Credit Risk Transfer, Informed Markets, and Securitization

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Abstract
Mortgage backed securities (MBS) funded the US housing bubble, while the bust resulted in systemic risk and the Global Financial Crisis. The pricing of MBS and the ABX securitization index failed to reveal growing credit risk. This paper draws lessons from this failure for the use of Credit Risk Transfers (CRT) to price credit risk. The central question is would the CRT market, as constituted today, have behaved differently than financial asset markets in the bubble years? If no, then this is a problem. If yes, then why?

I. Introduction

Across countries and over time, credit expansions have led to episodes of real estate booms and busts.[1] Ten years ago, the Global Financial Crisis (GFC), the most recent of these, began with the Panic of 2007.[2] The pricing of MBS had given no indication of rising credit risk. Nor had market indicators such as early payment default or delinquency – higher house prices censored the growing underlying credit risk. Myopic lenders, who believed that house prices would continue to increase, underpriced credit risk.[3]

In the aftermath of the crisis, under the Dodd Frank Act, Congress put into place a new financial regulatory architecture with increased capital requirements and stress tests to limit the banking sector's role in the amplification of real estate price bubbles (Duca et al. 2017, Calem et al. 2016). There remains, however, a major piece of unfinished business: the reform of the US housing finance system whose failure was central to the GFC. Fannie Mae and Freddie Mac, the government-sponsored enterprises (GSEs), put into conservatorship under the Housing and Economic Recovery Act (HERA) of 2008,[4] await a mandate for a new securitization structure. The future state of the housing finance system in the US is still not resolved.

Currently, US taxpayers back almost all securitized mortgages through the GSEs and Ginnie Mae.[5] While pre-crisis, as shown in Table 1, private label securitization (PLS) had provided a significant share of funding for mortgages, since 2007, PLS has withdrawn from the market (McCoy et al. 2017).

The appropriate pricing of mortgage backed securities can discourage lending if risk rises, and, potentially, can limit housing bubbles that are enabled by excess credit. Securitization markets, including the over the counter market for residential mortgage backed securities (RMBS) and the ABX securitization index, failed to do this in the housing bubble years 2003-2007.

GSEs have recently developed Credit Risk Transfers (CRTs) to trade and price credit risk. The objective is to bring private market discipline to bear on risk taking in securitized lending. For the CRT market to accomplish this, it must avoid the failures of financial assets to price risk. Are prerequisites for this in place? Moreover, how will CRTs fare under alternate scenarios of housing finance reform?

In the following, Section II describes the fundamental problem of nontransparent securitization that resulted in mispriced credit that contributed to the housing price bubble. Section III shows how the structure of securitization markets worsened this problem. Section IV compares CRTs to the securities markets that failed and examines GSE reform proposals to determine how they undermine or support the potential benefits of CRT trading.

II. RMBS Mispricing, the Lack of Transparency and Naïve Investors

While securities trading can price risk, in the run-up to the GFC, this did not happen. In order to draw lessons for credit risk transfer (CRT) markets as part of the reform of the housing finance system, it is necessary to understand why housing finance markets failed to price risk. Herring and Wachter (1999, 2003) show how housing finance ratifies and amplifies housing bubbles. Due to the heterogeneity of housing, lenders use "comparables," based on current market values to decide loan amounts, which creates a positive feedback loop between house price rises and lending expansions (Wachter 2016).

Housing markets are prone to bubbles. Due to high transaction costs and inelastic supply, housing prices (Glaeser, Gyourko, and Saiz 2008; Anundsen 2017) adjust slowly to changes in fundamentals, and are path-dependent and predictable (Case and Shiller 1989). Backward-looking price expectations result in buyers offering higher prices in markets where prices have increased after positive shocks. Optimistic buyers, subject to "bubble thinking," drive real estate prices up, even when prices exceed fundamental values.[6] Unlike in other asset markets, short-sellers do not counter optimist buyers. Even if homeowners recognize a bubble forming, they cannot short sell homes into the bubble and buy their specific home back at the bust, the short-sell exercise that works for commodity and financial asset markets to help keep bubbles in check. In this way, real estate markets are "incomplete."[7]

Optimist buyers affect market pricing when they have access to credit; without borrowed funding, buyers would soon be out of money.[8] The availability of lending at rates that underprice credit risk enables bubbles to build, whether financed on bank portfolios or through securitization.[9] Securitization provided funding in this bubble. While the GSEs and Ginnie Mae had provided securitization of long-term mortgages since the S&L debacle of the 1980s, in the run-up to this crisis, the structure of securitization had changed.

"Securitization was not new, but the explosion of private-label MBS was new and different than the traditional GSE-based securitization, especially when it came to the risks involved. As long as GSE securitization dominated the mortgage market, credit risk was kept in check through underwriting standards, and there was not much of a market for nonprime, nonconforming, conventional loans. Beginning in the 1990s, however, a new, un-regulated form of securitization began to displace the standardized GSE securitization. This private label securitization (PLS) was supported by a new class of specialized mortgage lenders and securitization sponsors … [the] PLS created a market for nonprime, nonconforming conventional loans7" (Mian and Sufi (2015, p. 97).[10]

Without enforced standards, "originate-to-distribute" lenders competed for fees by offering easier lending terms (Wachter 2013). With lowered lending constraints, borrowing expanded both to new (previously unqualified) borrowers and to existing borrowers who could now borrow more, both homeowners and house flippers (Lee, Mayer, and Tracy, 2012; Albanesi, De Giorgi, and Nosal, 2017) and, as a result, housing demand and prices in increased beyond levels justified by long-term fundamentals.[11]

The price of credit risk, as identified by residential mortgage backed securitization (RMBS) data, did not increase with the explosion of credit. As seen in Figures 1a and 1b, using loan-level data from a major American bank's issuance of RMBS, the risk mark-up did not rise over the years 2001 through 2006, and coefficients of LTV ratios and FICO scores remained relatively constant and decreased, respectively (Levitin, Lin and Wachter 2017).

The easing of credit constraints and the underpricing of credit risk on mortgage loans both led to higher housing prices (Pavlov and Wachter 2011), reinforced by backward looking expectations, and, in a positive feedback loop, to further increases in credit supply. By the beginning of 2006, as the demand of previously constrained borrowers became satisfied, the pace of increases in demand slowed and prices leveled out; in April 2006, as interest rates rose, prices began to fall (Figure 2). In 2007, with prices flattening in some markets and declining in others, the capitalization of expected future house price gains into current prices could not hold; price declines accelerated and financial firms providing nontraditional mortgages (NTMs) faltered, as investors and rating agencies questioned their viability.[12] The Panic of 2007 began in July with rating agencies announcing that they no longer could provide ratings for RMBS securities, and, with the failure of PNB Paribas, which along with other European banks, had invested heavily in US RMBS.

By 2008, the implosion of mortgage firms, shut out of capital markets, prevented risky buyers from borrowing, leading to defaults, further housing price declines, construction halts, and further financial distress among lenders. The 2008-2009 economic downturn resulted in additional unemployment and a massive rise in foreclosures as unemployed borrowers could not pay back or, given price declines, refinance their mortgages. With foreclosures and increased supply on the market, prices fell further and more financial firms failed. A self- reinforcing downward spiral was in place.

The yields on RMBS, along with the underlying mortgage yields, as shown in Figure 3, had not identified the growing risk. "Investor tapes" (according to US Court of Appeals for the 2nd District 2017) included invalid and unverifiable data: Debt to income (DTI) ratios were not verified and combined loan to value (CLTV) ratios not available (Levitin and Wachter 2012, 2015). The lack of data on loan terms, the multiplicity of instruments and complexity of loan underwriting terms made it difficult to track the aggregate credit risk related to loan terms and borrower characteristics.

Moreover, PLS traded infrequently and over the counter and were marked to "model" rather than to market; and given the lack of standardization, no widely reported measure of risk premiums existed (Davidson et al. 2014). The structural complexity of the private-label mortgage securitization system – which included not only mortgages securitized as MBS, but also MBS securitized as collateralized debt obligations (CDOs), CDOs securitized as CDO^2 and the inclusion of credit default swaps (CDS) into CDO contracts made monitoring counterparty risk difficult (Cordell, Huang and Williams, 2012). Packaging of risky BBB tranches of RMBS into CDOs led to more risky credit, rated as AAA, and held in asset-backed securities (DiNardo et al. 2009). The lack of transparency on credit expansion enabled market participants to ignore growing risk, as long as housing prices continued to rise. For naïve investors, the supply of

private label RMBS and CDOs satisfied a global demand for highly rated and apparently safe U.S. dollar denominated debt (Pavlov et al. 2011).

Through the bubble years, aggregate debt of households increased relative to GNP as did the debt of financial firms. As shown in Figure 4, overall household debt to GDP more than doubled (from 44 % to 91 % with the increase composed entirely by mortgage debt, as consumer debt decreased with credit consolidation), as housing prices relative to fundamentals exploded. Naïve investors in RMBS, however, would not have looked to these readily available simple aggregates to evaluate the underlying collateral default risk in housing markets. Financial firms (McCoy et al. 2008), as shown in Figure 4, also leveraged up to provide these loans (unlike corporations or the federal government whose debt ratios to GDP remained constant over these years) and were exposed to warehouse risk as they packaged RMBS into CDOs, increasingly insured against default risk by credit default swaps.

III. CDS Mispricing and Market Structure

CDS issuance skyrocketed over the years 2002 to 2007; the two years, 2005-2007 witnessed a tenfold increase in the issuance of CDS on MBS (BIS 2013). Contrary to the standard intuition, CDS premiums were insensitive to the underlying mortgage credit quality. Loans packaged in MBS that had CDS available substantially under-performed other securitized loans (Arentsen et al. 2015). Not only were the financial institutions providing CDS taking on more risk at lower premiums, they were also apparently doing so with less screening than undertaken by securitizers. They were also expanding the share of RMBS insured by CDS. Arentsen documents that CDS as a share of RMBS issued increased, until by 2006, CDS insured over 50% of RMBS. The failure of RMBS, discussed above, to price growing risk may reflect naïve investors, reliant on ratings; it may also reflect the growing use of CDS, which seemingly de-risked RMBS. This does not explain, however, CDS pricing, since in this case sellers were often large international financial firms.[13]

Competitive insurance (guarantor) firms, like naïve investors, might not look to aggregate measures such as the rise in debt to GDP ratios or the rise in the price of housing relative to income and rents (or adjust for declining user costs due to lower interest rates and backward-looking expectations), in determining their provision or pricing of CDS. Rather, competitive firms might rely on the available characteristics of the mortgages they were insuring (FICO score and LTV) and expected (rating firm estimated) losses on these and their issuance costs relative to market insurance premiums (fees). Similarly, to bank lenders and naïve investors, they might take housing prices as given without factoring in growing aggregate lending risk (Wachter 2014).

Most guarantor firms, however, were large and clearly exposed to growing risk. Managers of firms facing a large share of the market would have been aware of the growth of the CDS market and aggregate credit and increasing correlated risks. Yet, the actions of these large firms did not account for increasing risk. Pavlov, Schwartz and Wachter (2017) rationalize this using a risk-shifting argument. In this model, a financial institution generates positive profits from intermediation business, and is capable of issuing CDS, without a regulatory requirement of actuarially fair reserves. The optimal credit default swap premium such a financial institution

requires in order to assume the default risk of fixed income instruments is a function of the institution's capital (reserves) and current exposure. Hence, institutions generally require an increasing premium to assume additional risk.[14] However, if the financial institution already has a large CDS exposure and is under-capitalized, further issuance comes at a lower premium.[15] An under-capitalized institution that already has substantial default risk exposure would engage in risk shifting (to purchasers of CDS who are now exposed to counterparty risk) and assume more risk at lower rates to gain the short-term fees associated with the issuance of CDS.

Effectively, once a firm receives a negative signal about the value of the underlying mortgages, the firm issues more CDS at a lower premium, making cheap financing easily available. In other words, the presence of a financial institution with large default risk exposure in the market reduces the premium required to insure additional risk. Therefore, negative signals about the default risk of the debt instruments increase the quantity of insured instruments but do not increase the default insurance premium.[16].

This risk-shifting mechanism is consistent with the stylized facts observed in the GFC, including the explosive growth in CDS and the constant risk premiums on the underlying RMBS. It is also consistent with the stable pricing of an index introduced to trade CDS, at least through mid-2007. In January 2006, Markit, in collaboration with a group of major banks, launched the ABX.HE ("the ABX"), referencing the pricing of 20 specific home equity RMBS deals, including some of the largest deals during this period. The overall index incorporated a basket of indices, differentiated by credit risk rating.

At the onset, the purpose of the ABX was to create transparency, in the, as discussed above, otherwise opaque OTC market for credit risk, with daily updates on pricing. The ABX would provide a forum for market-based price discovery of mortgage credit risk, allowing market participants, insurers and supervisory authorities to identify and price the aggregate risk profile of the market.

The pricing of CDS, despite the daily updates and the growing volume, was notably constant as shown in Figure 4; until the collapse of the CDS providers, prices persisted unchanged from issuance value. While pricing was now transparent, the underlying characteristics and risk profile of the mortgage book of business was not, nor was the growing counterparty risk. The issuers of CDS had an incentive to increase the supply of insurance, which resulted in a lower price of insurance. The greater the risk of price declines and a future credit collapse, the greater the incentive to increase effort to provide credit and receive fees.

Short sellers like Ackman did eventually succeed in putting sufficient downward pressure on CDS providers to cause the counterparty risk to be exposed but the harm was done.[17] With the ensuing collapse of CDS providers, ABX pricing deteriorated quickly. Financial markets then used the ABX as a valuation and accounting standard to write down CDS and RMBS holdings. As the only source of market-based pricing, major CDS dealers relied on the ABX to account for losses. The ABX did bring market pressures to bear on pricing of RMBS, albeit in the aftermath of the crisis. After August 2007, CDS pricing identified an increase in systemic risk (Giglio 2010), although as Stanton and Wallace (2011) observe, the ABX indices were minimally correlated to the actual performance of the RMBS that they referenced, as they priced in the fear and uncertainty associated with the crisis.

The question is whether market-based price discovery and the trading of similar financial derivative instruments, such as CRTs, would have prevented the build-up of risk and the crisis from occurring in the first place. Alternatively, would the presence of naïve investors and financial institutions (with misperceived fortress capital) that write insurance no matter what, prevent risk from being appropriately priced?

IV. CRTs and The Restructuring of the GSEs

As the GFC unfolded, the US government put the GSEs, Fannie Mae and Freddie Mac, into conservatorship, under the Housing and Economic Recovery Act of 2008. As housing prices fell, the solvency of the GSEs was in question due to the correlated risks created by the credit expansion, their expanded guarantees (particularly of the 2007 book of business) and the GSEs purchase of private label MBS for portfolio investment (Frame et al.). As a result, together with FHA loans securitized by Ginnie Mae, the US taxpayer became responsible for the credit risk of almost all mortgages securitized in the US.[18]

In response to this exposure, the Federal Housing Finance Agency (FHFA), the GSEs regulatory overseer, in 2012 called for credit-risk transfer (CRT) programs, as a means to off-load some of that credit risk to the private sector. Fannie Mae and Freddie Mac now each allocate risk to private investors through CRT vehicles, predominantly Connecticut Avenue Securities (CAS) and Structured Agency Credit Risk (STACR), respectively (FHFA, 2015). Fannie Mae and Freddie Mac issue CRTs as unsecured debt obligations whose returns are tied to underlying reference loan pools, with payments determined by loan performance and repayments of the underlying reference pools. Figure 6 shows the credit spread at issuance of the M2 (lower rated mezzanine tranche) of the CAS security and its tightening over time relative the credit default swap index (FHFA 2017).

The structuring of CRTs enables markets to trade and price both credit risk and interest rate risk. Borrowers must ultimately pay for both. Particularly, the affordable pricing of long-term fixed rate mortgages requires the efficient pricing of credit *and* interest rate risks. With no taxpayer or government exposure, investors price and bear interest rate (and prepayment) risk through an efficient so-called TBA market.[19] This requires standard mortgages, with relevant information (such as date and interest rate) available, so that it is possible to estimate interest rate risk, but without other individual loan information, which would fragment the pool into separate securities, decreasing liquidity. The efficient pricing of interest rate and prepayment risks is central to the delivery of housing finance for long-term fixed rate mortgages. CRTs do not interfere with the TBA market given that CRT returns are separately determined based on portfolio performance of already issued RMBS.

The private label RMBS market conflated interest rate and credit risk, making a separate pricing of each difficult.[20] The question is whether the CRT market can, similarly to the TBA market, price and take on credit risk efficiently. This is likely to depend on the securitization and regulatory structures put into place by GSE reform.

The trading of CRTs currently provides information about what private capital markets would charge for the credit risk generated by the credit guarantee business of the GSEs (as well as sharing that risk). CRTs' relationship to the risk of the default of the underlying mortgages is clear, with credit losses born by CRTs tied to specific portfolios of GSE loans whose characteristics are known, tracked and available to investors, an important contrast from the earlier PLS.

As a result, CRT pricing helps identify market perceptions of the risk of mortgage lending based on the GSEs' portfolios. This too is in contrast to the lack of a traded security to enable price discovery, at least until the ABX was in place. The market implied pricing of CRTs, when compared to the GSEs' pricing of credit risk, through the GSEs' g fees, can determine whether GSE pricing of credit risk is in line with market perception of risk. There are now several entities, notably the American Enterprise Institute and the Urban Institute, that evaluate this risk in an ongoing way based on the characteristics of securitized credit (Oliner et al,; Goodman et al.). This is possible because the characteristics of the underlying securitized credit are standardized and transparent. The CRTs assured payout avoids counterparty risk and incentives to underprice CDS (Wachter 2017).

Going forward, the restructuring of the GSEs will interact with the functioning of CRT markets. GSE reform proposals differ on the structure of securitization markets, and, specifically, on whether there should be one, a few or multiple guarantors. In other dimensions, proposals have coalesced on elements of what is necessary for a securitization market to succeed (McCoy and Wachter, 2017). There is, for example, agreement across proposals on the necessity of a role for TBA markets for efficient pricing of interest rate risk. Two proposals explicitly call for mandatory CRTs and others, for their use to some degree, as discussed below. There is also agreement regarding private capital (in some form) in a first-loss position to absorb downturns in the MBS market in order to limit taxpayer losses, as well as the use of a common securitization platform (CSP) to provide enhanced transparency. There are major disagreements on the structure of the guarantor market, specifically, as noted, on the number and on the oversight of credit pricing by the regulators. The lessons of the recent crisis show that these differences may matter for the functioning of the CRT market.

One plan (Parrott et al. 2016) proposes a regulated government corporation, tentatively named the National Mortgage Reinsurance Corporation (NMRC), which would combine Fannie Mae and Freddie Mac. Although the authors envision the NMRC as free from the profit-driven or market share-driven motives inherent in a stock corporation, they contemplate private investment in NMRC consisting of common equity of 3.5% and preferred equity of the same percentage. The NMRC would perform the same core functions as the GSEs to buy and pool loans, issue MBS, and oversee master servicing activities. A second plan, developed by Andrew Davidson (2017) and based on earlier proposals from NY Fed researchers (Mosser, Tracy, and Wright 2016) is for one or more mutual companies that would replicate the functions of today's GSEs and the functions of the otherwise similar NMRC proposal. The third, the Milken Institute proposal (De Marco and Bright 2016), puts forth GNMA as a platform for the CSP and calls for multiple guarantors. A fourth proposal from the MBA (2017) has come out in favor of multiple guarantors as well, with all guarantors using the CSP, under a government wrap. Finally, a fifth,

Moelis (2017), offers a plan that would essentially reform the existing two entities, along current lines, but with private capital restored.

The eventual structure of the GSEs will influence how well the CRT market works or even whether the market can work at all. With multiple guarantors, it would be difficult to maintain a robust CRT market, as well as a TBA market (Kanojia and Grant 2016), simply because liquidity declines with multiple issuers. This problem would worsen if firms could choose their portfolio composition, lending terms and risks, and the g fees associated with the mortgages they underwrite. If there are multiple firms each offering their own CRT programs that are geographically concentrated, and if there is an income shock to their geography, there is likely to be an outflow of capital, which would lead to a reinforcing downward price spiral given the path-dependency of housing prices (Pavlov, Wachter and Zevelev 2016). While g fees might signal such risk, the path dependency of prices would reinforce the withdrawal of funding to riskier markets. Riskier markets would also experience a disproportionately widening of risk premiums, with a national slowdown of growth. Guarantors would have to raise their g fees at a time of regional market or national distress, leading to self-reinforcing decreases in house prices and declines in credit provision.

One way to avoid this outcome is to require tight regulation of multiple firms on mortgage criteria and to require the same mortgage g fees and lending rates (given mortgages terms and characteristics) reflecting the characteristics of the pooled portfolios of the firms, much as Ginnie Mae functions today through FHA enforcement of mortgage terms across all issuers. This option could indeed work and the CRT market could price credit risk in the overall book of business, consistent with the proposals that put forth more than a few guarantors. With the regulatory setting of standardized lending standards and g fee pricing, multiple guarantors can issue CRTs referenced to the market wide book of business, with the market pricing of CRTs providing feedback to regulators about credit risk.

In this regulatory set-up, g fees are determined either at the discretion of regulators or in a nondiscretionary way, with g fees linked to CRT pricing. Currently GSEs have discretion in issuing CRTs and linking CRT pricing to the setting of g fees. Restructuring, as called for in several of the reform proposals, with CRT pricing automatically linked to mortgage interest rates, may reintroduce instability into markets. As demonstrated by ABX pricing after the crisis, periods of market uncertainty translate into illiquid markets. Increases in the cost of credit affect housing prices and credit flows in turn, leading to reinforcing downward spirals. Reform proposals suggest circuit breakers to limit this destabilizing effect. The Parrott et al. proposal states that, in the case of interest rates increasing beyond a certain point, the NMRC should hold g fees constant thereafter.[21] However, having the government guarantee mortgage rates as risk increases to limit housing price declines would help private sector holders of CRTs and would increase taxpayers' risk exposure. On the other hand, as described above, it is possible to conjure a scenario in which the discretionary underpricing of credit by one or a few (or many) guarantors for market share or short term fees destabilizes markets in the long term. With few or many guarantors, naïve investors and path dependent housing prices, a role for macro prudential supervisory oversight of housing finance markets, informed by credit risk trading, remains.

V. Conclusion

The GFC began a decade ago. Along with the failure and bailout of many private sector financial institutions, the US government put the GSEs, Fannie Mae and Freddie Mac, into conservatorship under the Housing and Economic Recovery Act of 2008. Historically and across countries, real estate markets have been subject to bubbles, which have resulted in financial busts; in the GFC, mortgage backed securitization shrouded growing credit risk and amplified the real estate bubble. Going forward, well-structured securitization markets, such as the credit risk transfers (CRTs) established by the GSEs, can price and reveal credit risk.

A requirement, to avoid the pitfalls of the past mispricing of credit risk, is transparency. The full provision of information on the mortgages in the GSE portfolios referenced by CRTs does this (along with information on portfolio lending and other providers of finance). Standardization allows the tracking of aggregate credit risk, as currently provided by the predominance of the GSEs and Ginnie Mae, and, going forward, potentially enabled by the Common Securitization Platform. Second, credit risk instruments need to trade with open pricing in liquid markets, unlike in the crisis, where credit risk instruments traded over the counter. This too is in place. Third, the CRT market needs to avoid counterparty risk and incentives to underprice credit. As currently constituted, this is not a concern.

Nonetheless, the future structure of the GSE market will affect whether CRT markets can work to limit credit risk. CRTs issued by multiple guarantors may not be liquid and their pricing in times of distress may destabilize markets.

CRT markets, if appropriately structured, can signal a heightened likelihood of systemic risk. Capital markets failed to do this in the run-up to the financial crisis, due to misaligned incentives and shrouded information. With sufficiently informed and appropriately structured markets, CRTs can provide market based discovery of the pricing of risk, and, with appropriate regulatory and guarantor response, can advance the stability of mortgage finance markets.

[1] See Herring and Wachter (1999).
[2] See Cordell, Huang and Williams (2011).
[3] See Pavlov and Wachter (2007).
[4] See Frame, Fuster, Tracy and Vickery (2015) for a description of the process and its limitations.
[5] This does not take into account the credit risk covered by PMI. This is an alternative way to bring private capital into a risk-taking position ahead of the taxpayer.
[6]See Hendershott and Slemrod (1982) and Poterba (1984). Gallin 2008 shows that deviations between prices and rents have predictive power for future price changes.
[7]See Jeske, Krueger and Mitman for a discussion of housing as an incomplete market..
[8] Herring and Wachter (1998) shows how portfolio gains due to price rises cause lenders to believe that they have more than sufficient capital and encourage them to lend more, with shocks and price declines then leading to bank decapitalization, sudden halts to lending and reinforcing price declines. See Bernanke, Gertler, and Gilchrist (1999) for a general discussion.
[9] Concurrent real estate bubbles in Europe were bank financed (Wachter 2015), but securitization markets provided funding in the US mortgage lending expansion.
[10] As a percentage of all MBS issued, it increased from less than 20 to over 50 percent from 2002 to 2006, before collapsing entirely in 2007 (Levitin and Wachter, 2012).
[11]See McCoy et al. (2008) for a discussion of how deregulation resulted in the easing of lending terms. The literature that analyzes the impact of easier access to credit on house prices increases includes Albanesi, DeGiorgi and Nosal (2016), Anenberg et al. (2016), Adelino, Schoar and Severino (2016) and Pavlov and Wachter (2006).
[12] The passage of state level antipredatory legislation appears to have also slowed the growth of nontraditional lending (Acolin et al. 2017).
[13] As noted, RMBS and CDOs traded over the counter and infrequently and were less a vehicle for trading than for funding savings vehicles with highly rated US securities. CDS also traded over the counter sold by global financial entities. Bond guarantors, such as AIG, and the mono-lines, AMBAC and MBIA, provided CDS, insuring investors in private label RMBS and CDOs against default of the underlying securities (FCIC 2011).
[14] Historically managers of insurance firms appear to reserve for risk conservatively, as is explained by their incentive to stay in business (Kunreuther et al. 2013).
[15] The structure of compensation incentives at these firms magnified the problem. A partnership model might have performed better by making management hold their wealth in the firm.
[16] For this to occur, buyers of CDS from such institutions and their lenders would need to be naïve and blind to growing counterparty and default risk or would need to assume bail-outs would ensue with failure.
[17] See Ackman (2008) on what information was available to the market and the decision to short CDS.
[18] PMI provides additional coverage.
[19] With average daily trading volume nearly equal to half that of US treasuries, the liquidity and size of the market enable efficient pricing of interest rate and prepayment risks (Kanojia and Grant 2016). The cost is borne by borrowers and is approximately equal to that of 10-year treasuries, augmented by the prepayment risk premium, which covers borrowers' option to prepay absent on treasuries. See Kanojia and Grant for a discussion of the TBA market.
[20] In addition, naïve investors in AAA tranches may have believed that they faced exposure only to interest rate and prepayment risk.
[21] The fee for the government's tail insurance should be priced through the cycle and therefore would not change due to a downturn in the housing market. The portion of the guarantee fee that would re-price would be the expected loss component. A major component of the fee is the required return on the

guarantor's firm capital. The degree to which this re-prices likely depends on whether one is relying on external or internal capital financing. Internal capital can be more long-term and through the cycle.

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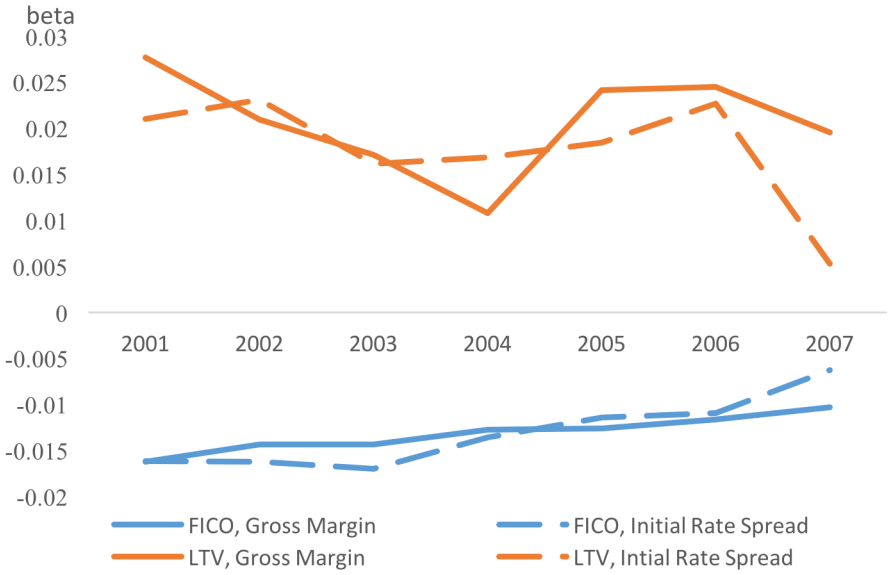
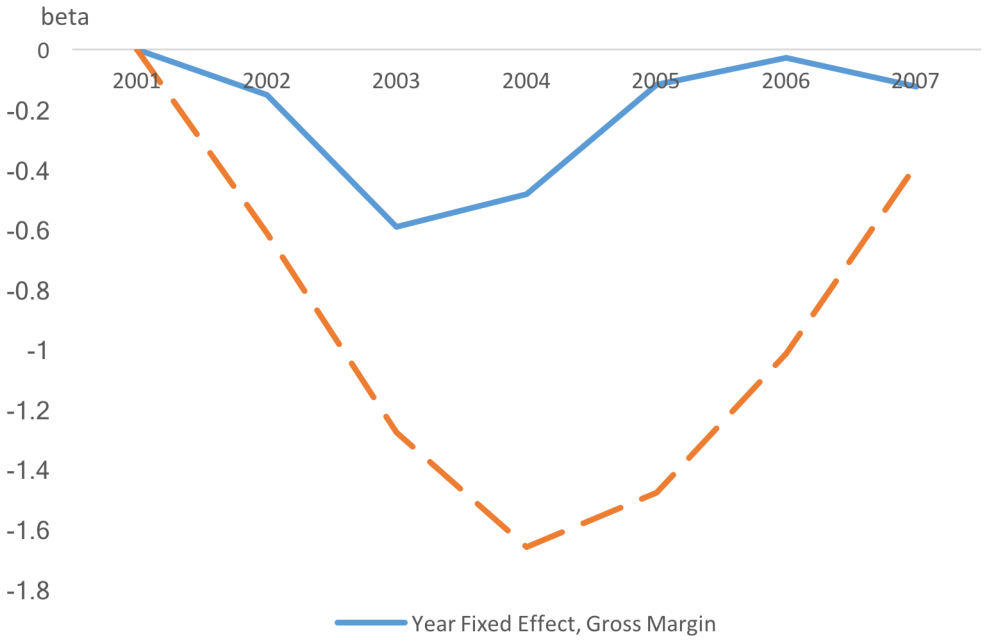
Figure 1a



Note: dependent variables are gross margin (solid) or initial rate spread (dashed). The beta reflects the response of the dependent variable to one unit change in FICO/LTV, *ceteris paribus*.
Source: Levitin, Lin and Wachter (2017)

Figure 1b



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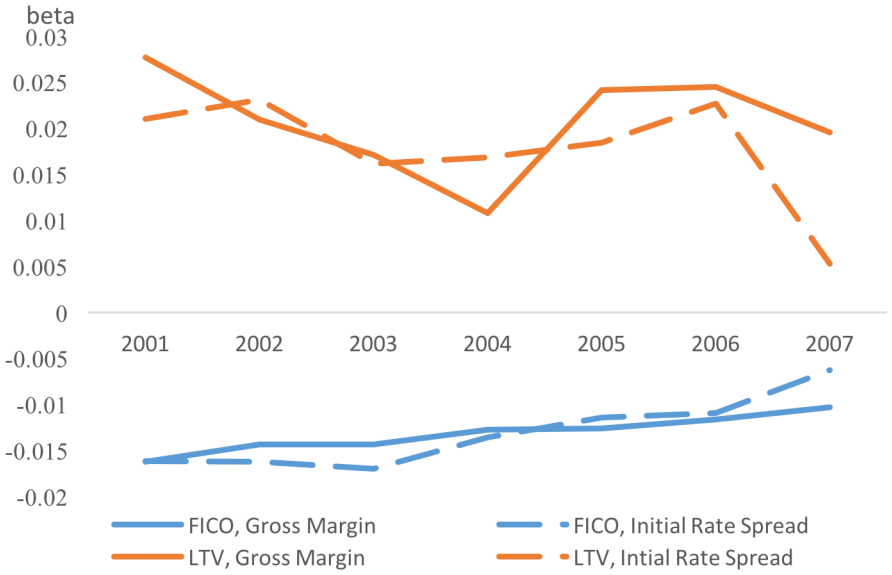
Source: Levitin, Lin and Wachter (2017)

Figure 1a



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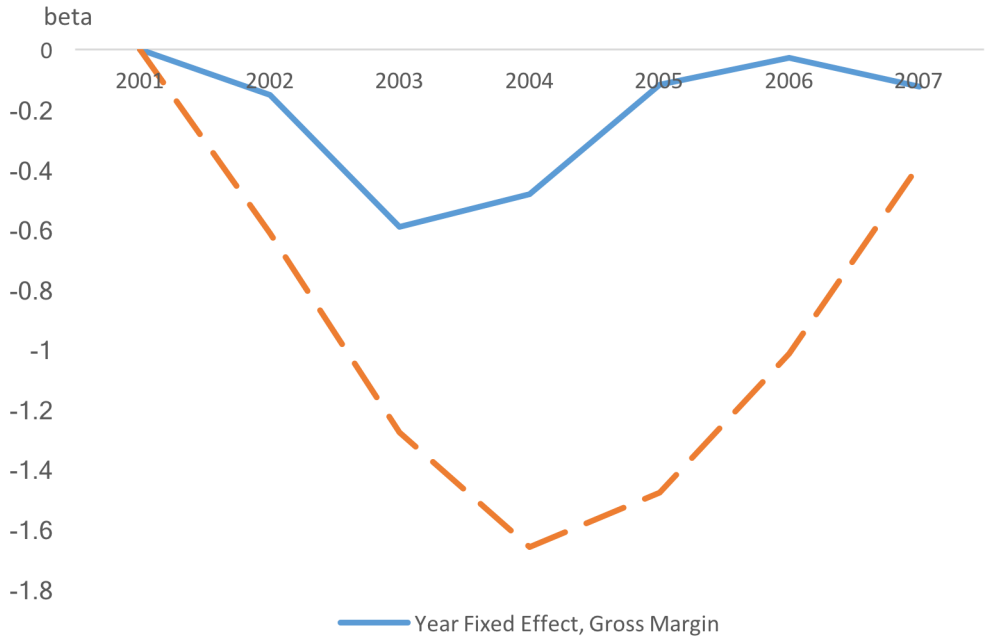
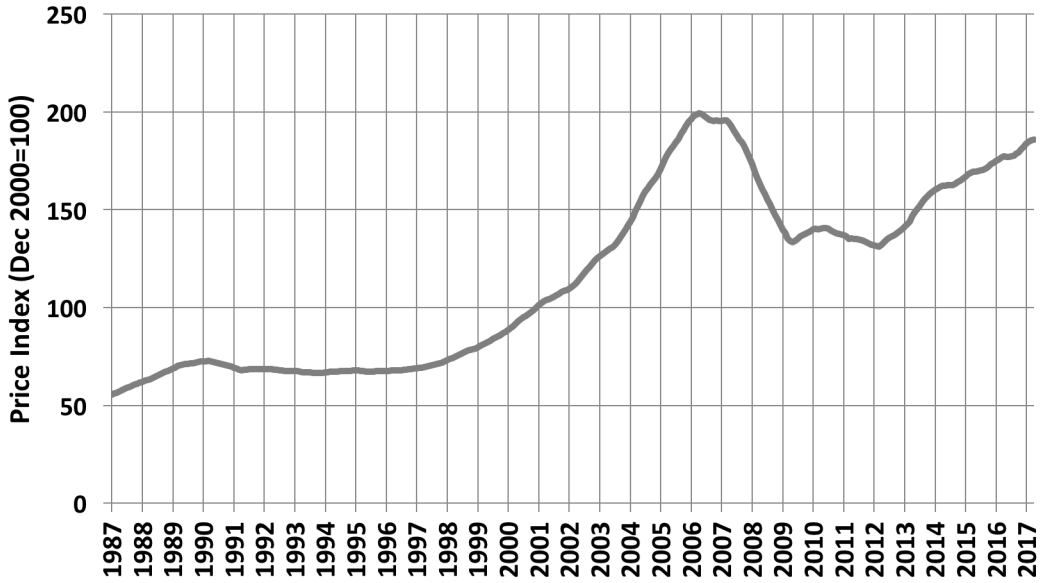
Source: Levitin, Lin and Wachter (2017)

Figure 1b



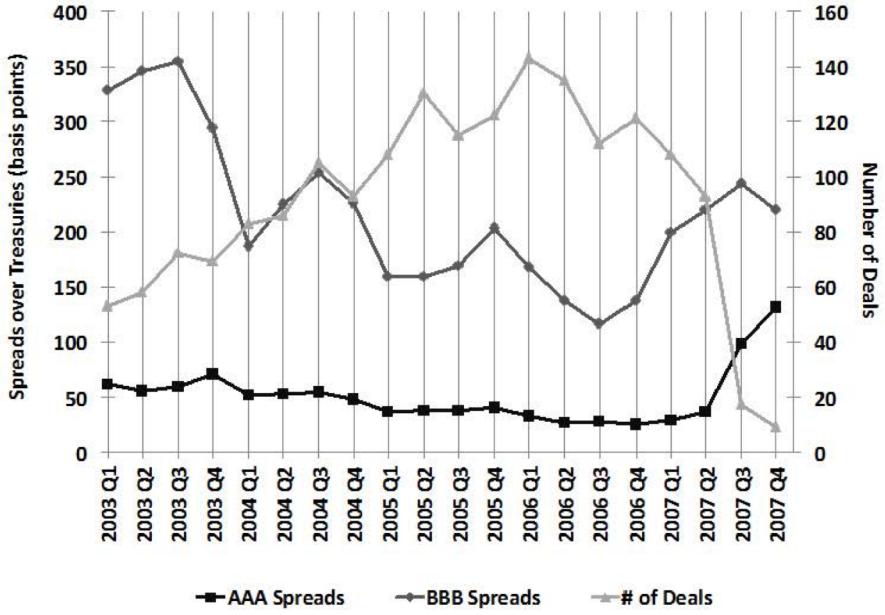
Note: dependent variables are gross margin (solid) or initial rate spread (dashed). The beta reflects the response of the dependent variable to mortgage origination, *ceteris paribus*.
Source: Levitin, Lin and Wachter (2017)

Figure 2: Residential Real-Estate Bubble



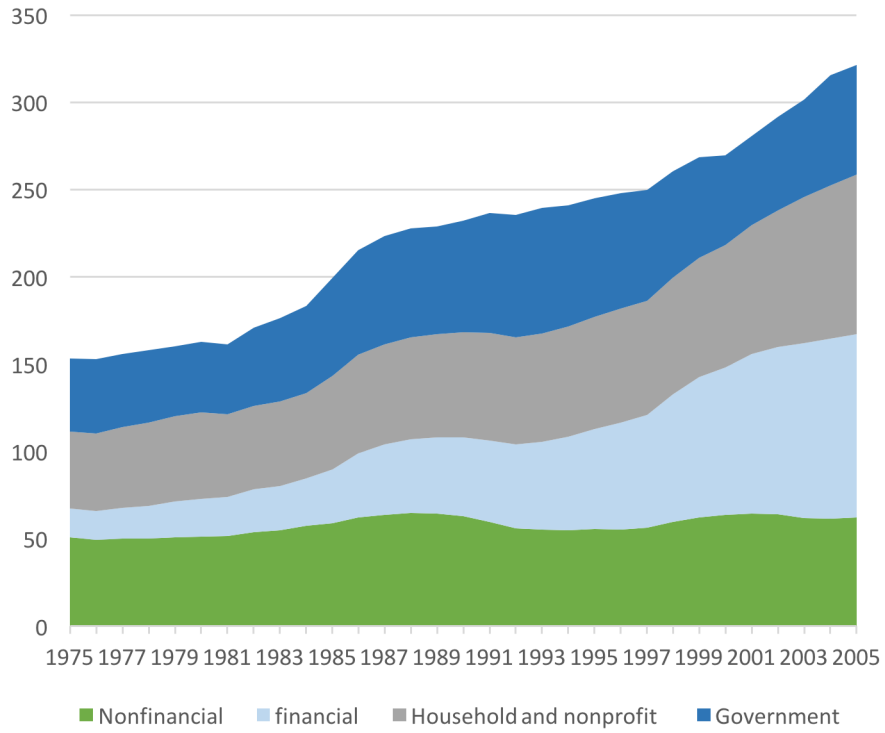
Source: Levitin and Wachter (2011)

Figure 3: PLS Issuance and Spreads for AAA- and BBB- Rated Tranches, 2003-2007



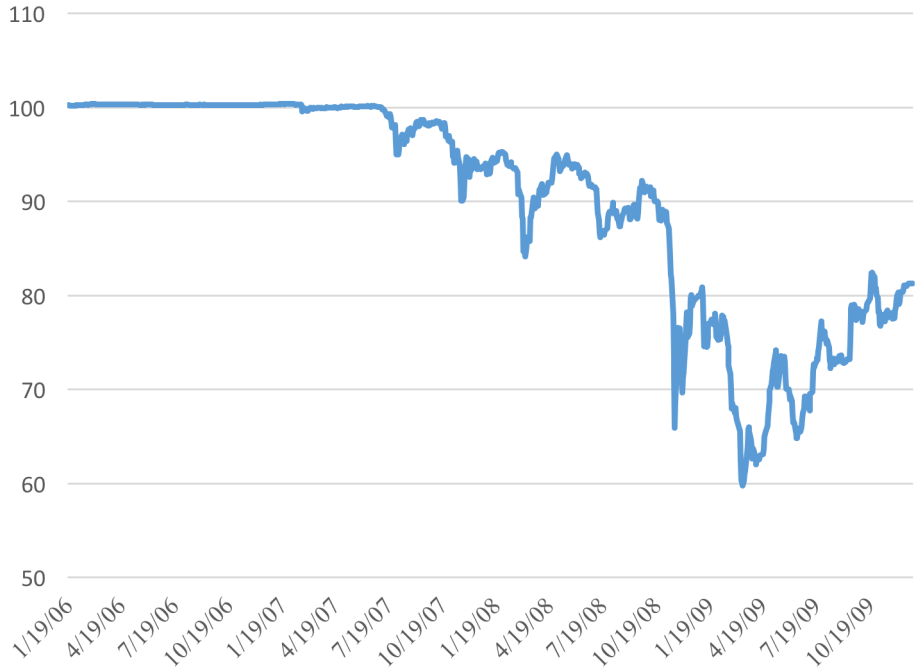
Source: Levitin and Wachter (2011)

Figure 4: Sectorial Contribution of US Gross Debt Percentage of GDP



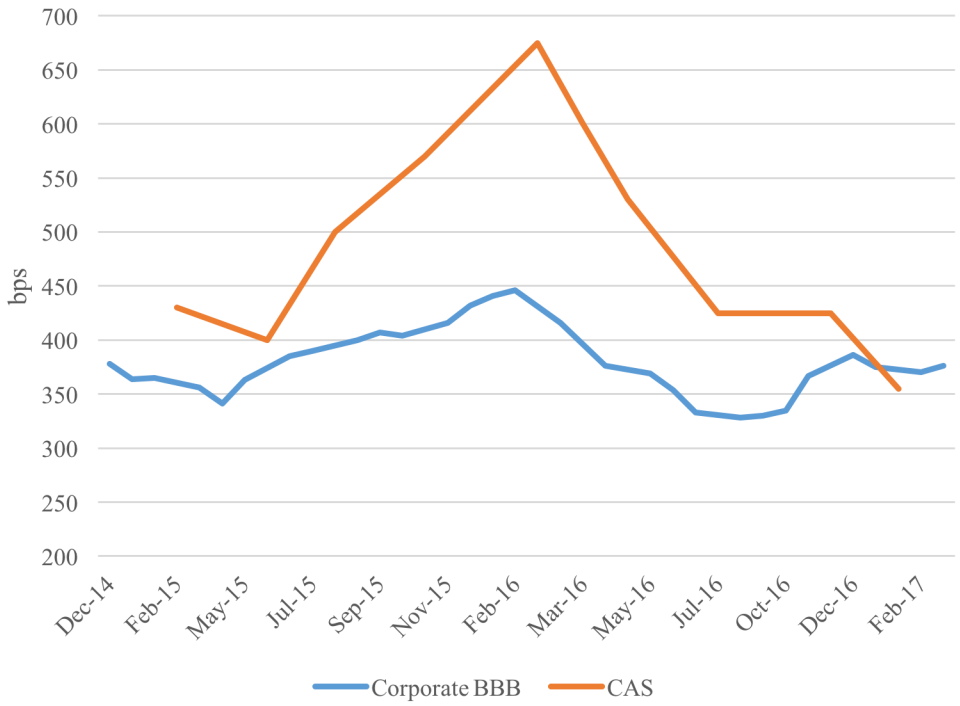
Source: US Financial Account, Z1 Table, Federal Reserve Board

Figure 5: ABX.HE.AAA.06-1 Index from January 19, 2006 to December 31, 2009



Source: Markit and Bloomberg.

Figure 6: Fannie Mae CAS M2 Credit Spread at Issuance vs BBB Corporate Bond Index (bps)



Source: CAS Data is from Bloomberg. BBB Corporate Bond Index is Bank of America Merrill Lynch US Corporate BBB Effective Yield from FRED.

Table 1: Securitization's Share of the US Mortgage Market in the 2000s

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Originations	1,048	2,215	2,885	3,945	2,920	3,120	2,980	2,430	1,485
Total Securitized	615	1,355	1,857	2,716	1,882	2,156	2,045	1,864	1,264
% of Originations Securitized	59%	61%	64%	69%	64%	69%	69%	77%	85%
Private Label Securities	136	267	413	586	864	1,191	1,145	707	58
Pvt Label as % of Total Orig	13%	12%	14%	15%	30%	38%	38%	29%	4%
F&F Securities as % of Total Orig	46%	49%	50%	54%	35%	31%	30%	48%	81%

Source: Inside Mortgage Finance