The Securitization Flash Flood

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Abstract

What caused the flood of securitized products in the years immediately preceding the crisis? This paper presents evidence that demand for safe collateral in repo markets made it attractive for financial institutions to issue securitized products. Using the 2005 Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) as a natural experiment that shocked the demand for collateral in repo markets, this paper establishes collateralized borrowing in short-term debt markets as a contributing factor to the rise of mortgage securitization. Hand-collected data on over 900 repurchase contracts from S.E.C N-Q filings reveals underwriters of securitized products increased use of mortgage-based repos in the months following the law change. The evidence provides a direct test of liability-centric theories of banking that link the money creation function of financial intermediaries to the balance sheet holdings of liquid assets (Hanson et al. [2015]).

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Introduction

When banks securitize mortgages, the underlying risks transfer out of their balance sheets. Or so we thought until the financial crisis of 2007-2009. During the crisis, banks faced more than $40bn in write-downs on their exposures to AAA-rated mortgage-backed securities (He et al. [2010], Vyas [2011], Beltran et al. [2013]). Despite securitization, risks never left banks' balance sheets (Acharya et al. [2013]). So two puzzling questions arise: a) Why did banks securitize mortgages and *simultaneously hold* large quantities of MBS on their balance sheets? b) What explains the dramatic rise in securitization, specifically in the years just before the crisis?

This paper suggests that a sudden demand for MBS - to be used as collateral in repurchase contracts - contributed to the securitization flash flood. Because AAA tranches of securitized products are safe and liquid, repo markets heavily use them as collateral (Figure 1). Federal Reserve Flow of Funds data (Figure 2) shows a 250% increase in MBS issuance at the same time when repo activity witnessed explosive growth in the pre-crisis period. When demand for repo collateral went up in the pre-crisis period (2005-2006), banks flooded the market with these products. Prior work (Acharya et al. [2010], Gorton and Metrick [2012a], Nadauld and Sherlund [2013]) has hypothesized the relationship between repo markets and securitization, but systematic evidence is missing. The goal of the paper is to address this gap. Using a natural experiment, I connect the sudden increase in pre-crisis securitization to the repo activities of banks.

The Bankruptcy Act of 2005 or BAPCPA[1] introduced a shock to repo collateral demand for a specific asset class - mortgage backed securities. BAPCPA expanded safe harbor provisions for repo contracts collateralized by MBS. Safe harbor is a powerful exemption that gives repo counter-parties super-priority[2] over senior creditors. Safe harbor means that unlike secured creditors, repo counter-parties can seize collateral and terminate contracts during bankruptcy. We know assets of secured creditors get frozen during bankruptcy because of automatic stay. By giving special privileges to repo contracts backed by MBS, the Act unintentionally increased mortgage securitization activity in banks.

[1] BAPCPA stands for Bankruptcy Abuse Prevention and Consumer Protection Act.

[2] Formally, the exemption is better characterized as "effective" super priority because the priority rules set forth in Bankruptcy code remain unaffected. See Roe [2011] for further discussion.

Why are safe harbor exemptions attractive to banks? Suppose a repo cash lender accepts AAA-rated MBS as collateral from a bank. By legally allowing the lender to liquidate their collateral in a bankruptcy event, the law allowed them to isolate their risk exposure away from the bank's *aggregate risk*. After safe harbor, only the risk of the underlying collateral mattered. Thus, the bankruptcy exemption encouraged cash lenders to focus on the collateral in possession rather than the aggregate risk of the counter-party. Counter-parties live in an environment of information frictions, so assessing aggregate risks of a bank (with operations in multiple subsidiaries across geographies) is challenging. In this non-Modigliani-Miller world, the ability to isolate risk exposure is a source of positive NPV.

I design a difference-in-differences (DiD) strategy around BAPCPA. I assume BAPCPA *differentially* affects banks that are more active in trading (*treated* sample) relative to banks that are less active in trading[3] (*control sample*). I base this assumption on an institutional feature of repo markets - banks actively involved in trading regularly borrow cash from repo markets (Krishnamurthy [2010]). By repeatedly "repoing out" their securities to borrow cash, trading-active banks build a large securities portfolio with a small amount of capital.[4] Repo markets are critically important for trading, so banks with high trading activity are well positioned to exploit funding opportunities that arise in these markets. Figure 3 suggest this is indeed the case. Average repo outstanding for treated and control sub-samples follow similar dynamics before BAPCPA. Upon introduction of the bill in the Senate (2005Q1), repo activity for treated banks diverges from that of control banks.

I estimate the differential increase in securitization activity by treated banks due to BAPCPA. To take advantage of BAPCPA's repo safe harbor provisions, treated banks hold 1.6% more AAA-rated securitized bonds (relative to control banks) immediately after the law change. The magnitude of this difference increases to 3.1% as we move closer to the financial crisis (2006Q4). When securitization activity is measured as the book value of loans sold,[5] I find BAPCPA increased mortgage securitization by 7.1% for treated banks in

[3] *Treated Banks* are banks whose trading liabilities (as a percentage of total liabilities) lie in the top quartile of the sample before the law change, while *Control* banks lie in the bottom quartile of the distribution. Trading liabilities represent liabilities for short positions in equity, debt and derivatives. See Appendix for a complete definition. I show in Section 7 that results are not sensitive to the somewhat arbitrary choice of quartlie-based cut off points.

[4] See Copeland et al. [2014] for a numerical example describing this strategy.

[5] I follow Erel et al. [2014] who measure mortgage securitization activity as the outstanding principal balance of assets sold and securitized where the underlying assets are 1-4 family residential loans.

the quarter (2006Q4) immediately preceding the financial crisis. Thus increase in demand for MBS due to safe harbor not only led to greater holdings of AAA-rated securitized products but also an increase in mortgage securitization activity. In Section 5.3.1, I discuss these economic magnitudes in a macro context.

Did the increase in securitization due to BAPCPA alter the lending activity of banks? Treated banks increase mortgage origination activity by 3.6% in the quarters following expansion of safe harbor. Using synthetic control estimations (Abadie et al. [2012]), I show key players in the sub-prime lending space (Citibank, Bank of America etc) lowered rates on their adjustable-rate mortgages following safe harbor expansion. Anecdotal evidence shows that JP Morgan Chase expanded home equity loan and line of credit amounts as soon as Congress passed BAPCPA.[6] The effect of securitization on mortgage origination activity adds to a recent line of research (Mian and Sufi [2009], Loutskina and Strahan [2009], Keys et al. [2010], Nadauld and Sherlund [2013]) investigating real effects of the secondary mortgage market.

Perhaps the biggest concern with the DiD design is inherent unobservable differences between trading-active banks and banks not active in trading may drive the observed result. I can never perfectly rule out this possibility, but I test a number of alternate explanations. For example, my results could be driven by a capital effect - BAPCPA resulted in a positive shock to collateral value; as a result, trading-active banks become better capitalized. Encouraged by better capitalization, treated banks undertake riskier activities such as securitization to a greater extent than the control sample.[7]

I address the above concern in a number of ways. First, after controlling for capital levels, I see a statistically significant jump in repo activity for treated banks only in the quarters following BAPCPA. Second, I ensure attributes such as capital are similar across treated and control banks - I confine estimations to a sample matched using the nearest-neighbor (NN) matching technique.[8] Third, I test for parallel trends in the pre-period, so time-invariant differences such as a bank's risk culture is unlikely to confound my result. Finally, all

[6]To quote from official communication to Chase Brokers and Correspondent Lenders, April 6, 2005 "In continued efforts to enhance products that are more attractive to borrowers, Chase Home Equity [Brokers and Correspondent Lenders] should be aware of the expanded home equity loan and line of credit amounts, which become effective April 7." I am grateful to Rajesh Aggarwal for directing me to this evidence.

[7]I thank Amiyatosh Purnanandam for pointing this out.

[8]I match along dimensions of size, profitability, non-interest income and leverage prior to the law change.

estimations are restricted to a narrow window of twelve quarters to minimize interference from time-varying confounds. This means, any unobservable time-varying difference has to appear *within* the twelve quarter window to bias my estimates. Taken together, these elements of my research design strengthen the evidence in support of a repo channel.

Another explanation for my results could just be differences in size between treated and control samples: Large institutions tend to be highly active in both repo as well as securitization markets. I test whether my results change with or without the inclusion of non-parametric size controls (size fixed effects). They don't. We could still argue that fixed effects are inadequate to capture the true effect of size. So, I hand-collect an entirely new sample of only the largest broker-dealers active in mortgage securitization and correlate their repo and securitization activity. When I perform a DiD estimation within this sample, I still find consistent results (Section 7.6) that expansion of safe harbor provisions increased securitization activity via the repo channel. Again, size is unlikely to be driving my main result. Other alternate explanations such as the general equilibrium effects of BAPCPA[9] are discussed in Section 7.

Ultimately, my argument on the repo channel would be stronger if we could actually see that banks changed the underlying collateral in repo contracts following BAPCPA. Unfortunately, the FR-Y9C data has no information on the underlying collateral of repo contracts. So, I hand-collect individual repo contracts from N-Q filings of money market mutual funds who are major cash lenders to banks in the triparty repo market[10]. I analyze the aggregate share of collateral types underlying over 900 hand-collected repo contracts. My analysis reveals a change in usage of private-label MBS by banks in the quarters following the expansion of safe harbor. Share of private-label MBS in repo collateral jumps from 11% to 23% following the expansion of safe harbor provisions, a difference that is both economically and statistically significant. Banks responded to safe harbor expansion by increasing usage of MBS collateral in repo transactions.

This paper makes four contributions. The right way to treat financial contracts in bankruptcy is a question that eludes policymakers. Special treatment for (liquid) repo collateral was intended to reduce risk of contagion among market participants. However,

[9] White [2007] shows evidence of increase in personal bankruptcy filings due to BAPCPA.

[10] This procedure is inspired from Krishnamurthy et al. [2014] who collect similar data but for a time period that does not overlap with mine.

in the aftermath of the global financial crisis, finance and legal scholars (Roe [2011], Duffie and Skeel [2012], Bolton and Oehmke [2014], Auh and Sundaresan [2015]) have questioned the logic of extending it to a wider asset class. For instance, should illiquid securities deserve the same safe harbor status as U.S. Treasuries? This paper is a systematic study of the consequences of broadening preferential treatment. The Commission to Study the Reform of Chapter 11 (American Bankruptcy Institute) concedes that safe harbor may have "*extended to contracts and situations beyond the original intent of the legislation.*" In May 2016, the Federal Reserve proposed to roll back preferential treatment for repo contracts in bankruptcy for systemically important institutions.[11] There is little doubt that systematic empirical evidence, which I have tried to provide in this paper, would enrich a policy debate dominated purely by theoretical arguments. If safe harbor expansion contributed to the proliferation of securitized products in the run up to the financial crisis, the preferential treatment of financial contracts deserves much greater empirical scrutiny than it currently receives.

My results suggest post-crisis regulation of securitization (Title IX, Subtitle D, Dodd-Frank Act) may be incomplete because it misses the link between repo markets and securitization activity. Elaborate guidelines on securitization activity *without* understanding the connection to repo markets suggests the regulatory energy of Dodd-Frank may be misdirected. Acharya et al. [2010] make an important observation that repo regulation receives little attention in the Dodd-Frank Act.

Why do banks hold highly rated securitized products on their balance sheet? In the prevailing view (Erel et al. [2014]), banks signal to investors that they have skin-in-the-game in the securitized products they issue. Thus, holdings are a *by-product* of securitization activity.[12] In contrast, this paper is about "the-tail-wagging-the-dog" - securitization itself can be *driven by* collateral holdings and the intention to take advantage of repo markets.

Finally, the paper provides an empirical basis for the liability-centric view of banking (Gorton and Pennacchi [1990], Sunderam [2014], Krishnamurthy and Vissing-Jorgensen [2015], Hanson et al. [2015]). In Hanson et al. [2015], both traditional and shadow banks are creators of safe, money-like claims. The nature of money creation (or equivalently,

[11] See https://www.federalreserve.gov/newsevents/press/bcreg/20160503b.htm

[12] Shleifer and Vishny [2010] argue an important side benefit of the securitization process is that AAA-securities can be used as collateral in short term debt markets.

funding strategy) implies a specific liquidity structure for the asset side of a bank's balance sheet. Intermediaries with unstable funding strategies (e.g. repos) invest in liquid assets whereas those with stable funding strategies (e.g. deposits) invest in illiquid loans. In their model, Hanson et al. [2015] predict that an equilibrium shift towards greater liquid asset holdings should induce banks to create unstable money. This paper confirms their prediction - expansion of safe harbor provisions made MBS more liquid, as a result banks shifted their funding strategy toward increased repo usage.

1 Related Literature

Gorton and Metrick [2012a] hypothesize that demand for collateral in repo markets could make securitized products more attractive to issue. Similarly, Nadauld and Sherlund [2013] note that highly highly rated bonds produced from securitization deals can serve as collateral in repo markets. In their setting, investment banks that rely heavily on repo markets could have strong incentives to retain portions of the securitization deals they originated. Acharya et al. [2010] suggest the Bankruptcy Act of 2005 could have led to greater issuance of mortgage-backed products.

Erel et al. [2014] analyze retention of securitized products on bank balance sheets. Their main finding is that banks engaged in securitization also invest more in highly rated securitization tranches. If changes in repo markets due to the 2005 bankruptcy law led to greater securitization activity, the result helps explain their finding that securitization-active banks also invested more in highly rated tranches of securitized products.

Recent research in accounting (Chircop et al. [2016]) performs an event study around BAPCPA announcement to find an increase in average bid-ask spreads and dispersion in analyst's EPS forecasts following BAPCPA. Ganduri [2016] analyzes BAPCPA as a funding shock to independent mortgage companies (IMCs) which respond by increasing issuance of risky loans. In contrast to Ganduri [2016], the emphasis in this paper is the *securitization* of loans - specifically, the goal is to understand bank holdings of MBS products and the supply of structured finance products in the run up to the financial crisis. The primary objective of this paper is to draw attention to the use of securitized products as collateral in repo markets. This relationship between repo markets and securitization activity has not

been systematically studied in an empirical setting.

Duffie and Skeel [2012] debate the costs and benefits of automatic stays for financial contracts, a policy question with renewed interest after the financial crisis. Duffie and Skeel [2012] support safe harbor for repos backed by liquid securities and oppose preferential treatment when collateral is illiquid. Sissoko [2010] argues that BAPCPA's safe harbor provisions for financial contracts may have contributed to financial fragility by encouraging collateralized interbank lending and discouraging a careful analysis of the credit risk of counter parties. Simkovic [2009] and Roe [2011] attribute the dramatic growth in derivatives market to increasing bankruptcy safe harbor provisions to a variety of financial contracts. Auh and Sundaresan [2015] show that expanding safe harbor provisions results in greater short-term (repo) debt as an equilibrium outcome. Their model predicts banks decrease long-term debt and increase their long-term spreads.

2 Bankruptcy Treatment of Qualified Financial Contracts

Qualified Financial Contracts (QFCs) such as derivatives and repurchase agreements have had a long history of preferential treatment during bankruptcy. Sissoko [2010] traces the historical development of safe harbor provisions beginning with the 1978 reforms that gave commodities and forward contracts special treatment in a bankruptcy event, allowing counterparties of these contracts to seize collateral and close out their positions. In 1984, the repo amendment to the Bankruptcy Code allowed traders of repos backed by Treasury and Agency securities, Certificates of Deposit and bankers' acceptances to liquidate and net their proceeds without hindrance from the bankruptcy trustee. These laws intended to reduce systemic risk by preventing cascade effects from creditors to the rest of the financial system. If financial participants are unable to net out their positions in financial contracts due to bankruptcy event, regulators were concerned the freeze on financial assets could have a "domino effect" on other financial institutions in the economy.

Campbell [2005] places BAPCPA in the context of the collapse of Long Term Capital Management (LTCM) in 1998. Following the LTCM crisis, regulators highlighted immediate

closeout and netting of financial contracts as key to maintaining financial market stability.[13] Of the several regulatory recommendations, expansion of safe harbor provisions and cross-product netting made their way into BAPCPA.

BAPCPA considerably widened safe harbor provisions of repo contracts with a generic reference to "mortgage related securities", which covers a large class of products including but not limited to mortgage loans, interests in mortgage related securities and synthetic mortgage backed assets such as CDOs.

An interesting pattern noted in Campbell [2005] is the use of ambiguous phrases by BAPCPA in framing critical definitions. Flexible definitions reflect an intent to accommodate product innovations that may occur in the future. Sissoko [2010] argues BAPCPA provided a legal foundation for the growth in complex securitized products, because the safe harbor provisions were generic enough to accommodate virtually any level of complexity in structuring these products.

3 Data and Summary Statistics

3.1 Bank Holding Company Data

Financial information comes from the Federal Reserve's FR Y9-C reports on U.S domestic bank holding companies. I collect quarterly data from 2003 and 2007. This dataset covers large (> \$150mn in assets) U.S. domestic bank-holding companies. I divide banks in my sample based on their trading expertise prior to the law change year (2005). I classify a bank as *Treated* if its average trading liabilities, over 2003 and 2004, lies in the top quartile of the distribution. Similarly, *Control* banks are those whose trading liabilities lie in the bottom quartile. For empirical estimation, I focus on a narrow window around the law change (2004Q1 to 2006Q4). I drop banks that have missing values during this period. My panel dataset of treated and control banks is a total of 307 entities over 12 quarters.

Table 1 shows descriptive statistics of key variables by sub-sample. Observable differences between treated and control banks (Columns (1) - (4) of Table 1 Panel (a)) can be a

[13] Report of the President's Working Group on Financial Markets, April 1999. See Campbell [2005] for further discussion.

concern because identification of the treatment effect relies on these groups being comparable to each other. To address this, I select a control sample that is *matched* to the treated sample, using a Nearest-Neighbor (NN) matching technique with the Mahalanobis distance metric. I match along four dimensions - Log(total assets), Return on Equity, Tier 1 Capital and Non-interest income. I use average values of these variables in the years *before* the law change (2003 and 2004).

Panel (b) of Table 1 presents summary statistics for the matched subset of treated and control banks in the years before the law change. Treated and control banks are comparable in terms of profitability (ROE) but differ along leverage (Tier 1 capital) and non-interest income. Although these differences are economically insignificant (less than 0.4%), I use these variables as controls in all empirical specifications. Since the focus of the study is mortgage securitization activity, I test for pre-existing differences in mortgage loan portfolio between treated and control banks. Panel (b) shows control banks had similar exposure to mortgage assets relative to treated banks before the law change. To verify whether risk taking behavior affects the propensity towards securitization, I compare Z-score levels between treated and control banks and find no significant differences. Finally, I see no differences in the holdings of available-for-sale securities between treated and control banks.

Treated and control banks differ along the size dimension. So, I use controls for size in all my estimations. I also use a flexible non-parametric method (size fixed effects) to control for this effect. In Section 7, I restrict the sample to the set of the *largest* underwriters of structured finance products and test whether my results hold in this sample.

3.2 Hand collected data on repo contracts

One of the biggest challenges with empirical studies on repo markets is the lack of data on collateral underlying repo transactions (Baklanova et al. [2015]). I address this data limitation by hand-collecting individual repurchase contracts from public disclosures of money market mutual funds (N-Q filings). This procedure is inspired by Krishnamurthy et al. [2014] who collect similar data but for a different time period.[14] Following their strategy, I

[14] In Krishnamurthy et al. [2014], the focus is on the financial crisis period (2007-2009).

focus on the largest fund families[15] and hand-collect repo contract details from N-Q filings. For over 900 repo contracts, I obtain data on repo rate, repo dates (contract date and due date), notional amount and type of collateral. This novel dataset allows me to observe granular variation in collateral activity using the exact date the contract was entered into. I classify underlying collateral into five categories: U.S Government Obligations, U.S Government Agency Mortgages, Private-label MBS, Corporate Obligations and Others. Table 3 Panel (a) classifies repo contracts by the term (duration) of the repo contracts. Most repo contracts are very short term, we see 780 contracts with tenure less than or equal to 3 days. The notional amount in repo is 260 million for the most common category of tenure.

3.3 Mortgage Pricing data

I use Rate-Watch data for historical information on product-specific loan rates and deposit rates of commercial banks. Rate-Watch data on deposit rates have been used in earlier studies (Egan et al. [2014]; Drechsler et al. [2016]). Rate-Watch has categories for different loan terms for a fixed principal amount. For example, a fixed mortgage product reported as 15 Yr Fxd Mtg @ 175K represents a 15 year fixed mortgage rate for a 175K principal amount. Similarly, an adjustable rate product reported as 5 Yr ARM @ 175K represents a 5 year adjustable rate mortgage for a 175K principal.

3.4 Structured Mortgage Issuance Data

Data on structured mortgage issuance is from Bloomberg's *Structured Finance Calendar*. Bloomberg provides information on the type of product issued, the lead underwriter involved, date of issuance and value of the deal. For analysis, I drop deals less than $100mn. Table 2 Panel (a) gives a summary of deals by product type. The four main product types are CMO (Collateralized Mortgage Obligations), ABS (Asset Backed Securities), CMBS (Commercial Mortgage Backed Securities) and CDO (Collateralized Debt Obligations).

I classify *Treated* underwriters as those with above-median levels of repo borrowing prior to the law change while *Control* underwriters are those with below-median repo borrowing levels. This classification is consistent with the *Treated-Control* classification of banks. Ta-

[15] Krishnamurthy et al. [2014] provide a list of CIK numbers (Internet Appendix,Table IA.I, pg 4).

ble A.2 in the Appendix lists the broker-dealers under each category. These underwriters are a major class of borrowers in the repo markets (Gorton and Metrick [2012b], Krishnamurthy et al. [2014]) and represent a mix of bank holding companies and investment banks.

4 Research Design

A positive correlation between repo borrowing and securitization of financial institutions, in and of itself, is inconclusive because greater supply of securitized products could render collateralized borrowing more attractive, reversing the causal interpretation. Furthermore, if certain institutions are predisposed not only to borrow more on the repo market but also to securitize more assets, an omitted unobservable confounds our inference. To address this, my research design involves two steps: First, I use a Nearest-Neighbor (NN) matching method to select control banks that are observationally similar to treated banks.[16] Second, I use the *matched* sample, to execute a dynamic difference-in-differences estimation around the Bankruptcy Act of 2005.

$$y_{it} = \beta_0 + \sum_{\tau=1}^{T} \beta_\tau Treated * \delta_\tau + \gamma X_{it-1} + \delta_i + \delta_t + \epsilon_{it}$$

Here, *Treated* refers to a dummy variable that turns on for treated banks and is zero for control banks. δ_t refers to quarterly time-indicators and δ_i refers to bank indicators. Thus the specification controls for quarter fixed effects and bank fixed effects. X_{it-1} refer to the main control variables: Tier 1 capital and Non-interest income. The main coefficients of interest are the dynamic interaction terms β_τ. These coefficients capture the difference-in-difference estimate and the interaction is performed before and after the law change. Standard errors are double-clustered at the bank and year-quarter level to address the serial correlation problem in diff-in-diff estimations on panel datasets (Bertrand et al. [2004]).

Treated banks are those whose trading liabilities (as a percentage of total liabilities) lie in the top quartile of the sample before the law change, while *Control* banks lie in the bottom

[16] If residual differences persist after matching, I use these variables as controls in my specification.

quartile of the distribution before the law change. The strategy of classifying treated and control based on high and low values of a variable is common in applied work.[17]

4.1 Identifying Assumption

To claim a causal effect, we would ideally need to observe securitization activity of treated banks in a world where they did not receive treatment. Since we never observe both outcomes for the same unit,[18] I adopt the popular approach of using changes in outcome variables of control banks as a counter-factual for treated banks. But such a comparison, at a minimum, requires outcomes of treated and control banks (securitization activity in our case) to move in parallel before treatment. This necessary condition is known as the parallel trends assumption. The advantage of a dynamic difference-in-differences specification is we can *test* for parallel trends by verifying whether coefficient estimates in the pre-treatment period are statistically different from zero. If the estimates differed significantly from zero, we worry time trends between treated and control groups may drive the observed effect.

Since parallel trends can be statistically tested (as I show in all my estimations), they render the dynamic difference-in-differences design transparent. However, tests of parallel trends are not *sufficient*, so any diff-in-diff design needs to assume time-varying unobservables do not invalidate the causal interpretation. I need to assume there are no time-varying unobservables that a) correlate with repo activity *and*, b) differentially affect securitization of the treated sub-group. While we can never formally test for sufficiency, I provide credence to this assumption with a battery of robustness tests discussed in detail in Section 7.

4.2 Choosing a base quarter for dynamic estimation

Dynamic difference-in-differences estimation requires a fully saturated model where the coefficients are relative to (an omitted) base quarter. In the following analyses, I choose the base quarter as 2004Q1. Two reasons motivate this choice: First, the base quarter should be during a period where we should not expect treatment effects. Second, the base quarter should not coincide with significant economic events because the treatment effect

[17] See for e.g. Duchin et al. [2010] who estimates the effect of the financial crisis on investment of firms in a difference-in-difference setting.

[18] Fundamental Problem of Causal Inference, Holland [1986]

is estimated relative to the base quarter. In year 2004, there were two significant events relevant to our study: 1) In 2004Q2, the SEC proposed a Net Capital Rule for broker-dealers who are part of consolidated supervised entities. To the extent regulatory capital arbitrage can influence the securitization of loans, this rule may confound the estimated treatment effect of BAPCPA. However, it is important to note that Erel et al. [2014] find no evidence of capital arbitrage as the primary reason for securitization. 2) In 2004Q4, Senate elections resulted in a Republican majority. Market observers believed that the Senate (as well as the Presidential elections) gave new impetus to the bankruptcy bill. Thus, 2004Q1 is a safe choice for the base quarter representing a pre-treatment period *before* both these events occur.

5 Empirical Results

Did repo exposure vary between treated and control banks after BAPCPA? Figure 3 shows similar time trends between treated and control banks before 2005. Starting 2005Q1, treated banks significantly increased their repo market participation. In the post period, repo activity of control banks remains relatively stable following the law change. The main takeaway from Figure 3 is BAPCPA differentially affected repo access for a *subset* of banks, supporting the rationale for a difference-in-differences design.

5.1 Banks hold more securitized products after expansion of safe harbor

If banks use securitized bonds as repo collateral, we expect them to hold these products on their balance sheets. Repo borrowing requires highly liquid and safe collateral (Krishnamurthy et al. [2014]), so highest rated tranches are used as collateral in repo transactions. Table 4 shows difference-in-difference estimates on the holdings of highly rated tranches before and after BAPCPA. We see a) parallel trends in the pre-BAPCPA period and b) an increase in the quarters following the introduction of BAPCPA in the Senate. The change in holdings in 2004Q4 suggests an anticipatory effect by market participants.

In terms of economic magnitude, we see an increase in holdings of highly rated tranches by 0.9% for treated banks in 2004Q4, relative to control banks. The economic magnitude

increases to 3.1% in 2006Q4. Treated banks increase their holdings of AAA-rated MBS as we advance closer to the financial crisis. This result is robust to changes in the underlying sample (Column (3) and Column (4)).

5.2 Effect of safe harbor expansion on MBS yields

Figure 4 plots the option-adjusted yield spreads between two bond indices of mortgage-backed securities: one representing agency bonds and the other, private-label securities. In the plot, the blue time-series stands for private-label MBS and the red represents agency MBS. If safe harbor expansion made mortgage-backed repo collateral more valuable, we should observe a price change for this particular asset class following BAPCPA. Figure 4 highlights the key dates of the Bankruptcy Act using vertical lines. The plot reveals two interesting patterns. In the period before BAPCPA's introduction in the Senate, the yields on agency and non-agency MBS follow similar dynamics. However, soon after the introduction of BAPCPA, yields on private-label MBS fall relative to agency MBS. The price of private-label MBS increases, so this particular asset class becomes more valuable after expansion of safe harbor provisions. The ability to isolate risk exposure is reflected in the observed price increase.

5.3 Banks increase securitization activity after expansion of safe harbor

Securitization activity is measured in line with Erel et al. [2014], as the outstanding principal balance of loans securitized by a bank holding company.[19] Since we are interested in mortgage securitization activity, I focus the definition to a specific asset class: 1-4 family residential loans. Table 5shows difference-in-difference estimates of mortgage securitization activity within a 3-year window. From Table 5, we do not see a difference in securitization activity between treated and control groups prior to treatment. Robust parallel trends confirm the validity of DiD estimates. Table 5 shows an increase in mortgage securitization activity from 2005Q3 that turns statistically significant in 2006Q1. As repo collateral demand increased due to safe harbor, mortgage securitization became more attractive for treated banks. Acharya et al. [2010] suggest expansion of safe harbor for mortgage-based

[19] See Appendix for a complete definition.

assets may have led to growth in mortgage-based securities from 2005 to 2007.

From Table 4 and Figure 4, we saw price adjusts immediately to changes in demand. When should we expect a significant change in supply? Securitization is a complex manufacturing process that involves pooling loans and selling those loans to special purpose vehicles set up as legal entities under a state's business trust law. We should expect this elaborate process to impose natural constraints on the responsiveness to the law change. In Table 5, we see securitization activity for treated banks does not differentially change soon after BAPCPA's introduction in the Senate. This implies the price elasticity of supply is less than 1.

Before safe harbor expansion to mortgage-related assets, securitization activity of treated banks is economically indistinguishable from that of control banks. From Table 5, we see treated banks, on average, increased their mortgage securitization activity by 3.8% per quarter relative to control banks in 2006Q1.[20] This estimate increase in economic magnitude in subsequent quarters. By 2006Q4, treated banks securitized 7.1% more mortgages relative to control banks. The highest levels of securitization activity are in the quarters immediately preceding the financial crisis. Changes to the underlying sample as well as addition/deletion of controls do not alter the robustness of this result.

Results in Table 5 are robust to a variety of fixed effects. Bank fixed effects restrict estimation *within-bank,* by differencing out time-invariant differences between treated and control groups. For instance, treated and control banks in the sample may differ along a (time-invariant) *quality* dimension, and banks of higher quality may be more efficient in securitizing assets. The estimation in Table 5 is robust to such time-invariant differences. Year-Quarter fixed effects control for average macro-economic changes that affect mortgage securitization activity.

5.3.1 Note on measurement and macro interpretation

Since banks are the focus of this study, I measure mortgage securitization activity as the book value of loans sold (Erel et al. [2014]). Thus the 7.1% increase in mortgage securitization by treated banks in 2006Q4, refers to the average *difference* in book value across these

[20] The overall sample mean is 4.5%

two samples. The macro trend in Figure 2 differs in two important ways. First, the Federal Reserve Flow of Funds shows the average market value of securitization issuance, whereas Table 5 is a differential trend in book values. Second, data from FR Y9-C reports used in Table 5 do not include pure investment banks such as Goldman Sachs, Lehman Brothers and Morgan Stanley[21] which significantly contributed to rise in structured products issuance seen in Figure 2.

5.4 Real effects of safe harbor expansion

5.4.1 Mortgage origination

In a seminal article, Mian and Sufi [2009] show that in the pre-crisis period, expansion of mortgage credit to subprime ZIP codes was closely related to the increase in securitization of subprime mortgages. Nadauld and Sherlund [2013] argue increase in securitization in the pre-crisis period was driven by forces exogenous to factors affecting the primary mortgage market. My setting uses repo collateral demand as an exogenous factor affecting securitization. If securitization activity increased as a result of repo collateral demand, this increase may have a real effect on mortgage credit expansion.

Table 6 presents estimates of mortgage loan activity of treated banks relative to control banks. Mortgage loan activity is measured as the ratio of 1-4 family residential loans to total loans. We see no significant differences between treated and control banks in the pre-period. Table 6 shows increase in mortgage lending activity for treated banks following BAPCPA. The increase in securitization in order to facilitate borrowing in repo markets has a real effect on mortgage origination activity.

5.4.2 Mortgage loan pricing

Data from Rate-Watch provides an interesting setting to study the effect of safe harbor expansion on mortgage loan pricing. I focus on adjustable rate mortgages as these loan types were heavily used by banks in subprime lending (Financial Crisis Inquiry Commission Report, 2011). However, analysis on adjustable rate mortgages runs into statistical power

[21] Goldman Sachs and Morgan Stanley were not bank holding companies before 2007.

issues due to lack of lending rate data for treated and control banks *within a specific product type*. To analyze pricing behavior for a 5 Yr ARM @ 175K product, we need sufficient observations along time series and cross-sectional dimensions (for both treated and control banks). Instead of estimating an average treatment effect on the entire treated subsample, I select a few specific treated banks such as Citibank, JP Morgan and Bank of America.

I focus on these systemically important banks as they have disproportionate real effects on the economy. Furthermore, these banks faced lawsuits by the Department of Justice (DoJ) and the Securities and Exchange Commission (SEC) for abusive lending practices after the financial crisis. Focusing on specific banks raises an econometric question: how do we estimate a "treatment effect" on individual units?

Here, I rely on synthetic control estimation (Abadie et al. [2012]), an econometric technique to evaluate treatment effects on individual units. Synthetic control estimation is a data driven procedure to select control units from a donor pool of controls to construct an artificial unit that mimics the dynamics of a specific treated unit. There are two main advantages of this method: First, it overcomes the practical limitation of finding a single control unit that best approximates the specified treated unit. Second, the method does not require data on post-intervention outcomes for the donor pool. In our setting, adjustable rates for the synthetic bank can be extrapolated into the post-period even if actual data is lacking for individual control banks that form the donor pool.

Figure 5 shows treatment effects for Citibank using the synthetic control estimation technique. The figure shows two time series of lending rates: one for Citibank and the other for the hypothetical ("synthetic") Citibank which mirrors the dynamics of the lending behavior of Citibank. The main dependent variable is a 5 year adjustable rate mortgage for a 175K principal. Matching covariates used to construct *synthetic* Citibank are bank characteristics such as the growth rate of mortgage loans, capital ratio, profitability and non-interest income. Relative to *synthetic* Citibank, Figure 5 shows Citibank lowered adjustable-mortgage rates in the quarters following safe harbor expansion. Safe harbor expansion induced systemically important banks to increase their mortgage lending activity by lowering mortgage lending rates in the quarters immediately preceding the crisis.[22]

[22]I obtain similar results for Bank of America and JP Morgan Chase. To conserve space, I do not report them but they are available upon request.

A potential limitation of synthetic control estimation is that statistical inference is still an ongoing area of research. Figure 6 uses a permutation method of inference (Abadie et al. [2012]). The plot shows the lending behavior of Citi moves from the center of the distribution in the pre-period to the tail of the distribution in the post-period. The lending behavior of Citibank is significantly lower in the quarters following expansion of safe harbor provisions relative to the behavior of placebo banks in the same time period.

6 The mix of collateral in repo contracts

If expansion of safe harbor encouraged the use of mortgage-backed collateral for repo contracts, we should see greater use of mortgage-related collateral underlying actual repo contracts. However, there are no known sources of data on underlying repo collateral (Baklanova [2015]). So, I hand-collect data on tri-party repo market activity through public disclosures of money market mutual funds (N-Q filings). For over 900 repo contracts, I get data on repo rate, repo dates (contract date and due date), notional amount and type of collateral. This data lets me verify whether use of mortgage-related assets increased post-BAPCPA.

Figure 7 plots aggregate share of various collateral types underlying these repo contracts for the year 2005. We see non-agency mortgage collateral was around 11% in the quarters before BAPCPA but increased to 23% of the total share of collateral following the expansion of safe harbor provisions. We know banks increased their holdings of MBS after expansion of safe harbor provisions. Figure 7 confirms these securities were indeed used as collateral to facilitate borrowing in repo markets.

7 Robustness

7.1 Was the increase in mortgage securitization part of an overall trend?

I test whether increase in mortgage securitization was a part of an overall trend and not necessarily due to BAPCPA's expansion of safe harbor provisions for mortgage-related assets. I run a placebo DiD estimation on *non-mortgage* related securitization activity.

Non-mortgage securitization activity includes securitization of assets such as credit card receivables, auto loans, commercial and industrial loans etc. Table 8 presents results. We see no differential trend in (non-mortgage) securitization activity between treated and control banks. This falsification test confirms expansion of safe harbor provisions to mortgage-collateral was responsible for the increase in mortgage-related securitization.

7.2 Are results sensitive to quartile-based cut-off points?

I classify treated and control banks based on top or bottom quartiles of trading liabilities (as a percentage of total liabilities). To test whether results are sensitive to this classification, I repeat the main analysis in Table 5 using two different cut-off points: median-levels and decile levels. Table 7 shows results are qualitative unchanged. So results are not sensitive to quartile-based definitions of cut-off points. As a further check, I repeat the main analysis by defining *Treated* banks as those in the top quartile of repo outstanding, and *Control* banks in the bottom quartile of repo outstanding. Here again, I find robust results.[23]

7.3 Is mortgage securitization driven by systematic variation in loan demand between treated and control banks?

We might observe a differential increase in securitization if treated and control banks faced different loan demand functions. It is not immediately clear why banks with high trading activity should systematically face a different loan demand relative to banks with low trading activity. Nevertheless, I perform a robustness test to rule out this explanation. I collect yearly loan application data from the Home Mortgage Disclosure Act (HMDA) database and test whether the dollar amount of loan applications in any given geographical area (Metropolitan Statistical Area) varies between treated and control banks. Table 9 presents difference-in-difference coefficients using MSA times year fixed effects and bank fixed effects. These estimates capture the difference in loan demand between treated and control banks within the same MSA. Table 9 shows no significant difference in loan demand between treated and control banks.

[23] Results are suppressed to conserve space. They are available upon request.

7.4 Did BAPCPA increase mortgage securitization independent of the repo-collateral-demand channel?

Did treated banks increase their lending activity following BAPCPA for reasons *unrelated* to changes in repo markets? This question bears merit because BAPCPA made bankruptcy law less-debtor friendly by increasing the cost of bankruptcy filing. Could increase in personal bankruptcy costs of homeowners systematically affect the mortgage lending activity of treated banks relative to control banks? There is evidence (Morgan et al. [2009], Li et al. [2011]) that mortgage defaults by homeowners rose following BAPCPA. However, this evidence is unlikely to confound my estimates for two reasons.

First, the evidence in Morgan et al. [2009] and Li et al. [2011] compares default rates in states that passed homestead exemptions against those that did not. Even if BAPCPA differentially affected default rates in homestead exemption states, it is unclear why defaults should systematically vary between banks of high trading activity and banks of low trading activity. A case for a confounding factor arises only if the geographic presence of bank branches between treated and control sub-groups *systematically varied* between states that passed homestead exemptions and those that did not. However, an analysis of bank branch locations between treated and control banks reveals a significant overlap of both groups with homestead-exemption states. As an example, Figure 9 shows significant overlap with homestead exemption states for a sample control bank. There is no systematic sorting of treated and control banks along states with or without homestead exemptions.

Second, Luzzetti and Neumuller [2014] argue mortgage lenders will respond to increasing defaults by tightening lending standards, thereby offsetting the potential for households to default on mortgages. This countervailing force may mitigate the direct impact of BAPCPA on the housing market. Even if lenders tighten lending standards, the effect can only bias against finding a result because I report an *increase* in securitization/origination activity.

7.5 Does treated group assignment matter for the observed difference in mortgage securitization?

To ensure differences in securitization activity are driven by the treatment effect on the treated subgroup, I perform a block bootstrap procedure where I introduce treatment to

group of banks at random. This simulation randomly assigns treatment to M banks and casts the remaining N-M banks as controls.[24] To plot the empirical distribution of the DiD estimates, I use the t-statistic for the coefficient on *Treated X 2006Q1* and simulate 1,000 values of this statistic. If treatment group assignment did not matter, the t-statistic will not lie in the tail of the distribution (insufficient rejection). Figure 8 shows the estimated t-statistic is in the right tail, indicating the specific assignment of treatment units matters for the observed difference in mortgage securitization.

7.6 Are results driven by a size effect?

All empirical specifications control for the effect of size. I use size fixed effects to control for this effect in a flexible non-parametric manner. Despite this, we might still be concerned some unobservable dimension of size may potentially confound our result. So I collect new data from SEC and Bloomberg on the *largest* underwriters of structured finance products. Analysis on the new sample has two benefits. First, restricting the sample to the largest players in the MBS market ensures treated and control groups are closely comparable. Second, the new sample sheds light on the securitization behavior of large underwriters such as Bear Stearns, Lehman Brothers, Goldman Sachs. Note that these are not bank holding companies so they were not part of the original sample.

Table 10 analyzes *Issuance of Structured Mortgage Products* which refers to the average issuance (in millions of dollars) of CMBS (commercial mortgage backed securities) and CMO (Collateralized Mortgage Obligations) for underwriters in a given quarter. In the spirit of earlier analyses, I classify *Treated* underwriters as those with above-median levels of repo borrowing prior to the law change and *Control* underwriters are those with below-median repo borrowing levels. As in Table 5, I focus on a narrow window around BAPCPA to see if issuance of mortgage-related products for *Treated* underwriters increases post-BAPCPA. Table 10 shows parallel trends in mortgage issuance for treated and control sub-groups prior to treatment. A significant increase in issuance for *Treated* underwriters occurs after BAPCPA. Treated investment banks underwrote $270mn (estimated diff-in-diff coefficient of 0.43 on a log-scale) more mortgage-backed securities relative to *Control* underwriters in 2006Q1. Again, expansion of safe harbor provisions in repo markets drives the difference in

[24] Each time, I pick a number equal to the original number of treated banks.

observed mortgage securitization activity.

In addition to being a robustness test, an interesting takeaway from Table 10 is the effect of BAPCPA's flexible definition of asset classes permissible under safe harbor. BAPCPA introduced safe harbor for a generic class of assets broadly defined as "mortgage-related". As Campbell [2005] points out, this definition accommodated *complex* structured products, as long as the underlying asset was mortgage-related. Consistent with this notion, Table 10 shows issuance of complex structured products increased in the quarters immediately preceding the financial crisis.

8 Conclusion

The need to understand the securitization flash flood cannot be underestimated. Proliferation of structured finance products, ultimately labeled "toxic", was the eye of the financial crisis storm. The $700bn Troubled Asset Relief Program (TARP) and the Legacy Securities purchase plan were specifically targeted at buying the alphabet-soup of securitized assets (CDO, RMBS, CMBS and ABS) that wrecked havoc on bank balance sheets. In the aftermath of the financial crisis, the Dodd-Frank Wall Street Reform and Consumer Protection Act 2010 (Dodd-Frank Act) adopted a sweeping, multi-pronged approach to curb securitized banking along various dimensions. But unless we understand how these dimensions interact, we run the risk of misdirecting regulatory energy. For instance, Title IX of Dodd-Frank[25] specifies elaborate guidelines for banks active in securitization. Repo markets, on the other hand, have received little or no attention in the regulatory reaction following the financial crisis.[26]

This paper draws attention to collateralized borrowing as a contributing factor to the rise of structured finance. Using a dynamic difference-in-difference estimation around the 2005 Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA), treated banks show a 3.1% increase in holdings of AAA-rated MBS and a 7.1% increase in mortgage securitization right before the worst financial crisis in recent history. These results suggest safe-harbor provisions afforded to mortgage-related assets contributed to the rise in struc-

[25] Subtitle D (Improvements to the Asset-Backed Securitization Process)
[26] See Chapter 11 of Acharya et al. [2010].

tured finance. This paper underscores an unintended consequence of bankruptcy law and brings into question the preferential treatment of financial contracts during bankruptcy.

More broadly, the paper tests a specific prediction of banking theory articulated in Hanson et al. [2015]. Banks are creators of safe, money-like claims determined by the nature of liabilities on the balance sheet. Shadow banks create "unstable" money (e.g. repos) by investing in liquid assets whereas traditional banks create "stable" money by investing in illiquid loans. The analysis of safe harbor expansion using the BAPCPA experiment shows that as assets grow more liquid, intermediaries create unstable money via repo funding.

Appendix

Variable definitions

- *Treated:* A dummy variable that takes a value 1 if a bank's trading liabilities (as a percentage of total liabilities) lies in the top 25% of the distribution.
- *Trading Liabilities*: Item 3548 (BHCK series) defined as "Trading Liabilities, Total". This item includes liabilities for short positions (Equity, Debt and other securities) and derivatives with a negative fair value.
- *Total Liabilities*: Item 2948 (BHCK series) defined as "Total Liabilities and Minority Interest". This item includes the sum of all liability items including subordinated notes and debentures.
- *Repo Exposure*: Item B995 (BHCK Series) defined as "Securities Sold Under Agreements to Repurchase".
- *Tier 1 Capital*: Item 8274 (BHCK series) defined as "Tier 1 Capital Allowable under the Risk-Based Capital Guidelines".
- *Non-Interest Income*: Item 4079 (BHCK series) defined as "Total Noninterest Income".
- *Highly Rated Residual*: Replicates the construction in Erel et al. [2014], reproduced in Table A.1 for convenience.
- *Mortgage Securitization Activity:* Item B705 (BHCK series) defined as "Outstanding Principal Balance of Assets Sold and Securitized with Recourse or Other Seller-provided Credit Enhancements - 1-4 Family Residential Loans"
- *Mortgage Lending Activity*: Ratio of total loans secured by 1-4 family residential properties over total loans. Sum of Items BHDM1797 (revolving), BHDM5367 (first liens) and BHDM5368 (junior liens) over BHCK2122 (total loans and leases, net of unearned income).

Table A.1: Highly Rated Residual construction as per Erel et al. [2014]

Variable	Definition
+ BHC21754	Held-to-maturity securities, total
+ BHC51754	Held-to-maturity securities, total
+ BHC21773	Available-for-sale securities, total
+ BHC51773	Available-for-sale securities, total
- BHCK1294	Amortized cost of held-to-maturity u.s. government agency and corporation obligations issued by u.s. government- sponsored agencies (excluding mortgage-backed securities)
- BHCK1297	Amortized cost of available-for-sale u.s. government agency and corporation obligations issued by u.s. government- sponsored agencies (excluding mortgage-backed securities)
- BHCK1703	Amortized cost of held-to-maturity mortgage pass-through securities issued by FNMA and FHLMC
- BHCK1706	Amortized cost of available-for-sale mortgage pass-through securities issued by FNMA and FHLMC
- BHCK1714	Amortized cost of other held-to-maturity mortgage-backed securities (include cmos, remics, and stripped mbs) issued or guaranteed by fnma, fhlmc, or gnma
- BHCK1716	Amortized cost of other available-for-sale mortgage-backed securities (include cmos, remics, and stripped mbs) issued or guaranteed by fnma, fhlmc, or gnma
- BHCK1718	Amortized cost of other held-to-maturity mortgage-backed securities (include cmos, remics and stripped mbs) collateralized by mbs issued or guaranteed by fnma, fhlmc, or gnma
- BHCK1731	Amortized cost of other available-for-sale mortgage-backed securities (include cmos, remics and stripped mbs) collateralized by mbs issued or guaranteed by fnma, fhlmc, or gnma
- BHCK8496	Amortized cost of held-to-maturity securities issued by states and political subdivisions in the u.s.
- BHCK8498	Amortized cost of available-for-sale securities issued by states and political subdivisions in the u.s.
+ BHCK3536	Trading assets - all other mortgage-backed securities

Table A.2: List of largest underwriters active in structured mortgage issuance

Bear Stearns	ABN AMRO
Goldman Sachs	Bank of America
Greenwich Capital Markets	Barclays Capital
Lehman Brothers	Credit Suisse
Merrill Lynch	Citibank
Morgan Stanley	Countrywide
Nomura Securities	Deutsche Bank
RBC Capital Markets	HSBC
Salomon Brothers	JP Morgan Chase
	Societe Generale
	UBS
	Washington Mutual
	Wachovia Capital Markets

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Table 1: **Summary Statistics of Bank Holding Companies**

This table presents descriptive statistics of the key variables used in the following analyses. Panel (a) provides summary statistics for treated and control samples for the data period 2003 to 2007. The total number of bank-quarter observations is indicated by N. Panel (b) presents comparative statistics of treated and control banks before the law change (years 2003 to 2004). The number of bank-quarter observations in years before the law change is indicated by N. The *Values* column shows the mean values of key variables for each sample. The *p-values* column compares the means of the two samples on the matching parameters.

(a) Full sample (years 2003 to 2007)

	All banks		Treated banks		Control banks	
	N	Mean	N	Mean	N	Mean
Log (total assets)	6273	15.186	906	17.416	5367	14.810
Return on Equity	6244	0.034	892	0.035	5352	0.033
Tier 1 capital	6251	0.09	894	0.116	5357	0.086
Non-interest income	6266	0.005	904	0.011	5362	0.004
Repo outstanding	6273	0.07	906	0.233	5367	0.042
Mortgage Securitization Activity	3683	0.022	905	0.137	5359	0.003
Holdings of highly rated tranches	3683	0.048	854	0.062	961	0.013

(b) Matched sample (years 2003 to 2004)

	N		Means		Medians		Diff of medians	
	Treated	Control	Treated	Control	Treated	Control	Estimate	p-value
ROE	420	376	0.039	0.040	0.041	0.04	-0.001	0.62
Tier 1 capital	420	376	0.109	0.082	0.08	0.077	0.003	0.02
Non-int. income	428	376	0.009	0.005	0.005	0.004	0.001	0.00
Mortgage loans	428	376	0.249	0.172	0.163	0.169	-0.006	0.81
Z-score	428	376	5.60	5.93	5.897	5.865	0.032	0.71
Securities (AFS)	420	376	0.198	0.194	0.183	0.192	-0.009	0.33
Log(Total assets)	428	376	17.056	15.882	17.382	15.854	1.528	0.00

Table 2: **Summary of Securitization deals by largest underwriters**

This table presents descriptive statistics securitization deals of broker-dealer investment banks from Bloomberg's *Structured Finance Calendar*. Bloomberg provides data on issuance of structured products and information on the type of the product, the lead underwriter, date of issuance and value of the deal. For analysis, I drop deals less than $100mn. Panel (a) gives a summary of deals by product type. The four main product types are CMO (Collateralized Mortgage Obligations), ABS (Asset Backed Securities), CMBS (Commercial Mortgage Backed Securities) and CDO (Collateralized Debt Obligations). Panel (b) gives the top 3 underwriters by number and average value in each product category.

(a) Securitization deals by product (years 2003 to 2007)

Product Type	All deals		Deals by sub-group			
			Treated		Control	
	N	Value ($mn)	N	Value ($mn)	N	Value ($mn)
Collateralized Mortgage Obligations	4618	886.2	1967	944.4	2651	843
Asset-Backed Securities	3370	819.2	1338	869.2	2032	786.2
Commercial Mortgage Backed Securities	556	1221.3	224	1295.2	332	1171.5
Collateralized Debt Obligations	137	664.3	45	654.1	92	669.2

(b) Top underwriters of securitization deals (years 2003 to 2007)

Product Type	Top 3 underwriters by	
	Number	Value
CMO	Bear Stearns, Lehman Brothers, BOA	BOA, Salomon Brothers, WaMu
ABS	Lehman Brothers, Citi, Credit Suisse	ABN AMRO, WaMu, Countrywide
CMBS	Credit Suisse, Morgan Stanley, JP Morgan	Wachovia, JP Morgan, BOA
CDO	Wachovia, Citi, Merrill Lynch	Merrill Lynch, UBS, Citi

Table 3: **Hand-collected data on repo contracting activity**

This table presents a granular view of the repo activity of underwriters, hand-collected from public disclosures of money market mutual funds (N-Q filings). Following Krishnamurthy et al. [2014], the focus of the data is on the largest fund families and the data is restricted to year 2005 (year of the law change). Contract details include repo rate, repo dates (contract date and due date), notional amount and type of collateral. High-frequency variation in repo activity helps observe repo data at the monthly level. The notional amounts in Panel (a) refer to median values.

(a) Repurchase contracts of underwriters from N-Q filings

Term of contract	Tri-party repo	
	N	Notional ($mn)
Less than or equal to 3 days	780	260
Between 3 and 30 days	69	162
Between 30 and 60 days	95	80
Over 60 days	23	153

Table 4: **Expansion of safe harbor increased holdings of securitized products**

This table reports the results of regressions investigating:

$$y_{it} = \beta_0 + \sum_{\tau=1}^{T} \beta_\tau Treated * \delta_\tau + \gamma X_{it-1} + \delta_i + \delta_t + \epsilon_{it}$$

The model is estimated on all firm-quarter observations from 2004Q1 to 2006Q4. *Treated* refers to a dummy variable that turns on for treated banks. The main variable is *Holdings of Highly Rated Tranches* which estimates the holdings of securitization tranches that are highly rated. This definition follows Erel et al. [2014]. Column (1) and (2) refer to the matched sample and Column (3) and (4) refer to the full sample. Column (2) and (4) presents estimates without non-parametric controls for size. Regressions includes controls, bank FE, size FE and year quarter FE. Coefficients on controls and FEs are suppressed for brevity. Robust standard errors are double clustered at the bank and year quarter level.

	Holdings of highly rated tranches			
	(1)	(2)	(3)	(4)
Treated X 2004Q2	0.003	0.004	-0.006	-0.006
	[0.426]	[0.487]	[-0.700]	[-0.727]
Treated X 2004Q3	0.001	0.003	0.001	0.004
	[0.302]	[1.048]	[0.433]	[1.364]
Treated X 2004Q4	0.009***	0.008**	0.009***	0.009**
	[3.107]	[2.877]	[3.888]	[2.747]
Treated X 2005Q1	0.016***	0.014***	0.015***	0.014***
	[3.362]	[3.485]	[4.082]	[3.571]
Treated X 2005Q2	0.022***	0.023***	0.021***	0.022***
	[3.210]	[3.451]	[3.336]	[3.133]
Treated X 2005Q3	0.019**	0.019**	0.021***	0.021***
	[2.601]	[2.757]	[3.564]	[3.506]
Treated X 2005Q4	0.024**	0.025***	0.025***	0.025***
	[3.040]	[3.210]	[3.550]	[3.605]
Treated X 2006Q1	0.023**	0.023**	0.025***	0.025***
	[2.742]	[2.874]	[3.524]	[3.583]
Treated X 2006Q2	0.029**	0.029***	0.031***	0.031***
	[3.051]	[3.118]	[3.338]	[3.331]
Treated X 2006Q3	0.033**	0.033**	0.035**	0.035**
	[2.650]	[2.763]	[2.964]	[3.043]
Treated X 2006Q4	0.031**	0.030**	0.031**	0.031**
	[2.455]	[2.536]	[2.656]	[2.737]
Observations	743	743	997	997
R-squared	0.912	0.910	0.910	0.907
Controls	Yes	Yes	Yes	Yes
Size FE	Yes	No	Yes	No
Year Quarter FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes

Table 5: **Expansion of safe harbor increased mortgage securitization activity**

This table reports the results of regressions investigating:

$$y_{it} = \beta_0 + \sum_{\tau=1}^{T} \beta_\tau Treated * \delta_\tau + \gamma X_{it-1} + \delta_i + \delta_t + \epsilon_{it}$$

The model is estimated on all firm-quarter observations from 2004Q1 to 2006Q4. *Treated* refers to a dummy variable that turns on for treated banks. The main variable is *Mortgage Securitization Activity* which is the total outstanding balance of assets sold and securitized where the underlying securitized assets are 1-4 family residential loans. Column (1) and (2) refer to the matched sample whereas Column (3) and (4) refer to the full sample. Column (2) and (4) presents estimates without non-parametric controls for size. Regressions includes controls, bank FE, size FE and year quarter FE. Robust standard errors are double clustered at the bank and year quarter level. Coefficients on controls and FEs are suppressed for brevity.

	Mortgage Securitization Activity			
	(1)	(2)	(3)	(4)
Treated X 2004Q2	-0.000	0.001	0.005	0.005
	[-0.007]	[0.021]	[0.141]	[0.157]
Treated X 2004Q3	0.030	0.032	0.030	0.031
	[1.297]	[1.366]	[1.336]	[1.358]
Treated X 2004Q4	0.025	0.025	0.024	0.024
	[1.549]	[1.516]	[1.474]	[1.504]
Treated X 2005Q1	0.017	0.015	0.015	0.014
	[0.906]	[0.852]	[0.841]	[0.806]
Treated X 2005Q2	0.024	0.024	0.024	0.024
	[1.012]	[1.039]	[0.993]	[0.980]
Treated X 2005Q3	0.029	0.029	0.028	0.027
	[1.507]	[1.522]	[1.479]	[1.445]
Treated X 2005Q4	0.031	0.030	0.029	0.028
	[1.581]	[1.595]	[1.526]	[1.499]
Treated X 2006Q1	0.038*	0.038*	0.036*	0.035*
	[1.889]	[1.917]	[1.864]	[1.836]
Treated X 2006Q2	0.055*	0.053*	0.054*	0.053
	[1.887]	[1.839]	[1.833]	[1.788]
Treated X 2006Q3	0.061**	0.058**	0.059**	0.056**
	[2.383]	[2.351]	[2.372]	[2.311]
Treated X 2006Q4	0.071**	0.068**	0.069**	0.066**
	[2.760]	[2.723]	[2.745]	[2.698]
Observations	1,202	1,202	3,771	3,771
R-squared	0.965	0.964	0.966	0.966
Controls	Yes	Yes	Yes	Yes
Size FE	Yes	No	Yes	No
Year Quarter FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes

Table 6: **Expansion of safe harbor led to real effects on mortgage originations**

This table reports the results of regressions investigating:

$$y_{it} = \beta_0 + \sum_{\tau=1}^{T} \beta_\tau Treated * \delta_\tau + \gamma X_{it-1} + \delta_i + \delta_t + \epsilon_{it}$$

The model is estimated on all firm-quarter observations from 2004Q1 to 2006Q4. *Treated* refers to a dummy variable that turns on for treated banks. The main variable is *Mortgage Lending Activity* which is the ratio of loans secured by 1-4 family residential properties to total loans. Column (1) and (2) refer to the matched sample whereas Column (3) and (4) refer to the full sample. Column (2) and (4) presents estimates without non-parametric controls for size. Regressions includes controls, bank FE, size FE and year quarter FE. Robust standard errors are double clustered at the bank and year quarter level. Coefficients on controls and FEs are suppressed for brevity.

	Mortgage Lending Activity			
	(1)	(2)	(3)	(4)
Treated X 2004Q2	0.009	0.007	0.010	0.010
	[1.053]	[0.800]	[1.201]	[1.125]
Treated X 2004Q3	0.003	0.001	0.004	0.004
	[0.485]	[0.129]	[0.576]	[0.551]
Treated X 2004Q4	0.003	0.000	-0.001	-0.000
	[0.717]	[0.098]	[-0.254]	[-0.072]
Treated X 2005Q1	0.021	0.019	0.022*	0.023*
	[1.618]	[1.605]	[1.930]	[1.968]
Treated X 2005Q2	0.020	0.017	0.020	0.022*
	[1.529]	[1.491]	[1.704]	[1.851]
Treated X 2005Q3	0.031*	0.026**	0.025*	0.028**
	[2.174]	[2.211]	[2.166]	[2.361]
Treated X 2005Q4	0.036*	0.030*	0.031*	0.032**
	[2.052]	[2.113]	[2.155]	[2.299]
Treated X 2006Q1	0.033*	0.028*	0.027*	0.031**
	[1.999]	[2.078]	[1.986]	[2.232]
Treated X 2006Q2	0.036*	0.031**	0.030*	0.033**
	[2.081]	[2.221]	[2.052]	[2.337]
Treated X 2006Q3	0.035*	0.028*	0.028*	0.032**
	[1.969]	[2.037]	[1.924]	[2.294]
Treated X 2006Q4	0.030	0.025	0.025	0.030*
	[1.680]	[1.721]	[1.652]	[2.025]
Observations	1,202	1,202	3,772	3,772
R-squared	0.926	0.924	0.943	0.942
Controls	Yes	Yes	Yes	Yes
Size FE	Yes	No	Yes	No
Year Quarter FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes

Table 7: **Robustness: Variation in cut-off point**

This table reports the results of regressions investigating:

$$y_{it} = \beta_0 + \sum_{\tau=1}^{T} \beta_\tau Treated * \delta_\tau + \gamma X_{it-1} + \delta_i + \delta_t + \epsilon_{it}$$

The model is estimated on all firm-quarter observations from 2004Q1 to 2006Q4. *Treated* refers to a dummy variable that turns on for treated banks. The main variable is *Mortgage Securitization Activity* which is the total outstanding balance of assets sold and securitized where the underlying securitized assets are 1-4 family residential loans. Column (1) and (2) refer to the full sample. In Column (1), treated firms are defined as those with above-median trading liabilities. In Column (2), treated firms are defined as those in the top decile of trading liabilities. Regressions includes controls, bank FE, size FE and year quarter FE. Robust standard errors are double clustered at the bank and year quarter level. Coefficients on controls and FEs are suppressed for brevity.

	Securitization Activity	
	(1)	(2)
Treated X 2004Q2	0.005	0.014
	[0.141]	[0.224]
Treated X 2004Q3	0.030	0.068
	[1.336]	[1.467]
Treated X 2004Q4	0.024	0.055
	[1.474]	[1.706]
Treated X 2005Q1	0.015	0.038
	[0.841]	[1.048]
Treated X 2005Q2	0.024	0.056
	[0.993]	[1.122]
Treated X 2005Q3	0.028	0.061
	[1.479]	[1.619]
Treated X 2005Q4	0.029	0.060
	[1.526]	[1.608]
Treated X 2006Q1	0.036*	0.078*
	[1.864]	[2.004]
Treated X 2006Q2	0.054*	0.116*
	[1.833]	[2.035]
Treated X 2006Q3	0.059**	0.128**
	[2.372]	[2.637]
Treated X 2006Q4	0.069**	0.147**
	[2.745]	[2.997]
Observations	3,771	3,447
R-squared	0.966	0.968
Controls	Yes	Yes
Size FE	Yes	Yes
Year Quarter FE	Yes	Yes
Bank FE	Yes	Yes

Table 8: **Robustness: Non-mortgage securitization activity**

This table reports the results of regressions investigating:

$$y_{it} = \beta_0 + \sum_{\tau=1}^{T} \beta_\tau Treated * \delta_\tau + \gamma X_{it-1} + \delta_i + \delta_t + \epsilon_{it}$$

The model is estimated on all firm-quarter observations from 2004Q1 to 2006Q4. *Treated* refers to a dummy variable that turns on for treated banks. The main variable is *Non-Mortgage Securitization Activity* which is the total outstanding balance of all assets sold and securitized where the underlying securitized assets excludes 1-4 family residential loans. Column (1) and (2) refer to the matched sample whereas Column (3) and (4) refer to the full sample. Column (2) and (4) presents estimates without non-parametric controls for size. Regressions includes controls, bank FE, size FE and quarter FE. Robust standard errors are double clustered at the bank and quarter level. Coefficients on controls and FEs are suppressed for brevity.

	Non-mortgage Securitization Activity			
	(1)	(2)	(3)	(4)
Treated X 2004Q2	0.001	0.001	0.001	0.001
	[0.485]	[0.555]	[0.597]	[0.651]
Treated X 2004Q3	0.001	0.001	0.001	0.001
	[0.445]	[0.532]	[0.463]	[0.600]
Treated X 2004Q4	0.000	0.000	0.001	0.001
	[0.261]	[0.189]	[0.783]	[0.977]
Treated X 2005Q1	0.002	0.001	0.001	0.001
	[1.242]	[1.498]	[1.328]	[1.624]
Treated X 2005Q2	-0.000	-0.000	-0.001	-0.000
	[-0.064]	[-0.130]	[-0.222]	[-0.205]
Treated X 2005Q3	-0.000	-0.000	-0.001	-0.001
	[-0.294]	[-0.357]	[-1.170]	[-1.049]
Treated X 2005Q4	0.000	-0.000	-0.001*	-0.001
	[0.189]	[-0.226]	[-2.031]	[-1.599]
Treated X 2006Q1	0.006	0.006	0.005	0.005
	[1.142]	[1.139]	[0.865]	[0.913]
Treated X 2006Q2	0.006	0.005	0.004	0.004
	[0.863]	[0.845]	[0.602]	[0.640]
Treated X 2006Q3	0.005	0.005	0.004	0.004
	[0.892]	[0.925]	[0.623]	[0.690]
Treated X 2006Q4	0.006	0.006	0.004	0.004
	[1.004]	[1.034]	[0.736]	[0.801]
Observations	1,202	1,202	3,772	3,772
R-squared	0.958	0.958	0.961	0.961
Controls	Yes	Yes	Yes	Yes
Size FE	Yes	No	Yes	No
Quarter FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes

Table 9: **Robustness: No systematic variation in loan demand between treated and control banks**

This table reports the results of regressions investigating:

$$y_{it} = \beta_0 + \sum_{\tau=1}^{T} \beta_\tau Treated * \delta_\tau + \delta_i + \delta_t + \epsilon_{it}$$

The model is estimated on all bank-year observations from 2003 to 2007. *Treated* refers to a dummy variable that turns on for treated banks. The main variable is *Loan demand* which represents dollar amounts (in thousands of dollars) of loans granted or requested under the Home Mortgage Disclosure Act (HMDA). Column (1) refers to Conventional Loans. Column (2) refers to Federal Housing Administration (FHA) - insured loans. Column (3) refers to Veterans Administration (VA) - guaranteed and Column (4) refers to FmHA (Farmers Home Administration) - insured loans. Regressions includes MSA (Metropolitan Statistical Area) FE, bank FE and year FE. Robust standard errors are double clustered at the bank and MSA level. Coefficients on FEs are suppressed for brevity.

	Loan demand			
	(1)	(2)	(3)	(4)
Treated X 2004	34.998	-25.004	0.898	14.669
	[0.558]	[-0.569]	[0.149]	[1.263]
Treated X 2005	78.401	-17.601	2.134	8.927
	[0.968]	[-0.445]	[0.345]	[0.634]
Treated X 2006	29.624	-0.006	5.636	-0.845
	[0.466]	[-0.000]	[0.822]	[-0.057]
Treated X 2007	88.293	-4.130	3.870	13.717
	[1.363]	[-0.078]	[0.633]	[1.279]
Observations	72,496	12,943	10,390	2,612
R-squared	0.586	0.382	0.609	0.599
MSA X Year FE	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes

Table 10: **Robustness: Expansion of safe harbor increased underwriting of structured finance products**

This table reports the results of regressions investigating:

$$y_{it} = \beta_0 + \sum_{\tau=1}^{T} \beta_\tau Treated * \delta_\tau + \gamma X_{it-1} + \delta_i + \delta_t + \epsilon_{it}$$

The model is estimated on all firm-quarter observations from 2004Q1 to 2006Q4. *Treated* refers to a dummy variable that turns on for treated underwriters (UW). The list of underwriters is in the Appendix. The main variable is *Issuance of Securitized Products* which captures the average issuance (in logs) of CMBS (commercial mortgage backed securities) and CMO (Collateralized Mortgage Obligations) for each underwriter in a given quarter. Column (1) is the number of deals whereas Column (2) is the log of the deal origination amount in millions of dollars. Regressions includes Underwriter FE and Year Quarter FE. Robust standard errors are double clustered at the underwriter and year quarter level. Coefficients on FEs are suppressed for brevity.

	Structured product issuance	
	(1)	(2)
Treated X 2004Q2	-0.417	0.028
	[-0.432]	[0.155]
Treated X 2004Q3	-0.104	-0.186
	[-0.141]	[-1.281]
Treated X 2004Q4	-0.372	0.187
	[-0.479]	[1.072]
Treated X 2005Q1	-0.984	0.209
	[-1.322]	[1.355]
Treated X 2005Q2	-0.426	0.029
	[-0.331]	[0.174]
Treated X 2005Q3	0.516	0.059
	[0.974]	[0.558]
Treated X 2005Q4	1.183*	0.061
	[2.183]	[0.424]
Treated X 2006Q1	2.634***	0.423**
	[3.793]	[2.811]
Treated X 2006Q2	1.005	0.141
	[0.770]	[0.585]
Treated X 2006Q3	0.888	0.444**
	[0.781]	[3.093]
Treated X 2006Q4	1.110	0.211
	[0.568]	[0.599]
Observations	353	353
R-squared	0.221	0.291
Year Quarter FE	Yes	Yes
Underwriter FE	Yes	Yes

Figure 1: Heavy use of mortgage-backed securities as collateral in repo markets

The figure is reproduced from the U.S Repo Factsheet by Securities Industry and Financial Markets Association (SIFMA). We see increasing use of mortgage collateral from 2005 to 2007, the years following expansion of safe harbor provisions to mortgage-backed assets.

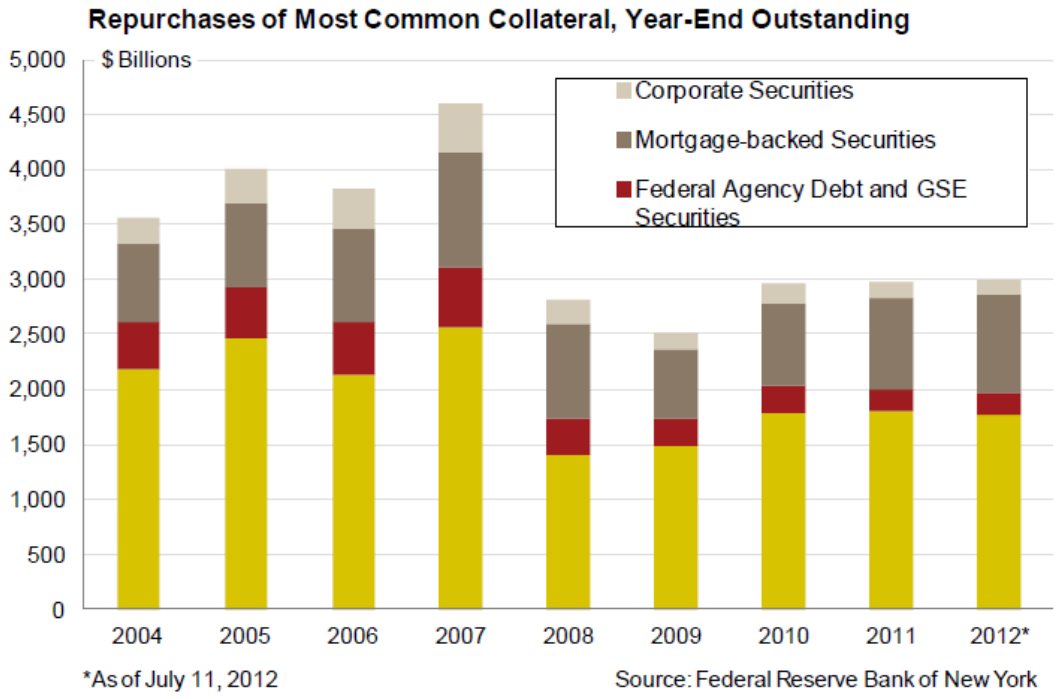


Figure 2: Synchronous growth in repo activity and structured finance issuance

The figure plots Flow of Funds data from the Federal Reserve Statistical Release. The quarterly data is from 2000 to 2010. The red line represents activity (in billions of dollars) by issuers of asset-backed securities. The instrument type is home mortgages, including home equity loans and construction loans on one-to-four family homes (Series 30651). The series in blue refers to repurchase agreements (in trillions of dollars) of security broker dealers (Series 21510). The figure suggests synchronous growth in repo and securitization activity.

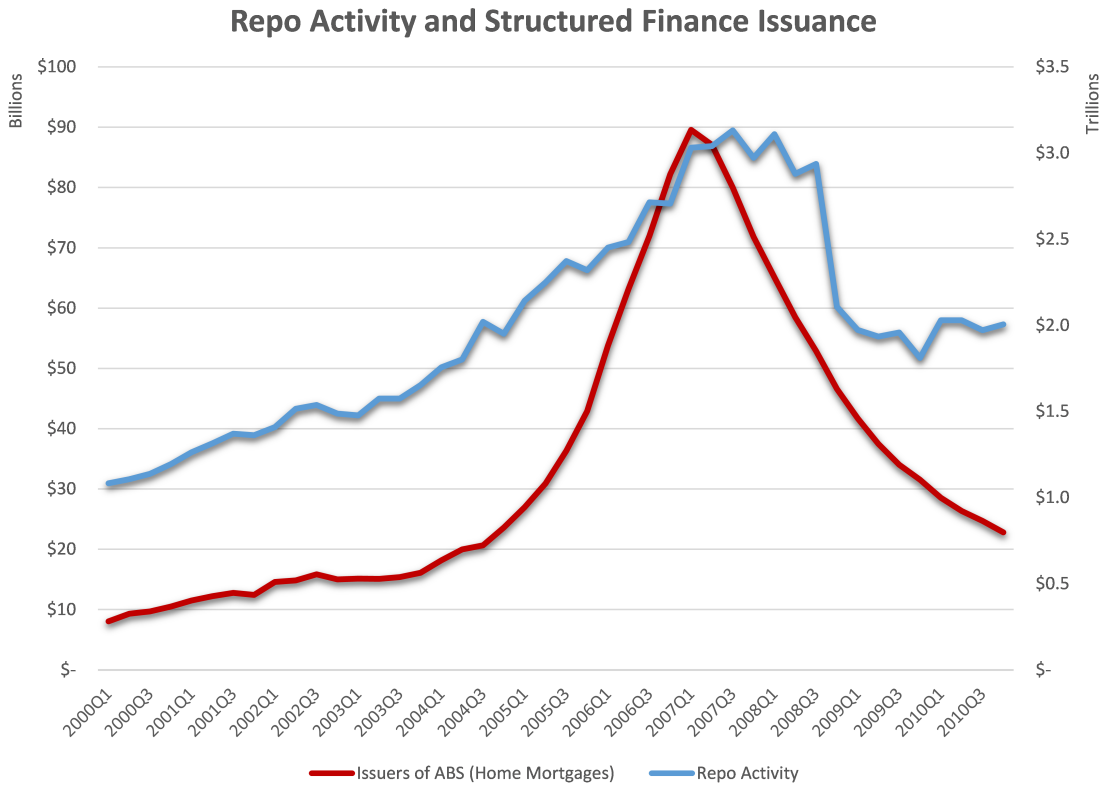


Figure 3: The Repo Channel

This figure plots difference-in-difference estimates of gross repo exposure from 2004 to 2007 along with vertical bars for 90% confidence intervals. The figure shows parallel trends in the years before the law change. Gross repo exposure increases only in the quarters post introduction of BAPCPA in the Senate. Coefficient estimates are from a fully saturated model of (*Treated* X *Quarter*) interaction terms. 2004Q1 is the excluded category.

$$y_{it} = \beta_0 + \sum_{\tau=1}^{T} \beta_\tau Treated * \delta_\tau + \gamma X_{it-1} + \delta_i + \delta_t + \epsilon_{it}$$

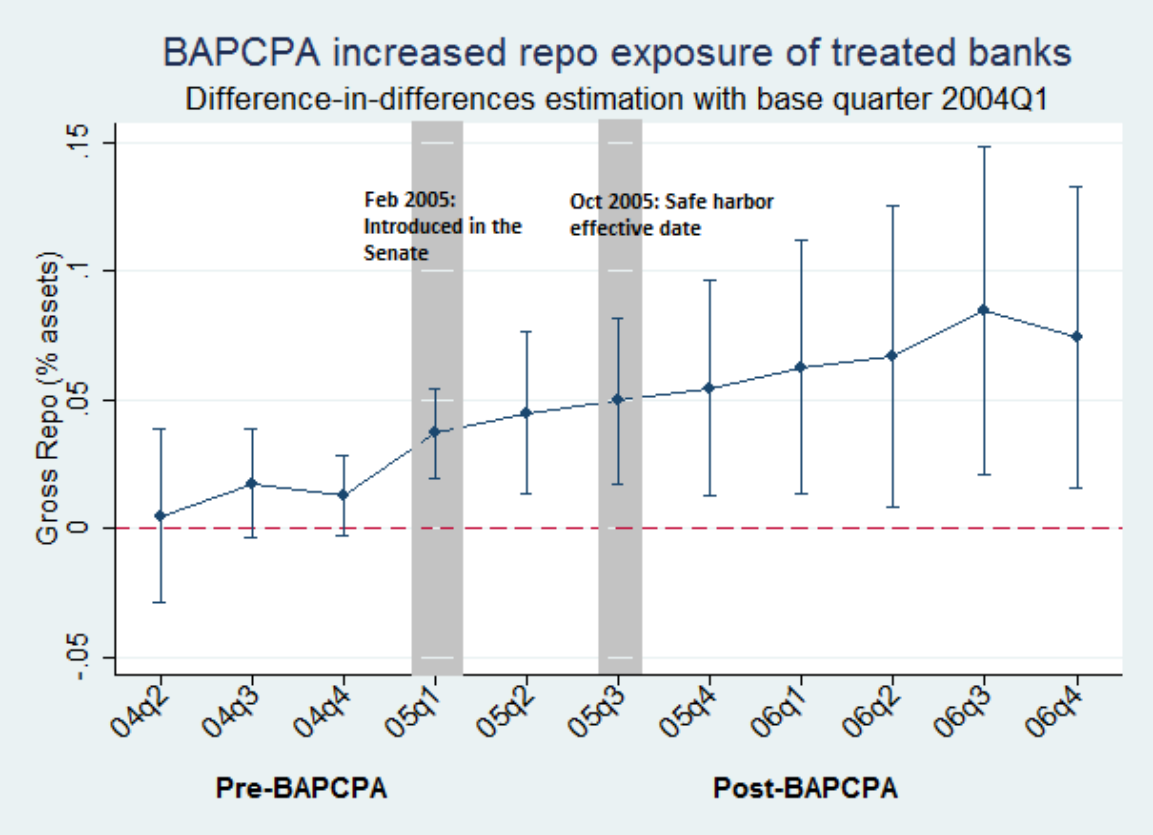


Figure 4: Expansion of safe harbor lowered yields on private-label MBS

This plot shows a price effect due to the expansion of safe harbor. The figure shows yields on indices that capture agency and non-agency mortgage backed securities. The blue line represents private-label MBS and the red line is agency MBS. The key dates of the Bankruptcy Act of 2005 are highlighted by the vertical lines. The plot shows yields on private-label (non-agency) MBS decreased relative to agency MBS following expansion of safe harbor provisions. Private-label MBS became more valuable following expansion of safe harbor.

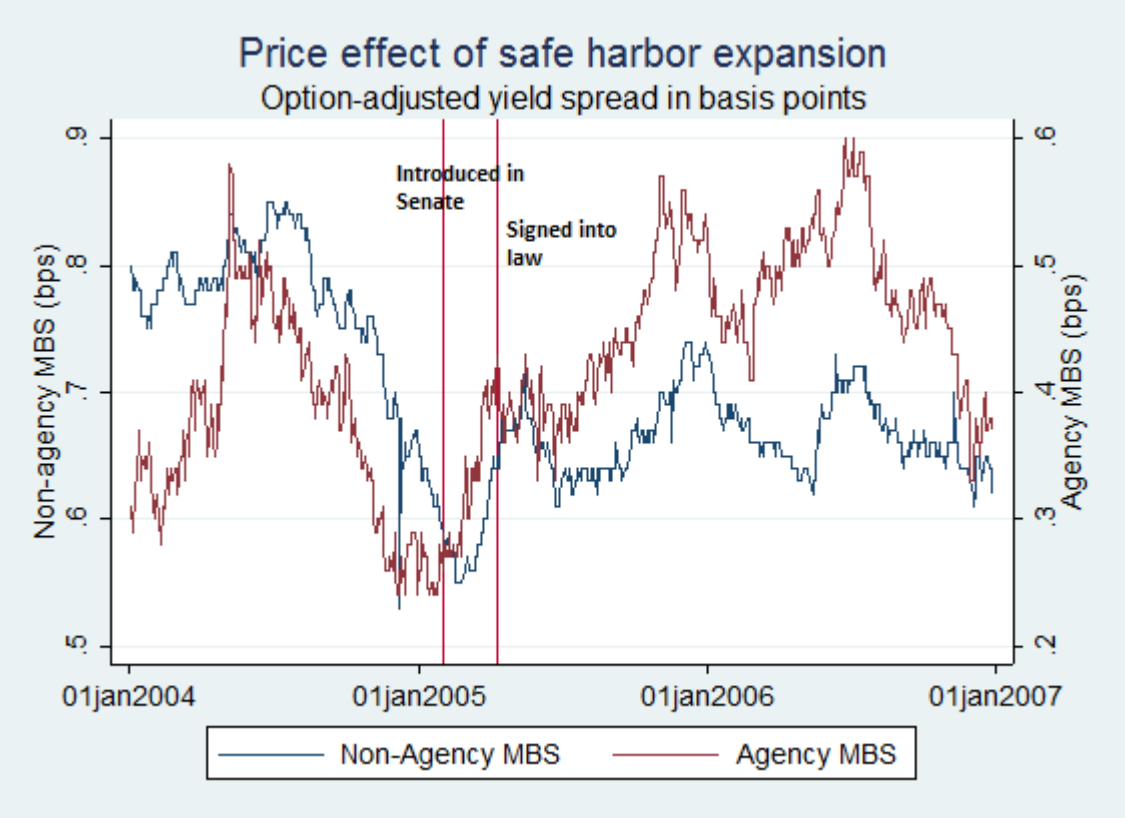


Figure 5: Real effects on mortgage loan pricing (Synthetic Control Estimation)

This plot tests whether banks altered the pricing of mortgage loans following expansion of safe harbor provisions. The plot shows the effect of treatment on a single bank (Citibank) using the synthetic control estimation technique described in Abadie et al. [2012]. The figure shows Citibank lowered adjustable-mortgage rates relative to the estimated "synthetic" counterfactual. The main dependent variable is 5 year adjustable rate mortgage for a 175K principal. The matching covariates used to construct synthetic Citibank are mortgage loan growth, capital ratio, profitability and non-interest income.

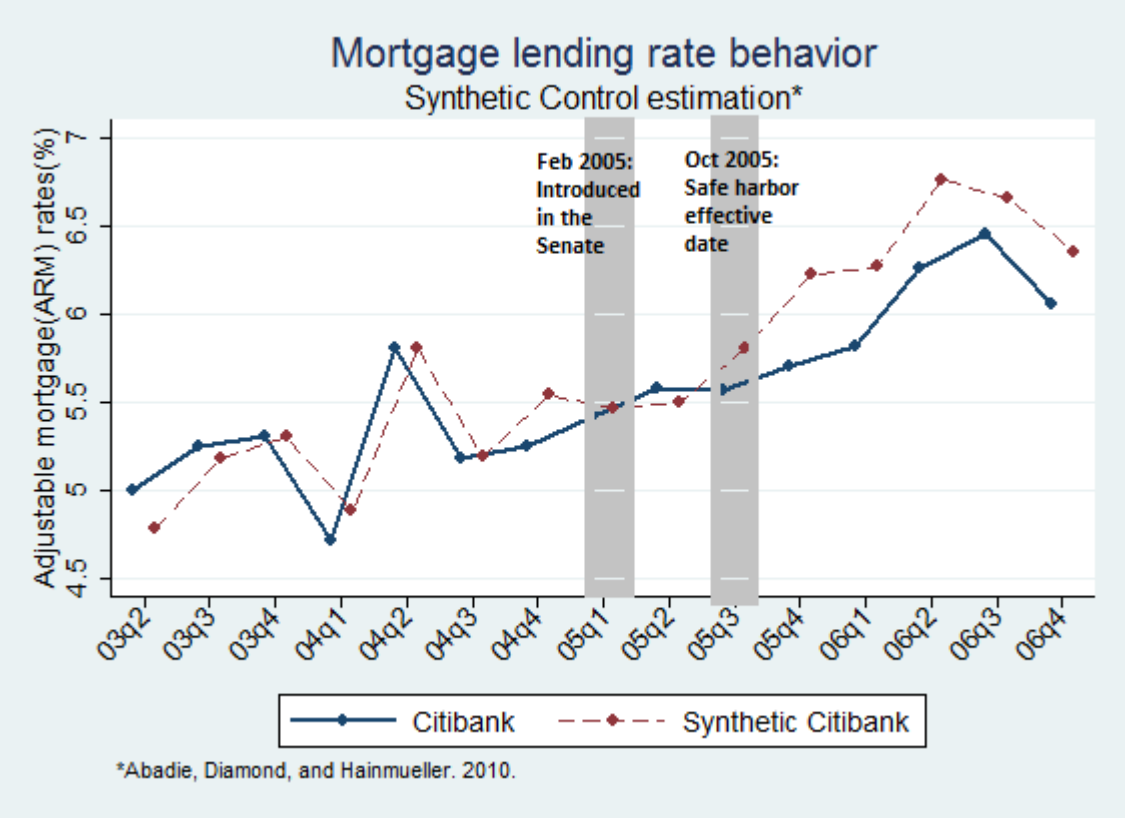


Figure 6: Real effects on mortgage loan pricing (Synthetic Control Inference)

This figure tests whether banks altered the pricing of mortgage loans following expansion of safe harbor provisions. This plot shows inference based on permutation methods using the synthetic control estimation technique described in Abadie et al. [2012]. The main dependent variable is 5 year adjustable rate mortgage for a 175K principal. The matching covariates used to construct synthetic Citibank are mortgage loan growth, capital ratio, profitability and non-interest income. The figure compares the synthetic rate difference between Citibank relative to the corresponding difference for placebo banks. We see the rate difference is close to zero in the pre-period but moves to the tail of the distribution in the post-period.

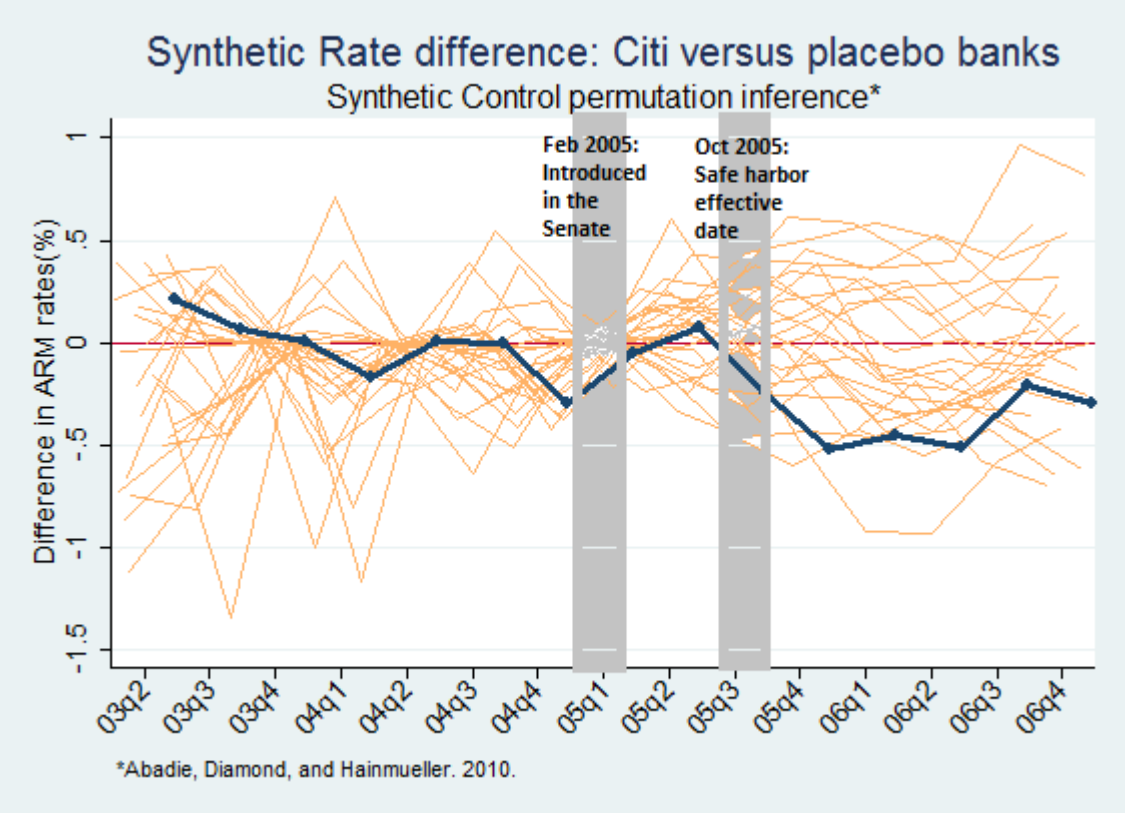
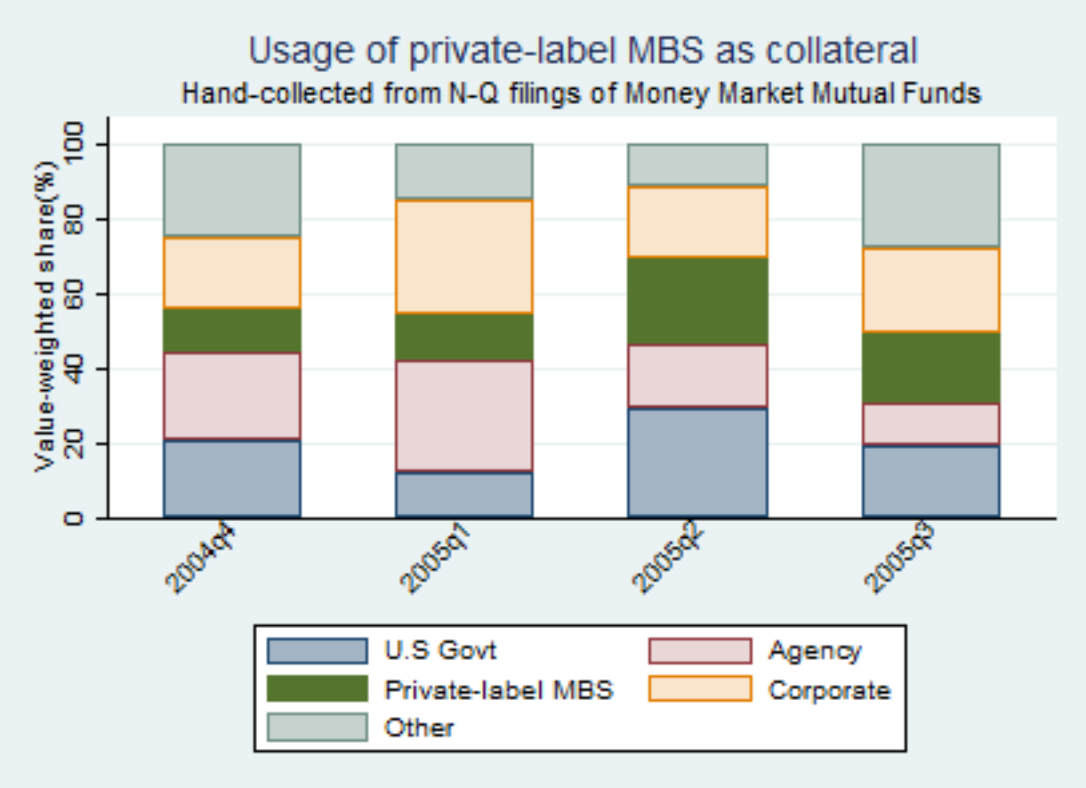


Figure 7: Share of private-label MBS as repo collateral increased after safe harbor expansion

This figure plots collateral data from tri-party repo contracts hand collected from N-Q filings of money market mutual funds. The time dimension is measured quarterly. The y-axis measures the value weighted share of various types of collateral. The graph shows an increase in the percentage of private-label mortgage collateral used after BAPCPA.



Two sample test (Proportion of private-label MBS)			
Variable	Observations	Mean	Std. Err.
2005Q2	211	0.23	0.0292
2005Q1	266	0.12	0.0197
Difference		0.11***	.723
Z-statistic		3.38	
P-value		0.00	

Figure 8: Block bootstrap assignment of treated banks

This figure plots bootstrapped t-statistics from randomly assigning a block of banks to treatment. To plot this distribution, the difference-in-differences estimate in Table 5 (Column (1)) is run 1,000 times. The t-statistic corresponds to the coefficient on *Treated X 2006Q1*. The figure confirms the assignment to treatment matters for the observed difference in securitization activity.

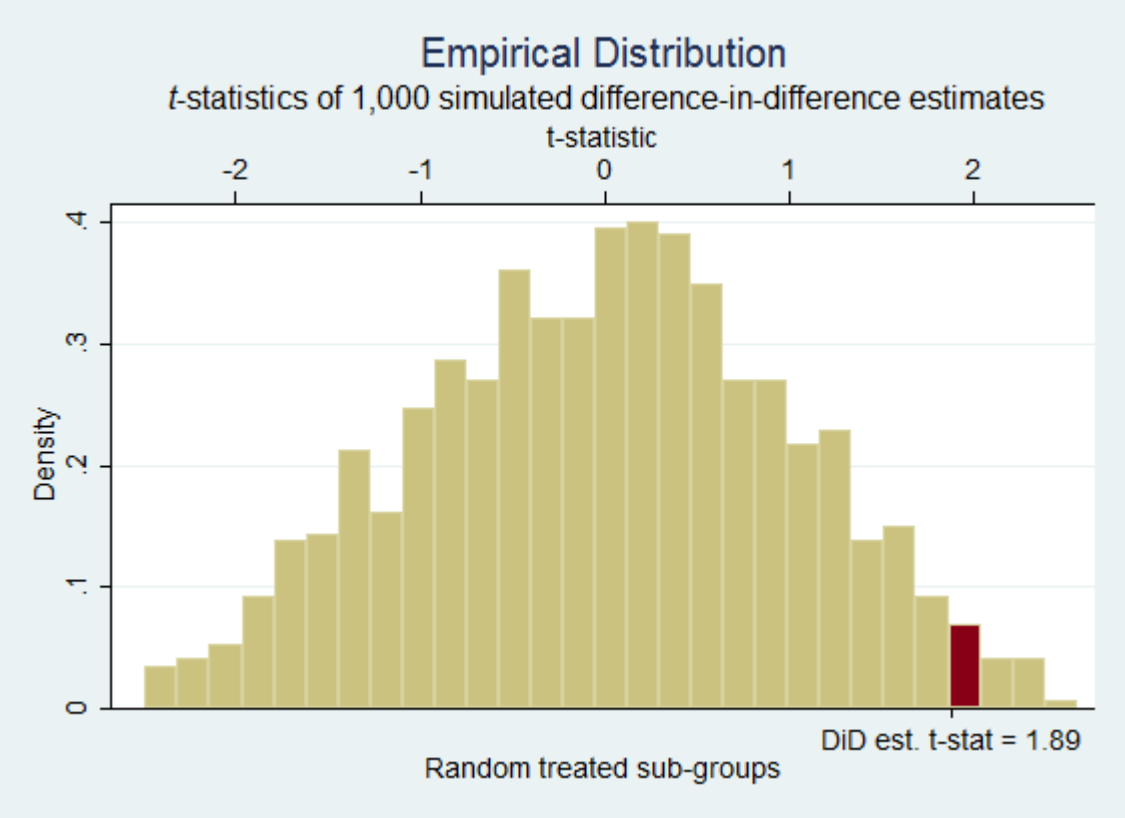


Figure 9: Overlap of control branch network with homestead exemption states

This figure picks a sample control bank (SVB bank), and plots the overlap between states the passed homestead exemption laws in the sample period and the branch network of that bank. The plot shows significant overlap between the branch network and homestead exemption states. Since treated banks such as Bank of America have presence in all homestead exemption states, this overlap suggests there are no systematic differences between treated and control banks with respect to homestead exemptions.