relying on ratings, contrary to sound risk management practices. When examining subordination levels and securities spreads, we see much more conservative valuations in the more broadly owned AAA class than in the bank-dominated mezzanine classes.

There was a regulatory arbitrage point to these investments as well. Banks that hold each other's equity are not allowed to count these as capital, but no such restrictions were placed on TruPS CDO investments at banks, which are hybrid debt/equity TruPS. Here the opaqueness of the structure itself and the limited disclosure made it difficult for regulators to actually determine how to account for TruPS CDOs for regulatory accounting purposes. Had banks been required to deduct portions of their TruPS CDO investments from capital, this may have limited bank investments in TruPS CDOs, which, in retrospect, would not have been a bad thing.

Future TruPS CDO issuance was dead long before Dodd-Frank placed restrictions on TruPS as regulatory capital. More important is the highly uncertain future of existing deals. Defaulting BHCs have yet to resolve their TruPS, but this will have to be done at least by their fifth year of deferral, which is the limit to which they can defer without defaulting. Rating agencies are making a conservative assumption that all existing deferrals are leading to defaults with little or no recovery. This has created disagreements among analysts responsible for conducting valuations. More work needs to be done to determine how these deferrals will play out and what assumptions are most reasonable to make regarding recoveries. In the meantime, efforts to resolve defaulted bank TruPS claims could add greater clarity to assumptions on recoveries so critical to loss forecasts.

As for current valuations of bonds and their accounting, much work needs to be done. We see two urgent issues here requiring prompt action. First, in order to resolve discrepancies in pricing, issuers should make public the names of the TruPS assets in all TruPS CDOs. This could easily happen in the next reporting cycle, at little cost to trustees or collateral managers. This is something rating agencies have requested for years, and something issuers should do immediately.

A critical gap also exists in accounting policy that needs urgent attention. FASB 2009 established rules for assessing valuations for allocation of fair values between OTTI and AOCI for non-traded securities, which we demonstrate can be consistently applied in practice. This is a positive. Yet on evaluating the quality of the valuations themselves, accountants frequently attest that they are not responsible for assessing the quality of the models used to conduct valuations. But if accountants don't evaluate the models, who does? In cases where accounting firms do not provide this assessment, we believe this is a gap that regulators need to fill. In many cases this gap is filled by outside consultants, a situation where expertise and the quality of valuations can vary greatly. We believe regulators need to serve as arbiters here, in effect, rating the raters.

Banks should also all be disclosing their securities holdings in their investment portfolios to regulators each quarter. For these, bank regulators should follow the model adopted by the

National Association of Insurance Commissioners (NAIC), which receives from members CUSIPs and other information on investment portfolios so that regulators can do a full evaluation of all holdings in insurers' investment portfolios. Applying models like the one we developed to all banks' TruPS CDO holdings would offer a consistent, independent assessment to compare with banks' internal analyses. Exactly this type of exercise was conducted as part of the 2008 Supervisory Capital Assessment Program (SCAP), commonly referred to as the "stress tests," and the 2011 Comprehensive Capital Analysis and Review (CCAR) exercise for the largest banks. With a simple NAIC-style schedule, this type of analysis could be extended to smaller banks' investment portfolios, with enormous gains in information and the quality and consistency of regulatory supervision.

Finally, what is needed in ABS/MBS markets is objective, critical analysis from analysts and researchers who are not profiting in any way from new issuance. An important aspect of the development of the TruPS CDO market, and of structured finance markets in general, is the dominance of analysis by companies directly profiting from new issuance. This is not unusual, and, in fact, is necessary. Innovation is greatest with economic incentives, and this process should not be hampered by regulation. Having said this, a more critical analysis of these deals may well have uncovered the high-risk nature of these investments that appeared to be captured in the large spreads and exceptional amounts of subordination in the AAA-rated senior classes of TruPS CDOs.[52] More important, as the above-mentioned market concentrations became clearer, rating agency and issuer pricing models should have taken more account of this. In some sense this is a gap fueled by the unregistered status of the TruPS CDO and rating agencies' inability to capture investor-level information. But the concentrated investor base was reported publicly as early as 2004, so it should not have come as a surprise. We also point out that the model used to justify the zero inter-regional correlation assumption, apparently critical to the development of the single industry TruPS CDO market, was based on a model developed for an unrelated class of securities.

The best response to this is for academics and policymakers to take a much more active role in conducting research on evolving—and existing—structured product markets. A group of objective, dispassionate analyses would fill a much needed void. Indeed, this is purportedly a goal of the OFR; it should become one for regulators as well. For academics, research in these areas offers interesting and rewarding research opportunities, which should be incentive enough for them.

[52] A great example of such research is that of Heitfield (2009), who critically examines copula models applied to CDOs. Like this paper, this analysis was regrettably done after problems in the market became manifest.

I. Bibliography

Davis Polk, 2010, "Summary of the Dodd-Frank Wall Street Reform and Consumer Protection Act, Enacted into Law on July 21, 2010."

Financial Accounting Standards Board (FASB), 2009, FASB Staff Position (FSP) FAS 157-4, "Determining Fair Value When the Volume and Level of Activity for the Asset or Liability Have Significantly Decreased and Identifying Transactions That Are Not Orderly," April 9.

FDIC,2010, Historical Statistics on Banking, http://www2.fdic.gov/hsob/.

Fitch, 2010a, "US Structured Finance Snapshot," May.

Fitch, 2010b, "Bank TruPS CDO Default and Deferral Index," July.

Fitch, 2010c, "US Structured Finance Snapshot," August 5.

Fitch, 2011, "Fitch Bank TruPS CDO Default and Deferral Index", May 31.

Fitch, 2012, "Fitch Bank TruPS CDO Default and Deferral Index as of February 2011," March 28, 2011.

FTN, 2011, http://www.ftnfinancial.com/SitePages/home.aspx.

Goodman, Laurie, Shumin Li, Douglas J. Lucas, Thomas A. Zimmerman and Frank J. Fabozzi, 2008, *Subprime Mortgage Credit Derivatives*. John Wiley & Sons, Inc., Hoboken, NJ.

Gorton, Gary, 2008, "The Financial Panic of 2007," NBER Working Paper, Prepared for the Federal Reserve Bank of Kansas City Jackson Hole Conference, August.

Heitfield, Erik, 2009, "Parameter Uncertainty and the Credit Risk of Collateralized Debt Obligations," Working Paper, Federal Reserve Board, January.

Lucas, Douglas J., 1995, "Default Correlation and Credit Analysis," *Journal of Fixed Income*, March, 76-87.

Merrill Lynch, 2004, "Trust Preferred CDOs: A Primer," Merrill Lynch CDO Primer Series, November 11.

Merton, Robert C., 1974, "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates, *Journal of Finance* 29, 449-470.

Moody's, 2004, "Moody's Approach to Rating U.S. Bank Trust Preferred Security CDOs," April 14.

Moody's 2008a, "Announcement: Moody's U.S. TRUP CDO Outlook Stable, Outside of REIT TRUPS," March 11.

Moody's 2008b, "Rating Action: Moody's puts TRUP CDOs Exposed to U.S. Banks on Downgrade Review," July 22.

Moody's 2008c, "Rating Action: Moody's Downgrades and Places on Review TRUP CDOs Exposed to US Banks," August 14.

Moody's 2008d, "Rating Action: Moody's Downgrades TRUP CDOs Exposed to US Banks," November 12.

Moody's Analytics, 2009, "Analysis and Valuation of CDO Investments Collateralized by Trust Preferred Securities," August 6.

Moody's, 2010a, "Portfolio Credit Performance Report for TRUP CDOs: May 2010," May 21.

Moody's, 2010b, "Moody's Approach to Rating U.S. Bank Trust Preferred Security CDOs," June 11, 2010.

Onaran, Yalman and Jody Shenn, 2010, "Banks in 'Downward Spiral' Buying Capital in CDOs (Update 2)," Bloomberg.com. http://www.businessweek.com/news/2010-06-08/banks-in-downward-spiral-buying-capital-in-cdos-update2-.html.

Siegel, Joshua, 2009, "Non-Control Equity Options for Community Banks," presentation before the Iowa Division of Banking.

Salomon Smith Barney, 2001, "Regional Bank Diversification," Structured Bond Research, May 15, 1-16.

Salomon Smith Barney, 2002, "Historical Default Rates of FDIC-Insured Commercial Banks, 1934-2001," Structured Bond Research, July 31, pp. 1-26.

Table 1

TruPS CDOs Issuance by Year & by Collateral Type ($ million)						
Year	Bank	Bank & Thrift	Bank, Thrift & Insurance	Insurance	REIT	Total
2000	553		200			753
2001	0					3,376
2002	337	4,256		359		4,953
2003	1,413	2,802	1,528	2,049		7,793
2004	1,848	2,537	2,312	1,054		7,751
2005	1,055	872	4,651		3,224	9,803
2006	362		9,220		5,008	14,590
2007	611	539	5,943		2,802	9,895
Total	6,180	11,007	23,853	3,463	11,035	58,913

Notes: This table categorizes the composition of collateral types by vintage
Sources: Intex, Merrill Lynch 2004 primer, pitchbooks, estimates

Table 2

TruPS CDO Outstanding by Dealer							
Lead Dealer	# Deals	# Bonds	# Assets	Original Deal Balance	Current Deal Balance	% of Original Deal Balance	Factor
FTN Financial Capital Markets	31	209	1,718	$20,793M	$16,267M	32.7%	0.78
Merrill Lynch	20	192	1,341	12,443M	10,077M	23.8%	0.81
Bear Stearns	14	108	833	7,568M	6,255M	13.2%	0.83
Credit Suisse	10	75	450	3,675M	3,010M	6.3%	0.82
JPMorgan	6	66	349	3,585M	3,390M	6.9%	0.95
Sandler O'Neill & Partners	9	42	324	3,219M	2,168M	4.5%	0.67
ABN AMRO	3	25	284	1,862M	1,635M	3.6%	0.88
Salomon Smith Barney	4	12	93	1,885M	841M	1.8%	0.45
Citigroup	3	17	144	1,152M	1,031M	2.1%	0.90
Cohen & Company Securities	1	5	58	509M	432M	1.0%	0.85
Vining Sparks IBG	1	7	56	409M	401M	0.8%	0.98
Deutsche Bank Securities	1	8	42	346M	324M	0.6%	0.94
Wachovia	1	5	70	342M	324M	0.7%	0.95
Keefe, Bruyette & Woods	1	3	33	311M	232M	0.6%	0.74
Morgan Stanley	1	7	32	302M	278M	0.6%	0.92
RBS Greenwich Capital	1	6	52	312M	278M	0.6%	0.89
1st Union	1	3	18	200M	125M	0.3%	0.62
	108	790	5,897	58.9 Bill	47.1 Bill	100.0%	0.80

Notes: This table is a comprehensive summary of TruPS CDO issuances by Lead Dealer and provides the
Source: Intex (as of May 2011)

Table 3 (a)

TruPS CDO Original Subordination Levels Weighted by Original Face										SF CDO Original Subordination
Subordination Level	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Weighted Averages**	**Weighted Averages**
Senior AAA	40%	37%	53%	51%	50%	48%	48%	47%	48%	30%
Junior AAA	NA	NA	43%	43%	39%	37%	38%	37%	39%	24%
AA	NA	NA	25%	35%	29%	27%	26%	26%	27%	13%
A	7%	9%	10%	12%	11%	14%	14%	14%	12%	11%
BBB	9%	8%	8%	9%	8%	9%	7%	8%	8%	6%
BB	NA	NA	NA	NA	8%	8%	5%	7%	6%	4%
Deal Balances	$753	$3,376	$4,953	$7,806	$7,751	$9,803	$14,590	$9,895		
No. Deals	3	6	10	18	19	16	20	16		

Notes: This table compares the subordination levels, across rating categories and vintages for TruPS CDOs. The SF CDOs, in the last column, are introduced to delineate the difference in subordination levels between TruPS CDOs and SF CDOs. SF CDO = Structured Finance CDO.
Source: Intex, NA = No bonds received ratings

Table 3(b)

TruPS Original Spread (bps) weighted by Original Face (Floating)										SF CDO Margin (bps)	
Subordination Level	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Weighted Averages**	**Weighted Averages**	**Diff**
Senior AAA	NA	100	89	81	53	38	32	35	50	40	10
Junior AAA	NA	NA	92	93	74	51	43	46	61	60	1
AA	NA	NA	106	116	117	78	65	72	77	84	(7)
A	NA	223	191	175	163	137	126	112	155	177	(22)
BBB	NA	310	319	308	291	253	248	229	257	331	(74)
BB	NA	NA	NA	NA	445	465	484	515	490	536	(46)

Notes: This table compares the discount margins, across rating categories and vintages for TruPS CDOs. The SF CDOs, in the last column, are introduced for comparative purposes to delineate the spread differentials between TruPS CDOs and SF CDOs. SF CDO = Structured Finance CDO.
Source: Intex, NA = No bonds received ratings

Table 4 - TruPS CDO OC/IC Trigger Status

TruPS CDO OC/IC Trigger Status

Senior Tests Status	# of Deals	% of Total
Passing All Tests	6	6%
Passing Sr. Tests, but failing Sub Tests	18	17%
Failing Sr. Tests	77	71%
Deal Paid off	1	1%
Senior Classes Paid off	6	6%
Total Pooled TruPS Deals in Intex:	108	

Notes: This table demonstrates the number of deals which are passing and failing deal triggers. If deals are failing Senior tests then interest payments from junior bonds are typically diverted to the Senior bond waterfall. SR= Senior, OC = Overcollateralization, IC = Interest Coverage.
Source Intex (as of May 2011)

Table 5 - TruPS CDO Tranche Rating Transitions

TruPs CDO Tranch Rating Transition
Original Rating Through June 2010

Original Rating	Current Rating (Lowest of Moody's, S&P, & Fitch Ratings)											Total	Ratings Changes		
	AAA	AA	A	BBB	BB	B	CCC	CC	C	D	NR		% Upgraded/ Unchaged	% Downgraded	% Downgraded Below Inv. Grade
AAA[1]	12	19	8	44	65	50	15	11	3	21		248	5%	95%	67%
AA				2	3	9	21	34	12	6		87	0%	100%	98%
A					3	16	5	12	184	7		227	0%	100%	100%
BBB[2]			1		1	3	7	1	85			98	1%	99%	99%
BB							1		20			21	0%	100%	NA
NR											109	109	NA	NA	NA
Total	**12**	**19**	**9**	**46**	**72**	**78**	**49**	**58**	**304**	**34**	**109**	**790**	**2%**	**98%**	**87%**

Notes: This table summarizes the rating migrations over time for TruPS CDO bonds, comparing orginal ratings with current ratings.
(1) Nine bonds had their ratings withdrawn due to payoffs, but were AAA before payoff. One bond was BBB before payoff.
(2) One bond had its rating withdrawn but was upgraded to A- before payoff.
Sources: Intex for Moody's and Fitch Ratings, S&P for S&P ratings.

Table 6 – Summary Performance Measures for TruPS CDOs

Summary Performance Measures for TruPS CDOs By Collateral Type							
Collateral Type	**Count**	**Pool Factor**	**Original Balance**	**Current Balance**	**Defaulted Balance**	**% Defaulted/ Original Balance**	**% Defaulted/ Current Balance**
Bank	20	0.66	$8B	$5B	$2B	27%	41%
Bank & Thrift	25	0.71	$11B	$7B	$3B	27%	38%
Bank & Thrift & Insurance	40	0.93	$25B	$24B	$8B	31%	33%
Insurance	9	0.77	$3B	$3B	$B	4%	5%
REIT	13	0.87	$9B	$8B	$2B	23%	26%
	107	**83%**	**$56B**	**$47B**	**$15B**	**26.7%**	**32.0%**

This table summarizes performance measures by collateral type.
Sources: Intex (as of May 2011), Merrill (2004), PF2,

Table 7

Comparison of Bank and Thrift Failures TruPS CDOs Vs. All Bank and Thrift Failures 2007--April 2011		
Category	**Banks and Thrifts in TruPS CDOs**	**Total FDIC-Insured Banks and Thrifts**
Total Banks and Thrifts	1,813	8,171
Total Failed Banks and Thrifts	176	383
Failure Rate	9.7%	4.7%

Notes: This table compares failure rates on banks and thrifts in TruPS CDOs to failure rates on all commercial banks and thrifts. Figures for TruPS CDOs are taken from Fitch (2011). Figures on FDIC-insured institutions are taken from FDIC (2011).

Table 8 - Model Validation Comparison with Moody's

Validation Moody's versus Model forecasts			
Statistics		**% Difference**	**Frequency**
Mean	-4.44%	(28%)	1
Standard Error	0.72%	(25%)	0
Median	-3.10%	(22%)	1
Standard Deviation	6.69%	(19%)	0
Range	40.57%	(16%)	2
Minimum	-27.76%	(13%)	6
Maximum	12.81%	(10%)	6
Count	87	(7%)	8
		(4%)	17
		(1%)	25
		2%	11
		5%	7
		8%	2
		11%	0
		14%	1
		More	0

This table provides statistical comparisons of the expected collateral losses between Moody's and the our model for 87 bank TRuPS CDOs reported by Fitch in May 2010. On average, our model had a 4.4% lower expected collateral loss than Moody's. Sources: Moody's Credit Performance Report 05/21/10, Intex, First Tennessee (FTN).

Table 9 – TruPS Loss Estimates

TruPS CDO Bonds Summary Loss Estimates
April 2011

Forecasts	N	Current Balance ($Million)	% Bonds	% Balance	Loss Forecast ($Million)
Full Write Down with Existing D/D	327	$11,836	42%	24%	$11,836
Partial Write Down with Existing D/D, Full W/D with Forecast	110	$6,396	14%	13%	$6,396
No Write Down with Existing D/D, Full WD with Forecast	15	$629	2%	1%	$629
Write Downs >50%-99% with Forecast	27	$2,754	3%	5%	$1,904
Write Downs >0%-50% with Forecast	27	$3,470	3%	7%	$648
No Write Down with Forecast	279	$25,097	36%	50%	$0
Totals	**785**	**$50,182**	**100%**	**100%**	**$21,413**

Notes: This table computes losses by bonds based on the extent of the write downs, factoring in if the extent to which the write downs are a result of exisiting defaults and deferrals (D/D) or if it is the result of the forecast losses. For two bonds we did not have information to compute losses.
Source: Intex, FTN (2011)

Table 10 TruPS Loss Estimates by Seniority

TruPS CDO Tranche Loss Estimates by Seniority/Original Rating					
Current Subordination vs. Default Analysis	Intex Base Deal Adjusted Default Curve Analytics				
	No WD	< 50% WD	< 100% WD	Full WD	Total
Sr. AAA					
No Write Down	108	11	5		124
Partial Write Down	1	3	1		5
Total Sr. AAA	109	14	6	0	129
% Total	84%	11%	5%	0%	**129**
Jr. AAA					
No Write Down	87	4	2	9	102
Partial Write Down	3	1	1	9	14
Full Write Down				2	2
Total Jr. AAA	90	5	3	20	118
% Total	76%	4%	3%	17%	
AA					
No Write Down	24	1		4	29
Partial Write Down	13	2	5	24	44
Full Write Down				14	14
Total AA	37	3	5	42	87
% Total	43%	3%	6%	48%	
A					
No Write Down	25	1	3	1	30
Partial Write Down	6	2	5	69	82
Full Write Down				115	115
Total A	31	3	8	185	227
% Total	14%	1%	4%	81%	
BBB					
No Write Down	9			1	10
Partial Write Down	1			6	7
Full Write Down				80	80
Total BBB	10			87	97
% Total	10%			90%	
BB					
No Write Down					0
Full Write Down	1			20	21
Total BB	1			20	21
% Total	5%			100%	
Equity					
Partial Write Down	2	2	5	2	11
Full Write Down				95	95
Total Equity	2	2	5	97	106
% Total	2%	2%	5%	92%	

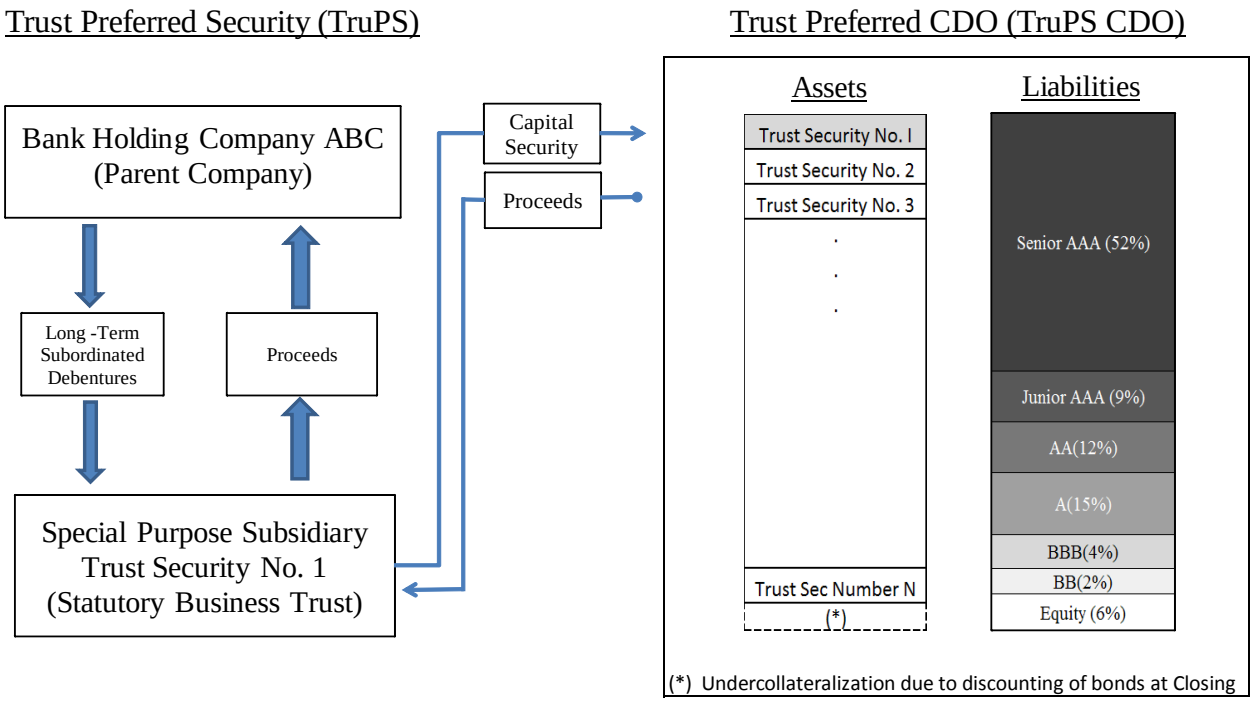
Notes: This table summarizes TruPS CDO losses by original bond rating, classifying them between the extent of the write down.
D/D = Defaults plus deferrals; WD = Write Down.
Sources: Intex, FTN (2011)

Table 11

TruPS CDO Weighted Average OTTI Value by Percentage of Deal Default Curve										
Original Rating	Current Face in $mm	# of Bonds	Percentage of Base Deal Default Curve							
			0%	25%	50%	75%	100%	125%	150%	175%	200%
Sr. AAA	21,777	129	99.96	99.59	99.06	98.31	97.23	96.06	94.52	92.61	90.28
Jr. AAA	6,479	118	98.34	97.79	96.72	95.03	93.36	90.49	87.36	82.92	78.37
AA	3,902	87	88.87	82.53	74.29	65.55	56.22	46.42	37.27	30.72	25.95
A	10,198	227	57.78	49.36	41.65	34.98	29.60	25.52	22.53	20.23	18.45
BBB	2,909	97	27.16	21.07	17.78	15.27	12.98	11.19	9.68	8.96	8.38
BB	543	21	6.02	2.67	1.21	1.18	1.18	1.18	1.18	1.13	0.45
Equity	4,375	106	6.76	6.04	5.39	4.90	4.45	4.04	3.64	3.25	2.94

Notes: This table summarizes other than temporarily impaired (OTTI) prices by original bond rating and the percent of the deal default curves, ranging from 0% (only considers existing defaults) to 200%.
Some Equity classes (mostly insurance) have OTTI values but the deals do not have BB bonds
Source: Intex

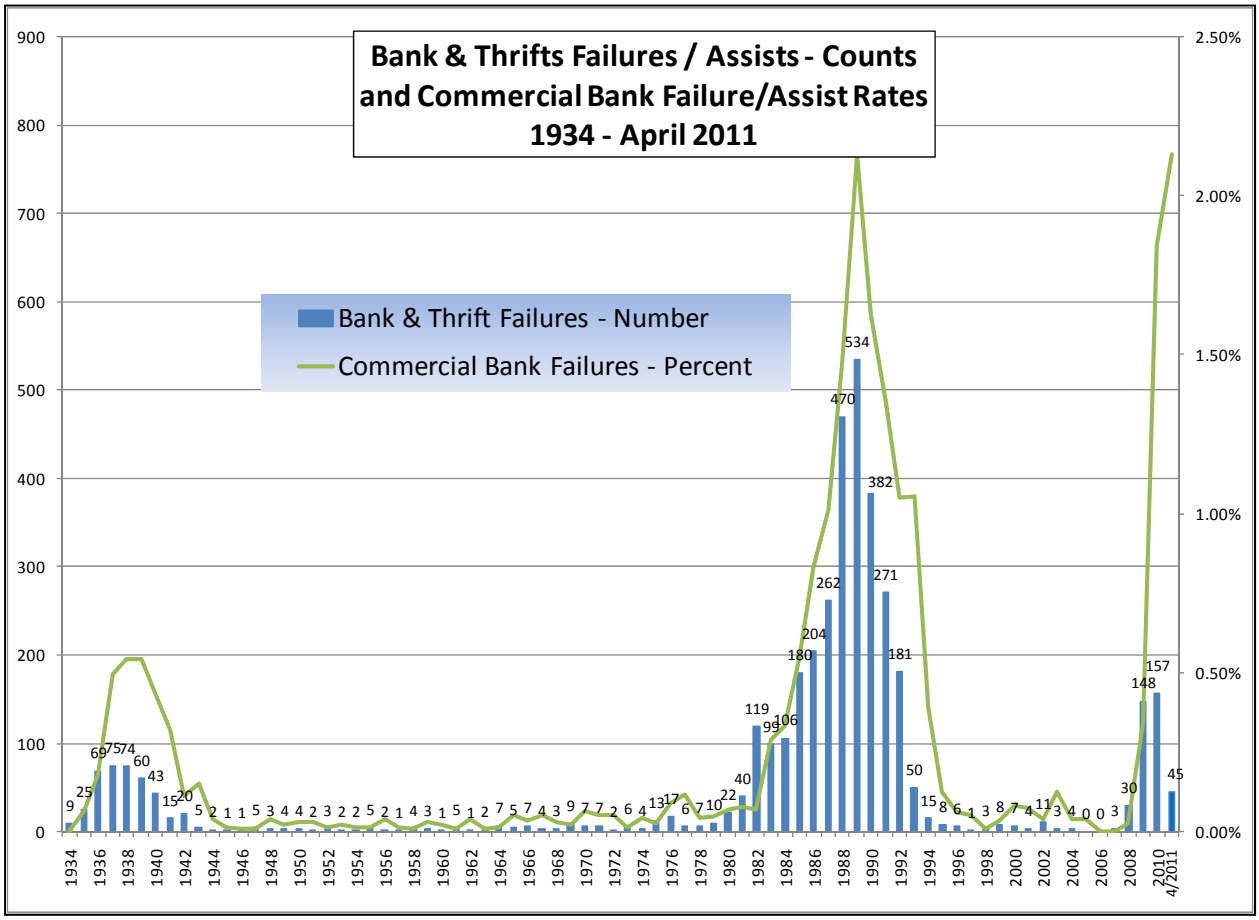
Figure 1 - Capital Structure of a Trust Preferred Security and Trust Preferred CDO



Notes: Tranche percentages are industry averages computed from Intex.

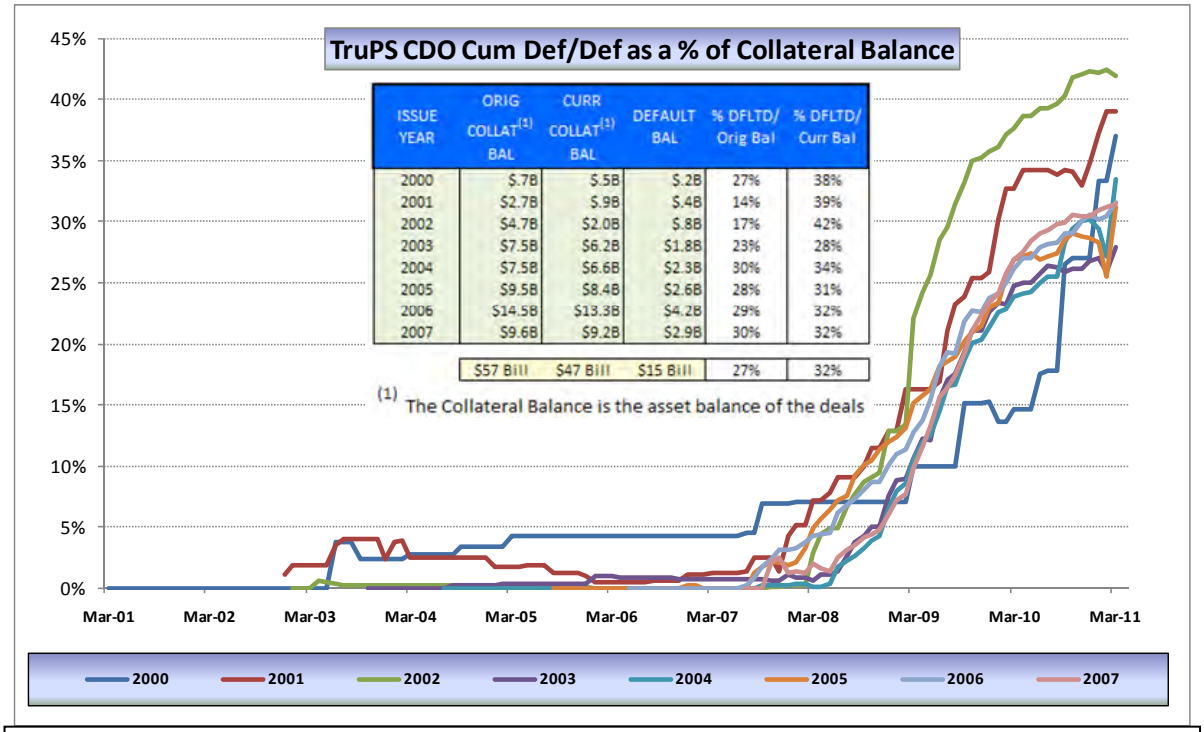
This illustration shows the capital structure for a trust preferred CDO.

Figure 2 - Bank and Thrift Failures



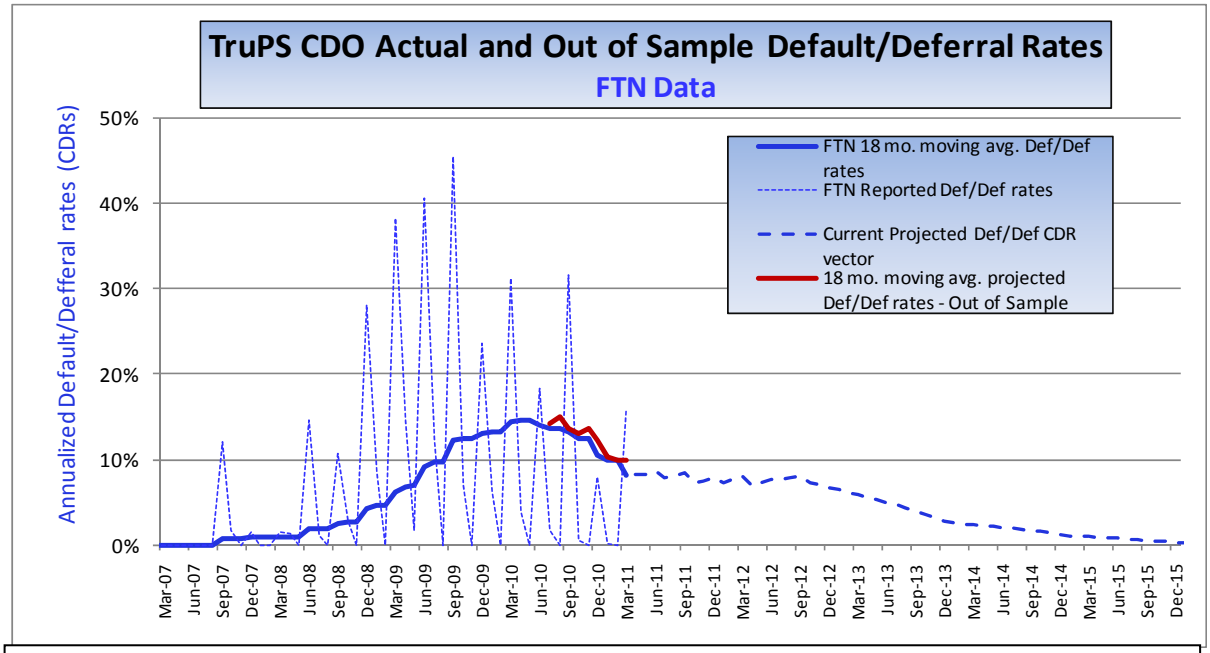
This graph illustrates the highly correlated relationship between bank and thrift failures and failures at commercial banks.
Source: FDIC

Figure 3 - TruPS CDO Cumulative Defaults/Deferrals/Downgrades



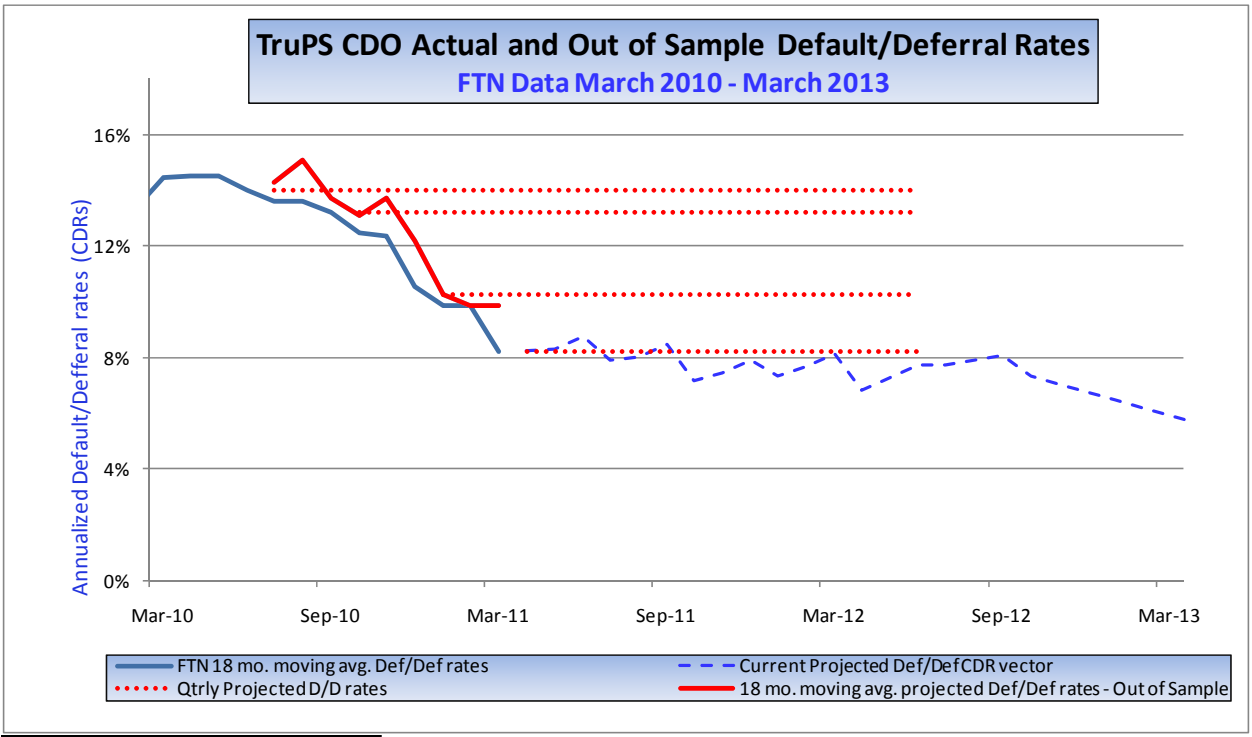
This graph shows the trust preferred CDO cumulative defaults and deferrals.
Sources: Intex and FTN 2011

Figure 4 - FTN Default and Deferral Data and Projections



This graph shows the model, the historical data used to create the model, and the out-of-sample comparison (in red).
Sources: Intex and FTN 2011

Figure 5 - FTN Default and Deferral Data Out-of-Sample Results

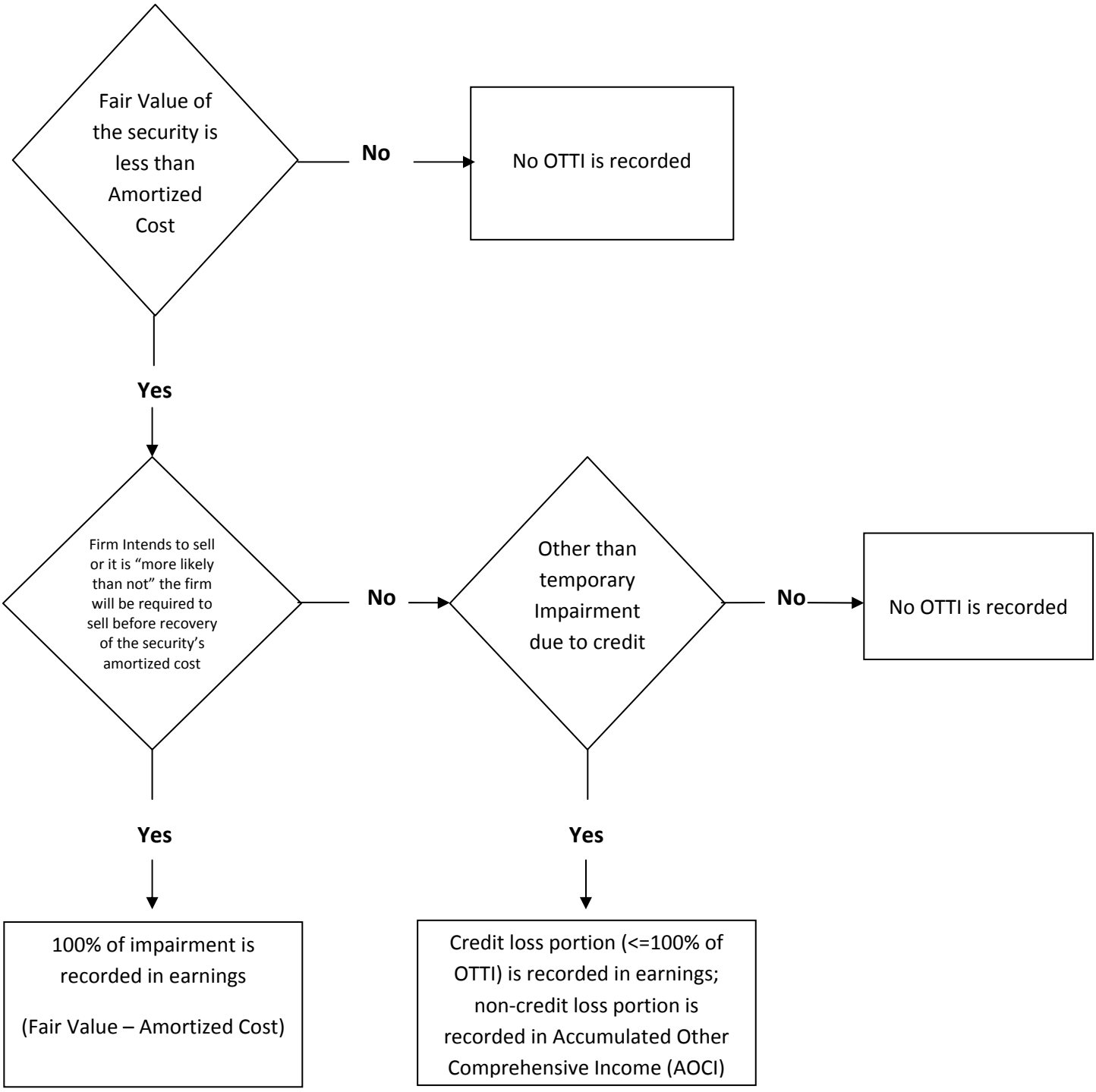


Sources: Intex and FTN (2011)

This graph shows the quarterly projections compared against actuals. The dotted line shows the unit root short-term forecast. The 18-month moving average actuals are in blue. The 18-month moving average forecast is in red. The blue dotted line is the forecast past June 2012.
Sources: Intex and FTN 2011

Figure 6

OTTI Decision Tree for Available for Sale (AFS) and Held to Maturity (HTM) Debt Securities
Recognition and Presentation of Other-Than-Temporary Impairments



Source: Financial Sector Analysis, Federal Reserve Bank of New York.

This flow chart demonstrates the FASB 157 OTTI accounting implications for AFS and HTM securities.