The Effect of Dealer Leverage on Mortgage Quality

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Abstract

This paper explores how strengthening creditor rights on collateral used in large short-term funding markets, known as the sale and repurchase markets (the "repo" markets), both generates a credit supply shock and deteriorates the quality of the assets underlying the collateral. I study a policy change in 2005 that strengthened creditor rights on mortgage-backed repo collateral. I present evidence that these stronger creditor rights relaxed large securities dealers' cost of funding. To study whether dealers passed the resulting increased supply of credit on to the mortgage companies that they funded, I hand-collect data on credit lines linking dealers to mortgage companies. Using an across dealer, within mortgage company difference-in-differences analysis, I find that in response to the policy change, dealers increased their funding to mortgage companies. I also find evidence that dealers systematically increased funding for the riskiest mortgage products. Using a county-level difference-in-differences analysis, I estimate that the expansion in credit led to a 9% increase in mortgage lending volume and increased originations of the riskiest mortgage products. I estimate that mortgages originated in response to the policy change made up 38% of mortgage defaults among all mortgages originated during 2005-2006. This paper provides evidence that the increase in dealer funding to mortgage companies post shock amplified both the "last gasp" of the housing boom and the severity of the home price decline in the Financial Crisis.

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1 Introduction

Mian and Sufi (2009) established that the evolution of the housing boom of the 2000s was consistent with an increase in credit supply rather than demand. Since their seminal work, a large number of studies have engaged in a massive effort to understand the credit supply shocks that drove the Financial Crisis (Di Maggio and Kermani (2017), Mian and Sufi (2018), Drechsler, Savov and Schnabl (2019)). All of these studies further our understanding of credit supply leading up to the Financial Crisis. Yet, there remain a number of important puzzles. Much of the literature suggests that the credit expansion took place mainly in the subprime mortgage segment, while new literature suggests that the rise in mortgage defaults was concentrated in the middle and top of the credit score distribution (Albanesi, De Giorgi and Nosal (2017)). Why were 2006, 2007 vintage mortgages so much worse than 2000-2004 vintages, defaulting only a few months after origination as found in Demyanyk and Van Hemert (2009)? How were the boom and bust in the repo market linked to the boom and bust in the housing market? Gorton and Metrick (2010a), (2010b), and (2012) propose a run on the sale and repurchase market (the 'repo' market) was at the nexus of the Financial Crisis. However, Krishnamurthy, Nagel and Orlov (2014) present evidence that only a small fraction of total outstanding private-label asset-backed securities was exposed to this run. Ospina and Uhlig (2018) find that the MBS securities' prices returned to pre-crisis levels with only 42 basis points in realized losses on subprime MBS and slightly higher losses in the prime segment. How did relatively small realized losses on a two trillion dollar market put 12 of the 13 most systemically important financial institutions at risk of failure in a period of two weeks? Without understanding these questions, we run the risk of repeating the same mistakes that led to the Financial Crisis of 2008.

This paper furthers our understanding of these questions. It provides evidence that improving creditor rights in the repo market increases credit creation through re-use of collateral. Increased re-use of collateral functions like a "money multiplier" in the fractional reserve banking system. This paper establishes that the money multiplier effect in the repo markets is large for risky assets, such as private assets rather than government assets. I study this credit creation in the repo markets through the lens of the housing boom and bust of the 2000s in order to utilize a policy change in 2005 as a natural experiment that shocks creditor rights on repo. The policy change was the Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) of 2005, which granted preferred bankruptcy status to a new class of assets used as collateral in the repo markets, private-label mortgage collateral (PLS), or risky mortgage collateral. While the shock affected the re-use of private-label mortgage collateral in 2005-2008, treasuries, agency mortgages, and to some extent

corporate securities are still being used in the repo markets in a similar way.

I trace the transmission of the shock from the dealers, to the mortgage companies that they fund, and ultimately to homebuyers. Securities dealers are important intermediaries who supply credit outside the regulated banking sector. Prior to the Financial Crisis, independent mortgage companies (IMCs) relied heavily on dealers to fund them (Stanton, Walden and Wallace (2014), Echeverry, Stanton and Wallace (2016)). The market for repos - short-term loans collateralized with financial securities - played a central role in supplying credit to the IMCs and to the financial system as a whole.

I exploit BAPCPA as a natural experiment to shock creditor rights on repo collateral. In Figure 2, I show new evidence,[1] that dealers' re-use of private-label mortgage collateral (PLS), and therefore securities financed, tripled following BAPCPA and crashed when the repo run on mortgage-backed securities (MBS) began. To establish that BAPCPA increased dealers' ability to re-use PLS in the repo markets, I utilize institutional detail and micro-level data to create a treatment intensity research design that is inspired by dealers' ability to generate a money multiplier. Dealers holding more PLS at the time of the shock will suddenly have a larger fraction of collateral become re-usable. Infante (2019) presents a theoretical framework where dealers re-use collateral to take advantage of differential haircuts required in two different repo markets in order to finance their asset inventory and create a liquidity windfall. This paper tests whether treated dealers are better positioned to take advantage of larger haircut differentials to generate a larger money multiplier and lower their cost of capital. To capture heterogeneity in dealers' ability to re-use PLS collateral post shock, I use pre-existing variation in dealers' underwriting of PLS mortgage collateral, proxying for their warehousing this collateral, the year prior to shock.

I utilize a difference-in-differences approach to test whether treated dealers increase their holding of repledgeable collateral post BAPCPA. The analog to increasing re-use of repo collateral by lowering haircuts would be lowering the reserve requirement in the fractional reserve banking system. All else equal, traditional banks holding a larger fraction of reserves at the time of the shock would be able to supply more credit (receive more deposits) supported by each new marginal dollar deposited. What I measure with dealers' reported repledgeable collateral is the analog of new deposits. By repledging their existing mortgage collateral holdings immediately following BAPCPA, treated dealers could support multiple rounds of new lending to an IMC. Each round would increase dealers' holdings of warehoused mortgage collateral, which they would report as repledgeable collateral. I establish that post

[1]To establish which line item captured private-label mortgage collateral prior to the Financial Crisis, I hand link the variables in the Federal Reserve's FR2004 survey data on primary dealers to the line items in the survey forms actually filled out by the dealers.

BAPCPA, treated dealers increased their reported repledgeable collateral significantly by 18% relative to control dealers.

The IMCs made up close to one third of the mortgage lending market prior to the Financial Crisis. Prior to this paper, there has been no direct evidence of who the funders to the mortgage companies were or how they operated. I hand collect novel micro-level data that allows me to identify funding lines from dealers to twelve of the largest public independent mortgage companies between 2004Q3 and 2006Q3. Mortgage companies depended on the sale of mortgages to fund themselves. While they waited to sell mortgages that they had originated, they packaged the mortgages into *warehouse* facilities and posted these warehoused loans as collateral to receive funding. My data probes deeper into their funding during this warehouse phase. I provide evidence that mortgage companies posted their warehouse loans to receive warehouse lines of credit. These credit lines were provided by the largest most interconnected 27 dealers in the bilateral repo market and comprised 61% of IMC funding on average.

The paper studies dealer funding to the IMCs in response to BAPCPA. Within a narrow window around the policy change, I establish that dealers more intensely treated increased their credit supply within the same mortgage company relative to those less intensely treated. Isolating the credit supply channel requires simultaneously estimating both the *dealer lending channel* and the *firm borrowing channel*. A benefit of my data is that I observe the same mortgage company receiving funding from multiple dealers. This key feature allows me to study differential dealer lending within the same mortgage company. Following Khwaja and Mian (2008), I run a difference-in-differences analysis of the credit lines to a given mortgage company by more- versus less-exposed dealers. This setting allows me to isolate the dealer credit supply channel by controlling for mortgage company demand confounders. I establish that treated dealers increased their funding to mortgage companies significantly by 29% relative to control dealers. I present evidence that suggests that this was not a substitution from control to treated dealers but an increase in overall credit supplied to mortgage companies. I establish that mortgage companies who were more dependent on treated dealers in the pre-period received a 13% increase in their total credit lines post shock relative to mortgage companies who were more dependent on control dealers. My research design causally links dealers' ability to re-use collateral in the repo market to their increased provision of credit to mortgage companies. I present evidence that post BAPCPA, dealers systematically loosened covenants on their credit lines to mortgage companies following the shock. Rather than increasing funding for lines collateralized by traditional mortgages, dealers increased funding for balloon, interest-only, 120-180 day delinquent mortgage collateral, and for "wet" (unsecured) credit lines. This evidence suggests that dealers incentivized mortgage companies to

originate mortgage products with low initial mortgage payments with less consideration of the borrowers' ability to pay the mortgage long term, consistent with the collateral being a valuable funding source for dealers.

The paper tests whether the IMCs increased funding to households in response to the policy change. I conduct a difference-in-differences analysis which utilizes variation in the county level market share of IMCs in 2004, the year before the shock. Prior to the shock, I observe no statistically significant difference in mortgage characteristics between counties with low IMC market share versus counties with high IMC market share. Post shock, I find that counties with higher exposure to IMCs increased their mortgage originations and originated riskier mortgages in response to the shock. A 10% increase in treated mortgage company market share leads to an 8.7% increase in mortgage originations. The distribution of these originations significantly shifted toward balloon, adjustable-rate with artificially low introductory interest rates, negative amortizing, and non-owner-occupied mortgages. These were Alt-A rather than subprime mortgage products. Although these products required a higher credit score, Foote and Willen (2016) discuss the fact that the structure of alternative mortgages may increase their risk of default.

This paper presents evidence that these mortgage originations contributed to the "last gasp" in the increase in originations, driving up home prices in the short run, however they were the most vulnerable to default. I find that a 10% increase in IMC market share led to a statistically significant increase in home prices of 9.5% during 2005-2006. Within a five-month window around the shock, a loan originated one month post shock in a county with a higher IMC market share was twice as likely to default relative to a loan originated in that county one month prior to the shock. Consistently, a 10% increase in IMC market share led to a significant 19% decrease in home prices during 2007-2008. I estimate that mortgages originated in response to BAPCPA accounted for an increase in total mortgage originations of between 2%-9%, however these mortgages accounted for 14%-38% of defaults among all mortgages originated during 2005-2006, depending on assumptions. This evidence sheds light on the puzzle of why 2006 and 2007 vintage mortgage loans were of worse quality than 2001-2004 mortgage loans after controlling for borrower characteristics.

Mian and Sufi (2018) attribute the boom and bust in home prices to housing speculation by "flippers," or homebuyers purchasing investment properties. My paper explores who was funding these speculators during 2005 through early 2007. By early 2007, I observe the majority of mortgage companies in my sample fail. The bankruptcy filings in all cases were triggered by the mortgage company's inability to meet margin calls or other requirements stipulated on their repo credit lines. The data that I collect provides evidence that the 27 most critical dealers were disproportionately exposed due to their role as warehouse lenders.

As the IMCs failed the dealers would face a sudden withdraw of their collateral funding on their asset side triggering collateral runs as discussed in Infante and Vardoulakis (2018). At the same time, the results in this paper show that the re-use of mortgage collateral allowed these dealers to become extremely levered post BAPCPA. Singh and Aitken (2010) shows that the re-use of collateral allowed the shadow banking system to be 50% more levered than standard estimates during 2007-2009. On their liability side, the dealers would therefore be highly exposed to repo runs, where cash funders refused to roll-over repo funding backed by mortgage collateral, even if the runs were confined to the private-label MBS collateral.

There is a legal literature (Edwards and Morrison (2005), Roe (2010), Skeel and Jackson (2012), Duffie and Skeel (2012), Morrison, Roe and Sontchi (2013)) that debates whether risky collateral backing repos should be exempt from automatic stay. The intention of the policy change was to improve stability of the financial markets by insulating markets from bankrupt debtors and bankruptcy judges (Edwards and Morrison (2005)). Morrison, Roe and Sontchi (2013) note that safe harbor for repurchase agreements was intended for collateral that maintains its price in a crisis. Merrill, Nadauld, Stulz and Sherlund (2014) find PLS collateral did not maintain its price in the crisis. This paper contributes the insight that requiring a collateral class to maintain its price in a crisis in order to grant preferred bankruptcy status is crucial when such status increases re-use of the collateral in the repo markets.

This paper also has implications for central banks' use of the tri-party market to conduct monetary policy. In 1999, the Federal Reserve set up facilities in the tri-party market to begin purchasing mortgage pass-through securities.[2] In 2020 the Bank of Israel began purchasing corporate bonds in the repo market. These activities have the potential to increase re-use of collateral, impacting both credit supply and the quality of the underlying assets.

There is an existing literature that uses the BAPCPA policy change as a natural experiment. Chircop, Fabrizi and Parbonetti (2018) conduct an event study and find evidence that information asymmetry increases for banks more exposed to the BAPCPA repo 'safe harbor' provisions. Srinivasan (2017) presents evidence that demand increased for private-label mortgage collateral in the tri-party repo market following BAPCPA. Bellicha (2016) and Ganduri (2016) study the impact of BAPCPA on the deterioration of mortgage warehouse loans. I innovate relative to this literature by studying BAPCPA's effect on dealers' re-use of mortgage collateral in the repo markets and their resulting credit supply generation. I provide new micro data linking dealers to mortgage originations which allows me to draw a direct connection between the behavior of institutional investors and the real economy.

[2]I discuss this policy further in the Online Appendix.

2 Institutional Background

In this paper, I study the borrowing and lending of independent mortgage companies and dealers in the repo market. This section describes how (1) mortgage companies depend on credit lines from dealers; (2) dealers operate in the repo market; (3) BAPCPA affected the interactions between these two groups of players.

Independent Mortgage Company (IMC) Warehouse Credit Lines Independent mortgage companies are not deposit taking institutions. They depend heavily on the sale of their mortgages in order to fund themselves. This sale typically takes between 30-60 days. In the meantime, mortgage companies originate mortgages, package them into a warehouse facility and use this warehouse facility to borrow against.[3] My sample is restricted to the 12 public IMCs that report the lenders funding them. These were 12 of the largest public IMCs and generated 59% of all mortgages originated by IMCs in 2006.[4] I find that these IMCs' main source of funding is from *"warehouse repurchase facilities"* funded by dealers in the bilateral repo market. Each IMC reports the dealer funding each credit line and the maximum amount of the credit line. These warehouse repurchase facilities make up 60% of IMC assets on average. I find that 29 warehouse lenders were funding these IMCs. 16 of the 29 were primary dealers[5] in the bilateral repo market.[6] The primary dealers are a subset of broker dealers who deal directly with the government to make the market for newly issued US Treasuries. They are the most interconnected broker dealers. Two of the 29 dealers are not considered in my within mortgage company across dealer analysis as they are only lending to one IMC in my sample. This leaves 27 dealers, 15 of which were primary dealers.

Repo Market Functioning The repo markets are large short-term funding markets where securities are sold and repurchased, creating short-term loans collateralized by financial

[3] HomeBanc 2005 10-Q3 p 101 of 173 states that: the repayment of these warehouse credit lines varied by contract but they were often repayable either when the loans financed by the facility were sold or on the maturity date of the warehouse facility contract.

[4] Stanton, Walden and Wallace (2014) find that after accounting for both mortgage originations and purchases from correspondent lenders five of the IMCs in my dataset originate 7% of all mortgage lending in the United States and, at minimum, 49% of all IMC mortgage lending in 2006. Summing originations including purchases for the five largest IMCs from Stanton, Walden and Wallace (2014) plus the HMDA data market share for the additional seven IMCs in my data, I estimate the total market share of IMCs captured in my data 59% of all originations made by IMCs in 2006. This number is likely to be a lower bound since I do not see the purchases by the additional 7 IMCs in my dataset. Using HMDA origination data alone (which does not account for purchases from correspondent lenders), I estimate that the 12 IMCs account for 15% of IMC mortgage originations in 2005.

[5] These dealers make up 16 of 22 primary dealers in 2005 were lending to the 12 IMCs whose data I observe.

[6] Almost all of the IMCs that I observe classify as Real Estate Investment Trusts (REITs). Using a snapshot of data from early 2015, Baklanova, Caglio, Cipriani, Copeland et al. (2016) finds that REITs enter into the bilateral repo market to secure funding.

assets.[7] Copeland, Martin and Walker (2014) estimate that during July-August 2008, the sum of all repos outstanding on a typical day was approximately $6.1 trillion. The sum of all reverse repos outstanding was about $4 trillion.[8]

The repo market consists of two segmented markets: the **bilateral** and the **tri-party** bilateral market. These markets differ mainly by the participants who trade in them. The tri-party repo market is the market that connects dealers with nonbank cash investors such as money market funds (MMFs) and securities lenders. Krishnamurthy, Nagel and Orlov (2014) state that the tri-party market is the way in which cash funding enters the shadow banking system through repo. The bilateral repo market is a market through which funds are reallocated between dealers and between dealers and hedge funds, or mortgage companies in this paper.

Different overcollateralization or "haircuts" are charged in each market on the same collateral due to differing counterparty risk. The bilateral market is where opaque, less credit-worthy agents seek short-term funding. Cash borrowers in this market are riskier and face larger haircuts to protect the dealers lending to them. Prior to the Financial Crisis, the tri-party market was historically where more credit-worthy agents such as large dealers and cash investors borrow and lend. The tri-party market receives its name because it has a clearing house which is a third party to the cash borrower and cash lender. The clearing house provides several important roles including taking custody of securities, valuing securities, settling transactions and netting transactions across dealers.[9] Due to the traditionally more credit worthy market participants and the fact that collateral is held by a clearing house in the tri-party market, lower haircuts are required to borrow in this market than in the bilateral market. Dealers intermediate lending between these two markets.

In practice, dealers receive collateral in the bilateral market. Dealers enter the tri-party market for at least two reasons, to finance the securities that they are holding in their role as market makers and to provide intermediation services for clients seeking cash, such as hedge funds or IMCs. *"Rehypothecation"* or *"reuse"* of collateral occurs when dealers borrow against the collateral posted with them by cash borrowers (Copeland, Martin and Walker (2014)). The interest rate on lending will typically be lower if the cash borrower

[7] Bevill, Bresler & Schulman Asset Management Corp v. Spencer S&L Ass'n (In re Bevill, Bresler & Schulman Asset Management Corp.), the Third Circuit provide a succinct description of repos. *Bevill, Bresler & Schulman Asset Management Corp. v. Spencer Sav. & Loan Ass'n* (1989) 878 F.2d 742, 743 (3d Cir. 1989).

[8] About 40% of repo activity was in tri-party repos and the remaining 60% was in bilateral repos. About 92% of reverse repos took place in the bilateral market. Due to double counting, summing the total repo and reserve repo values may overstate the total size of the market. Copeland, Martin and Walker (2014) p. 2348.

[9] Copeland, Martin and Walker (2014) p. 2350.

allows the dealer to rehypothecate the collateral posted. Reuse of collateral allows dealers to take advantage of the differential between haircuts in the bilateral and tri-party markets to generate liquidity for themselves.

Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA) Lumpkin (1993) states that although, repo market participants had long operated under the assumption that the purchaser of repo securities was entitled to liquidate them if the seller was unable to fulfill the terms of agreement, the validity of this assumption relies importantly on the court's interpretation. In September 1982 in the court case involving Lombard-Wall, the court ruled that certain types of repos would be considered secured loans rather than an outright sale of the securities. As a consequence the repos became subject to *automatic stay*, the process by which a hold is placed on a firm's assets when it enters bankruptcy proceedings. The automatic stay blocked the creditor from either using the funds obtained or from selling the underlying repo securities without the court's permission. As a result, the perceived risks of lending in the repo market were raised, resulting in a contraction of the volume of repo transactions entered into by non-dealer entities including mutual funds and state and government authorities. With the reduction of a major source of repo funds, the financing costs of some dealers rose (Lumpkin (1993)). In June 1984, in response to the court case, Congress enacted the Bankruptcy Amendments Act of 1984 which amended Title 11 of the U.S Bankruptcy Code to exempt repurchase agreements in Treasury, agency securities, certain CDs and bankers acceptances from the automatic stay provision of the Bankruptcy Code. This resolved the question about the status of repo collateral in bankruptcy proceedings by enabling lenders to liquidate the underlying securities under interpretation of the repo either as an outright purchase and sale or as a secured loan (Lumpkin (1993)).

Ross (2020) states dealers borrowing in the tri-party market leave their collateral inside their custordial account - called the *box* - at the tri-party clearing house. The custodian then moves the collateral from the borrower's box to the lender's box since the custodian holds both box accounts on its balance sheet. Dealers carefully choose what collateral to put in the box because they cannot easily access that collateral later, there is a nontrivial friction to moving collateral in and out of the box. Blocking the timely settlement of collateral held in the box to comply with an automatic stay would interfere with the clearing house's core functions of taking custody of and valuing securities and settling and netting transactions. Market participants' responses to Lombard-Wall and Criimi Mae court cases, where the court failed to grant repo collateral preferred bankruptcy status, suggest that collateral must be exempt from automatic stay in order for cash lenders to lend against it.[10] This suggests that

[10]Congressman Walter Fauntroy, one of the sponsors of the repo exemption from automatic stay in 1984, reported that Lombard-Wall alarmed market participants, magnifying their uncertainty and slowing the

without exemption from automatic stay, the clearing house would be reluctant to accept private-label mortgage collateral from dealers.

BAPCPA was introduced in Congress in February 2005 and signed into law in April 2005.[11] BAPCPA expanded the types of collateral that are protected under the safe harbor provisions of the Bankruptcy Code[12] by expanding the definition of "repurchase agreement" to include to include the following additional instruments: (1) mortgage loans; (2) mortgage-related securities;[13] (3) interests in mortgage-related securities or mortgage loans.[14] This expansion only affected private-label mortgage collateral by exempting it from automatic stay and granting it preferred bankruptcy treatment or safe harbor. Agency mortgage collateral had been granted this status by the 1984 amendments to the Bankruptcy Code. The exemption from automatic stay meant that the cash lender holding the PLS collateral would be the outright owner of the collateral even if the mortgage company declared bankruptcy. This would mean that the clearing house in the tri-party market could hold the collateral without worry that a counterparty's failure would trigger automatic stay.

Srinivasan (2017) collects data on individual repurchase contracts reported in the N-Q filings of money market mutual fund lending in the tri-party market from 2004 to 2006. The paper shows that the average value of contracts collateralized by private label mortgage collateral increased from $200 million in 2005 to $575 million in 2006, after the collateral was exempted from automatic stay. I present additional evidence in this paper that dealers' ability to reuse PLS collateral in the repo markets expanded following BAPCPA 2005.

growth of repos (statement of Del. Walter Fauntroy). An industry witness, Robert Brown, Chairman of the Board of Directors of the Public Securities Association, stated that the decision "create[d] a risk of market 'grid-lock.'" See Bankruptcy Law and Repurchase Agreements: Hearing on H.R. 2852 and H.R. 3418 Before the Subcomm. of Monopolies & Commercial Law of the H. Comm. on the Judiciary, 98th Cong. 61 (1984), at 19 and at 84. Schroeder (2002) states that the Criimi Mae ruling profoundly disturbed the repo industry because it set the precedent that mortgage repo collateral would not receive preferred bankruptcy status. See: Schroeder (2002) p. 567. Criimi Mae was a highly levered Real Estate Investment Trust (REIT) that funded itself using repo loans from dealers in the bilateral repurchase market. Criimi Mae filed for protection from its repo lenders under Chapter 11 Bankruptcy Code. Contrary to the expectations of the market, in 2000, the court ruled that the repo collateral that Criimi Mae had posted was not an outright sale and would therefore be subject to automatic stay. This meant that the dealers did not have a senior claim on the collateral and could not seize it while Criimi Mae reorganized itself in bankruptcy. See: Kirkpatrick, David D. "Criimi Mae Seeks Bankruptcy Protection in a Blow to Commercial-Mortgage Debt." The Wall Street Journal, 6 Oct. 1998, https://www.wsj.com/articles/SB907629811575386000.

[11]The law was introduced in Congress on February 1, 2005 by Republican Senator Chuck Grassley, passed by Congress on April 14, 2005, and signed into law by the president of the United States on April 20, 2005. (https://www.congress.gov/bill/109th-congress/senate-bill/256/text/enr) It applied to consumer bankruptcy cases after October 17, 2005.

[12] American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case No. 07-11047 (CSS) p. 3.

[13]As defined in section 3 of the Securities Exchange Act of 1934.

[14]Bankruptcy Abuse Prevention and Consumer Protection Act of 2005, Pub. L. No. 109-8, §907, 119 Stat. 23, 171-172 (codified as amended at 11 U.S.C. §101(47) (2012))

Conceptual Framework In this section, I present the conceptual framework of the implications of expanding the reuse of PLS collateral in the repo markets. I test the implications below in the sections that follow.

In Figure 1, I depict the proposed change in dealers' ability to re-use the collateral posted by a mortgage company prior to BAPCPA in (a) versus after BAPCPA in (b). Prior to the shock, this paper proposes that re-use of the mortgage collateral was limited - the collateral was simply held, with limited reinvestment capability, to protect dealers from the default risk of the mortgage companies. In the stylized example, in (a) I depict the tri-party market refusing to lend against PLS, corresponding to a 100% haircut, to simplify the exposition of the money multiplier. The evidence in Srinivasan (2017) as well as in the following sections suggests that prior to BAPCPA some repo contracts in the tri-party market were backed by PLS, however that the use of PLS collateral in the tri-party market was restricted relative to post BAPCPA. After BAPCPA granted the collateral preferred bankruptcy status, I propose that dealers ability to re-use the collateral increased. The argument would also go through either if dealers were able to repledge whole mortgage loans from the mortgage warehouse in the tri-party market following the policy change or if they were able to securitize the warehoused collateral quickly and pledge the securities newly minted from the loans in the mortgage warehouse. The figure (b) and the argument below focus on re-use of collateral in the tri-party market however the argument would also go through if dealers increased re-use of collateral in the bilateral market following the policy change and received lower haircuts than the IMCs due to their reputation.

The literature shows that differences in haircuts between the bilateral and tri-party market are large for riskier collateral classes (Copeland, Martin and Walker (2014), Infante (2019)). The differential between haircuts on the same collateral generates a money multiplier effect when dealers reuse the collateral. Due to these large differences in haircuts the money multiplier potential of PLS was larger than that of Treasuries and agency-MBS. A subset of the IMCs whose data I collect report the utilization of their credit and the value of the mortgages pledged as collateral. This allows me to calculate the haircut that dealers charged the IMCs in the bilateral market. In 2005Q4, I calculate this haircut is 36%. In Figure 1, I depict this as a dealer paying \$100 to buy mortgage collateral valued at \$136, a 36% haircut, from the mortgage company in the bilateral market with an agreement to sell it back in 60 days at \$101. In this example, the dealer charges the IMC an interest rate of 1%. The extra \$36 was overcollateralization, or a haircut, to protect dealers from the risk of the mortgage company. I propose that, following BAPCPA cash lenders' willingness to lend against the collateral increased, decreasing haircuts. The earliest estimate of the haircuts charged in the tri-party market is from July 2008 (Copeland, Martin and Walker (2014)).

The paper reports that a 5% haircut or 105% overcollateralization was required on borrowing against private-label mortgage collateral. It is likely that the haircut in the tri-party market was also at 5% or lower during the period following BAPCPA until 2008, since the use of PLS in the repo markets was at an all time high during this time.

Using the above haircuts supported by the data, dealers could re-sell the collateral posted by the IMCs, valued at \$136 for \$130.[15] The differential between haircuts on reused mortgage collateral following BAPCPA would lower dealers' cost of capital. Imagine that pre BAPCPA, the dealer funded the IMC initially with \$100 of capital. Post BAPCPA, if the dealer still funded the IMC with the initial \$100 of capital, the dealer could borrow an additional \$130 by repledging the IMC's \$136 collateral in the tri-party repo market. If the dealer reinvested in PLS by lending the \$130 back to the IMC, the IMC would need to post \$177 of new mortgage collateral, if the same haircuts remain. By repledging this \$177 of mortgage collateral in the tri-party market, the dealer could borrow \$169 in the tri-party market. Continuing this process, the dealer could support total lending to IMCs many times using its initial \$100 of capital. Continuing to reinvest in more PLS each round would increase the amount of collateral that the dealer received and continuing to repledge the collateral in the repo markets would increase the dealers' leverage. This would allow the dealer to leverage up the return that it received from the IMC in the form of interest rates on the warehouse lines of credit. The reinvestment into more PLS would generate a "money multiplier" effect similar to the fractional reserve banking system due to the differential haircuts. The formula to find the value of the total lending is $1 + 1.3 + 1.3^2 + ... = \sum_{i=0}^{\infty} 1.3^i$. This series diverges to infinity, so the market must impose a limit.

[Figure 1 about here.]

I see the dealers offering more and more favorable overcollateralization terms to the IMCs in my data post BAPCPA. In my data the haircut required is 36% in 2005Q4, 26% in 2006Q1, 11% in 2006Q2, 15% in 2006Q3, and 16% in 2006Q4. The earliest that IMCs report overcollateralization begins in 2005Q4 and the latest that it is reported as 2006Q4. The haircuts that I measure are consistent with the haircut differential measured in Copeland, Martin and Walker (2014) which measures the difference between median repo haircuts on private-label collateralized mortgage obligations across the bilateral and tri-party repo market in July 2008 to be 17%. As a reference, the haircut differential on agency MBS at the time was 2%.[16] The decline in haircuts required by dealers is consistent with the collateral

[15] Posting \$136 as at 105% overcollateralization yields \$130 = $\frac{136}{105}$ of borrowing rounded to the nearest dollar.

[16] Copeland, Martin and Walker (2014) p. 2346.

becoming more valuable to them. The slight increase in 2006Q3 and 2006Q4 could be driven by an increase in risk of underlying mortgages increasing. Decreasing the haircut that they charged the IMC would lower the differential in haircuts that the dealer could generate. In the limit, I would expect dealers to lower the haircut differential between what they charged on the collateral and what they would be charged to reuse the collateral to zero, holding constant the risk of the underlying mortgages. One potential explanation for why this did not happen is that the tri-party market realized that the system was highly levered and refused to rollover repos backed by private-label MBS. The freeze on short-term funding and interbank lending sparked by the funding market run on U.K. mortgage bank Northern Rock in August 2007 [17] is consistent with this narrative.

3 Data

I combine dealer and mortgage company borrowing and lending data. Below I describe the data structure and representativeness and the construction of key variables.

3.1 Independent Mortgage Companies (IMC)

To select the sample of IMCs whose lines of credit I collect, I narrow the IMCs to the public companies and of these, I further narrow the sample to the companies that report the dealers from whom they borrow. This gives me a sample of 12 IMCs that file quarterly and annual financial statements with the SEC from 2004Q3 to 2006Q3. These 12 IMCs make up about 59% of total IMC mortgage originations in 2006 while IMCs overall make up one third of the mortgage market. The data report the lender on each credit line as well as the maximum credit line available from a lender to an IMC each quarter. A subset of these mortgage companies also report their utilization on credit lines and the mortgage collateral that they post with a dealer allowing me to calculate their overcollateralization as discussed above. The data capture credit lines reported as warehouse lines of credit, warehouse repurchase facilities, and repurchase agreements. These credit lines make up 61% of mortgage company assets on average. I use these data to link independent mortgage companies to the dealers who were lending to them. I find that the IMCs are borrowing from 29 dealers, 16 of whom were primary dealers. After 2006Q3 seven of the IMCs filed for bankruptcy or were acquired,

[17] Shin (2009) calls Northern Rock the mortgage bank that heralded the Financial Crisis and notes that the short-term funding markets froze on August 9, 2007 due to French bank BNP Paribas announcing troubled investments in U.S. mortgages funded by short-term borrowed money. On August 13, 2007 Northern Rock, which was also heavily reliant on borrowed money in the short-term credit markets informed its regulators at the Financial Services Authority (FSA) that it was having funding problems. (p. 102)

so that I am no longer able to pull their quarterly financial statements.[18]

3.2 Dealers

Dealer Repledgeable Collateral There is limited data on the repo markets prior to 2008 (Baklanova, Copeland and McCaughrin (2015)). To study the repo liabilities of the dealers funding the IMCs, I collect dealers' reported repledgeable collateral for 16 of the 29 dealers that are lending to the IMCs that I observe. The 16 dealers whose repledgeable collateral I am able to collect are the primary dealers. Dealers report in a footnote of their annual reports the amount of collateral that they receive which is permitted to be re-sold or repledged. I collect these data from year end 2000 through year end 2008, with varying start dates. Year end 2004 is the earliest date in which all 16 dealers available (the primary dealers) report. These data allow me to study the amount of collateral that dealers receive which they are permitted to repledge pre versus post BAPCPA. I report the dealers and the data collected for them in the Online Appendix.

Dealer Repo Data In addition to the dealers' repledgeable data, I use the Federal Reserve Bank of New York's weekly survey of primary dealers (FR 2004) to measure primary dealers' aggregate trading activity by collateral class. Due to their role making the market for US Treasuries, the primary dealers are required to report trading data to the Federal Reserve. There is no external data dictionary identifying financing positions and collateral classes for these data outside the Federal Reserve. I hand match the FR 2004 variables to the survey instructions given to the survey respondents in order to create a weekly time series of total dealer holdings and secured financing by collateral class. The key variables that I utilize are "*securities out*" and "*securities in*." Securities out reports dealers' secured borrowing (cash received) and securities in reports dealers' secured lending (cash lent).[19] [20] The FR 2004 data report the primary dealers' aggregate activity in both the tri-party and bilateral repo markets. These data allow me to study whether primary dealers' trading in the repo markets using PLS collateral increased post BAPCPA.

Ideally I would observe all dealers that lend to the IMCs in my data. However, the FR2004 reports data only for the primary dealers, which make up 16 of the 29 dealers that I observe lending to the IMCs. Copeland, Martin and Walker (2014) states that primary dealers made up 79% of all dealer activity in the tri-party repo market in July and August 2008 and the authors assume that this percentage holds across both the bilateral and tri-

[18] For example New century formally filed for bankruptcy in April 2007. ECC Capital Corp was purchased by Bear Stearns and this sale was closed in February 2007.

[19] Infante (2019) p. 46.

[20] *Securities out* and *securities in* include repos/securities lending and reverse repos/securities borrowing, respectively. See: FR 2004.

party repo markets. Therefore, the FR2004 trading activity is likely to be representative of trading activity in the repo markets as a whole during 2005-2007.

This paper innovates by establishing that prior to 2013 the FR2004 data included dealers' trading in private-label mortgage collateral in the line item *"corporate securities."*[21] In the Online Appendix, I decompose corporate securities into the collateral classes that comprise it. As of June 2018, I estimate that the private-label mortgage collateral made up close to 14% of corporate securities. This is a lower bound for the fraction of corporate securities that private-label mortgage collateral comprised in 2005. Baklanova, Copeland and McCaughrin (2015) states that since reaching a peak of supply in 2007, securities lending activity has decreased substantially due to changes in the economics of the business. Use of private-label mortgage collateral in repo markets was at an all-time high during 2005-2007.

I follow Infante (2019) and calculate securities out minus securities in to proxy for the total amount of cash the dealers generate through their secured financing activities. Figure 2 plots securities out minus securities in for the collateral class corporate securities. Dealers are likely to be cash borrowers (send securities out), in the tri-party market[22] and to be cash lenders (receive securities in) in the bilateral market (Copeland, Martin and Walker (2014)). The securities in report the dollar value of the lending to participants in the bilateral market, not the total value of collateral received. When haircuts are large in the bilateral market, the true value of collateral received by dealers is not known. Securities out report the dollar value of funding received by the dealer. The increase in this measure post BAPCPA supports a large haircut differential between securities out and securities in, allowing dealers to implicitly raise PLS collateral in one repo market to borrow against in another. Subtracting securities out minus securities in gives an estimate of the amount of borrowing dealers could access by reusing PLS collateral post BAPCPA. This proxy suggests that dealers' ability to borrow against PLS more than triples following BAPCPA until the run on Northern Rock in August 2007. There were no significant changes that affected the other collateral classes that comprised corporate securities around the time of BAPCPA.

Consistent with the view that PLS made up a large fraction of corporate securities, there is a steep and pronounced decline in this measure beginning in August 2007 as shown in Figure 2. This decline coincides with the run in the funding market on Northern Rock, followed by another decline in March 2008 with the failure of Bear Stearns, and a final decline in September 2008 with the failure of Lehman Brothers. These institutions were all heavily invested in mortgage backed collateral and reliant on short term repo funding.

[21] See FR 2004 Government Securities Dealers Reports Instructions for January 2013 and earlier. Available at: https://www.federalreserve.gov/apps/reportforms/reporthistory.aspx?sOoYJ+5BzDZq2f74T6b1cw==.

[22] Infante (2019) p. 44

Krishnamurthy, Nagel and Orlov (2014) find that the run on repo was isolated to private-label asset backed securities (including PLS), a relatively small segment of the tri-party repo market. In light of this result, the dramatic fall in dealer leverage backed by corporate securities concurrent with the failure of the institutions most heavily invested in mortgage backed collateral suggests that the lion's share of corporate securities comprised of mortgage-backed collateral.

[FIGURE 2 about here.]

Securitization and Price of Mortgage Backed Securities (MBS) This paper leverages data on dealer securitization of private-label MBS from CoreLogic ABS database and Inside Mortgage Finance's Mortgage Market Statistical Annual. These data allow me to identify dealers more heavily exposed to PLS securitization and therefore warehoused private-label mortgage collateral in 2004, the year prior to BAPCPA. These data capture the value, year, and collateral class of deals underwritten by each dealer. Using these data, I compute the value of subprime residential MBS deals securitized in 2004 by each dealer lending to the IMCs in my sample.[23]

In order to study the effect of BAPCPA on the price of PLS in the secondary market, I study the daily average yields on the LD10OAS Bloomberg Barclays agency MBS index and the BNA10AS Bloomberg Barclays private-label MBS index. I study the yields reported on these indices from October 2003 through December 2006.

3.3 Mortgage Market Data

To establish the effect of BAPCPA on IMCs lending to households, I study the effect of a county's independent mortgage company market share on mortgage originations and characteristics in that county pre and post BAPCPA. I leverage "Home Mortgage Disclosure Act" (HMDA) data and "CoreLogic Loan Performance Data" (LLMA).

HMDA Data The HMDA data are loan application-level data constructed from disclosure reports submitted by mortgage lenders.[24] In order to supervise and enforce fair lending practices nationwide, the U.S. Congress mandates that all loan applications related to home purchase, refinancing, and home improvement be reported to the federal government. These data provide information on the flow of new mortgage and home equity loans being originated. The loan application information is publicly available through HMDA from 1990. HMDA reports millions of loan applications every year and is one of the best sources for

[23]The mortgages that make up the private-label market generally are comprised of "near prime" and "subprime" mortgages. (Adelino, Gerardi and Hartman-Glaser (2019))

[24]https://www.ffiec.gov/hmda/hmdaproducts.htm

understanding loan origination patterns. The public version of the data reports only the year that a loan is created. The main variables that I leverage from this dataset are whether a mortgage was originated, who the originator was, whether the originator was an IMC, the year, and county in which it was originated.

I use these data to construct the county level market share of independent mortgage companies in 2004, the year prior to the shock. To identify the IMCs, I use the crosswalk maintained by Robert Avery to match subsidiaries belonging to the same parent company[25] to identify the originator of a given mortgage loan. This allows me to aggregate all mortgages originated by subsidiaries of the same parent company. I define a mortgage company as an IMC if it underwrites and funds a loan in its own name, following the HMDA definition of IMCs.[26]

CoreLogic Data I use the CoreLogic Loan Level Market Analytics (LLMA) data to study mortgage characteristics and originations by IMCs pre and post BAPCPA. In the ideal scenario I would test mortgage characteristics of mortgages originated directly by my treated and control IMCs pre vs post the policy change. Due to data restrictions however, I am not able to link mortgage originator name to mortgage performance characteristics. Therefore I study county level mortgage characteristics and performance outcomes in counties with higher versus low marketshare of independent mortgage companies. The LLMA contain detailed information on mortgage characteristics at origination as well as monthly performance data for a large sample of anonymized borrowers. CoreLogic collects these data from 25 of the largest mortgage servicers in the United States. The LLMA data track approximately 5.7 million mortgages each year and in a typical year include 45% of mortgages originated in the US over the sample period (2003-2008). The main variables that I utilize in the LLMA origination data record a mortgages' initial interest rate, occupancy status, mortgage product (balloon, negative amortizating, adjustable rate mortgage (ARM)), and prime versus subprime status.

I use the mortgage monthly performance data over the life of a loan in order to study the effect of BAPCPA on likelihood of default. I use the variable "mba_delinquency_status" which records the status of a borrower's payments on the loan and provides indicators for foreclosure, bankruptcy, and Real Estate Owned properties (REO). REO properties are home properties that have been seized by banks or other lenders from borrowers who are unable to pay their mortgages. CoreLogic records these indicators in accordance with the Mortgage Bankers' Association (MBA) standards. I aggregate these statistics to the county level and

[25] Available upon request at Robert.Avery@fhfa.gov.

[26] I merge the public HMDA data with the subset of confidential HMDA data that I have in order to identify IMCs using the TYPE variable in the confidential data. I merge the TYPE variable onto the public HMDA data using the mortgage originator identifiers (HM5RID and CODE).

merge with the IMC county market share. This allows me to analyze the effect of 2004 IMC county market share on changes in loan characteristics in response to BAPCPA 2005.

Home Price Data In order to study the effect of BAPCPA on home prices at the county level, I use the county level Zillow Home Value Index (ZHVI). ZVHI is a time series tracking the monthly median home value in a particular county across the sample period. I utilize these data to causally identify the effect of a credit supply expansion in the repo markets on home prices. To do this, I compare county level home prices both pre and post BAPCPA for counties that have a higher versus lower IMC market share.

4 Expansion of Repledgeable Collateral: Motivating Facts and Empirical Model

To understand whether enhancing creditor rights on the mortgages underlying PLS securities increased demand for private-label MBS, I study the yields on private-label relative to agency MBS in the secondary market pre versus post the introduction on BAPCPA in Congress.

For MBS index i, in month t, I regress average yield on the indicator variable PLS_i, which equals one for the private-label MBS index and zero for the agency MBS index, and interaction terms that interact PLS_i with monthly indicators. $\log(yield_{i,t})$ is the log of the average yield on an index of MBS securities. i indicates whether the index is the LD10OAS Bloomberg Barclays agency MBS index or the BNA10AS Bloomberg Barclays private-label MBS index. β_T is the coefficient of interest. It is the coefficient on the indicator variables that interact PLS_i with an indicator for each month pre and post shock. The indicator variable in January 2005 is set to zero as it was the month before BAPCPA was introduced in Congress in February 2005.

$$\log(yield_{i,t}) = \nu PLS_i + \sum_T \beta_T \ PLS_i \times \mathbb{1}_{t=T} + \epsilon_{i,t} \tag{1}$$

Figure 3 plots the coefficient β_T. The figure indicates that the yield on the PLS index decreased significantly relative to the yield on agency MBS following the introduction of BAPCPA in Congress, consistent with the price of PLS increasing. Prior to the introduction of BAPCPA 2005, PLS relative to agency yields were fairly stable. There is a slight downward trend beginning in November 2004, some market participants note that this was due to the Republicans gaining seats in the 2004 Senate elections. This evidence is consistent with demand for PLS increasing after BAPCPA granted preferred creditor rights on the mortgages underlying the PLS securities.

[FIGURE 3 about here.]

If BAPCPA increased dealers' ability to borrow against PLS, securities out in the collateral class containing PLS should increase relative to agency mortgage collateral, as agency mortgage collateral was not affected by BAPCPA. In Figure 4, I plot dealers' securities out (borrowing) collateralized by agency[27] and by private-label[28] mortgage collateral each as a fraction of total securities out (total dealer borrowing). Prior to the shock the fraction of total securities out that dealers pledged as private-label relative to agency relative to private-label mortgage collateral moved in parallel and remained stable. This suggests that prior to BAPCPA, a relatively constant fraction of dealers' total borrowing was collateralized by PLS and by agency MBS. Following the policy change dealers increased their use of private-label mortgage collateral to secure their borrowing while their borrowing backed by agency mortgage collateral as a fraction of total secured borrowing remained relatively constant.

After BAPCPA, in April 2005, the borrowing collateralized by PLS as a fraction of total securities out (total borrowing) nearly doubled from about 6% to close to 12%. The value of borrowing backed by PLS almost doubled from $247 billion in March 2005 to $466 billion in July 2007, before crashing in late 2007, consistent with the timing of the Financial Crisis. Over this period, the fraction of borrowing backed by agency MBS remained relatively constant at about 22% of dealers' total borrowing. This evidence suggests that granting private-label mortgage collateral preferred bankruptcy treatment increased demand for it, making it easier for dealers to pledge as collateral to raise funding.

[FIGURE 4 about here.]

To test the statistical significance of dealers' increased use of private-label collateral to borrow following BAPCPA, Equation 2 compares both the log value of securities out and the fraction of total securities out (total borrowing) pre versus post BAPCPA for agency versus private-label mortgage collateral.[29] Table 1 reports the regression results. The coefficient

[27] Agency MBS is comprised of Federal Agency and GSE MBS in the FR 2004 data.

[28] Private-label MBS is comprised of Corporate Securities Total from 7/4/2001 to 3/27/2013. From 4/3/2013 to 6/6/2018 it is comprised of: (1) Non-Agency Residential MBS, (2) Other CMBS, (3) Corporate Securities Commercial Paper, (4) Corporate Securities Investment grade bonds, notes, and debentures of various maturities, (5) Corporate Securities Below investment grade bonds, notes, and debentures of various maturities, (6) State and Municipal Government Obligations of various maturities, (7) Credit card-backed, Student loan-backed, Automobile loan-backed, Other Asset Backed Securities.

[29] From January 1, 2001 through July 31, 2007 Equation 2 estimates the following regression on both the log value of securities out and the fraction of total securities out (total borrowing).

$$Y_{i,t} = \omega Post_t + \nu PLS_i + \beta Post_t \times PLS_i + \epsilon_{i,t} \quad (2)$$

For collateral class i at time t, $Post_t$ an indicator variable that is equal to zero prior to April 15, 2005 and

on the interaction term estimates a statistically significant 18.6% increase in private-label securities out relative to agency securities out in the post period. A quote from Adrian, Burke and McAndrews (2009) supports this view, stating that, by 2008, there had been a relaxation in the asset classes used as collateral in the repo markets, allowing even whole loans to be pledged as collateral. [30]

[Table 1 about here.]

4.1 Dealer Liquidity Shock: Empirical Evidence

The preceding results suggest that BAPCPA increased demand for and the price of PLS. To establish whether some dealers were more affected by the shock than others, this paper innovates by developing a treatment intensity research design that defines dealers who were holding more PLS collateral at the time of BAPCPA to be more exposed to the policy change. BAPCPA affected repo at the national level, however the identifying assumption that I make is that dealers who have a larger fraction of their balance sheet exposed to private-label mortgage collateral will be differentially affected immediately following the shock. The design relies on the assumption that dealers holding more treated collateral at the time of BAPCPA had more illiquid collateral suddenly become liquid. These dealers were likely to experience a greater relaxation of their leverage constraint following BAPCPA since they would have more private-label mortgage collateral available to re-pledge as collateral for secured financing.[31] I do not directly observe dealers' holding of PLS mortgage collateral at the time of the policy change so I proxy for it using dealers' underwriting of PLS mortgage collateral. The assumption that this relies on is that dealers who were securitizing more PLS were also warehousing more of the collateral. Excerpts from the IMCs' public filings support this. For example if a dealer was securitizing or underwriting an IMC's mortgages, it also had a "gestational line of credit" with that mortgage company.

equal to one on this date and later. PLS_i is an indicator term that is equal to one for private-label mortgage collateral and zero for agency mortgage collateral. $Post_t \times PLS_i$ is the interaction of interest. The coefficient on the interaction term measures the difference in borrowing backed by private-label and agency mortgage collateral after BAPCPA, less the difference between the two prior to the shock.

[30] [C]onditions in 2008 [became] particularly precarious [due to] the resort to less liquid collateral in repo agreements ... . Originally focused on the highest quality collateral - Treasury and Agency debt - repo transactions by 2008 were making use of below-investment-grade corporate debt and equities and even **whole loans** and trust receipts. This shift toward less liquid collateral increased the risks attending a crisis in the market since, in the event of a crisis, selling off these securities would likely take time and occur at a significant loss. (Adrian, Burke and McAndrews (2009) pp. 3-4.)

[31] In the Online Appendix, I discuss the accounting treatment of repos for dealers. Dealers were not required to report their borrowing in the repo markets as secured loans on their balance sheet and therefore financing themselves in this manner did not increase their reported leverage ratio.

I assign dealers to the treatment and control groups by computing the total value of subprime residential MBS deals underwritten and securitized by dealer in 2004, the year prior to the policy change. I scale the total value of deals underwritten by total book value of assets in 2004Q4 for each dealer.[32] I assign dealers in the top quartile of the scaled value of deals underwritten to the treatment group. The control dealers are the dealers in the bottom three quartiles of subprime MBS underwritten in 2004. The securitization process generally takes several months to complete, indicating that the deals that determine the treatment variable must have been completed before November 2004. It was not thought that the BAPCPA bill would pass in Congress until November 2004 when the Republicans gained seats in Congress. There had been drafts of the bill in Congress as early as 2002, alleviating concerns that treated and control dealers had differential information prior to November 2004.

The heterogeneity in dealer exposure to PLS was likely driven by dealers moving in to PLS in 2003 and 2004 when Fannie Mae and Freddie Mac, the two largest creators of agency MBS, were accused of accounting fraud. News articles report that these scandals shocked Wall Street and regulators imposed limits on the two companies' mortgage debt holdings.[33] The scandals both increased investors' interest in private-label MBS and restricted the creation of agency MBS, lowering barriers to entry for IMCs and private label securitizations. In Table 2, I present descriptive statistics showing that the treated and control dealers had similar total assets[34] number of mortgage originations, and originated mortgages in a similar number of counties in 2004.

[Table 2 about here.]

I study the amount of repledgeable collateral that dealers report in their annual reports from 2002 to 2007. I run a difference-in-differences regression to causally identify the effect of BAPCPA on dealers' re-use of private-label mortgage collateral. This paper estimates is a "turning on the faucet" effect when the PLS that treated dealers were holding in 2005 suddenly became a valuable source of collateral. I estimate the regression

[32] This measure was taken from Nadauld and Sherlund (2013) p. 457 and updated with information from the CoreLogic ABS database and Inside Mortgage Finance's Mortgage Market Statistical Annual to compute the value of subprime deals underwritten by a dealer. I am very grateful to Shane Sherlund for his help calculating this measure. I scaled the value of subprime deals underwritten by each dealer by total assets of either the holding company of the dealer or the total assets of the dealer itself when a dealer was not part of a larger holding company.

[33] https://abcnews.go.com/Business/story?id=3664473&page=1

[34] In addition to total assets, treated and control dealers did not have statistically significant differences in $\log(TotalEquity)$ and $\log(TotalLiabilities)$, tables are available upon request.

$$\log(Repledgeable\ Collateral_{j,t}) = \eta_j + \omega Post_t + \beta Post_t \times Treated\ Dealer_j + \epsilon_{j,t} \qquad (3)$$

Where $\log(Repledgeable\ Collateral_{j,t})$ is the log of the repledgeable collateral reported by dealer j at year t. $Treated\ Dealer_j$ is an indicator variable that equals one for treated dealers. $Post_t$ is an indicator variable that equals one for 2005 and later - since BAPCPA was passed by Congress on April 20, 2005 - and zero otherwise. β is the coefficient of interest. It is the coefficient on the interaction term that equals one for treated dealers in the post period. The coefficient on $Post_t \times Treated\ Dealer_j$ measures the difference in repledgeable collateral between treated and control dealers after the shock less the difference between the two before the shock. Since the liquidity shock occurs at the dealer level, changes in credit lines from the same dealer may be correlated, I observe 16 dealers that report repledgeable collateral. I calculate the standard errors clustered at the dealer, year level. η_j contains fixed effects for each $Dealer_j$.

[Table 3 about here.]

I report the results of Equation 3 in Table 3. Treated dealers significantly increase their reported repledgeable collateral by 18% relative to control dealers following BAPCPA. This large increase in repledgeable collateral supports the view that treated dealers were more able to repledge warehoused or newly securitized mortgage collateral following BAPCPA. This result supports treated dealers being in a better position to take advantage of the large money multiplier by repledging the collateral that they were holding at lower haircuts than those they had charged. The sizable increase in repledgeable collateral is consistent with treated dealers reinvesting their increased credit supply in more PLS collateral. As they increased investment in PLS collateral by lending to IMCs and requiring the IMCs to pay large overcollateralization rates, dealers would receive more repledgeable collateral to report.

In the analog to the fractional reserve banking system, the treated dealers would be more exposed to a decrease in the reserve ratio, allowing them to lend out more of each new marginal dollar deposited. An increase in lending would increase the amount of deposits that entered the banking system. The results suggest that the same effect is happening with treated dealers in the repo market or the shadow banking system. Treated dealers would be more exposed to increased repledgeability of PLS, allowing them to lend out more of each new private-label mortgage held as collateral. An increase in lending to IMCs would result in new mortgage collateral posted with dealers in return. The reported increase in repledgeable collateral measures the increase lending to IMCs (mortgages created), just as in

the fractional reserve banking system, measuring an increase in deposits following a decrease in the reserve ratio would indirectly measure the increase in lending.

5 Expansion of Dealer Funding to Mortgage Companies: Motivating Facts and Empirical Model

The evidence in the previous section suggests that BAPCPA increased dealers' investment in PLS collateral. There are several ways in which dealers could increase investment in PLS collateral, for example by: (a) increasing the value of credit lines to mortgage companies, (b) decreasing haircuts that they required IMCs to post; (c) walking down the quality curve on the types of mortgage collateral that they funded; and (d) lowering the interest rate on their credit lines to mortgage companies. In this section I focus on the value of credit lines that dealers sent to mortgage companies. I present evidences that suggests these additional channels were also at play at the end of this section.

As suggestive evidence that dealers increased their funding to IMCs post BAPCPA, I plot the average total value of warehouse credit lines extended to an IMC in my sample pre and post the shock in Figure 5 (a). Prior to BAPCPA, the average value of total IMC warehouse credit lines was relatively stable around $3 billion dollars. Post shock the average increased sharply to close to $5 billion dollars. In Figure 5 (b), I plot the average number of dealers that an IMC was borrowing from pre and post BAPCPA. Prior to the shock an average of five dealers were lending to IMCs. Directly following 2005Q2, when BAPCPA was passed, the average number of dealers lending to an IMC began to increase. By 2006Q1, the number increased to seven.

[Figure 5 about here.]

5.1 Dealer Lending to Mortgage Companies - Causal Evidence

Due to their greater liquidity, I expect treated dealers to differentially increase investment in the mortgage companies that they fund. In order to causally link increased supply of credit to increased ability to repledge PLS collateral, I utilize a within mortgage company, across dealer empirical strategy similar to Khwaja and Mian (2008). I exploit the fact that the mortgage companies in my data borrow from multiple dealers simultaneously. I estimate the extent to which treated dealers increase lending to a mortgage company post shock relative to control dealers lending to the same IMC within a tight window around the shock. BAPCPA was passed in April 2005, I estimate the change in lending by treated dealers relative to

untreated dealers from 2004Q3 to 2006Q3.[35] Studying an increase in lending within a tight window allows me to isolate the effect of BAPCPA by alleviating the concern of confounding shocks occurring over the same period and by increasing the likelihood that the pre-period is a valid counterfactual for the post period in the absence of BAPCPA. I make the following identifying assumptions. Dealers who have a larger fraction of their balance sheet exposed to private-label mortgage collateral at the time of BAPCPA experience immediate ability to re-use the PLS collateral. Treated dealers have established credit lines with IMCs which allow them to immediately pass on credit supply shocks.

The dealer lending channel (supply channel) is typically difficult to estimate because supply shocks are often correlated with demand shocks. Both supply and demand shocks would affect the dealer lending volume that I want to measure. In order to identify the supply effect, it is important that I control for changes in mortgage company demand for credit. If the dealers who receive a positive credit supply shock due to BAPCPA lend more to IMCs, a concern for identification is that the IMCs to whom they lend are more productive and thus demand more credit. In order to control for this, I collect a panel dataset of the warehouse credit lines received by twelve of the largest public IMCs from 2004Q3 to 2006Q3. Each of these IMCs receives warehouse funding from three or more dealers.

Following Khwaja and Mian (2008), I run the difference-in-differences regression in Equation 4 where I regress the log dollar value of the credit line from a dealer to an IMC on an indicator for post BAPCPA, an indicator for whether the line was funded by a treated dealer, and their interaction term. The unit of observation is a credit line extended by a given dealer to a given IMC. The post period is 2005Q2 - 2006Q3. By studying the increase in value of credit lines offered by treated dealers relative to control dealers within an IMC, I tease out the increase in credit supplied to an IMC that is caused by the shock to the dealer's ability to re-use PLS, not the IMCs demand for credit. I run the following regression specification:

$$\log(CreditLine_{i,j,t}) \quad = \quad \gamma_{i,t} + \eta_j + \beta Post_t \times Treated\ Dealer_j + \epsilon_{i,j,t} \tag{4}$$

Where $\log(CreditLine_{i,j,t})$ is the log of the credit line extended to IMC i by dealer j in quarter t. $Treated\ Dealer_j$ is an indicator variable that equals one for treated dealers. $Post_t$ is an indicator variable that equals one for the second quarter of 2005 and later - since BAPCPA was passed in April 2005 - and zero otherwise. β is the coefficient of interest. It is the coefficient on the interaction term, $Post_t \times Treated\ Dealer_j$, that equals one for credit lines from treated dealers in the post period. β measures the difference in lending between

[35] Most IMCs in the sample become public in mid 2004 thus I am only able to observe data for the IMCs via their public filings beginning in third quarter of 2004.

treated and control dealers after the shock less the difference between the two before the shock. In my regression, I include $IMC_i \times Quarter_t$ fixed effects (FE) in $\gamma_{i,t}$ so that I compare the lending volumes of a treated dealer to that of a control dealer both lending to the same IMC in the same quarter pre and post BAPCPA. The FE approach tests whether the same IMC borrowing from two different dealers experiences a larger increase in lending from a dealer who is more exposed to the credit supply shock. These fixed effects absorb time-varying firm-specific factors, including firm specific credit demand shocks. I include $Dealer_j$ FE in η_j to control for unobserved dealer heterogeneity that may be constant overtime. Since the liquidity shock occurs at the dealer level, changes in credit lines from the same dealer may be correlated. I cluster my standard errors at the dealer level. This setting allows me to isolate the increase in credit supply that was caused by BAPCPA.

Table 4 presents the FE specification with a total 539 credit lines extended to the twelve IMCs from the 27 dealers between 2004Q3 and 2006Q3. The results indicate a large dealer lending channel effect. Being a treated dealer is associated with a 28.9% increase in lending post shock relative to untreated dealers lending to the same IMC. The results suggest that immediately after BAPCPA passed, dealers who were more exposed to private-label mortgage collateral prior to the shock differentially increased their lending to IMCs. This is a lower bound of the overall credit supply increase created by BAPCPA. It only captures the response of treated dealers over and above that of control dealers, however all dealers will eventually be affected, raising the total increase in credit supply.

[Table 4 about here.]

In Equation 5, I run the dynamic version of Equation 4. Figure 6 traces out the response of dealer lending volume to IMCs following BAPCPA. It plots the coefficients on the interaction terms between dealer treatment and indicators for each quarter pre and post the shock. The indicator variable is set to zero in 2005Q1, the quarter before BAPCPA was passed. This figure shows that prior to BAPCPA, treated and untreated dealers' lending volumes to IMCs are similar. Post BAPCPA, however, the shocked dealers begin to lend differentially more than untreated dealers within a given IMC.

$$\log(CreditLine_{i,j,t}) = \gamma_{i,t} + \eta_j + \sum_T \beta_T \; Treated \; Dealer_j \times \mathbb{1}_{t=T} + \epsilon_{i,j,t} \tag{5}$$

[Figure 6 about here.]

The fixed effects strategy that I use does not require that dealer liquidity supply shocks and IMC demand shocks be uncorrelated since the mortgage company fixed effects will absorb any mortgage company demand shocks. One potential concern, however, is that the BAPCPA shock to dealer liquidity was anticipated so that dealers could adjust their lending to IMCs prior to the law change. To alleviate this concern, I lean on my definition of dealer treatment as dealers' securitization of MBS in 2004. These deals must have been completed before November of 2004, the month in which Republicans gained seats in Congress. Further, if the shock was anticipated, I would expect to see the treated dealers increase their lending to IMCs prior to 2005Q2. However, Figure 6 presents the dynamic response of treated dealers' lending relative to control dealers and it does not seem to be trending up in the pre-period. A benefit of my research design is that since there were drafts of BAPCPA beginning in 2002, treated and control dealers are equally likely to anticipate the shock within a narrow window around the shock. Furthermore, if there was an adjustment due to anticipation, this would bias my result downward since treated dealers would increase their lending relative to control dealers in the pre-period, not only in the post-period.

Another potential concern is that treated and control dealers are systematically different in ways that are not eliminated by looking at pretreatment dealer balance in Table 2. In order to alleviate this concern, I limit the analysis to just the primary dealers lending to mortgage companies. These are the 15 largest dealers who make the market for the U.S. treasuries. These dealers are likely similar in terms of reputation and access to secured funding. Table 5 reports the results of this regression. The magnitude and significance of the coefficient of interest are similar.

[Table 5 about here.]

5.2 Testing Credit Supply Expansion Hypothesis

In this section, I test whether the increased supply of credit by treated dealers is more consistent with a substitution effect or with an overall credit supply increase following BAPCPA. To establish this, I break the twelve IMCs into two groups. "Treated IMCs" are defined as the six IMCs that receive an above median fraction of their warehouse credit lines from treated dealers during 2004, the pre-treatment period. "Control IMCs" are defined as the six IMCs that receive a below median fraction of their warehouse credit lines from treated dealers during 2004. I define $CreditLine_{i,t}$ as the sum of credit lines that a mortgage company receives from all dealers, j, that it is linked to in a given quarter: $CreditLine_{i,t} = \sum_j CreditLine_{i,j,t}$. In Table 6, I present descriptive statistics showing that the treated and control IMCs had

similar total assets[36] number of mortgage originations, and originated mortgages in a similar number of counties in 2004.

[Table 6 about here.]

$$\log(CreditLine_{i,t}) = \beta\ Post \times Treated\ IMC_i + \gamma_i + \alpha_t + \epsilon_{i,t} \tag{6}$$

In Equation 6, I regress $\log(CreditLine_{i,t})$ for a given mortgage company i in quarter t on an interaction term between an indicator variable equal to one in the post period and an indicator equal to one for $Treated\ IMC_i$. I include mortgage company fixed effects γ_i and quarter fixed effects α_t. There are twelve mortgage companies so I calculate my standard errors using bias-adjusted cluster version of heteroskedasticity consistent standard errors. I follow the advice of Imbens and Kolesar (2016) and apply the "LZ2" correction to the standard errors and compute confidence intervals using a t-distribution with degrees of freedom suggested by McCaffrey and Bell (2002). Imbens and Kolesar present Monte Carlo evidence that the resulting confidence intervals have good coverage even with as few as five clusters or unbalanced cluster size.[37] The results presented in Table 7, suggest treated mortgage companies receive a 13.8% increase in total maximum credit available in the post period relative to control mortgage companies. This evidence suggests that BAPCPA led to an increase in overall lending to mortgage companies with an above median fraction of their credit lines from treated dealers rather than a substitution of lending away from control toward treated dealers within a mortgage company. If BAPCPA caused IMCs to substitute away from control dealers toward treated dealers without increasing their total credit supply, there would be no statistically significant increase in total credit lines for treated IMCs.

[Table 7 about here.]

I present evidence suggesting that dealers also expanded credit by loosening the covenants that they required on their credit lines in response to BAPCPA. Dealers imposed covenants on the credit lines in the form of funding sublimits. These sublimits specified the maximum amount of the credit line that could be allocated to fund certain types of mortgage loans. Post shock, dealers increased the funding allocated to finance risky mortgage products. Two of the IMCs report the funding sublimits available from five dealers by mortgage type.

[36] In addition to total assets, treated and control IMCs did not have statistically significant differences in $\log(TotalEquity)$ and $\log(TotalLiabilities)$, tables are available upon request.

[37] I follow code provided by Gabriel Chodorow-Reich: https://scholar.harvard.edu/chodorow-reich/data-programs (Chodorow-Reich, Gopinath, Mishra and Narayanan (2018)).

Figure 7, plots the maximum amount of funding provided to one of these IMCs for interest only, second-lien, jumbo, non-owner occupied, and 120-180 day past due loans. The funding lines for all of these products doubled post BAPCPA. In the Online Appendix, I report sublimits on additional mortgage products by dealer.

[Figure 7 about here.]

Dealers extended credit to IMCs via both "*dry*" and "*wet*" funding. Dry funding is when the mortgage company posts as collateral mortgages that have already been created and transfers the loan documents prior to receiving the line of credit. Wet funding takes place when the IMC has not yet originated the mortgages posted as collateral and therefore transfers no loan documents prior to receiving the line of credit. All four of the dealers that report wet funding in my sample increase the sublimit following BAPCPA. Wet funding was implicitly unsecured, so the interest rate charged on it was greater than that charged on dry funding. In Figure 8, I plot the interest rate differential that a mortgage company in my sample reports on wet funding relative to dry funding. Following BAPCPA the spread halved from "0-25" basis points to "0-12" basis points. This evidence suggests that not only did dealers increase the value of implicitly unsecured funding, shown by the increased value of wet funding sublimits in the Online Appendix, but they also lowered its cost of funding.

[Figure 8 about here.]

6 Mortgage Company Lending

The evidence in the previous sections establishes that following BAPCPA dealers increased credit lines to the mortgage companies that they funded. Figure 7 (b) also suggests that dealers increased funding for balloon, non-owner occupied mortgages, and mortgages already 120-189 days delinquent among others. The typical definition for default is 90 days delinquent. This increased lending to mortgage companies need not have any effect on real outcomes if the mortgage companies do not lend the money out to homebuyers. In this section, I study whether IMCs pass the credit supply shock on to households.

I first study the effect on mortgages originated by the six treated IMCs in my sample. It is my most conservative analysis since all IMCs in the United States were likely to be affected by this policy change. I run a parallel analysis studying the effect on the mortgage originations of all independent mortgage companies. I identify dealers as the main funders of the 12 IMCs that I observe. Of the 12, on average the total dealer provided warehouse credit lines equaled 61% of mortgage company total assets. These IMCs are likely to be representative

of all IMCs as they capture a large fraction of total IMC mortgage originations as of 2006. While my research design exploits heterogeneity in dealer exposure to the shock to causally identify the effect of BAPCPA, eventually all dealers would have experienced a credit supply shock and increased incentive to invest in PLS. The 29 largest dealers were lending to the 12 IMCs in my sample and were likely lending to the IMCs that I am not able to collect data for as well. Stanton, Walden and Wallace (2014) finds that warehouse repurchase facilities dominate the IMC funding model.[38]

I conduct a county level analysis where I create a variable, $(Treated)IMCMarketShare_{c,2004}$, that captures the exposure of a county to the (treated) IMCs in 2004, the year prior to the shock. I calculate this variable using the number of mortgage originations as follows.[39]

$$(Treated)IMCMarketShare_{c,2004} = \frac{Number\ of\ originations\ by\ (\textbf{treated})\ IMCs_{c,2004}}{Total\ number\ of\ all\ originations_{c,2004}}$$

Figure 9 depicts the county level market share of treated independent mortgage companies in the United States in 2004. The states with the highest county level market shares are California, Nevada, Florida, parts of Texas and parts of Colorado. Many of these areas faced large expansions in home prices leading up to the Financial Crisis and large contractions in home prices directly following the crisis. The variation in IMC market share is likely due to the Fannie Mae and Freddie Mac scandals in 2003 and 2004 which decreased barriers to entry for independent mortgage companies to enter the mortgage market. Justiniano, Primiceri and Tambalotti (2017) shows that events in 2003 led to a sudden surge in the PLS market. I find no statistically significant difference in 1999 per capita income reported by the census in counties with high versus low IMC market share after controlling for state fixed effects. This helps to alleviate the concern that IMCs chose to locate in areas ex-ante more likely to see an increase in mortgage originations and home prices following BAPCPA.

[Figure 9 about here.]

I investigate how $(Treated)IMCMarketShare_{c,2004}$ affects county level mortgage characteristics and home prices. I use the CoreLogic LLMA data to capture mortgage contract variables and performance. [40] I run the following dynamic regression.[41]

[38] Stanton, Walden and Wallace (2014) pp. 267-269.

[39] I also construct the IMC county level market share in 2004 based on value of mortgage originations and find that the distribution of county market share is very similar to the measure based on number of mortgage originations.

[40] I limit the data to the top 5,000 counties captured in the county month HMDA dataset published by Neil Bhutta. I aggregate all variables of interest in the CoreLogic data to the county month level and merge on $(Treated)IMCMarketShare_{c,2004}$ for each county.

[41] As a robustness test, I repeat my analyses for total mortgage originations, purchase, and refinance

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \sum_T \beta_T (Treated) IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_{c,t} \quad (7)$$

Where $Y_{c,t}$ is the variable of interest in county, c at month t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects. $(Treated)IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. $(Treated)IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T}$ is the interaction term between the county level market share of treated IMCs in county c in 2004, and an indicator variable for the month in which the mortgage was originated. I set the reference month to March 2005, the month prior to the passage of BAPCPA.[42] Standard errors are clustered at the county level. I report the regression results with *county* fixed effects alone and with both *county* and $state \times month$ fixed effects. The regression with both *county* and $state \times month$ fixed effects is my preferred specification as this regression compares mortgage characteristics in counties with high versus low IMC market shares within the same state and month, absorbing state month housing market trends.

[FIGURE 10 about here.]

The first dependent variable that I study is $\log(Originations_{c,t})$. Originations includes both refinance mortgages, originated in order to refinance an existing mortgage loan, as well as purchase mortgages originated for the purpose of purchasing a home.[43] Figure 10 plots the evolution of the coefficient of interest, the interaction term between origination month and $(Treated)IMCMarketShare_{c,2004}$, from September 2004 to February 2006. The plot shows that originations in counties that had a higher IMC market share in 2004 were not statistically different from other counties prior to the policy change. Post BAPCPA, total mortgage originations increase disproportionately in counties where there was a higher IMC market share in 2004, after controlling for $state \times month$ fixed effects. A 10% increase in treated IMC market share results in a 8.7% increase in mortgage originations on average in the post period.[44] Although the dynamic plot shows a significant response post BAPCPA,

originations using the HMDA data reported at the county month level published on Neil Bhutta's website: https://sites.google.com/site/neilbhutta/data. All results remain the same.

[42] I run the equivalent regression to Equation 7, however with a single pre-period and a single post-period in order to estimate the cumulative effect of the shock in the post period.

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \beta\ Post_t \times (Treated) IMCMarketShare_{c,2004} + \epsilon_{c,t} \quad (8)$$

.

[43] The Online Appendix reports results for refinance and purchase originations.

[44] The marginal effects in the specification where the six most treated IMCs make up the treatment group are larger because the market shares of treated IMCs is small.

the average result in the post period is just below statistical significance. This is due to a fall in originations fall directly following BAPCPA and then increase significantly five months following BAPCPA in treated counties. I will discuss drivers of this effect when I discuss prime and subprime mortgage originations. A 10% increase in total IMC market share leads to a significant 2.7% increase on average in the post period. [45]

[Table 8 about here.]

Balloon mortgages do not fully amortize over the term of the loan. They leave a large balance or balloon payment due at maturity. Borrowers of these mortgages are more likely to experience negative equity when home prices stop rising. Negative equity decreases ability to refinance and the borrower may not have the resources to pay off the balance at the end of the loan even if she sells the home. Additionally Gerardi, Herkenhoff, Ohanian and Willen (2017) find that negative equity is a quantitatively important factor in default for strategic motives.

To study the effect of BAPCPA on balloon mortgage originations, I run the dynamic regression in Equation 7, where the dependent variable is fraction of balloon mortgages. I calculate the fraction of balloon mortgages as the total number of mortgages originated in that county in a given month. Figure 11 shows that prior to BAPCPA, the fraction of balloon mortgages originated in counties with higher IMC market share was not statistically different from other counties. Post shock there was a statistically significant increase in the fraction of originations that were balloon mortgages. A 10% increase in treated IMC market share results in a statistically significant increase in the fraction of balloon mortgages originated in that county by 1.13 percentage points following BAPCPA. A 10% increase in total IMC market share leads to a significant 0.3 percentage point increase on average in the post period.

[Figure 11 about here.]

[Table 9 about here.]

Figure 12 shows that prior to BAPCPA, the fraction of negative amortizing mortgages originated in counties with higher IMC market share was not statistically different from other counties. Post shock a 10% increase in total IMC market share leads to a significant 0.57 percentage point increase on average in the post period. The result for the six treated IMCs

[45] Table 8, presents the results from Equation 8, the regression with a single pre and post period.

are positive and significant in the specification with county only FE however it is not statistically significant in the specification with $state \times month$ FE. This is likely because counties with other IMCs are considered in the control group in this regression and they ware also increasing their use of negative amortizing mortgages post BAPCPA. The results indicate that not only did an increase in $IMCMarketShare_{c,2004}$ increase mortgage originations in a county, it shifted the composition of these mortgage originations toward balloon mortgages. Negative amortization occurs whenever a mortgage payment does not cover the incurred interest over that period. The result is that rather than being paid down over the life of the loan, the loan balance grows by the amount of the unpaid interest each period. This leaves a large payment due at the end of the mortgage term. Negative amortization loans allow the introductory payments to be lower than almost any other type of mortgage. For example, the mortgage may accrue interest at a 5% interest rate but have an introductory payment period at a 1% payment rate. This payment rate is not the interest rate, it simply represents the amount of interest that the borrower is required to pay during the introductory period which could be 5 years for example. Eventually the loan will enter a recast period when the payments reset to a fully amortizing schedule, increasing the risk of payment shock. Borrowers are more likely to experience negative equity in an environment where home prices are falling.[46] The results indicate that not only did IMCs increase mortgage originations in a county in response to BAPCPA but that they shifted the these mortgage originations toward balloon and negative amortizing mortgages.

[FIGURE 12 about here.]

[TABLE 10 about here.]

I estimate Equation 7 to study the effect of $(Treated)IMCMarketShare_{c,2004}$ on introductory interest rates on mortgage originations. I limit the sample to only adjustable rate mortgage (ARM) originations and study the average initial interest rates charged on these mortgages in a county pre and post shock as a function of IMC market share. In Figure 13, I plot the response of the $\log(Initial\ Interest\ Rate_{c,t})$ in a given county. Prior to the shock, there was no statistical difference in the average initial interest rate charged on mortgages

[46] A quote from the annual report from a mortgage company in my sample states: "Borrowers with adjustable-rate mortgage loans will likely be exposed to increased monthly payments ... A **decline in housing prices** ... [could] leave borrowers with insufficient equity in their homes to permit them to refinance ... borrowers who intend to sell their properties ... may find that they cannot sell their properties for an amount equal to or greater than the unpaid principal balance of their loans, especially in the case of **negative amortization mortgage loans.** These events could **cause borrowers to default** on their mortgage loans." HomeBanc 2005 Annual Report p. 56 of 173

between counties with high and low market share of treated IMCs. Post BAPCPA, a 10% increase in treated IMC market share results in a statistically significant decrease in the average interest rate on ARMs in a county by 6.98%. A 10% increase in total IMC market share leads to a significant 2.39% decrease on average in the post period.[47] The mortgage companies financial reports state that their adjustable rate mortgages were pegged to the twelve-month treasury rate. Figure 13 (c), shows that the twelve-month treasury rate over this period was increasing monotonically. This evidence is consistent with mortgage companies originating mortgages with low initial "teaser" interest rates. These interest rates did not reflect the interest payment required to fully amortize the loan but rather an artificially low interest rate advertised to attract potential borrowers. The interest rates would reset to the actual interest rate after a specified point in time, increasing the risk of "payment shock" to the borrower.

[Figure 13 about here.]

[Table 11 about here.]

I present results for owner occupied mortgage originations in the Online Appendix. The results show that prior to the shock, there was no statistically significant difference in the average fraction of these mortgage products between counties with high and low market share of treated IMCs. Post BAPCPA higher county exposure to both treated IMCs and all IMCs led to a decline in the fraction of owner occupied mortgage originations. The decreasing fraction of owner occupied mortgages implies that there was a higher fraction of second home and investment properties mortgages which were typically riskier than owner occupied mortgages.

Prior to BAPCPA, counties with a higher market share of all IMCs did not originate a significantly different fraction of prime or subprime mortgages. Figure 14 shows that following BAPCPA however, counties with a higher market share of all IMCs began originating a significantly higher fraction of prime mortgages and a significantly lower fraction of subprime mortgages as identified by CoreLogic. The PLS market is split into segments according to credit risk. The "Alt-A" segment is also commonly referred to as "near prime," and it is typically characterized by borrowers with credit scores comparable to to average credit scores in agency pools but the borrowers' income and/or assets are less than fully documented or the property is an investment property. "Subprime" refers to loans given to borrowers with low credit scores (Adelino, Gerardi and Hartman-Glaser (2019)). This paper suggests that

[47] In Table 11 (a), I report the results from Equation 8, the regression with a single pre- and post-period.

"Alt-A" mortgages also featured alternative mortgages products such as balloon, negative amortizing, and low introductory interest rate ARMs and were characterized as prime by CoreLogic.

[FIGURE 14 about here.]

To study mortgage default hazard rates, I limit the dataset to loans that were originated from November 2004 to September 2005, a five-month window around BAPCPA. I create the indicator variable $Defaulted\ Loan_l$ equal to one if the loan ever enters 90 day delinquency, foreclosure, or becomes an REO property in its lifetime and zero if the loan remains active. I run the following regression:

$$Defaulted\ Loan_l = \gamma_c + \eta_{s,t} + \sum_T \beta_T\ (Treated) IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_l \quad (9)$$

If the loans originated post shock by IMCs are of riskier quality, following BAPCPA, the default hazard rate should increase in counties with higher IMC market share in 2004. In Figure 15, I plot β_T, the coefficient on the interaction terms. I find a statistically significant increase for treated counties in the default hazard rate of mortgages originated in the months just post shock relative to those originated in the months prior to the shock. A 10% increase in treated IMC market share raises the default hazard rate on mortgages originated in the five months post shock by 11.1 percentage points. A 10% increase in total IMC market share raises the default hazard rate on mortgages originated in the five months post shock by 1.4 percentage points.[48] [49] I find that there is a statistically significant increase in default in counties with a higher total IMC market share post shock using this alternative measure. The results shed light on the finding in Albanesi, De Giorgi and Nosal (2017) that mortgage defaults during the crisis were concentrated in the middle and and top of the credit score distribution as well as the result in Ospina and Uhlig (2018) that that prime MBS performed significantly worse than subprime MBS.

[FIGURE 15 about here.]

[48] I run the equivalent regression to Equation 9, however with a single pre-period and a single post-period in order to estimate the cumulative effect of the shock in the post period. I report the regression results with a single pre- and post-period in Table 12 (a).

$$Defaulted\ Loan_l = \gamma_c + \eta_{s,t} + \beta\ Post_t \times (Treated) IMCMarketShare_{c,2004} + \epsilon_l \quad (10)$$

[49] In the Online Appendix, I define mortgage default rate to be the number of loans that default in the month that they default relative to all active loans in that month as an alternative measure of default. I estimate the regression in Equation 7 from June 2003 to December 2008 and plot the coefficient of interest.

[Table 12 about here.]

To understand whether increased mortgage originations increased the demand for homes and drove up home prices, I study the effect of IMC market share on county level home prices using the Zillow Home Value Index (ZVHI). I estimate Equation 7 where the dependent variable is $\log(HomePrice_{c,t})$ over the period from June 2003 to December 2008. Figure 16 (a), plots the coefficient of interest β_T. Prior to BAPCPA, IMC market share was not associated with a differential change in home prices. Post shock however, the figure shows a clear increase in home prices in counties with higher $(Treated)IMCMarketShare_{c,2004}$ between April 2005 and November 2006. A 10% increase in treated IMC market share is associated with a 9.5% increase in home prices. A 10% increase in total IMC market share is associated with a 2.1% increase in home prices.[50] This increase in home prices was followed by a steep and significant decline in home prices from the end of 2006 to 2008.

[Figure 16 about here.]

[Table 13 about here.]

I study a longer window of home prices pre and post BAPCPA. I find that there are parallel pre-treatment home prices for almost 2 years, June 2003 to March 2005, after controlling for $state \times month$ and $county$ fixed effects. This alleviates concerns the results are driven by these areas being different for reasons other than their exposure to BAPCPA. If IMCs located in these areas because they had differential potential to generate more mortgages and drive up home prices, we should have seen significant effects on home prices in 2003 and 2004 when IMCs market shares were surging.

6.1 Housing Market Implications of BAPCPA

One key feature of the Financial Crisis was an unexpected level of mortgage defaults. To understand the overall effect of BAPCPA on the housing market, I combine my results on the response of mortgage originations and default hazard rates to the policy change. My analysis on mortgage originations estimates the increase in mortgages originated by IMCs in response to BAPCPA. The analysis on the default hazard rates estimates the marginal increase in probability of mortgage default in response to BAPCPA. Combining these analyses allows me to estimate the number of mortgage defaults attributable to BAPCPA and the fraction that they account for relative to all defaults on loans originated between 2005 and 2006.

[50] I run the regression in Equation 8 with a single pre and post period. The post period is equal to April 2005 and later. Table 13 (a) reports the results of the regression.

I calculate the effect both under the assumption that only the six treated IMCs receive a credit supply shock and under the assumption that all IMCs receive a credit supply shock.

Assuming that only the six most treated IMCs with an above median fraction of funding from treated dealers were exposed to BAPCPA, I estimate that 2.3% additional mortgages were created in response to BAPCPA.[51] Following this same calculation using the market share and regression results assuming that all IMCs receive a credit supply shock due to BAPCPA, I calculate that BAPCPA was responsible for a 9% increase in mortgage originations.[52] I utilize my estimate of the mortgage default hazard rate reported in Table 12 to estimate the fraction of these mortgages that would default. The default hazard rate implies that each additional loan originated by treated IMCs in response to BAPCPA defaulted.[53] Applying this to the increase in mortgage originations, approximately 2.3% more loans entered default as a result of BAPCPA, than otherwise would have, accounting for 14% of defaults among all loans originated during 2005 and 2006.[54] When all IMC's are exposed to the policy change, the default hazard rate in that county increases by 21 percentage points when market share increases from 0% to 100%. The implied marginal default hazard rate on mortgages originated in response to BAPCPA is therefore 71%. These results shed light on the finding in Demyanyk and Van Hemert (2009) that mortgages originated in 2006 and 2007 performed significantly worse than mortgages originated between 2000-2004 even after controlling for borrower characteristics. Applying the margin default hazard rates to the increase in mortgage originations due to BAPCPA, approximately 6.4% more loans entered default than otherwise would have, accounting for 38% of defaults among all loans originated between 2005 and 2006. I describe this calculation in detail in the Online Appendix.

7 Conclusion

This paper provides three main contributions. First, it establishes that improved creditor rights increase the re-use of collateral in the repo markets. It then establishes that when overcollateralization requirements differ at each leg of the chain of re-use, increased re-use

[51] I multiply 87%, the estimated increase in mortgage originations caused by a 100% increase in IMC market share (Table 8), by the total market share of treated IMCs in the pre-period, which was 2.7%. This market share of treated IMCs is calculated using the HMDA data which does not account for mortgage purchases from correspondent lenders.

[52] I multiply 26.8%, the estimated increase in mortgage originations caused by a 100% increase in IMC market share (Table 8), by the total market share of IMCs in the pre-period, which was 34%. This market share of treated IMCs is calculated using the HMDA data which does not account for mortgage purchases from correspondent lenders.

[53] The default hazard rate on loans originated by the six most treated IMCs is high because these are the six IMCs most linked to the treated dealers.

[54] To calculate how much this contributed to total defaults, I divide 2.3% by the actual average default rate of loans originated in 2005 and 2006, which was 16.8%.

of collateral functions like a "money multiplier" in the fractional reserve banking system, creating a positive credit supply shock. Finally, this paper examines the real effects of the credit supply shock caused by increased re-use of private-label collateral.

The results suggest that following BAPCPA, there was increased demand for PLS mortgage collateral and that in order to generate more of the collateral, dealers increased credit lines to mortgage companies and relaxed restrictions on the credit lines. The results are consistent with dealers increasing funding for alternative products that lowered near term mortgage payments in an environment where a conforming mortgage would be very expensive. The expansion of credit increased the use of balloon, negative amortizing, and non-owner occupied mortgages with low introductory interest rates, in a rising interest rate environment. These products however would increase vulnerability to home prices and interest rate changes. The results suggest that the credit supply shock in response to BAPCPA drove up the price of homes in treated counties, which likely masked the fragility of the mortgages. Almost all of the six treated mortgage companies exit my sample by 2007. Their exit would create a pronounced contraction of credit in the treated counties. This contraction would decrease funding to potential homebuyers, lowering demand for housing, precisely in the areas with heavy use of the mortgage products most vulnerable to home price declines. The evidence presented in this paper suggests that BAPCPA increased the overall systemic risk of the repo markets leading up to and amplified the effects of the Financial Crisis.

My paper contributes to the legal debate on exemptions from automatic stay in the repo markets. Morrison, Roe and Sontchi (2013) states that the main argument supporting automatic stay is that it reduces systemic risk in the repo markets by reducing frictions on the collateral in bankruptcy. In this paper, I provide evidence that contradicts this argument. I establish that preferred bankruptcy status on private assets increases the interconnectedness of dealers by encouraging re-use of collateral. It also leads to the deterioration of the underlying assets by incentivizing dealers to increase funding for riskier assets.

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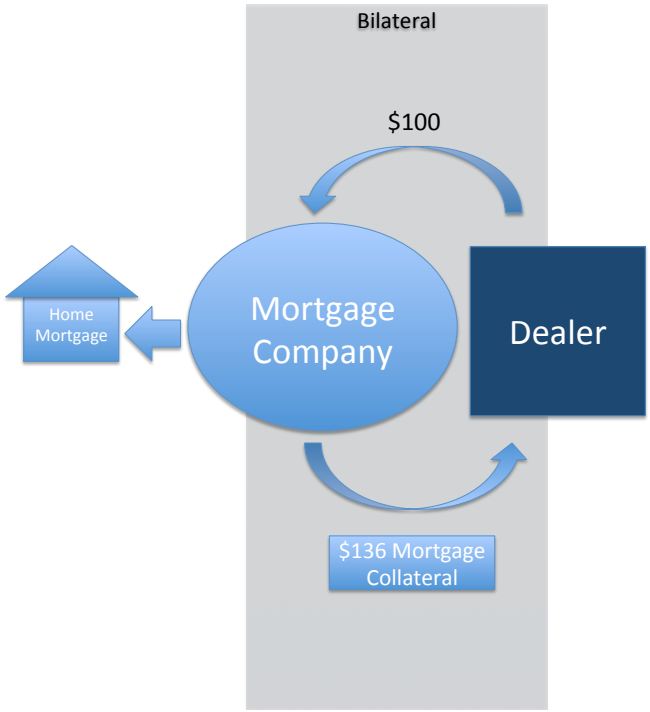
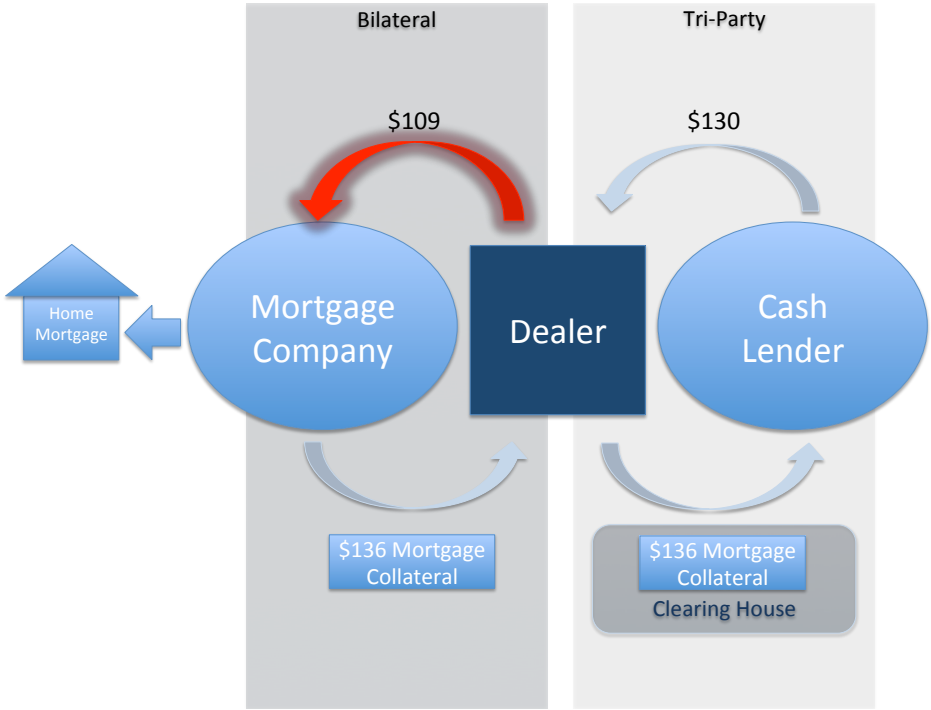
FIGURE 1: REPO MARKETS BEFORE AND AFTER BAPCPA 2005



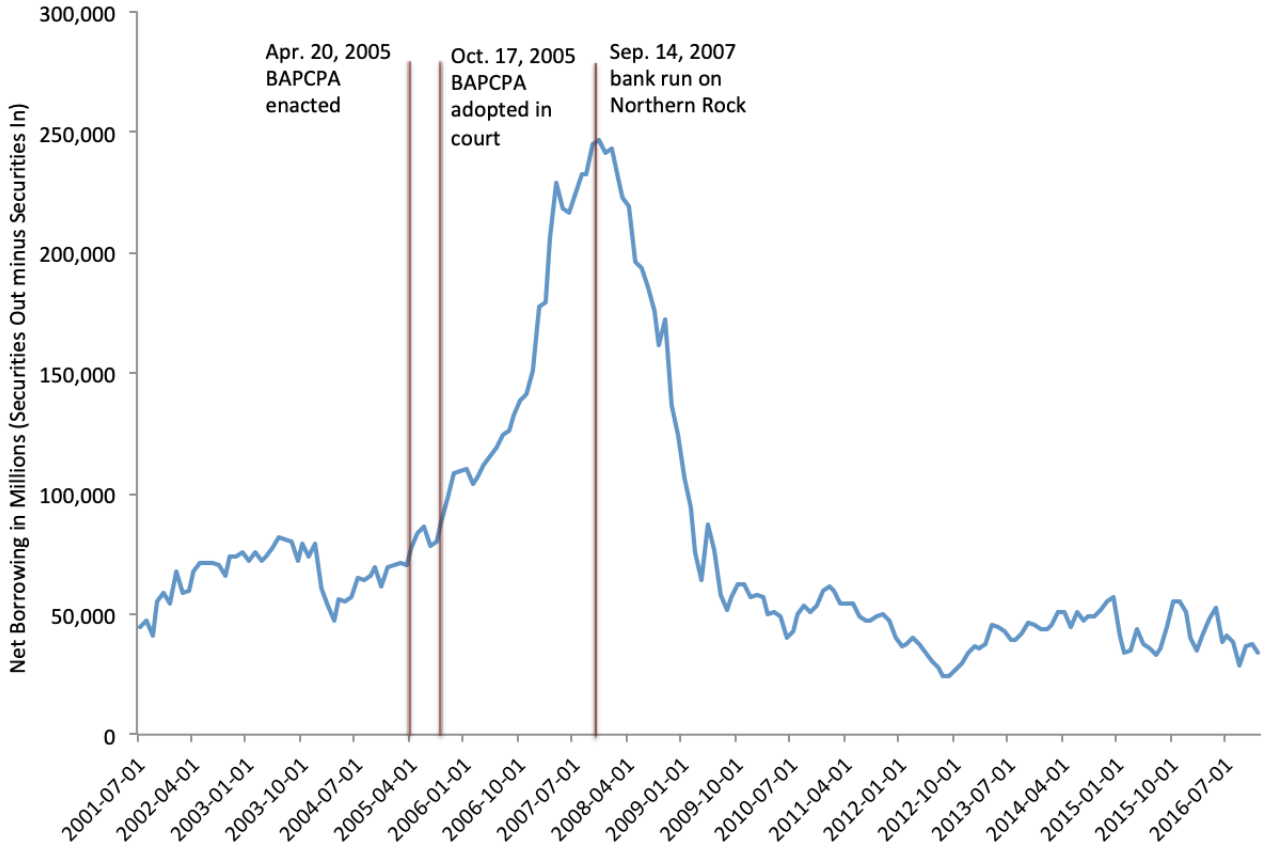
(a) Repo markets before BAPCPA



(b) Repo markets after BAPCPA

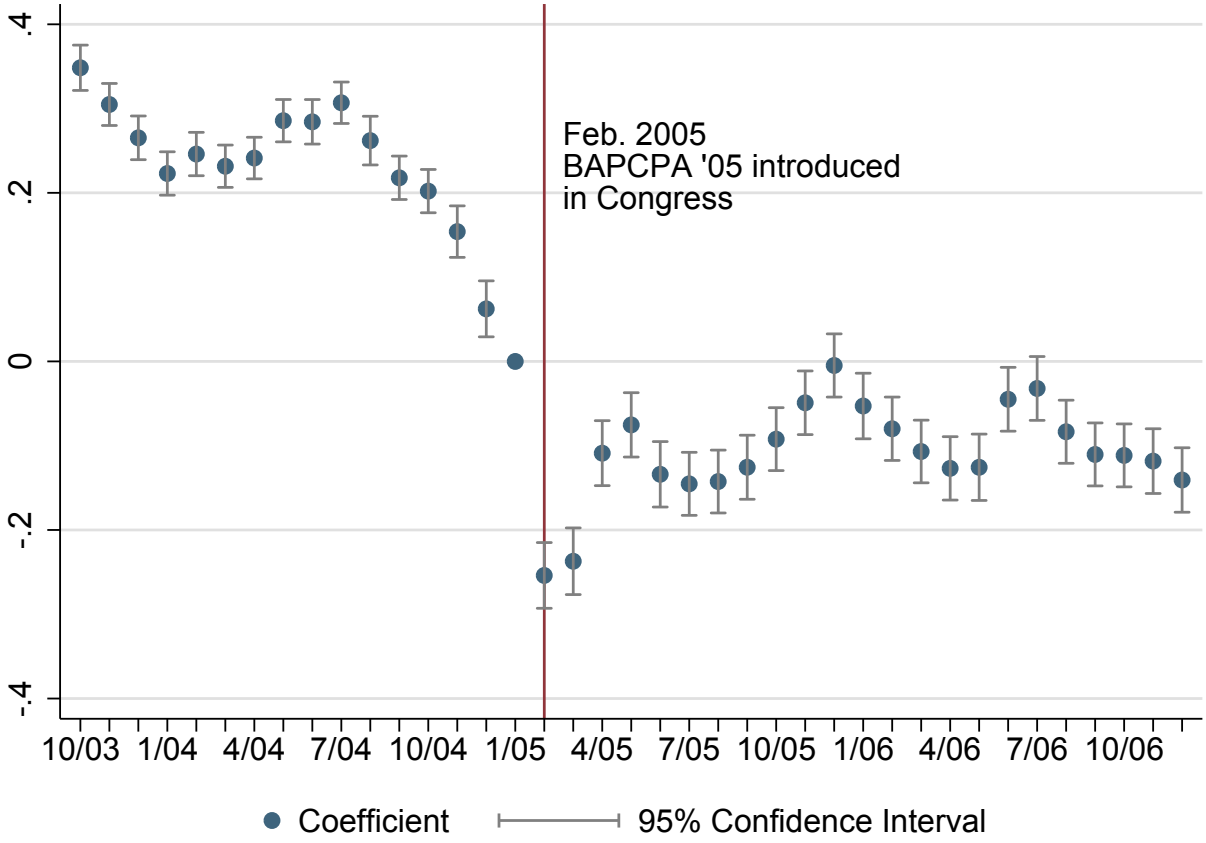
Notes: Figures depict the process by which a dealer can borrow and lend funds via the tri-party and bilateral repurchase market respectively, using the same underlying private-label mortgage collateral provided by the cash borrower for both contracts. Figure (a) depicts the intermediation chain before BAPCPA and Figure (b) depicts the proposed intermediation chain after BAPCPA.

Figure 2: Proxy for Dealer Net Borrowing Using Private-Label Mortgage Collateral
(Securities Out - Securities In)



Notes: Figure plots the weekly time series of dealer secured borrowing (securities out) minus dealer secured lending (securities in) in the collateral class corporate securities reported in the FR 2004. I calculate a lower bound estimate of the fraction that private-label mortgage collateral comprised of corporate securities to be 14% using 2018 data, due to data availability I cannot estimate the value for 2005. This is likely to be an underestimate as the use of private-label mortgage collateral was at an all time high in 2005. See the Online Appendix for details on the calculation. Securities out includes all dealer repo transactions and securities lending transactions. Securities in include all reverse repo transactions and securities borrowing transactions. Dealer net borrowing is calculated by securities out minus securities in.

FIGURE 3: PRIVATE-LABEL VS. AGENCY MBS YIELDS

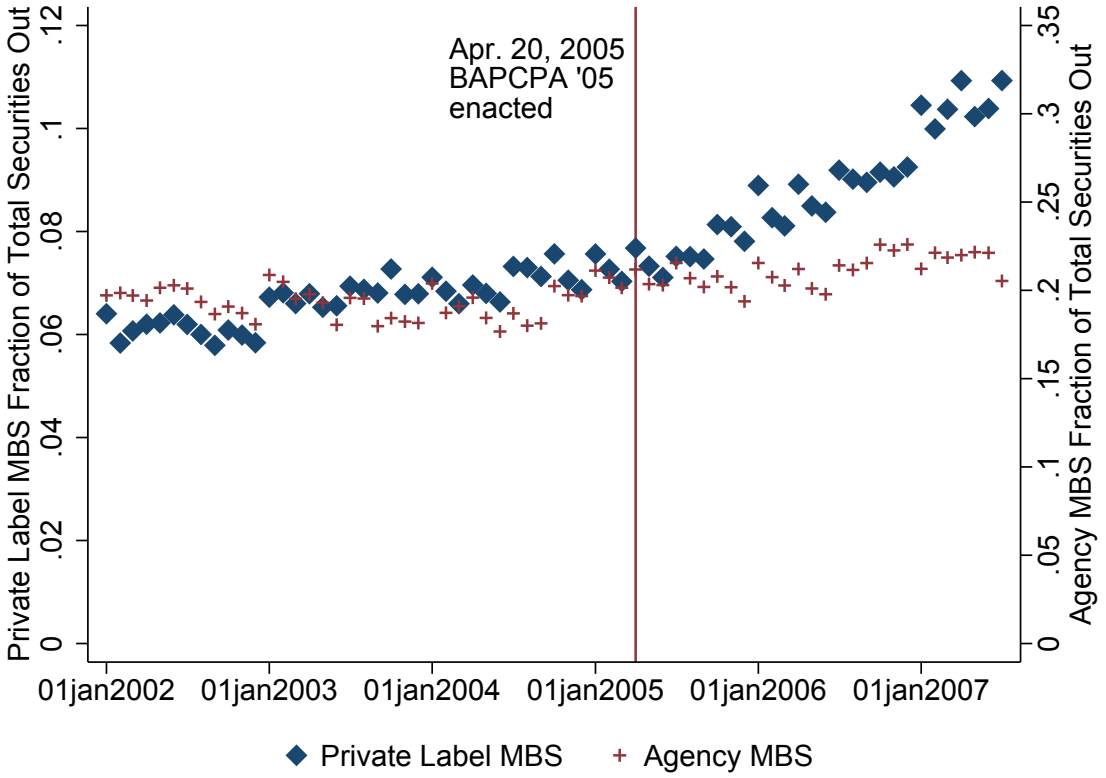


Notes: Figure plots the dynamic response of private-label MBS relative to agency MBS yields pre vs. post the introduction of BAPCPA 2005 in Congress on February 1, 2005. I estimate the regression

$$\log(yield_{i,t}) = \nu PLS + \sum_{T} \beta_T \ PLS_i \times \mathbb{1}_{t=T} + \epsilon_{i,t}$$

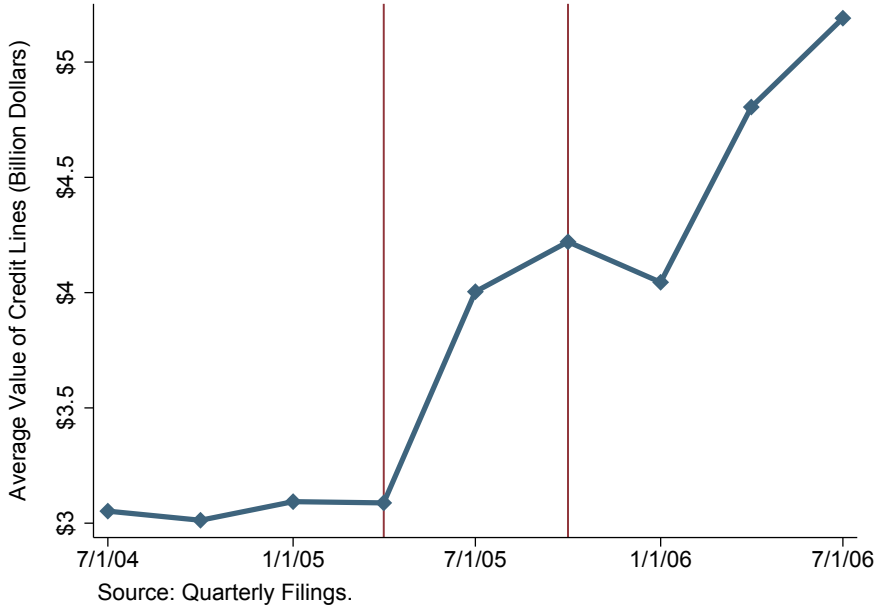
Where $\log(yield_{i,t})$ is the log of the average yield on an index of MBS securities. i indicates whether the index is the LD10OAS Bloomberg Barclays agency MBS index or the BNA10AS Bloomberg Barclays private-label MBS index. PLS_i is an indicator variable that equals one for the private-label MBS index and zero for the agency MBS index. t indicates the month. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts PLS treatment with an indicator for each month pre and post shock. The indicator variable is set to zero in January 2005, the month before BAPCPA was introduced in Congress.

Figure 4: Private Label vs. Agency Mortgage Backed Securities as a Fraction Total Collateral Posted by Dealers

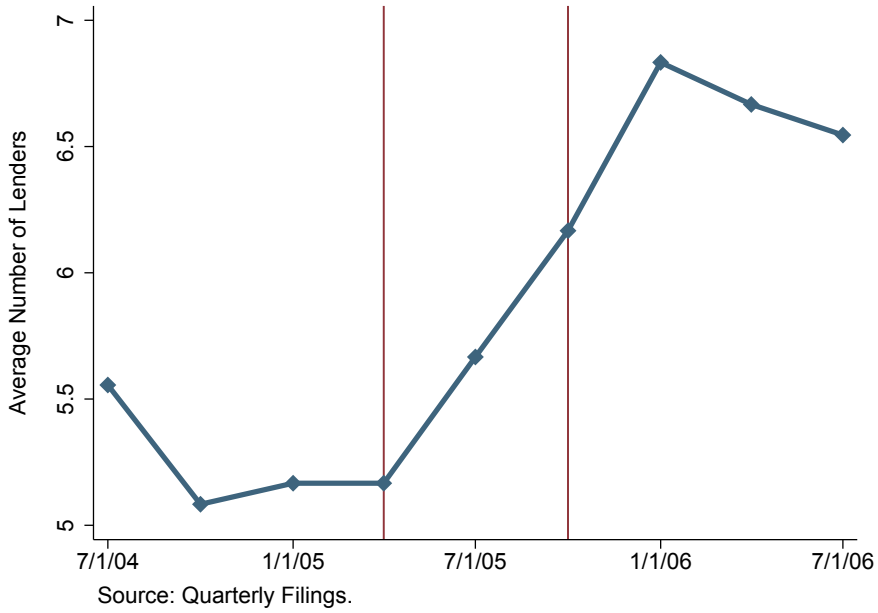


Notes: Figure plots the fraction of total primary dealer securities out made up of Private-Label MBS versus Agency MBS pre and post BAPCPA. I use the line item Corporate Securities as a proxy for Private-Label MBS. Directly after BAPCPA, Private-Label MBS as a fraction of securities began to increase significantly relative to Agency MBS. Agency MBS is comprised of Federal Agency and GSE MBS in the FR 2004 data. Private-Label MBS is comprised of Corporate Securities Total matching data from pre March 2013 indicates that Corporate Securities is comprised of: (1) Non-Agency Residential MBS, (2) Other CMBS, (3) Corporate Securities Commercial Paper, (4) Corporate Securities Investment grade bonds, notes, and debentures of various maturities, (5) Corporate Securities Below investment grade bonds, notes, and debentures of various maturities, (6) State and Municipal Government Obligations of various maturities, (7) Credit card-backed, Student loan-backed, Automobile loan-backed, Other Asset Backed Securities.

FIGURE 5: AVERAGE CREDIT LINES TO MORTGAGE COMPANIES



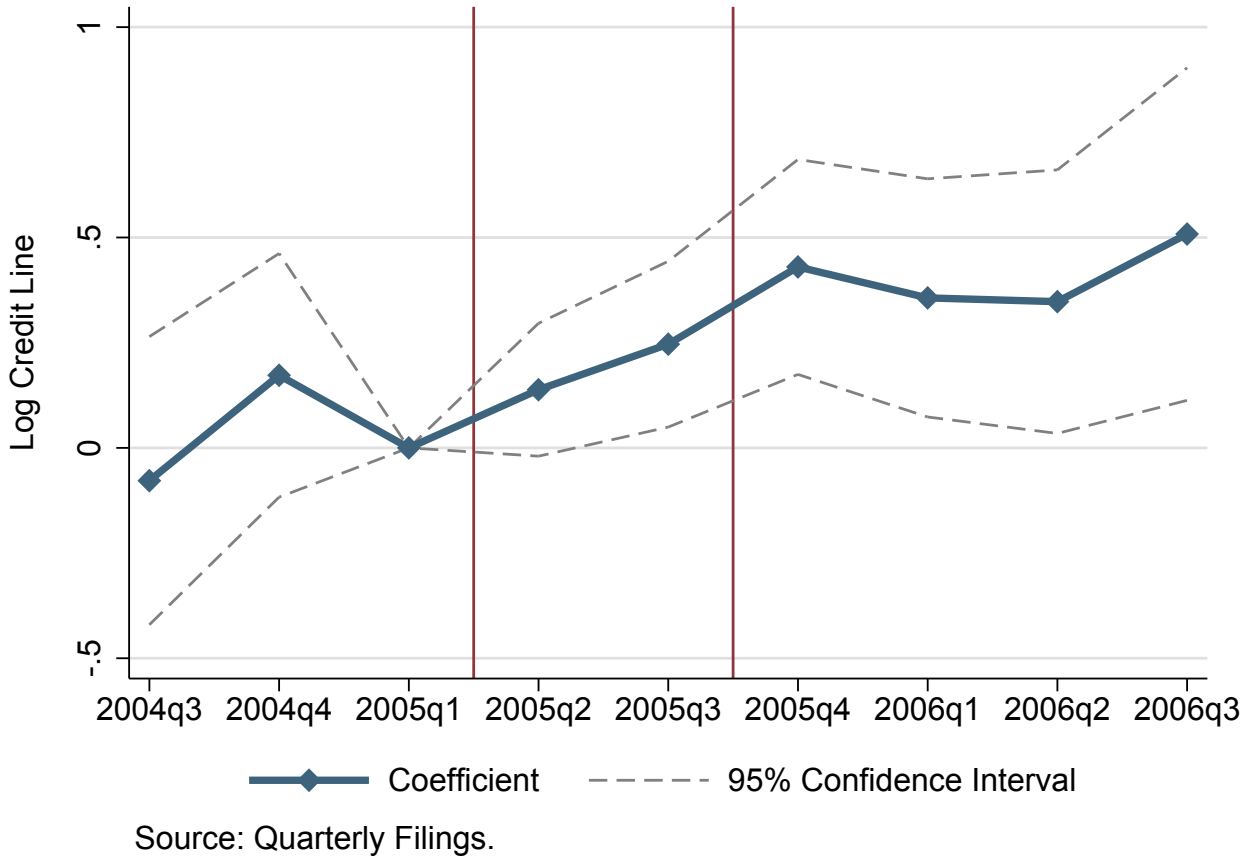
(a) Average Total Value of Credit Lines Available per Mortgage Company



(b) Average Number of Credit Lenders per Mortgage Company

Notes: Figures plot the average number of dealers lending to the Independent Mortgage Companies (IMCs) in my sample pre and post BAPCPA and average total value of credit lines available to an IMC. Post BAPCPA, the average number of dealers lending to an IMC and the average total credit extended to an IMC began to increase. This data is taken from IMC quarterly filings. Both figures include all twelve IMCs in my regression analysis. The second figure also includes GMAC which only reports aggregate data on the warehouse credit lines that it receives.

FIGURE 6: EFFECT OF DEALER TREATMENT EFFECT ON CREDIT LINES TO INDEPENDENT MORTGAGE COMPANIES (IMC)



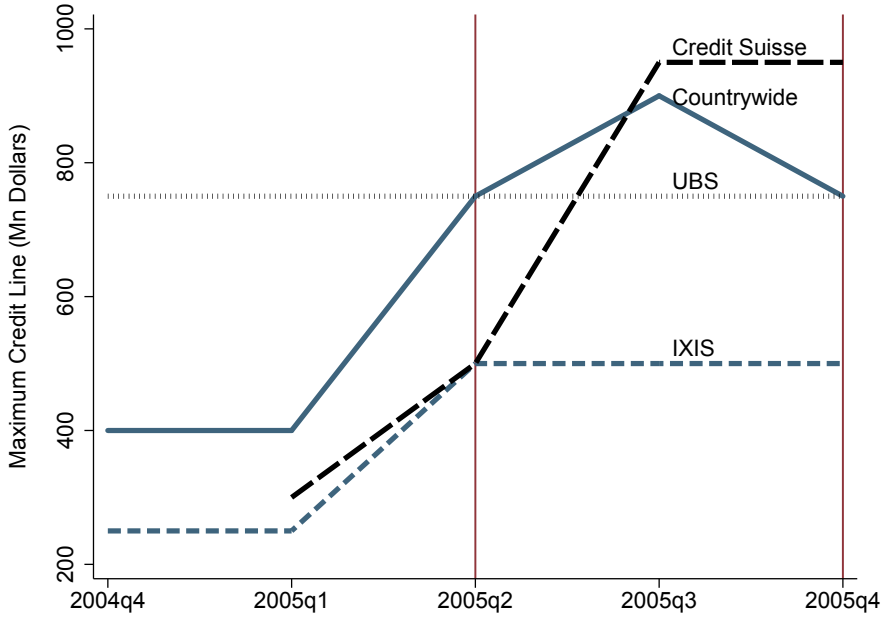
Notes: Figure plots the dynamic response of treated dealer funding relative to untreated dealer funding within a given IMC pre and post BAPCPA. I run the regression

$$\log(CreditLine_{i,j,t}) = \gamma_{i,t} + \eta_j + \sum_T \beta_T \; Treated \; Dealer_j \times \mathbb{1}_{t=T} + \epsilon_{i,j,t}$$

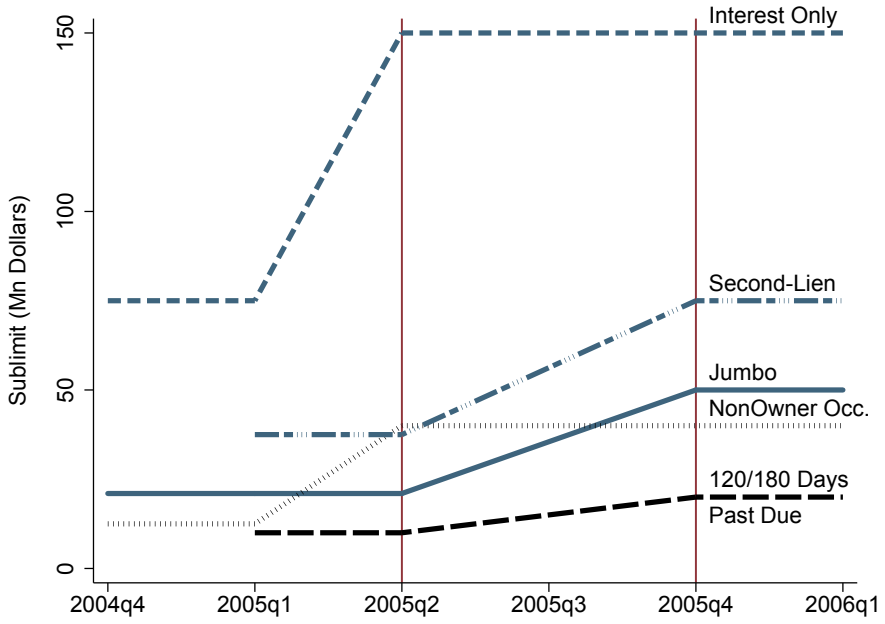
Where $\log(CreditLine_{i,j,t})$ is the log of the credit line extended to IMC i by dealer j at quarter t. $Treated\ Dealer_j$ is an indicator variable that equals one for treated dealers - those who were in the top quartile of underwriters for Subprime Residential Mortgage-Backed Securitized deals in 2004. $Post_t$ is an indicator variable that equals one for the second quarter of 2005 and later - since BAPCPA was passed by Congress on April 20, 2005 - and zero otherwise. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts dealer treatment with an indicator for each quarter pre and post shock. The indicator variable is set to zero in 2005Q1, the quarter before BAPCPA was passed. Since the liquidity shock occurs at the dealer level, changes in credit lines from the same dealer may be correlated. I calculate the standard errors clustered at the dealer level. $\gamma_{i,t}$ contains fixed effects for $IMC_i \times Quarter_t$ and η_j contains fixed effects for each $dealer_j$.

I plot the coefficient β_T. This figure shows that prior to BAPCPA, treated and untreated dealers lending volume to IMCs is similar. Post BAPCPA, however, the treated dealers begin to lend differentially more to IMCs.

FIGURE 7: CREDIT LINES TO AN EXAMPLE MORTGAGE COMPANY



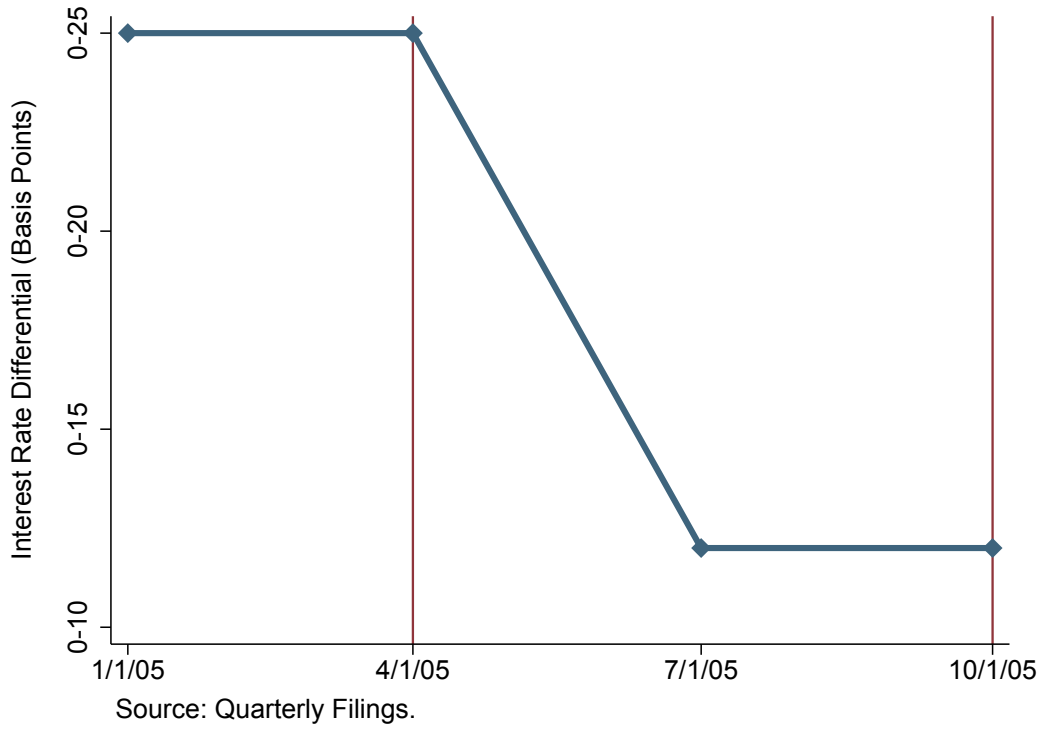
(a) Maximum Credit Line



(b) Sublimits by Collateral Type

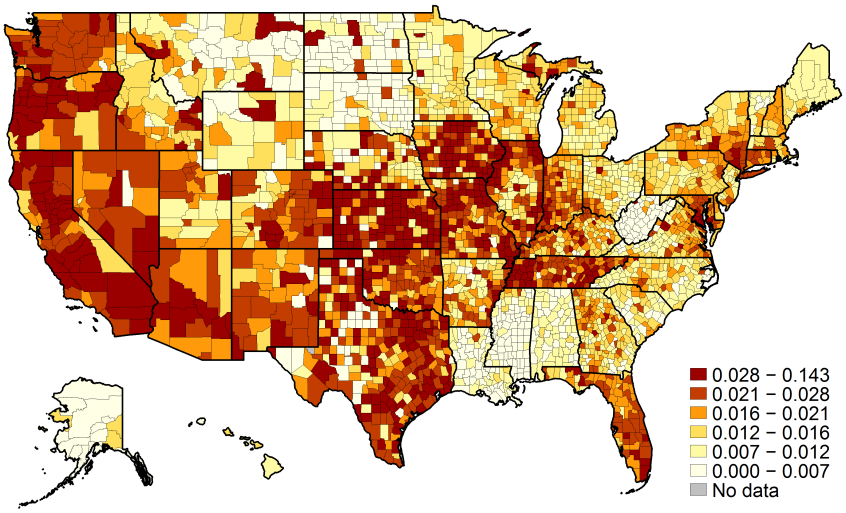
Notes: The first figure plots the maximum credit line values extended to an example mortgage company by dealers pre and post shock. The second figure plots the sublimit of funding available to fund certain mortgage products. In other words, the dealers would offer a maximum credit line value with covenants that specified the maximum amount of funding per credit line that could be applied to fund certain mortgage products.

Figure 8: Interest Rate Differential between Secured and Implicitly Unsecured Credit

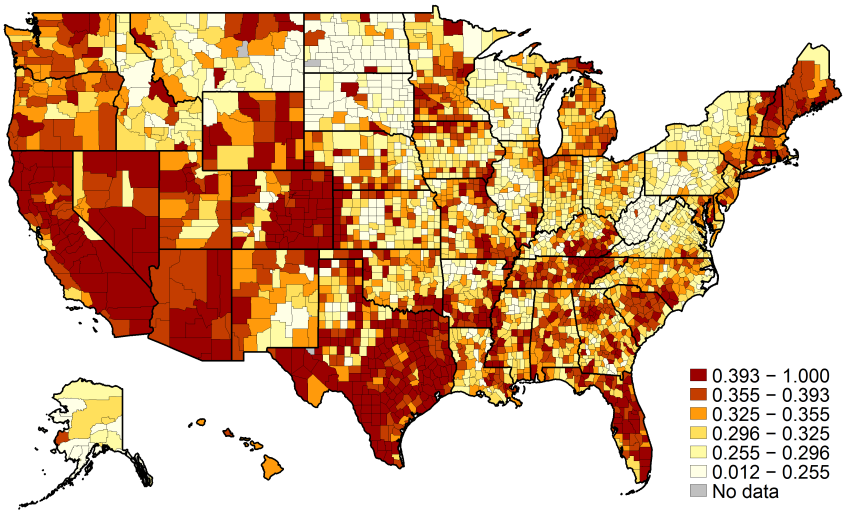


Notes: Figure plots the interest rate differential between credit lines backed by "wet" vs. "dry" collateral for an example mortgage company. Dry funding is secured by collateral that has already been created by the IMC, and requires that the loan documents be transferred to the dealer. Conversely, wet funding is implicitly unsecured. It is when the IMC posts collateral that has not yet been created, and therefore transfers no loan documents. This data is collected from IMC quarterly filings.

FIGURE 9: INDEPENDENT MORTGAGE COMPANY (IMC) MARKET SHARE



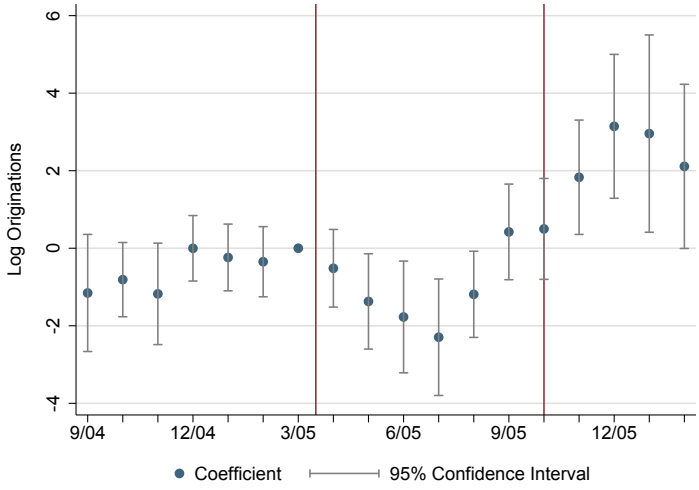
(a) Six Treated IMCs



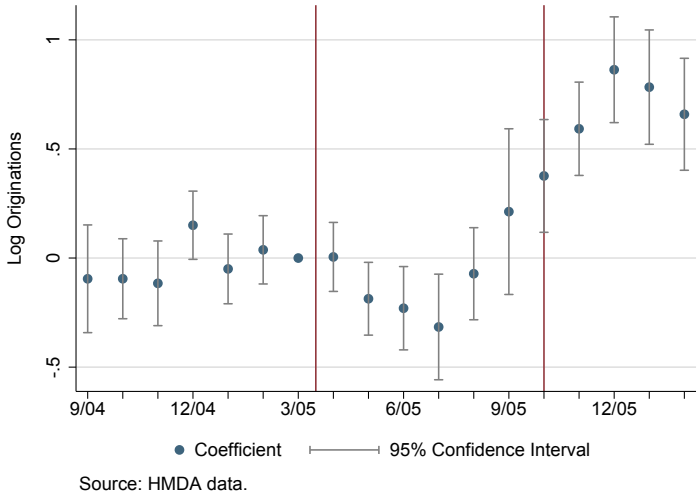
(b) All IMCs

Notes: The first figure depicts the county level market share of the six treated independent mortgage companies (IMCs) reported in 2004. The second figure depicts the county level market share of all IMCs reported in 2004. Data source: public HMDA data.

Figure 10: IMC County Market Share Effect on Total Mortgage Originations



(a) Six Treated IMCs



(b) All IMCs

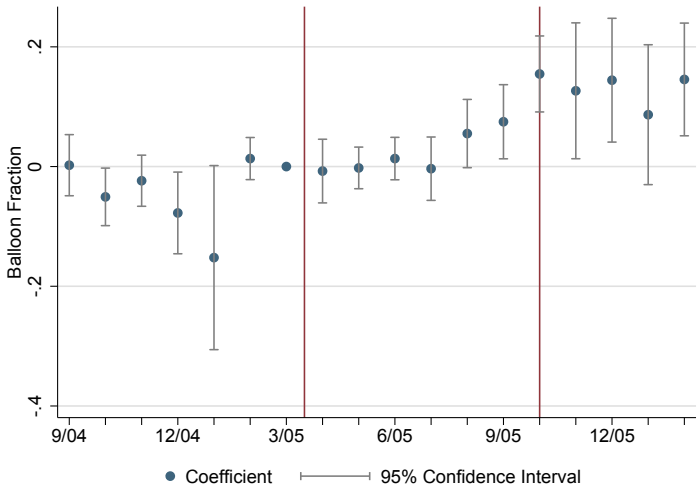
Notes: Figure plots the dynamic response of total mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I run the regression

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \sum_T \beta_T \ (Treated)IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_{c,t}$$

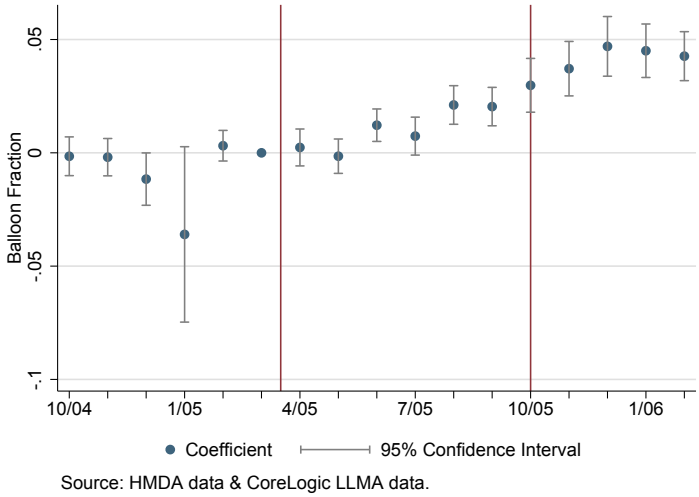
$Y_{c,t}$ is $\log(Originations_{c,t})$ in county, c at month t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $(Treated)IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts $(Treated)IMCMarketShare_{c,2004}$ with an indicator for each month pre and post the shock. I set the reference month to March 2005, the month prior to the passage of BAPCPA. I use the public HMDA data to compute the 2004 county level IMC market share and the county month HMDA data to study originations.[a]

[a]Neil Bhutta publishes the HMDA data reported at the county month level on his personal website: https://sites.google.com/site/neilbhutta/data.

FIGURE 11: IMC COUNTY MARKET SHARE EFFECT ON FRACTION OF BALLOON ORIGINATIONS



(a) Six Treated IMCs



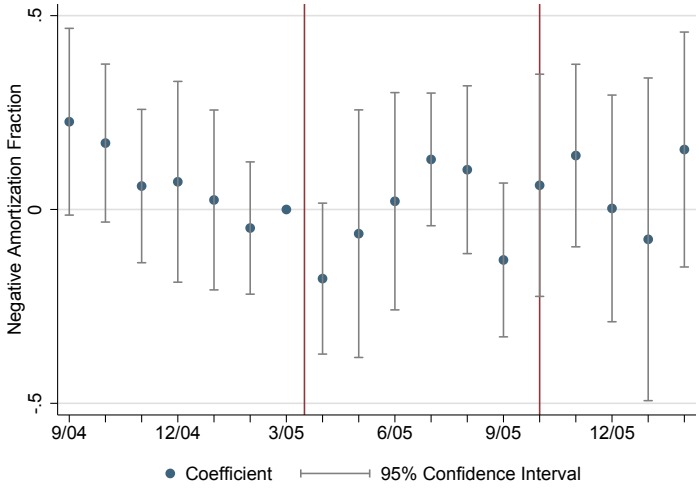
(b) All IMCs

Notes: Figure plots the dynamic response of the fraction of balloon mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I run the regression

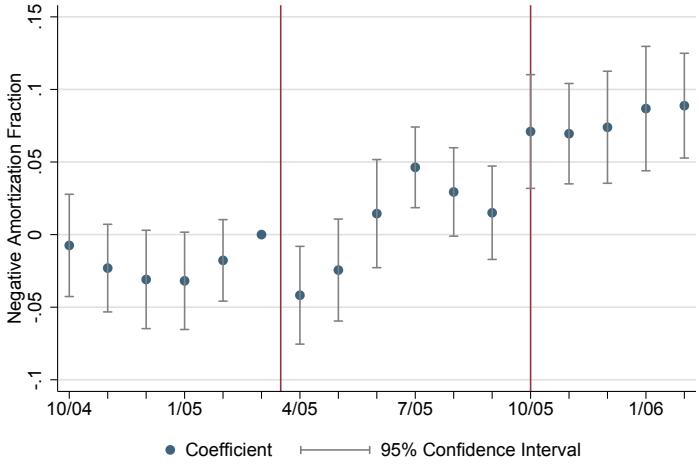
$$Y_{c,t} = \gamma_c + \eta_{s,t} + \sum_T \beta_T \ (Treated)IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_{c,t}$$

$Y_{c,t}$ is $Fraction\ Balloon\ Originations_{c,t}$ in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $(Treated)IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts $(Treated)IMCMarketShare_{c,2004}$ with an indicator for each month pre and post the shock. I set the reference month to March 2005, the month prior to the passage of BAPCPA. I use the Public HMDA data to compute the 2004 county level IMC market share CoreLogic origination data.

Figure 12: IMC County Market Share Effect on Fraction of NegAm Originations



(a) Six Treated IMCs

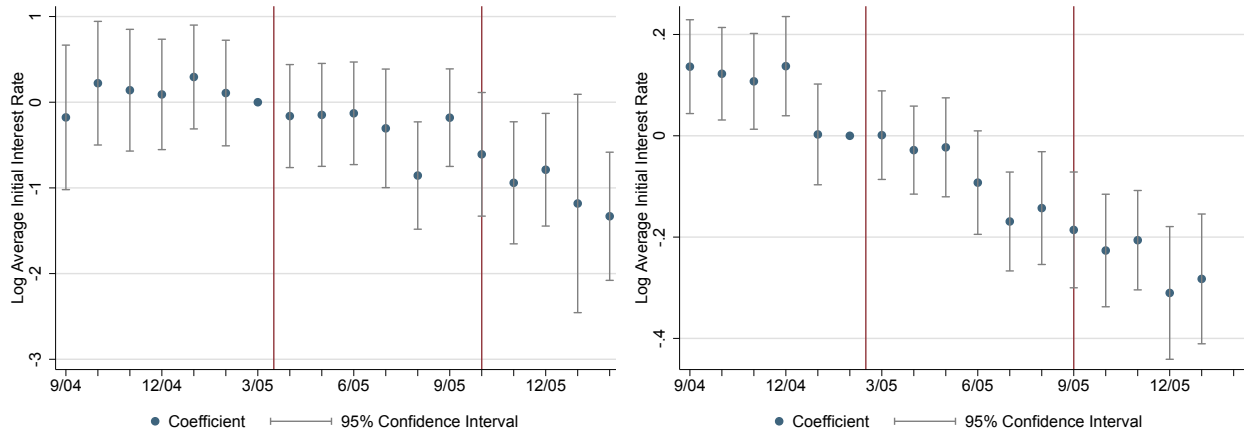


(b) All IMCs

Notes: Figures plot the dynamic response of county level mortgage characteristics as a function of county level market share of independent mortgage companies (IMCs) in 2004. I run the regression

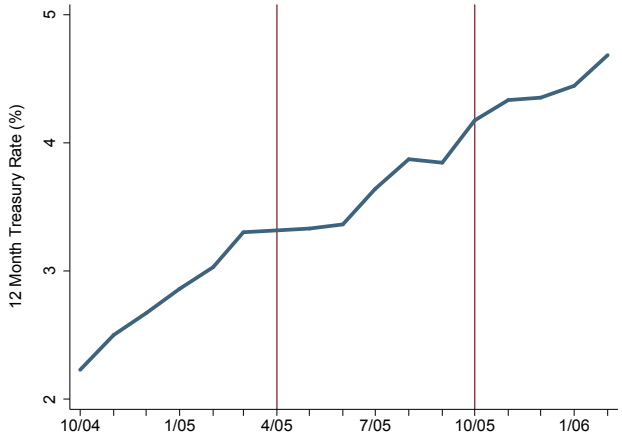
$$Y_{c,t} = \gamma_c + \eta_{s,t} + \sum_T \beta_T \; IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_{c,t}$$

in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β_T is the coefficient of interest. My standard errors are clustered at the county level.



(a) Treated IMC Market Share Effect

(b) All IMC Market Share Effect



(c) 12 Month Treasury Rate

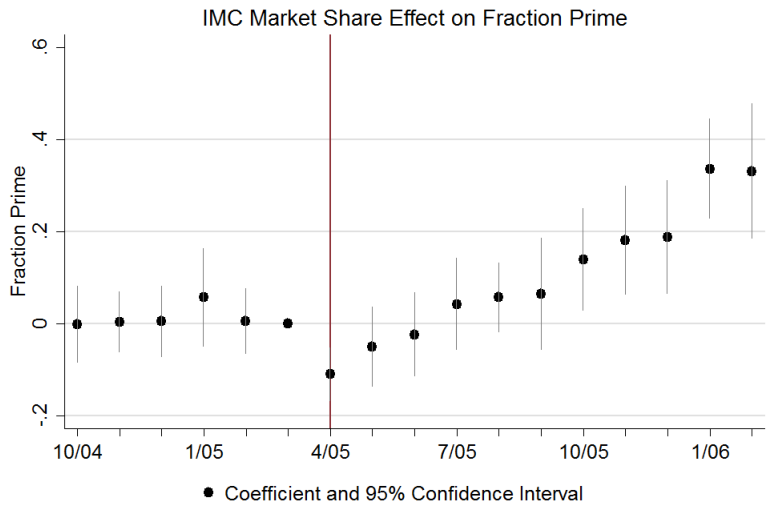
FIGURE 13: RESPONSE OF INITIAL INTEREST RATES ON ADJUSTABLE RATE MORTGAGES

Notes: Figures plot the dynamic response of county level average initial interest rates on adjustable rate mortgages as a function of county level market share of independent mortgage companies (IMCs) in 2004. I run the regression

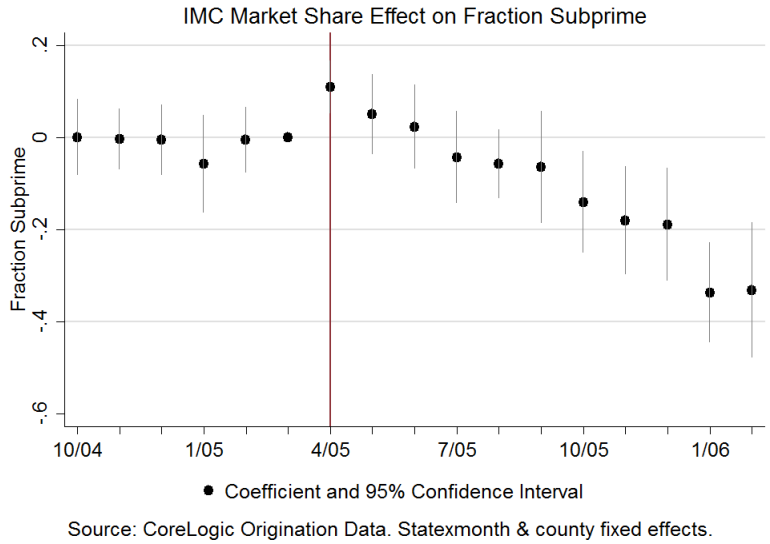
$$Y_{c,t} = \gamma_c + \eta_{s,t} + \sum_T \beta_T (Treated) IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_{c,t}$$

where $Y_{c,t} = \log(Initial\ Interest\ Rate_c, t)$ in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $(Treated) IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β_T is the coefficient of interest. My standard errors are clustered at the county level. Adjustable rate mortgages (ARMs) were pegged to the 12 month treasury rate which was increasing over this time.

FIGURE 14: IMC COUNTY MARKET SHARE EFFECT ON PRIME/SUBPRIME FRACTION



(a) All IMCs



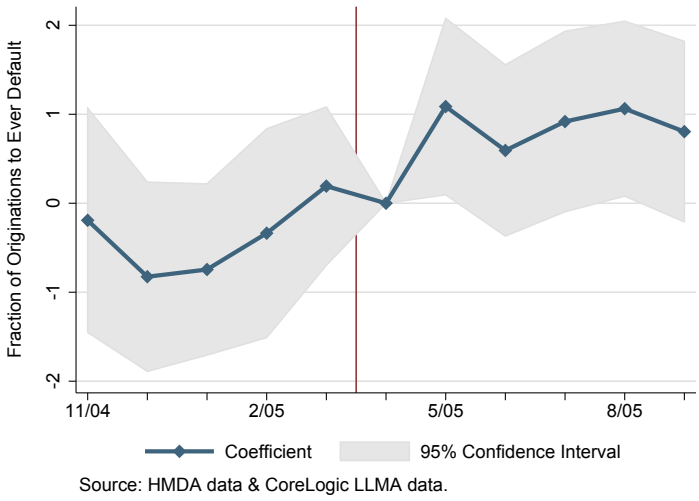
(b) All IMCs

Notes: Figures plot the dynamic response of county level mortgage characteristics as a function of county level market share of independent mortgage companies (IMCs) in 2004. I run the regression

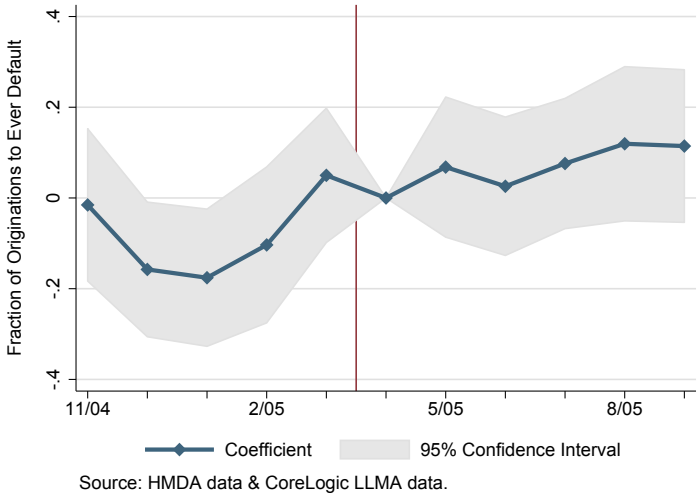
$$Y_{c,t} = \gamma_c + \eta_{s,t} + \sum_T \beta_T \; IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_{c,t}$$

in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β_T is the coefficient of interest. My standard errors are clustered at the county level.

FIGURE 15: IMC COUNTY MARKET SHARE IN 2004 EFFECT ON LOAN DEFAULT HAZARD RATE



(a) Six Treated IMCs



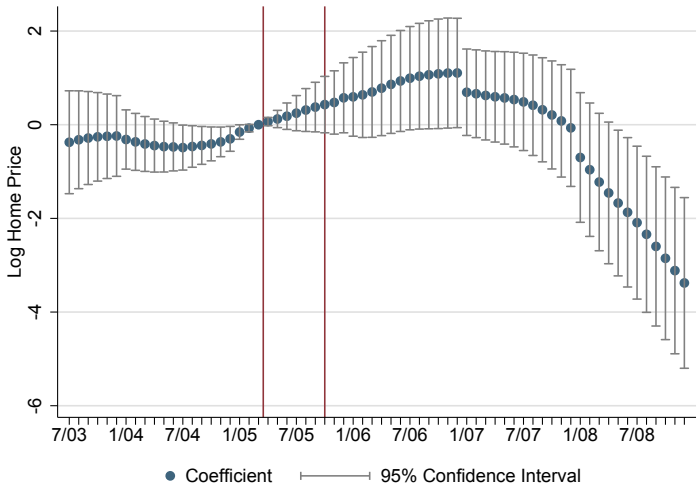
(b) All IMCs

Notes: Figures plot the dynamic response of Default Rate on loans originated five months prior to the shock and five months post the shock in a given county as a function of the 2004 market share of independent mortgage companies (IMCs) in that county. I run the regression

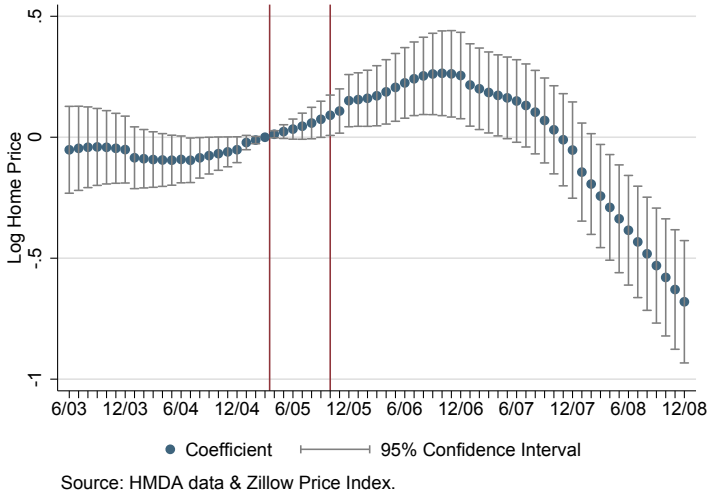
$$Defaulted\ Loan_l = \gamma_c + \eta_{s,t} + \sum_T \beta_T\ (Treated)IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_l$$

Where $Defaulted\ Loan_l$ is an indicator that is equal to one if a loan ever defaults in its lifetime, and zero otherwise. γ_c represents county level fixed effects. $\eta_{s,t}$ represents $state \times month$ level fixed effects. $(Treated)IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T}$ is the interaction term between the county level market share of (Treated) IMCs in a given county in 2004, the year before the shock occurs and an indicator variable for the month in which the mortgage was originated. I cluster my standard errors at the county level.

FIGURE 16: IMC COUNTY MARKET SHARE EFFECT ON HOME PRICES



(a) Six Treated IMCs



(b) All IMCs

Notes: Figures plot the dynamic response of home prices. I run the regression

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \sum_T \beta_T (Treated) IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T} + \epsilon_{c,t}$$

$Y_{c,t}$ is $\log(Home\ Price_{c,t})$ in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $(Treated)IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts $(Treated)IMCMarketShare_{c,2004}$ with an indicator for each month pre and post the shock. I set the reference month to March 2005, the month prior to the passage of BAPCPA. My standard errors are clustered at the county level. I use the Zillow Home Price data for this analysis.

Table 1: Increase in Dealer Secured Borrowing using Private-Label Mortgage Collateral

	(1) Fraction of Total Securities Out	(2) log(Securities Out)
Post	0.018***	0.423***
	(0.001)	(0.014)
PLSIndicator	-0.126***	-1.063***
	(0.001)	(0.020)
Post × PLSIndicator	0.004**	0.186***
	(0.002)	(0.027)
r2	0.9788	0.9172
N	582	582

Notes: Table reports the increase in use of private-label mortgage collateral in the repo market post BAPCPA. Regression run from January 1, 2002 through July 31, 2007. Where April 15, 2005 and after is considered the post period.

Table 2: Dealer Descriptive Statistics (2004)

	Mean (Control)	Mean (Treated)	Difference	P-value
log(Total Assets)	20.03	20.00	.03	.951
log(Originations)	6.24	6.17	.07	.955
Number of Counties	1795	1705	90	.890
N	15	7		

Notes: Table presents dealer descriptive statistics. Dealers in the top quartile of value of 2004 private-label MBS deals underwritten, scaled by total assets, are defined as treated dealers (scaled value of 2004 underwritten deals ≥ 0.023). Value of 2004 underwritten deals represents the total value of subprime residential mortgage-backed securitization deals underwritten by a financial institution in 2004, scaled by total assets of the financial institution. Data from the CoreLogic ABS database and Inside Mortgage Finance's Mortgage Market Statistical Annual were-used to compute the value of deals underwritten by a dealer.[a] Total assets reports the total value of book assets in 2004Q4 for each financial institution or holding company of the financial institution when applicable. There are 27 dealers in my dataset, five dealers' assets, liabilities, and equity I am not able to observe. These five dealers all underwrote \$0 of subprime residential mortgage-backed securitization deals in 2004. Origination and county statistics are generated using HMDA data.

[a]This measure was inspired by Nadauld and Sherlund (2013) p. 457. I am very grateful to Shane Sherlund for his help calculating this measure.

Table 3: Dealer Repledgeable Collateral

	(1) log(Repledgeable Collateral)
Post × Treated Dealer	0.181* (0.098)
DealerFE	Yes
r2	0.9009
N	85

Notes: Table reports the response of treated dealers reported repledgeable collateral relative to control dealers pre vs. post BAPCPA. I run the regression

$$\log(Repledgeable\ Collateral_{j,t}) = \eta_j + \nu Post_t + \beta Post_t \times Treated\ Dealer_j + \epsilon_{j,t}$$

$\log(Repledgeable\ Collateral_{j,t})$ is the log of the repledgeable collateral reported by dealer j at year t. $Treated\ Dealer_j$ is an indicator variable that equals one for treated dealers - those who were in the top quartile of underwriters for Subprime Residential Mortgage-Backed Securitized deals in 2004. $Post_t$ is an indicator variable that equals one for 2005 and later - since BAPCPA was passed by Congress on April 20, 2005 - and zero otherwise. β is the coefficient of interest. It is the coefficient on the interaction term that equals one for treated dealers in the post period. The coefficient on $Post_t \times Treated\ Dealer_j$ measures the difference in reported repledgeable collateral between treated and control dealers after the shock less the difference between the two before the shock. Since the liquidity shock occurs at the dealer level, changes in credit lines from the same dealer may be correlated, I observe 16 dealers that report repledgeable collateral. I calculate the standard errors clustered at the dealer, year level. η_j contains fixed effects for each $Dealer_j$.

Table 4: Within Mortgage Company Across Dealer Analysis

	log(Credit Line)
Post × Treated Dealer	0.289**
	(0.127)
IMCxQuarterFE	Yes
DealerFE	Yes
r2	0.7061
N	539

Notes: Table reports the response of treated dealer funding relative to untreated dealer funding within a given IMC post BAPCPA. I run the regression

$$\log(Credit\ Line_{i,j,t}) = \gamma_{i,t} + \eta_j + \beta Post_t \times Treated\ Dealer_j + \epsilon_{i,j,t}$$

$\log(Credit\ Line_{i,j,t})$ is the log of the credit line extended to IMC i by dealer j at quarter t. $Treated\ Dealer_j$ is an indicator variable that equals one for treated dealers - those who were in the top quartile of underwriters for Subprime Residential Mortgage-Backed Securitized deals in 2004. $Post_t$ is an indicator variable that equals one for the second quarter of 2005 and later - since BAPCPA was passed by Congress on April 20, 2005 - and zero otherwise. β is the coefficient of interest. It is the coefficient on the interaction term that equals one for treated dealers in the post period. The coefficient on $Post_t \times Treated\ Dealer_j$ measures the difference in lending between treated and untreated dealers after the shock less the difference between the two before the shock. Since the liquidity shock occurs at the dealer level, changes in credit lines from the same dealer may be correlated, I observe 27 dealers lending to the IMCs in my sample, I calculate the standard errors clustered at the dealer level. $\gamma_{i,t}$ contains fixed effects for $IMC_i \times Quarter_t$ and η_j contains fixed effects for each $Dealer_j$.

Table 5: Robustness: Within Mortgage Company Across Dealer Analysis (Primary Dealer Only)

	log(Credit Line)
Post × Treated Dealer	0.373**
	(0.142)
IMCxQuarterFE	Yes
DealerFE	Yes
r2	0.6881
N	401

Notes: Table reports the response of treated dealer funding relative to untreated dealer funding within a given IMC post BAPCPA. I run the regression

$$\log(Credit\ Line_{i,j,t}) = \gamma_{i,t} + \eta_j + \beta Post_t \times Treated\ Dealer_j + \epsilon_{i,j,t}$$

$\log(Credit\ Line_{i,j,t})$ is the log of the credit line extended to IMC i by dealer j at quarter t. $Treated\ Dealer_j$ is an indicator variable that equals one for treated dealers - those who were in the top quartile of underwriters for Subprime Residential Mortgage-Backed Securitized deals in 2004. $Post_t$ is an indicator variable that equals one for the second quarter of 2005 and later - since BAPCPA was passed by Congress on April 20, 2005 - and zero otherwise. β is the coefficient of interest. It is the coefficient on the interaction term that equals one for treated dealers in the post period. The coefficient on $Post_t \times Treated\ Dealer_j$ measures the difference in lending between treated and untreated dealers after the shock less the difference between the two before the shock. Since the liquidity shock occurs at the dealer level, changes in credit lines from the same dealer may be correlated, I observe 27 dealers lending to the IMCs in my sample, I calculate the standard errors clustered at the dealer level. $\gamma_{i,t}$ contains fixed effects for $IMC_i \times Quarter_t$ and η_j contains fixed effects for each $Dealer_j$.

Table 6: Independent Mortgage Company (IMC) Descriptive Statistics (2004)

	Mean (Control)	Mean (Treated)	Difference	P-value
log(Total Assets)	14.3	14.9	-.6	.593
log(Originations)	6.4	7.4	-1.1	.430
Number of Counties	1708	1976	-268	.660
N	6	6		

Notes: Independent Mortgage Companies (IMCs) descriptive statistics collected from quarterly filings and HMDA data.

Table 7: Treated IMC Credit Lines

	log(Credit Line)
Post × Treated IMC	0.138*
	(0.059)
IMCFE	Yes
QuarterFE	Yes
r2	0.9427
N	102

Notes: Table reports the response of the $\log(CreditLine_{i,t})$ for a given mortgage company i in quarter t as function of whether or not the mortgage company was treated.

$$\log(Credit\ Line_{i,t}) = \beta\ Post \times Treated\ IMC_i + \gamma_i + \alpha_t + \epsilon_{i,t}$$

I define a treated mortgage company to be a mortgage company who received an above median fraction of its credit lines from treated dealers in the pre-period. I include mortgage company fixed effects γ_i and quarter fixed effects α_t. There are 12 mortgage companies so I calculate my standard errors using bias-adjusted cluster version of heteroskedasticity consistent standard errors as in Imbens and Kolesar (RESTAT 2016) using the Bell-McCaffrey degrees of freedom adjustment as in Imbens and Kolesar (RESTAT 2016). I follow code provided by Gabriel Chodorow-Reich: https://scholar.harvard.edu/chodorow-reich/data-programs (Chodorow-Reich, Gopinath, Mishra and Narayanan (2018)).

Table 8: IMC County Market Share Effect on Total Originations

(a) Treated IMC County Market Share Effect

	(1) log(Originations)	(2) log(Originations)
Post × TreatedIMCMarketShare$_{c,2004}$	5.533***	0.870
	(0.291)	(0.694)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.9635	0.9946
N	8728	8572

(b) All IMC County Market Share Effect

	(1) log(Originations)	(2) log(Originations)
Post × IMCMarketShare$_{c,2004}$	0.375***	0.268***
	(0.013)	(0.080)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.9642	0.9947
N	8728	8572

Notes: Tables report the response of total mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I run the regression

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \beta\ Post_t \times (Treated)IMCMarketShare_{c,2004} + \epsilon_{c,t}$$

$Y_{c,t}$ is $\log(Originations_{c,t})$ in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $(Treated)IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β is the coefficient of interest. It is the coefficient on the interaction between $(Treated)IMCMarketShare_{c,2004}$ and the post period. This coefficient measures the change in the dependent variable if $(Treated)IMCMarketShare_{c,2004}$ increased from 0% to 100%. I use the Public HMDA data to compute the 2004 county level IMC market share and the county month HMDA data to study originations. [a]

[a] Neil Bhutta publishes the HMDA data reported at the county month level on his personal website: https://sites.google.com/site/neilbhutta/data.

Table 9: IMC County Market Share Effect on Fraction of Balloon Originations

(a) Treated IMC County Market Share Effect

	(1) Balloon Fraction	(2) Balloon Fraction
Post × TreatedIMCMarketShare$_{c,2004}$	0.095***	0.113***
	(0.009)	(0.027)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.1555	0.5191
N	9000	8874

(b) All IMC County Market Share Effect

	(1) Balloon Fraction	(2) Balloon Fraction
Post × IMCMarketShare$_{c,2004}$	0.005***	0.030***
	(0.001)	(0.004)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.1507	0.5239
N	9000	8874

Notes: Tables report the response of fraction of balloon mortgages originated in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I run the regression

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \beta \; Post_t \times (Treated) IMCMarketShare_{c,2004} + \epsilon_{c,t}$$

$Y_{c,t}$ is $Fraction\ Balloon\ Originations_{c,t}$ in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $(Treated)IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β is the coefficient of interest. It is the coefficient on the interaction between $(Treated)IMCMarketShare_{c,2004}$ and the post period. This coefficient measures the change in the dependent variable if $(Treated)IMCMarketShare_{c,2004}$ increased from 0% to 100%. I use the Public HMDA data to compute the 2004 county level IMC market share CoreLogic origination data.

Table 10: IMC County Market Share Effect on Fraction of NegAm Originations

(a) Treated IMC County Market Share Effect

	(1) Negative Amortization Fraction	(2) Negative Amortization Fraction
Post × TreatedIMCMarketShare$_{c,2004}$	0.483***	-0.056
	(0.039)	(0.103)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.9327	0.9623
N	9000	8874

(b) All IMC County Market Share Effect

	(1) Negative Amortization Fraction	(2) Negative Amortization Fraction
Post × IMCMarketShare$_{c,2004}$	0.030***	0.057***
	(0.002)	(0.015)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.9327	0.9627
N	9000	8874

Notes: Tables report the response of negative amortizing mortgages in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I run the regression

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \beta\ Post_t \times (Treated)IMCMarketShare_{c,2004} + \epsilon_{c,t}$$

$Y_{c,t}$ is $\log(Fraction\ NegAm\ Originations_{c,t})$ in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $(Treated)IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β is the coefficient of interest. It is the coefficient on the interaction between $(Treated)IMCMarketShare_{c,2004}$ and the post period. This coefficient measures the change in the dependent variable if $(Treated)IMCMarketShare_{c,2004}$ increased from 0% to 100%. I use the Public HMDA data to compute the 2004 county level IMC market share CoreLogic origination data.

Table 11: IMC County Market Share Effect on Initial Interest Rate

(a) Treated IMC County Market Share Effect

	(1) Log Average Initial Interest Rate	(2) Log Average Initial Interest Rate
Post × TreatedIMCMarketShare$_{c,2004}$	2.497***	-0.698***
	(0.154)	(0.268)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.8456	0.9473
N	9000	8874

(b) All IMC County Market Share Effect

	(1) Log Average Initial Interest Rate	(2) Log Average Initial Interest Rate
Post × IMCMarketShare$_{c,2004}$	0.175***	-0.239***
	(0.006)	(0.033)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.8543	0.9482
N	9000	8874

Notes: Tables report the response of initial interest rates on adjustable rate mortgages in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I run the regression

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \beta\ Post_t \times (Treated)IMCMarketShare_{c,2004} + \epsilon_{c,t}$$

$Y_{c,t}$ is $\log(Initial\ Interest\ Rate_{c,t})$ in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $(Treated)IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β is the coefficient of interest. It is the coefficient on the interaction between $(Treated)IMCMarketShare_{c,2004}$ and the post period. This coefficient measures the change in the dependent variable if $(Treated)IMCMarketShare_{c,2004}$ increased from 0% to 100%. I use the Public HMDA data to compute the 2004 county level IMC market share CoreLogic origination data.

Table 12: IMC County Market Share Effect on Default Hazard Rate

(a) Treated IMC County Market Share Effect

	(1) Default Hazard Rate	(2) Default Hazard Rate
Post × TreatedIMCMarketShare$_{c,2004}$	1.887***	1.117***
	(0.383)	(0.275)
CountyFE	Yes	Yes
StatexOrigMonthFE	No	Yes
r2	0.0401	0.0448
N	355154	355134

(b) All IMC County Market Share Effect

	(1) Default Hazard Rate	(2) Default Hazard Rate
Post × IMCMarketShare$_{c,2004}$	0.331***	0.141***
	(0.058)	(0.044)
CountyFE	Yes	Yes
StatexOrigMonthFE	No	Yes
r2	0.0402	0.0447
N	355154	355134

Notes: Tables report the fraction of loans originated in a given county between November 2004 and September 2005 that ever default. I calculate the fraction of loans originated in a given county just prior to April 2005 that ever defaulted and compare it to the fraction of loans originated just post April 2005 in that county that defaulted as a function of the 2004 market share of treated independent mortgage companies (IMCs). I run the regression

$$Defaulted\ Loan_l = \gamma_c + \eta_{s,t} + \beta\ Post_t \times (Treated)IMCMarketShare_{c,2004} + \epsilon_l$$

$Defaulted\ Loan_l$ is an indicator variable set equal to a loan if the loan defaults at any point in its lifetime in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ level fixed effects, $(Treated)IMCMarketShare_{c,2004}$ is the county level market share in 2004 of a treated IMC in a given county in 2004. β is the coefficient of interest. It is the coefficient on the interaction between $(Treated)IMCMarketShare_{c,2004}$ and the post period. This coefficient measures the change in the dependent variable if $(Treated)IMCMarketShare_{c,2004}$ increased from 0% to 100%. I use the Public HMDA data to compute the 2004 county level IMC market share and the CoreLogic LLMA loan performance data to calculate whether a loan ever defaults.

Table 13: IMC County Market Share Effect on Home Price

(a) Treated IMC County Market Share Effect

	(1) log(Home Price)	(2) log(Home Price)
Post × TreatedIMCMarketShare$_{c,2004}$	3.591***	0.953**
	(0.527)	(0.478)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.9771	0.9956
N	19232	18929

(b) All IMC County Market Share Effect

	(1) log(Home Price)	(2) log(Home Price)
Post × IMCMarketShare$_{c,2004}$	0.443***	0.209**
	(0.094)	(0.082)
CountyFE	Yes	Yes
StatexMonthFE	No	Yes
r2	0.9768	0.9957
N	19232	18929

Notes: Tables report the response of $\log(Home\ Price_{c,t})$ in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I run the following regression on data from June 2003 to November 2006.

$$Y_{c,t} = \gamma_c + \eta_{s,t} + \beta\ Post_t \times (Treated) IMCMarketShare_{c,2004} + \epsilon_{c,t}$$

$Y_{c,t}$ is $\log(Home\ Price_{c,t})$ in county, c at time t. γ_c represents county level fixed effects, $\eta_{s,t}$ represents $state \times month$ fixed effects, $(Treated) IMCMarketShare_{c,2004}$ is the IMC county level market share in a given county in 2004, the year before the shock occurs. β is the coefficient of interest. It is the coefficient on the interaction between $(Treated) IMCMarketShare_{c,2004}$ and the post period. This coefficient measures the change in the dependent variable if $(Treated) IMCMarketShare_{c,2004}$ increased from 0% to 100%. I use the Public HMDA data to compute the 2004 county level IMC market share and the Zillow county level home price index to study home prices.