Creditor Rights, Collateral Reuse, and Credit Supply*

Brittany Almquist Lewis†

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Abstract

Utilizing a change to bankruptcy treatment of repo collateral, I provide causal evidence that strengthened creditor rights increase credit supply and financial instability by increasing the reuse of collateral. I use the 2000's housing boom and bust as a laboratory and collect data linking dealers' repledgeable collateral to their lending to mortgage companies. Exposed dealers increased their repledgeable collateral and their credit provision to mortgage companies. Mortgage companies responded by increasing originations and pivoting toward non-traditional products. I estimate that the expansion in credit drove a 9% increase in originations and accounted for 38% of defaults on mortgages originated during 2005-2006, consistent with a financial accelerator. This paper changes our understanding of the size of the money creation generated in the repo markets.

Keywords: repo, creditor rights, rehypothecation, collateral reuse, money multiplier, mortgage-backed securities, bapcpa
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1 Introduction

Reuse of collateral in the sale and repurchase ("repo") markets functions like a *money multiplier* in the fractional reserve banking system (Singh (2011), Gorton and Metrick (2012)). Increasing reuse of repo collateral is like lowering the reserve requirement. To date the literature has studied repo reuse of Treasury and government securities (Infante and Saravay (2020), Jank and Moench (2020)). This paper is the first to study the money multiplier effect generated by reuse of private assets. It finds that the multiplier effect generated by the reuse of private assets is larger than that of government assets which has important implications for both credit allocation in the real economy and financial stability.

This paper provides evidence that improving creditor rights in the repo market increases credit creation by increasing the reuse of collateral. I study this credit creation through the lens of the housing boom and bust of the 2000s. I utilize a policy change in 2005 as a natural experiment that increases 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). PLS is mortgage collateral that does not meet the underwriting standards in the agency market. While the shock affected the reuse of private-label mortgage collateral during 2005-2008, Treasuries, agency mortgages, and to some extent corporate securities are still being used in the repo markets in a similar way.

Mian and Sufi (2009) established that the evolution of the housing boom and bust 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 an effort to understand the credit supply shocks that drove the Financial Crisis (Di Maggio and Kermani (2017), Mian and Sufi (2018), Justiniano, Primiceri and Tambalotti (2019), Drechsler, Savov and Schnabl (2019)). These studies further our understanding of credit supply leading up to the Financial Crisis. Yet, there remain a number of important puzzles. Without understanding these puzzles, we run the risk of repeating the same mistakes that led to the Financial Crisis of 2008.

First, much of the literature focuses on a credit expansion in the subprime mortgage segment for higher risk borrowers, however new literature suggests that the rise in mortgage defaults was concentrated in the prime segment (Albanesi, De Giorgi and Nosal (2017)). Second, why were 2006, 2007 vintage mortgages so much worse than 2000-2004 vintages, defaulting only a few months after origination (Demyanyk and Van Hemert (2009))? Third, was the run on the repo market (failure to roll over repo funding) central to the Financial Crisis? Gorton and Metrick (2010*a*,*b*, 2012) propose that a repo run plummeted asset prices and was at the nexus of the Financial Crisis. However, Krishnamurthy, Nagel and Orlov

(2014) present evidence that only a small fraction of total outstanding asset-backed securities was exposed to a repo run. Fourth, Ospina and Uhlig (2018) find that post crisis, mortgage-backed securities' (MBS) prices returned to pre-crisis levels with only a few basis points in realized losses and that the prime segment performed worse than the subprime segment. The question remains how these relatively small realized losses on a multi-trillion dollar market put 12 of the 13 most systemically important financial institutions at risk of failure in a period of two weeks.

Prior to the Financial Crisis, independent mortgage companies (IMCs) made up close to one third of the mortgage lending market. The market for repos – short-term loans collateralized with financial securities – played a central role in supplying credit to IMCs and to the financial system as a whole. The IMCs relied heavily on *warehouse* funding lines (Stanton, Walden and Wallace (2014), Echeverry, Stanton and Wallace (2016)). However, prior to this paper, there has been no direct evidence about who the funders to the mortgage companies were or how they operated. I hand collect novel micro-level data that links twelve of the largest public IMCs to their warehouse lenders between 2004Q3 and 2006Q3.

IMCs 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 IMCs' total warehouse funding amounted to 61% of their assets on average. These credit lines were implemented as repurchase agreements from the largest most interconnected 29 dealers. I trace the transmission of the credit increase – that dealers generated by increasing repo collateral reuse – from dealers to the IMCs that they funded, and ultimately to homebuyers.

First, I establish that an increase in creditor rights increases dealers' ability to reuse repo collateral. In Figure 3, I show new evidence that suggests dealers' reuse of private-label mortgage collateral tripled following BAPCPA and crashed when the repo run on MBS began. I utilize institutional detail to create a treatment intensity research design. The first insight of the research design hypothesizes that dealers holding more warehoused PLS collateral at the time of BAPCPA would be more exposed to the strengthening of repo creditor rights. A larger fraction of their balance sheet would consist of previously illiquid collateral suddenly eligible for reuse. Since I do not directly observe dealers' reuse of collateral, I define a sufficient statistic for reuse: reported repledgeable collateral. The second insight of the research design hypothesizes that the different overcollateralization requirements at each leg of repo intermediation chains, described in Infante (2019), would incentivize treated dealers to lower their cost of capital by reinvesting in PLS collateral. This would generate a larger money multiplier effect for treated dealers following BAPCPA by

increasing their reported repledgeable collateral faster than that of control dealers.

To test whether strengthened creditor rights increased collateral reuse, I estimate a difference-in-differences specification that tests whether treated dealers' reported repledgeable collateral increased relative to that of control dealers within a narrow window around BAPCPA. To define treated dealers, I capture heterogeneity in dealers' exposure to the change in creditor rights by proxying for pre-existing variation in dealers' holding of warehoused PLS collateral using their underwriting of PLS in 2004. I establish that post BAPCPA, treated dealers increased their reported repledgeable collateral significantly by 43% relative to control dealers. The evidence indicates that treated dealers increased reuse of collateral and generated a larger credit supply increase than control dealers following BAPCPA. This estimates a lower bound for the increase in credit supply caused by BAPCPA because all dealers experienced increased ability to reuse collateral due to strengthened creditor rights.

Second, this paper studies dealer funding to the IMCs pre versus post BAPCPA. By connecting repledgeable collateral of a dealer to the same dealer's funding to IMCs, my research design causally links dealers' ability to reuse collateral in the repo market to their increased provision of credit to mortgage companies. Isolating the credit supply channel requires simultaneously estimating both the dealer lending channel and the IMC 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. Within a narrow window around the policy change, I establish that treated dealers increased their funding within the same mortgage company significantly by 29% relative to control dealers. The results hold when I limit the sample to only the primary dealers who make the market for the United States Treasuries.

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. Mortgage companies who were more dependent on treated dealers in the pre-period received a significant 13.8% increase in their total credit lines post shock relative to mortgage companies who were more dependent on control dealers. I also present evidence for a subset of IMCs 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 post BAPCPA, dealers increased credit supply to IMCs and incentivized them to originate mortgage products with low initial mortgage payments.

Third, 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 high versus low IMC market share. Post BAPCPA, I find that counties with higher exposure to IMCs increased their mortgage originations and originated riskier types of mortgages. A 10% increase in treated mortgage company market share led to a 2.7% increase in mortgage originations during 2005-2006. The distribution of these originations significantly shifted toward balloon and adjustable rate mortgages with artificially low introductory interest rates. These were "near prime" or alternative rather than subprime mortgage products. Although these products required a higher credit score, Foote and Willen (2016) note that the structure of alternative mortgages may increase their risk of default. Consistently, I find that an increase in IMC market share drove a statistically significant increase (decrease) in the fraction of prime (subprime) originations post BAPCPA.

This paper presents evidence that the mortgages originated in response to BAPCPA contributed to the "last gasp" in the home price boom but 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 2.1% during 2005-2006. Within a five-month window around the shock, the estimated marginal default hazard rate increased from 13% prior to BAPCPA to 70% post BAPCPA. Consistently, a 10% increase in IMC market share led to a significant 3.3% decrease in home prices during 2008. I estimate that mortgages originated in response to BAPCPA accounted for an increase in total mortgage originations of 9%. However these mortgages accounted for 38% of defaults among all mortgages originated during 2005-2006. 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. These results help to explain the puzzles of why 2006 and 2007 vintage mortgage loans were of worse quality than 2001-2004 mortgage loans after controlling for borrower characteristics, why prime mortgages were responsible for the lions' share of defaults during the Financial Crisis, and why prime MBS performed worse than subprime MBS.

The results in this paper imply that the reuse of repo mortgage collateral allowed dealers to become extremely levered on their liability side post BAPCPA. Singh and Aitken (2010) show that due to the reuse of collateral, the shadow banking system was 50% more levered

than standard estimates during 2007-2009. In the Online Appendix, I discuss how repo accounting artificially lowered reported leverage ratios. The data that I collect provides evidence that, on their asset side, the most central dealers were disproportionately exposed to the IMCs due to their role as warehouse lenders. By early 2007, I observe the majority of the IMCs in my sample declare bankruptcy. The bankruptcy filings in all cases were triggered by the mortgage companies' inability to meet margin calls or other requirements stipulated on their repo credit lines. As the IMCs failed, the dealers would face sudden withdrawals of collateral funding on their asset side, triggering the type of collateral runs discussed in Infante and Vardoulakis (2021). The interplay between collateral runs on their asset side and repo runs on their liability side would allow a run in even a small segment of the repo market to have devastating effects on these dealers.

There is a legal literature (Edwards and Morrison (2005), Roe (2010), Lubben (2010), Skeel and Jackson (2012), Duffie and Skeel (2012), Morrison, Roe and Sontchi (2013)) that debates whether risky collateral backing repos should receive preferred bankruptcy status. The intention of the BAPCPA repo provision 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 preferred bankruptcy treatment for repurchase agreements was intended for collateral that maintains its price in a crisis. However, Merrill, Nadauld, Stulz and Sherlund (2014) find PLS collateral did not maintain its price in the crisis. This paper emphasizes that requiring that a collateral class maintain its price in a crisis as a prerequisite for granting preferred bankruptcy status is crucial when such status increases reuse of the collateral in the repo markets.

This paper also has implications for central banks' use of repo markets to conduct monetary policy. As discussed in the Online Appendix, in 1999, the Federal Reserve set up repo facilities to begin purchasing mortgage pass-through securities. In 2020 the Bank of Israel began purchasing corporate bonds in the repo market to increase liquidity in financial markets following COVID-19. These activities have the potential to increase demand for – and therefore reuse of – collateral, which has important implications for credit supply and financial stability.

There is an existing literature that uses the BAPCPA policy change as a natural experiment. Srinivasan (2017) presents evidence that demand for PLS collateral increased in one segment of the repo markets following BAPCPA. Bellicha (2016) and Ganduri (2016) study the impact of BAPCPA on the deterioration of mortgage warehouse loans. Chircop, Fabrizi and Parbonetti (2018) find evidence that information asymmetry increased for banks more exposed to the BAPCPA repo provision. I innovate relative to this literature by studying BAPCPA's effect on dealers' reuse of mortgage collateral in the repo markets and tracing

their resulting credit creation from the repo market to the housing market.

This paper proceeds as follows. The next section describes the institutional details and section 3 presents the data. The shock to dealer credit supply is established in section 4, section 5 presents dealer pass-through of the credit supply shock to IMCs, section 6 establishes that IMCs increased credit supply to households following BAPCPA, and section 7 concludes.

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.[1] IMCs overall make up one third of the mortgage market. 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.[2] 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 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 in the section on repo market functioning. These warehouse repurchase facilities make up 61% of IMC assets on average. I find that 29

[1] 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.

[2] 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 at minimum, 49% of all IMC mortgage lending in 2006, and 7% of all mortgage lending in the United States. Summing originations including purchases for the five 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.

warehouse lenders were funding these IMCs in the bilateral repo market.[3] 16 of the 29 were primary dealers.[4] 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.

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 assets.[5] 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.[6]

The repo market consists of two segmented markets: the **bilateral** and the **tri-party** 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 borrowed and lent. 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.[7] 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

[3]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.

[4]These dealers make up 16 of 22 primary dealers in 2005.

[5]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).

[6]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.

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

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 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.[8] This suggests that 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.[9] BAPCPA expanded the types of collateral that are protected under the safe harbor provisions of the Bankruptcy Code[10] by expanding the definition of "repurchase agreement" to include the following additional instruments: (1) mortgage loans; (2) mortgage-related securities;[11] (3) interests in mortgage-related securities or mortgage loans.[12] This expansion only affected private-label mortgage collateral. The law exempt PLS from automatic stay, 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.

[8]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 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.

[9]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.

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

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

[12]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))

Srinivasan (2017) collects data on individual repurchase contracts reported in the N-Q filings of money market mutual funds 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.

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 reuse 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 reuse 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) 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 reuse the collateral increased. The argument would go through either if dealers were able to repledge whole mortgage loans from the mortgage warehouse in the repo 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 reuse of collateral in the tri-party market however the argument would also go through if dealers increased reuse of collateral in the bilateral market following the policy change and received lower haircuts than they did prior to the policy change.

[Figure 1 about here.]

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 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 $100. This example abstracts from an interest rate charged on the repo borrowing in order to focus on overcollateralization. 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, dealers could re-sell the collateral posted by the IMCs, valued at $136 for $130.[13] 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 (the "*first round*"). 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 $176.8 of new mortgage collateral, if the same haircuts remained (the "*second round*"). Figure 2 depicts this so called first and second round of funding in (a) and (b). As long as the IMC generated enough money from fees or interest on the mortgages originated, it would have enough additional equity to fund the overcollateralization charged by the dealer. By repledging this $176.8 of mortgage collateral, 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 dealer's leverage. This would allow the dealer to leverage up the return that it received from the IMC in the form of interest rates (unpictured) on the warehouse lines of credit. In the Online Appendix, I discuss how accounting treatment of repos pre-Financial Crisis likely allowed dealers to increase their leverage by engaging in repo borrowing without increasing the leverage ratio reported to regulators.[14]

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

[14]In the Online Appendix, I discuss the accounting treatment of repos for dealers. Nomura states that since the transactions were recorded as sales, the related securities and repurchase obligations were not reflected on the accompanying consolidated balance sheets (Nomura 2005 20-F p. F-18).

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 supported by the initial $100 investment by the dealer, assuming constant haircuts, is $1 + 1.3 + 1.3^2 + ... = \sum_{i=0}^{\infty} 1.3^i$. In this way the dealer has incentive to reinvest in PLS, because each dollar invested in PLS generates more than a dollar in funding that the dealer could receive for its own account. This series diverges to infinity, so the market must impose a limit.

[FIGURE 2 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%.[15] The decline in haircuts required by dealers is consistent with the collateral 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 [16] is consistent with this narrative.

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

[16] 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)

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. The data capture credit lines reported as warehouse lines of credit, warehouse repurchase facilities, and repurchase agreements. I use these data to link independent mortgage companies to the dealers who were lending to them. After 2006Q3 seven of the IMCs filed for bankruptcy or were acquired, so that I am no longer able to pull their quarterly financial statements.[17]

3.2 Dealers

Dealer Repledgeable Collateral There is limited data on the repo markets prior to 2008 (Baklanova, Copeland and McCaughrin (2015)). To study reuse of repo collateral by the dealers funding the IMCs, I collect dealers' reported repledgeable collateral for 19 of the 29 dealers that are lending to the IMCs that I observe. These are made up of the 16 primary dealers in 2004 and 2005 as well as 3 additional 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 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 Financing Data In addition to the dealers' repledgeable collateral 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. To overcome this, I hand match the FR 2004 variables to the survey instructions given to the survey respondents

[17] 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.

in order to create a weekly time series of total dealer holdings and secured financing by collateral class.

Matching the FR 2004 variables to the survey instructions allows me to establish that prior to 2013 the FR2004 data included dealers' trading in private-label mortgage collateral in the line item *corporate securities.*[18] These data allow me to study whether primary dealers' trading in the repo markets using PLS collateral increased post BAPCPA. 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, since use of private-label mortgage collateral in repo markets was at an all-time high during 2005-2007. Indeed, 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.

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. Ideally I would observe all dealers that lend to the IMCs in my data. However, the primary dealers 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-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.

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 3 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[21] 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

[18] 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==.

[19] Infante (2019) p. 46.

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

[21] Infante (2019) p. 44

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 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 3. This decline coincides with the run in the funding markets 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. 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 3 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.[22]

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.

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

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.[23] 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 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[24] 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.[25]

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 market share 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

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

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

[25] 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).

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 amortizing, 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 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). ZHVI 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.

4 Expansion of Repledgeable Collateral: Motivating Facts and Empirical Model

4.1 Motivating Facts

To understand whether enhancing creditor rights on the mortgages underlying PLS securities increased price – consistent with a demand increase – 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 4 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 a relative increase in the price of PLS. 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. This may have been due to the Republicans gaining seats in the 2004 Senate elections. This evidence is consistent with demand for PLS increasing after BAPCPA strengthened creditor rights on the mortgages underlying the PLS securities.

[Figure 4 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 5, I plot dealers' securities out (borrowing) collateralized by agency[26] and by private-label[27] 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 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 fraction of borrowing backed by agency mortgage collateral remained relatively constant at about 22%.

After BAPCPA, in April 2005, the borrowing collateralized by PLS as a fraction of total securities out nearly doubled from about 6% to close to 12%. Its value 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. This evidence suggests that granting

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

[27] 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.

private-label mortgage collateral preferred bankruptcy treatment increased demand for it, making it easier for dealers to repledge as collateral to raise funding.

[FIGURE 5 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 pre versus post BAPCPA for agency versus private-label mortgage collateral.[28] Table 1 reports the regression results. The coefficient 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, consistent with an increase in dealers' ability to borrow against PLS. Indeed, a quote from Adrian, Burke and McAndrews (2009), at the Federal Reserve Bank of New York, states 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. [29]

[TABLE 1 about here.]

4.2 Empirical Model

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

[28] 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).

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

$Y_{i,t}$ is set equal to both the log value of securities out and the fraction of total securities out. For collateral class i at time t, $Post_t$ an indicator variable that is equal to zero prior to April 15, 2005 and 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.

[29] [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.)

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. 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.

The PLS market is split into the "Alt-A" segment and the subprime segment. The "Alt-A" mortgage originations really began after BAPCPA was passed in 2005. Therefore, 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.[30] 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.[31] 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

[30] 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.

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

assets[32], number of mortgage originations, and originated mortgages in a similar number of counties in 2004.

[Table 2 about here.]

If the conceptual framework described in the institutional details holds, 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 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' repledgeable collateral. I estimate the regression

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

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, $Post_t \times Treated\ Dealer_j$, that equals one for treated dealers in the post period. β the difference in repledgeable collateral between treated and control dealers after the shock less the difference between the two before the shock. η_j contains fixed effects for each $Dealer_j$.

The liquidity shock occurs at the dealer level so changes in repledgeable collateral of the same dealer may be correlated. Since the sample only has 19 dealers, as mentioned in the data section, I calculate my standard errors using the 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). I cluster at the dealer level. [33]

[Table 3 about here.]

[32] 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.

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

I report the results of Equation 3 in Table 3. Treated dealers significantly increased their reported repledgeable collateral by 43.2% relative to control dealers following BAPCPA. This result is consistent with treated dealers being in a better position to take advantage of the large money multiplier by repledging, at low overcollateralization rates, the warehoused or newly securitized PLS collateral that they were holding. This estimates a "turning on the faucet" effect. Treated dealers would receive a larger credit supply increase because they were holding more collateral that changed from illiquid to liquid at the time of the policy change. The sizable increase in reported repledgeable collateral is consistent with treated dealers reinvesting their increased credit supply in more PLS collateral. This is because as they increased investment in PLS by lending to IMCs – at high overcollateralization rates – dealers would receive more repledgeable collateral to report. They would also receive a first mover advantage by lending to IMCs before the haircuts charged to IMCs began decreasing. Thus the reported increase in repledgeable collateral indirectly measures dealers' increased lending to IMCs.

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

5.1 Motivating Facts

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 evidence that suggests these additional channels were also at play at the end of this section.

[Figure 6 about here.]

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 6 (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 6 (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. Following 2005Q2 the average number of dealers lending to

an IMC began to increase. By 2006Q1, the number increased to seven. In Figure 7 I present the maximum credit lines offered to an example mortgage company. Credit Suisse and Countrywide are treated dealers, and although all credit lines increased following BAPCPA, Credit Suisse and Countrywide increased their credit lines to the mortgage company by more than did the control dealers, UBS and IXIS.

[Figure 7 about here.]

5.2 Empirical Model

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. Each of these IMCs receives warehouse funding from three or more dealers. I estimate the extent to which treated dealers increase lending to an IMC 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.[34] I limit my sample to 2006Q3 since this is the last quarter that I observe all 12 IMCs in my dataset. This limits the number of dealers present in the data from 29 to 27, and the number of primary dealers from 16 to 15. 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 reuse 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. 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 identify the supply effect, it is important that I control for changes in mortgage company demand for credit.

[34] 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.

To do this, I run the difference-in-differences regression in Equation 4. 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 reuse PLS, not the IMC's demand for credit.

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

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 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 IMC specific factors, including IMC specific credit demand shocks. I include $Dealer_j$ FE in η_j to control for unobserved dealer heterogeneity that may be constant over time. 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 27 dealers between 2004Q3 and 2006Q3.[35] 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.

[35] I observe 29 dealers (16 primary dealers) lending to the IMCs between 2004Q3 and 2007Q3. However I run the within IMC across dealer specification for 2004Q3 to 2006Q3 as this is the last quarter that all IMCs remain in the sample. SocGen is only lending to New York Mortgage Trust between 2006Q4-2007Q3 and must be dropped. Nomura (a primary dealer) is only lending to New York Mortgage Trust between 2006Q3-2007Q3, and therefore has only one singleton observation in 2006Q3 that must be being dropped.

[Table 4 about here.]

In Equation 5, I run the dynamic version of Equation 4. Figure 8 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 8 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. 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. Additionally, I define dealers as treated using their securitization of PLS 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 8 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. 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.]

5.2.1 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 prior to 2005Q1. "Control IMCs" are defined as the six IMCs that receive a below median fraction of their warehouse credit lines from treated dealers prior to 2005Q1. 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 IMCs and I cluster my standard errors at the IMC level. Due to the small number of clusters, I calculate my standard errors using the 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).

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

[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.

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. 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 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. A subset of the IMCs I observe report the funding sublimits available from five dealers by mortgage type. Figure 9 plots the maximum amount of funding provided to a representative IMC for interest only, second-lien, jumbo, non-owner occupied, and 120-180 day past due loans. These were considered risky mortgage products. The typical definition for default is 90 days delinquent. The funding lines for all of these products doubled post BAPCPA, while I do not observe dealers increasing credit lines for conforming mortgage products. In the Online Appendix, I report sublimits on additional mortgage products by dealer.

[Figure 9 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. I report the value of wet funding sublimits in the Online Appendix. 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 10, 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 but they also lowered its cost of funding.

[Figure 10 about here.]

6 Mortgage Company Lending

6.1 Empirical Model

The evidence in the previous sections establishes that following BAPCPA dealers increased credit lines to the mortgage companies that they funded. Figure 9 also suggests that dealers increased funding for the riskiest mortgage products. 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 increase 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. All IMCs in the United States were likely affected by this policy change. Of the 12 IMCs that I collect data for, on average the total dealer provided warehouse credit lines equaled 61% of mortgage company total assets, making dealers their main funders. The 12 IMCs are likely to be representative of all IMCs as they capture approximately 59% of total mortgage originations as of 2006. I therefore run a parallel analysis studying the effect on mortgage characteristics as a function of all independent mortgage company market share in 2004. 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) find that warehouse repurchase facilities dominate the IMC funding model.[37] 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.

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 in the HMDA data as follows.[38]

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

Figure 11 depicts the county level market share of (treated) independent mortgage companies in the United States in 2004, the year prior to BAPCPA. The states with the highest county level market shares are California, Nevada, Florida, parts of Texas and parts of Col-

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

[38] 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.

orado. 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) and Drechsler, Savov and Schnabl (2019) show that events in 2003 led to a sudden surge in the PLS market. Consistently I find that the market share of IMCs was rising during 2000 to 2003 and there was a steep decline in all other mortgage originations in 2003, increasing the relative share of IMC (and therefore PLS) originations.

The market share of IMCs however was relatively stable throughout 2004.[39] The fact that market share of IMCs had stabilized by 2004 alleviates the concern that the results in this paper are driven by a pre-existing increasing trend in IMC expansion. In the Online Appendix, I provide evidence that percent of respondents reporting an increase in mortgage demand in the Federal Reserve's Senior Loan Officer Survey had been declining prior to BAPCPA. 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 demand for mortgages would be significantly different in ways that would vary with BAPCPA in treated counties after controlling for $state \times month$ fixed effects.

[FIGURE 11 about here.]

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

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

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. $(Treated)IMCMarketShare_{c,2004} \times \mathbb{1}_{t=T}$ is the interaction term between the county level market share of (treated) IMCs in county c in 2004, and an indicator variable for month of origination or of the characteristic

[39] I analyze the market share of IMCs, dealers, and all other originators from 2000 to 2004 using the confidential HMDA data aggregated at the month originator level. For brevity, I do not include the results in the paper, however they are available upon request.

[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.

of interest. I set the reference month to March 2005, the month prior to the passage of BAPCPA.[41] Standard errors are clustered at the county level. I report the regression results with *county* fixed effects alone and with both *county* and *state* × *month* fixed effects. The regression with both *county* and *state* × *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 effects. For all of the mortgage characteristic regressions, I study a narrow window around BAPCPA. The narrow window, fixed effects, and stable pre-period IMC market share help to ensure that the pre period is a valid counterfactual for the post period.

In my home price analysis, I study a longer window pre and post BAPCPA. This is to establish pre-treatment parallel trends in home prices for treated and control counties. The IMC market share was growing during 2003 and had stabilized by 2004. I find that there are parallel pre-treatment home prices for almost 2 years, June 2003 to March 2005, after controlling for *state* × *month* and *county* FE. This alleviates concerns that the results are driven by the rise of IMCs' presence in the mortgage market alone. If the increased presence of IMCs in the mortgage market alone drove up home prices, we should have seen significant effects on home prices in 2003 when IMCs' market shares were surging.

[FIGURE 12 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.[42] Figure 12 plots the evolution of the coefficient of interest, β_T – which studies the effect of 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 those in less exposed counties prior to the policy change. Post BAPCPA, total mortgage originations increase significantly in counties where there was a higher IMC market share in 2004. A 10% increase in treated IMC market share results in a 8.7% increase in mortgage originations on average in the

[41] 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.

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

.

[42] As a robustness test, I repeat the analysis for purchase, and refinance 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. The Online Appendix reports the results. I also repeat all analyses using CoreLogic mortgage originations and all results remain unchanged.

post period.[43] Although the dynamic plot shows a significant increase post BAPCPA, the average result in the post period is just below statistical significance. This is due to the fact that originations fall initially and then increase significantly following BAPCPA in treated counties. The initial drop is likely due to an initial increase in subprime mortgage originations before expanding into non-traditional mortgage products, which I will discuss in more detail later in the paper. In the parallel analysis, a 10% increase in total IMC market share leads to a significant 2.7% increase on average in the post period. [44]

[Table 8 about here.]

Next I study the effect of BAPCPA on non-traditional mortgage products that were near prime in borrower credit score but had riskier mortgage characteristics. I study balloon mortgages in CoreLogic which include ARM balloons. 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. Gerardi, Herkenhoff, Ohanian and Willen (2017) find that negative equity is a quantitatively important factor in default for strategic motives.

I estimate the dynamic regression in Equation 7, where the dependent variable is fraction of balloon mortgages. I calculate the fraction of balloon mortgages relative to the total number of mortgages originated in that county in a given month. Figure 13 shows that prior to BAPCPA, the fraction of balloon mortgages originated in counties with higher IMC market share was not statistically different from that in less exposed 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. I find similar results that the fraction of negative amortizing mortgages, which also have high risk of negative equity, increases.[45] I also find evidence that suggests the fraction of owner-occupied

[43] 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.

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

[45] 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

mortgage originations decreased in counties more exposed to IMCs following BAPCPA. The decreasing fraction of owner-occupied mortgages is consistent with a higher fraction of second home and investment property mortgages which were typically riskier than owner-occupied mortgages. I discuss the results for negative amortizing and owner-occupied mortgages in the Online Appendix and present them in Table 9.

[FIGURE 13 about here.]

I also 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 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 14, 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 between counties with high and low market share of 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.[46] The mortgage companies' financial reports state that their adjustable rate mortgages were pegged to the twelve-month Treasury rate. Figure 14, 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 14 about here.]

Prior to BAPCPA, counties with a higher market share of IMCs did not originate a significantly different fraction of prime or subprime mortgages. Figure 15 shows that following BAPCPA however, counties with a higher market share of 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 alternate A ("Alt-A") segment is also commonly referred to as "near

negative amortization mortgage loans. These events could **cause borrowers to default** on their mortgage loans." HomeBanc 2005 Annual Report p. 56 of 173

[46] In Table 8, I report the results from Equation 8, the regression with a single pre and post period.

prime," and it is typically characterized by borrowers with credit scores comparable 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 "Alt-A" mortgages also featured alternative products such as balloon, negative amortizing, and low introductory interest rate ARMs and were characterized as prime by CoreLogic. The results show that relative to other originators, following BAPCPA, IMCs initially increased the fraction of subprime mortgages that they originated slightly before increasing the fraction of prime mortgages they originated. This evidence suggests that the market for subprime mortgages was already saturated by 2005 and there was more room for expansion into the "Alt-A" segment.

[FIGURE 15 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:

$$Defaulted\ Loan_l = \gamma_c + \eta_{s,t} + \beta\ Post_t \times (Treated) IMCMarketShare_{c,2004} + \epsilon_l \quad (9)$$

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. For treated counties, I find a statistically significant increase in the default hazard rate of mortgages originated in the months just post BAPCPA relative to those originated in the months prior to the BAPCPA. A 10% increase in treated IMC market share significantly 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 significantly raises the default hazard rate on mortgages originated in the five months post shock by 1.4 percentage points. I report the regression results for Equation 9 in Table 8 (columns labeled HzdRt). 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 top of the credit score distribution; 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; as well as the result in Ospina and Uhlig (2018) that prime MBS performed significantly worse than subprime MBS.

To understand whether increased mortgage originations increased the demand for homes and drove up home prices, I estimate Equation 7 where the dependent variable is $\log(HomePrice_{c,t})$ over the period from June 2003 to December 2008. Figure 16, 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 lead to a significant 9.5% increase in home prices. A 10% increase in total IMC market share lead to a significant 2.1% increase in home prices.[47] This increase in home prices was followed by a steep and significant decline in home prices from January to December 2008. A 10% increase in (treated) IMC market share lead to a significant (15.9%) 3.3% decrease in home prices during this period.

[Figure 16 about here.]

6.2 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. 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 2.4% additional mortgages were created in response to BAPCPA.[48] Following this same calculation using the market share of all IMCs and the regression results that assume all IMCs receive a credit supply shock due to BAPCPA, I calculate that BAPCPA was responsible for a 9.1% increase in

[47] 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 8 reports the results of the regression.

[48] 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.

mortgage originations.[49]

I utilize my estimate of the mortgage default hazard rate reported in Table 8 to estimate the fraction of these mortgages that would default. The default hazard rate implies that each additional loan originated by the six most treated IMCs in response to BAPCPA defaulted.[50] Applying this to the increase in mortgage originations, BAPCPA accounts for 14% of defaults among all loans originated during 2005 and 2006. Under the assumption that all IMCs are exposed to the policy change, the default hazard rate in a county increases by 14 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 70%. Applying the marginal default hazard rates to the increase in mortgage originations, BAPCPA accounts for 38% of defaults among all loans originated between 2005 and 2006. I describe these calculations in the Online Appendix.

7 Conclusion

This paper provides three main contributions. First, it establishes that improved creditor rights increase the reuse of collateral in the repo markets. It then establishes that when overcollateralization requirements differ at each leg of the chain of reuse, increased reuse of collateral functions like a money multiplier, creating a positive credit supply shock. Finally, this paper examines the real effects of the credit supply shock caused by increased reuse of private-label mortgage collateral.

The results suggest that BAPCPA increased credit supply for private-label mortgage collateral by generating a money multiplier effect. In response, the results suggest that dealers increased funding for alternative mortgage products that lowered near term mortgage payments at the peak of the housing boom when conforming mortgages would be very expensive. These products however would increase vulnerability to home prices and interest rate changes. The results suggest that the credit supply increase drove up the price of homes in treated counties, which likely masked the fragility of the mortgages. The majority of the IMCs that I observe declared bankruptcy in 2007. Their bankruptcies were triggered by failure to meet requirements on their repo credit lines. Their exit would manifest as collateral runs on their dealer funders. This would create a pronounced contraction of credit, precisely in the areas with heavy use of the mortgage products most vulnerable to home price declines. The contraction in credit would increase defaults and amplify the declines. The evidence

[49] 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 IMCs is calculated using the HMDA data which does not account for mortgage purchases from correspondent lenders.

[50] These are the IMCs most closely linked to the treated dealers.

suggests that BAPCPA both increased the overall systemic risk of the repo markets and amplified the effects of the Financial Crisis.

In the Online Appendix, I present a natural extension of the Gertler and Kiyotaki (2015) model that features anticipated bank runs. In the model, I shock banks' operational advantage consistent with dealers' increased ability to reuse collateral. I find that relative to the baseline model, dealers increase their leverage and the amount of capital that they operate. This amplifies capital's price increase in a boom and its price decline in a bust. It also increases the probability of a bank run in every state.

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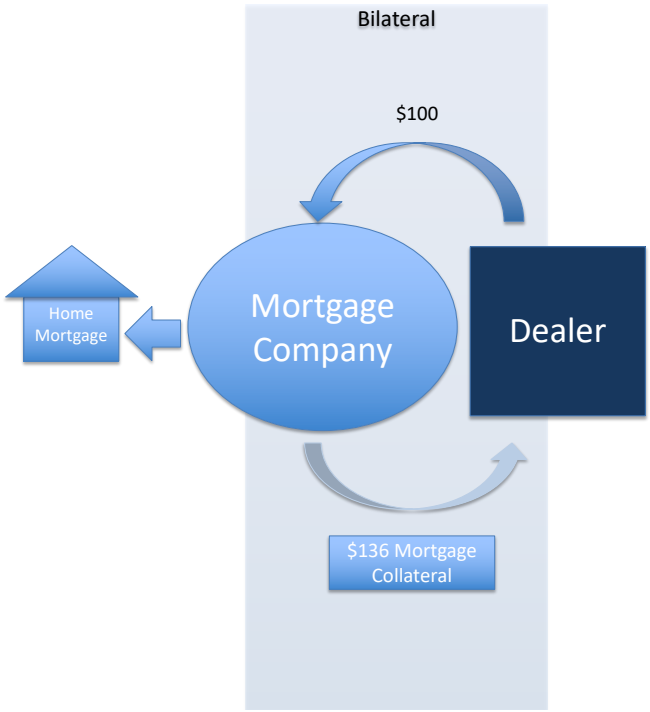
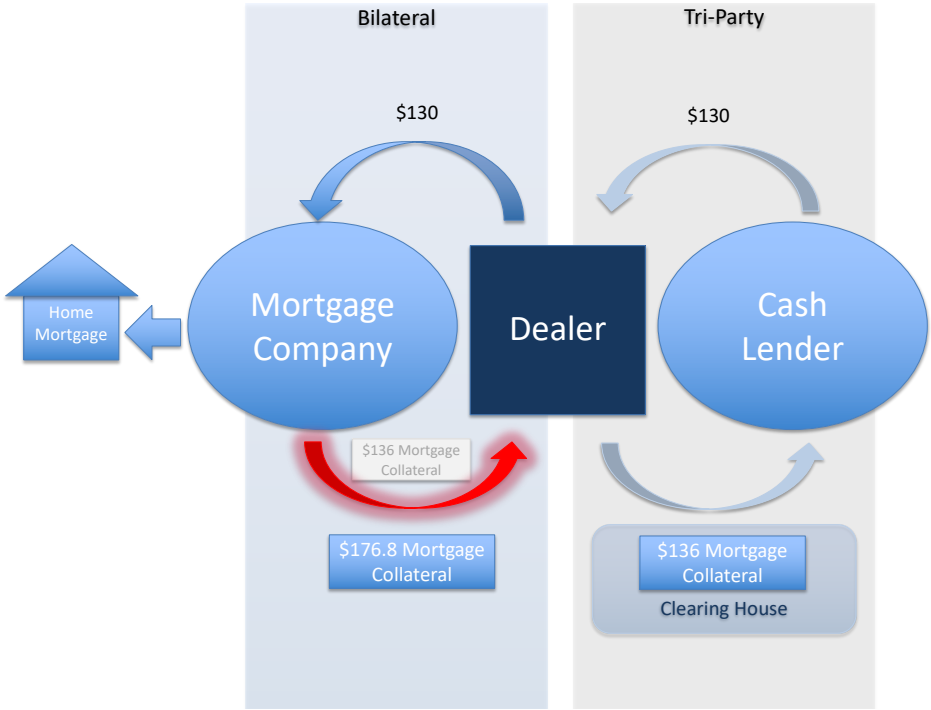
FIGURE 1: REPO MARKETS BEFORE AND AFTER BAPCPA 2005



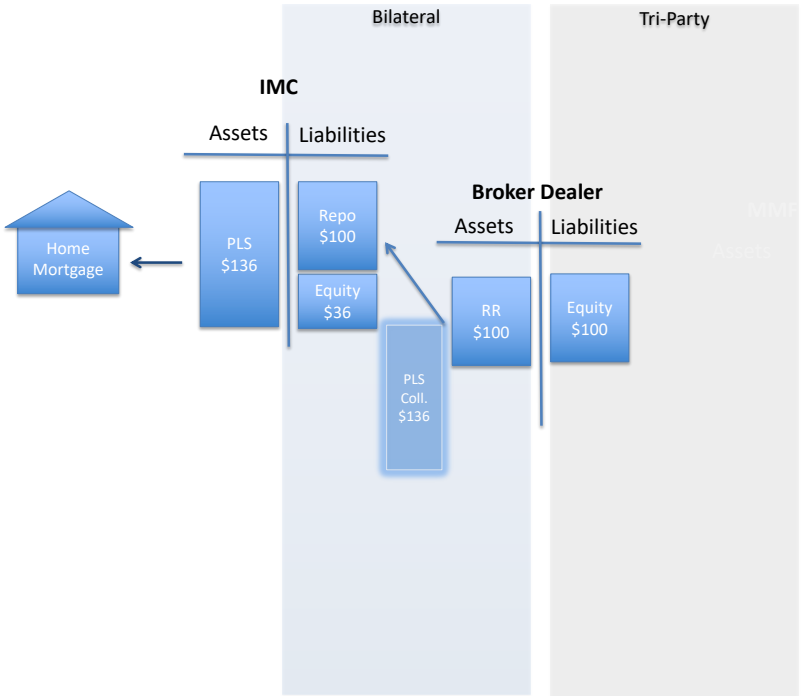
(a) Repo markets before BAPCPA



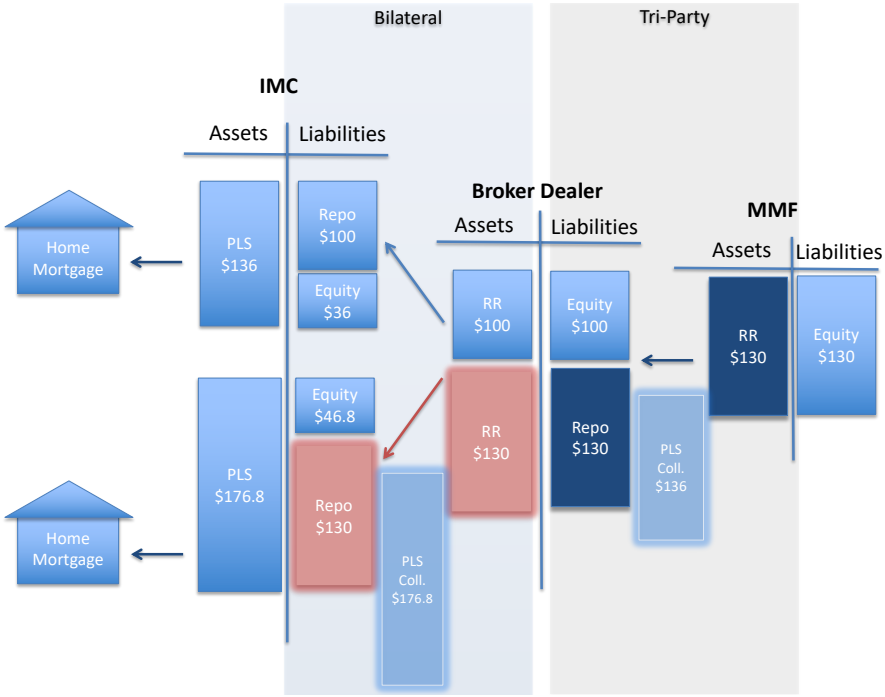
(b) Repo markets after BAPCPA

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 "first round" of lending from the dealer to the IMC before BAPCPA and Figure (b) depicts the proposed "second round" of lending enabled by BAPCPA.

FIGURE 2: REPO MONEY MULTIPLIER



(a) Repo markets before BAPCPA



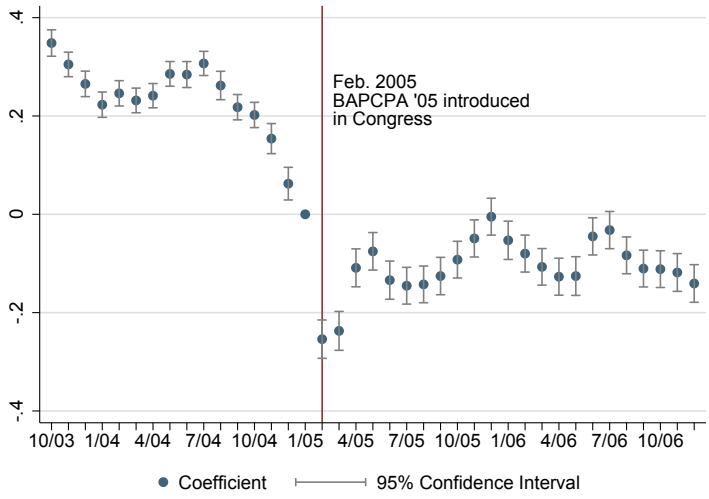
(b) Repo markets after BAPCPA

Notes: Figure (a) depicts the "first round" of dealer lending to an IMC. Figure (b) depicts funding after both a "first round" and "second round" have taken place. The figure abstracts from interest rates charged on repo agreements in order to focus on the money multiplier effect generated by different overcollateralization amounts charged to the IMC and to the dealer. "PLS Coll." is private-label mortgage collateral that is posted to collateralize a repo agreement. It is not reported on the balance sheet of the dealers.

Figure 3: Dealer Net Borrowing Using Private-Label Mortgage Collateral

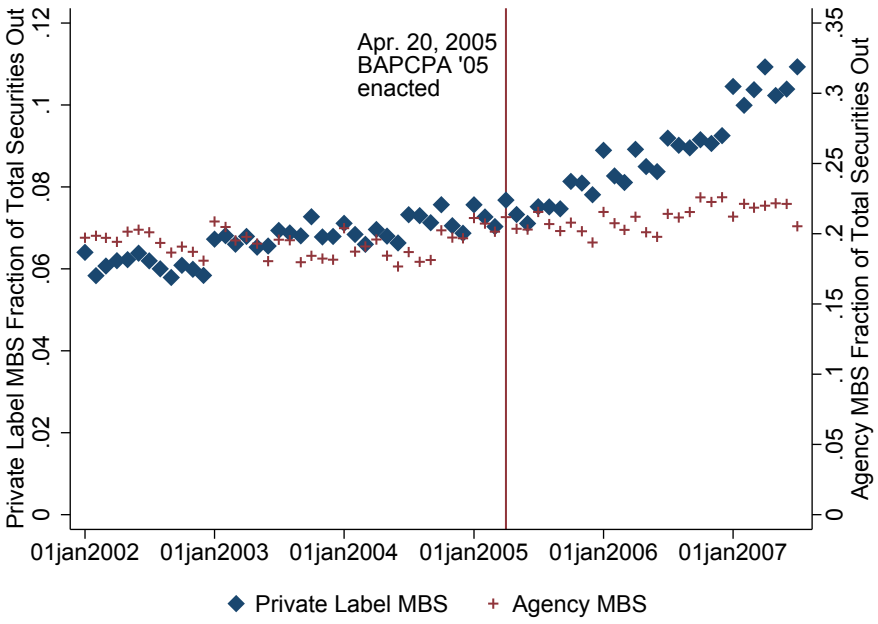
Notes: Figure plots the weekly time series of dealer net borrowing backed by private-label mortgage collateral, calculated by secured borrowing (securities out) minus dealer secured lending (securities in) in the collateral class corporate securities reported in the FR 2004. In subsection 3.2 and in the Online Appendix, I discuss the lower bound estimate of the percent that PLS collateral made up of corporate securities. Securities out includes all dealer repo and securities lending transactions. Securities in include all reverse repo and securities borrowing transactions.

Figure 4: Private-Label vs. Agency MBS Yields



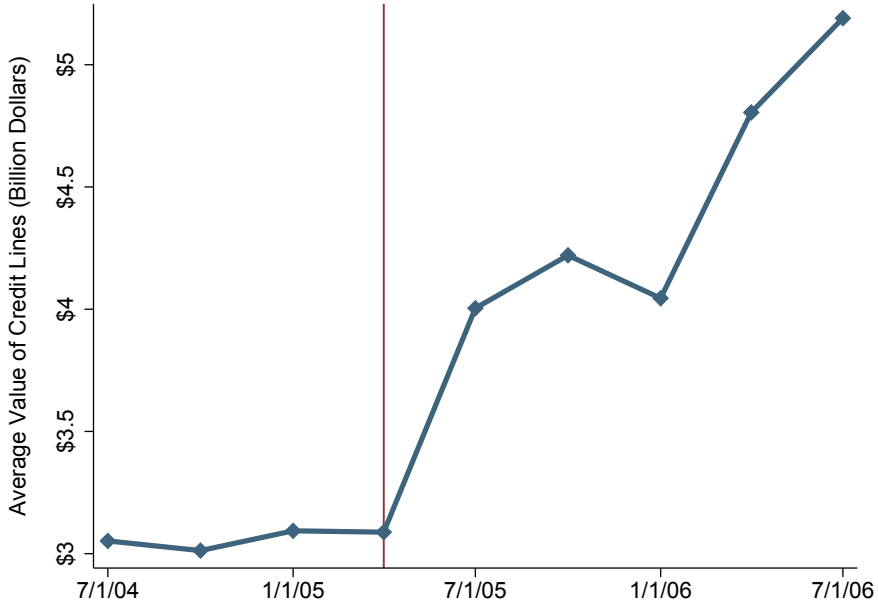
Notes: Figure plots the dynamic response of private-label MBS relative to agency MBS yields pre vs. post the introduction of BAPCPA 2005 in Congress on February 1, 2005. I estimate Equation 1. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts the indicator for PLS with an indicator for each month pre and post shock. The results indicate the yield on the PLS index dropped relative to those on the agency MBS index following BAPCPA. This is consistent with a differential increase in the price of the PLS index in February 2005 when BAPCPA was introduced in Congress.

FIGURE 5: DEALER BORROWING BACKED BY PRIVATE LABEL VS. AGENCY MORTGAGE COLLATERAL

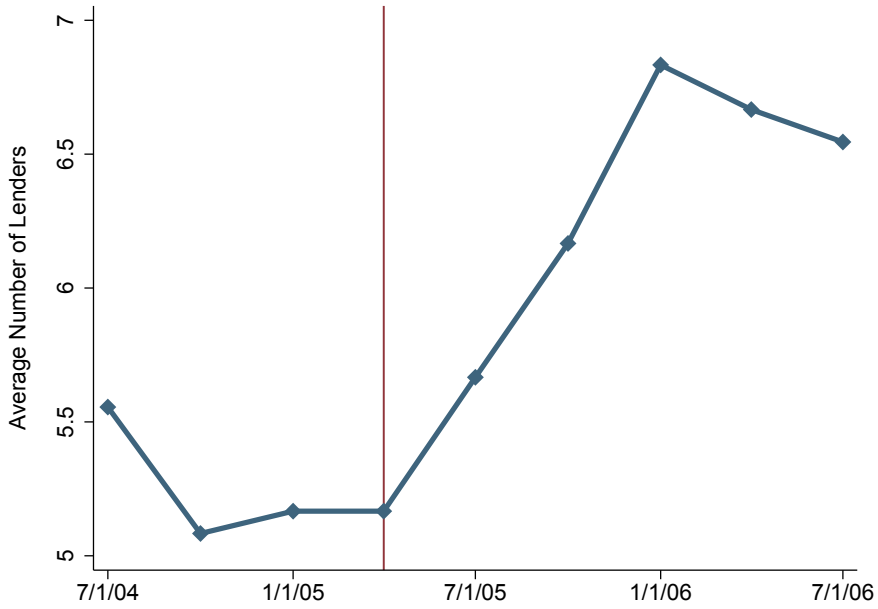


Notes: Figure plots the fraction of total primary dealer securities out that was made up of private-label MBS versus agency MBS pre and post BAPCPA. The variable corporate securities in the FR2004 proxies for private-label MBS. Agency MBS is comprised of Federal Agency and GSE MBS in the FR 2004 data. Directly after BAPCPA, private-label MBS as a fraction of securities began to increase significantly relative to agency MBS. The evidence is consistent with dealers increasing their use of PLS to borrow funds following BAPCPA.

FIGURE 6: AVERAGE CREDIT LINES TO MORTGAGE COMPANIES



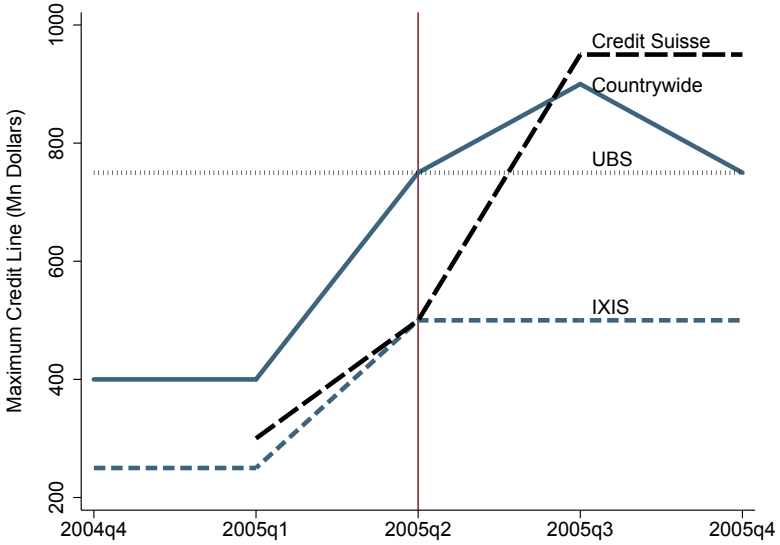
(a) Average Total Value of Credit Lines Available per Mortgage Company



(b) Average Number of Credit Lenders per Mortgage Company

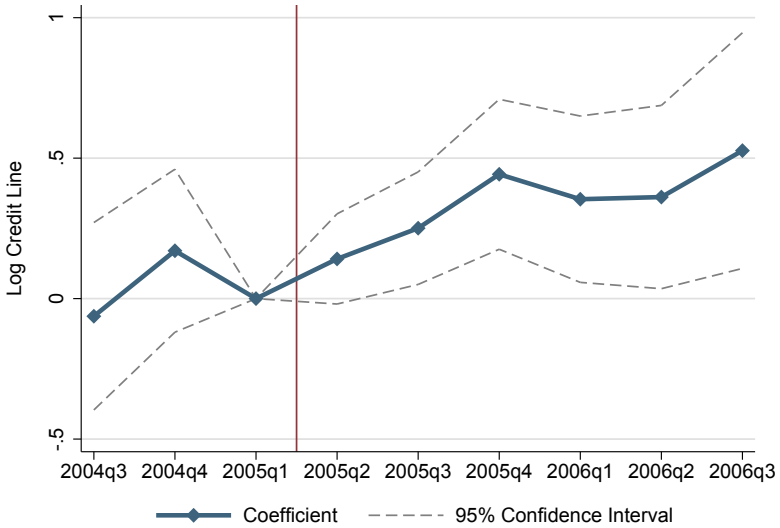
Notes: Figures plot the average number of dealers lending to the independent mortgage companies (IMCs) in my sample pre and post BAPCPA and average total value of credit lines available to an IMC. Post BAPCPA, the average number of dealers lending to an IMC and the average total credit extended to an IMC began to increase. This data is compiled 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 7: Maximum Credit Lines to an Example Mortgage Company



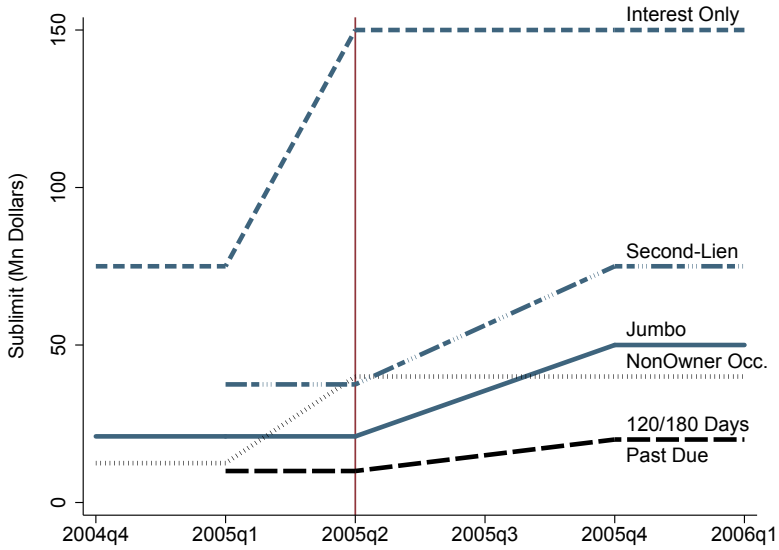
Notes: The figure plots the maximum credit line values extended to an example mortgage company by dealers pre and post BAPCPA. Credit Suisse and Countrywide are treated dealers. Although all credit lines increased following BAPCPA, Credit Suisse and Countrywide increased their credit lines to the mortgage company by more than did the control dealers, UBS and IXIS

Figure 8: Effect of Dealer Treatment on Credit Lines to Independent Mortgage Companies (IMC)



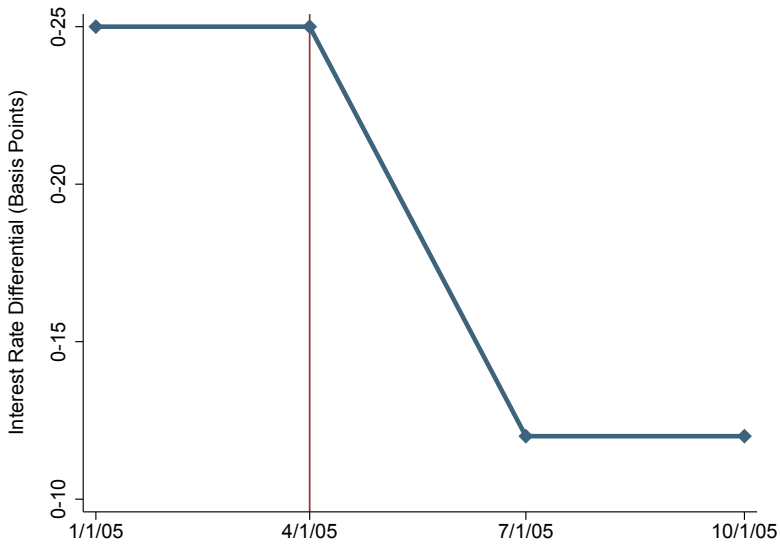
Notes: Figure plots the dynamic response of treated relative to untreated dealer funding within a given IMC pre and post BAPCPA. I estimate Equation 5. I plot the coefficient of interest, β_T. It is the coefficient on the indicator variable that interacts dealer treatment with an indicator for each quarter pre and post shock. 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 9: Maximum Credit Lines to an Example Mortgage Company



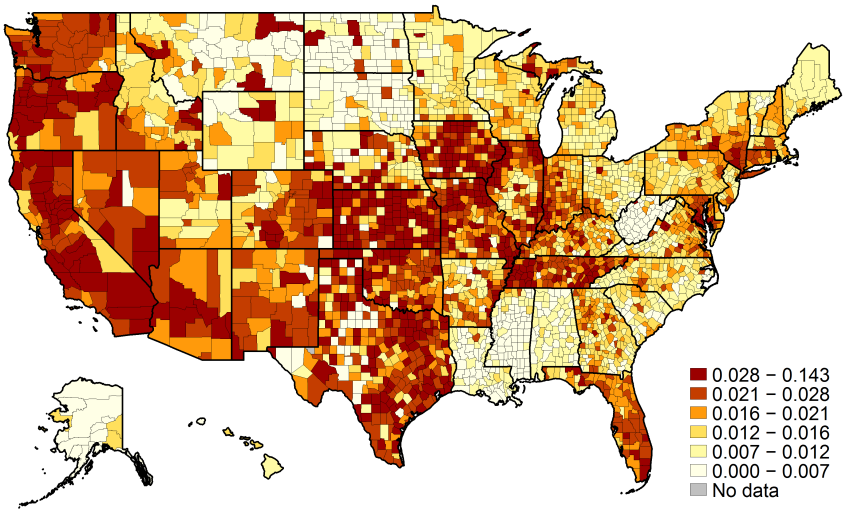
Notes: The figure plots the sublimit of funding available to fund certain mortgage products. The dealers would specify the maximum amount of funding per credit line available to fund certain mortgage products. The figure suggests that following BAPCPA dealers increased funding for riskier mortgage products.

Figure 10: Interest Rate Differential between Secured and Unsecured Credit

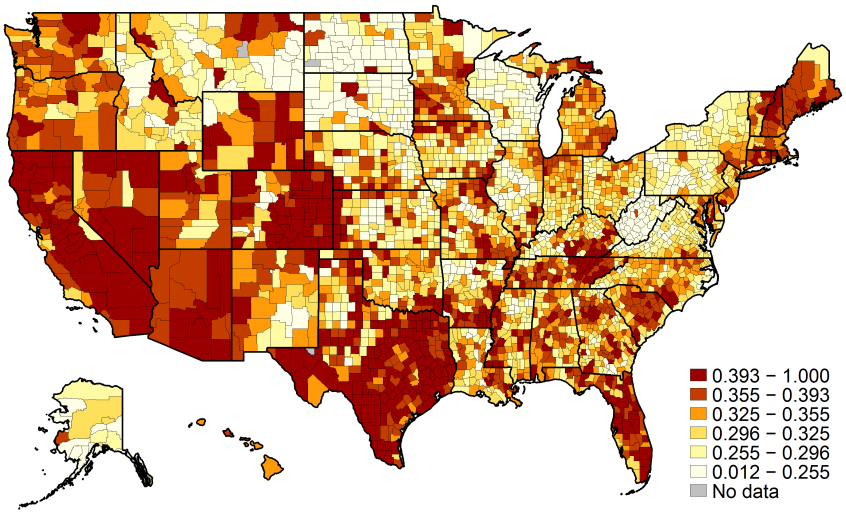


Notes: Figure plots the interest rate differential between credit lines backed by "wet" vs. "dry" collateral for an example mortgage company. Dry funding is secured by collateral that has already been created by the IMC, and requires that the loan documents be transferred to the dealer. Conversely, wet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

FIGURE 11: INDEPENDENT MORTGAGE COMPANY (IMC) MARKET SHARE



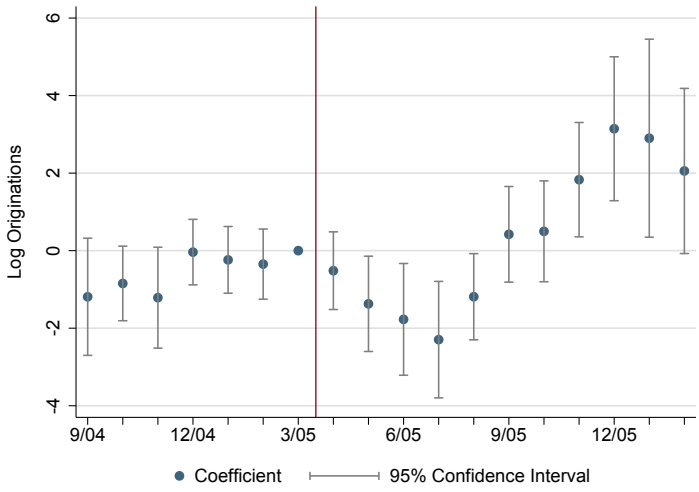
(a) Six Treated IMCs



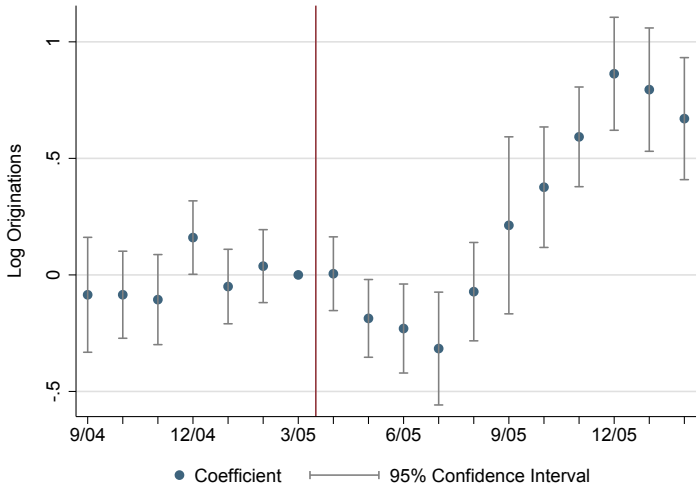
(b) All IMCs

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. The market shares are calculated using the 2004 HMDA data.

Figure 12: IMC County Market Share Effect on Total Mortgage Originations



(a) Six Treated IMCs

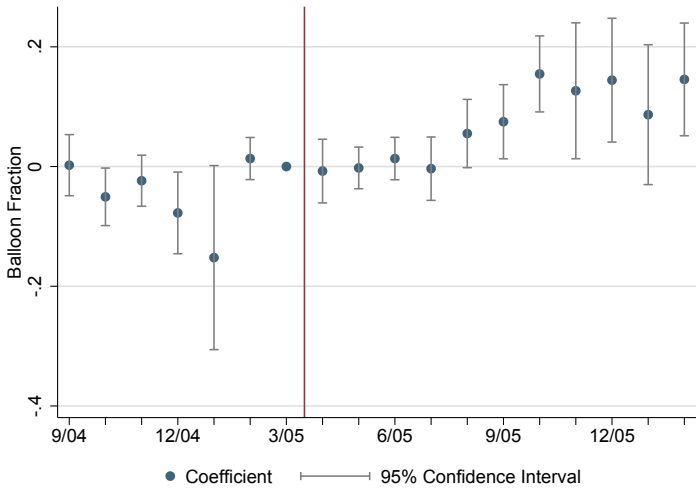


(b) All IMCs

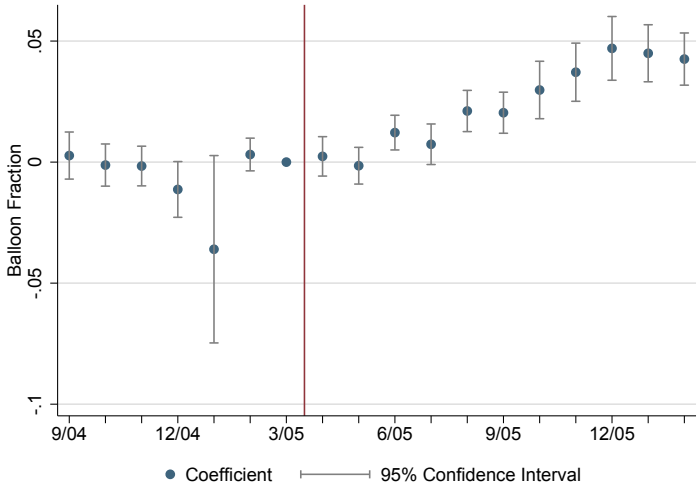
Notes: Figure plots the dynamic response of total mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I estimate Equation 7. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts $(Treated)IMCMarketShare_{c,2004}$ with an indicator for each month pre and post the shock. I use the public HMDA data to compute the 2004 county level IMC market share and the county month HMDA data to study originations.[a] The figure indicates that following BAPCPA counties more exposed to policy change significantly increased the number of mortgages that they originated relative to less exposed counties.

[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 13: IMC COUNTY MARKET SHARE EFFECT ON FRACTION OF BALLOON ORIGINATIONS



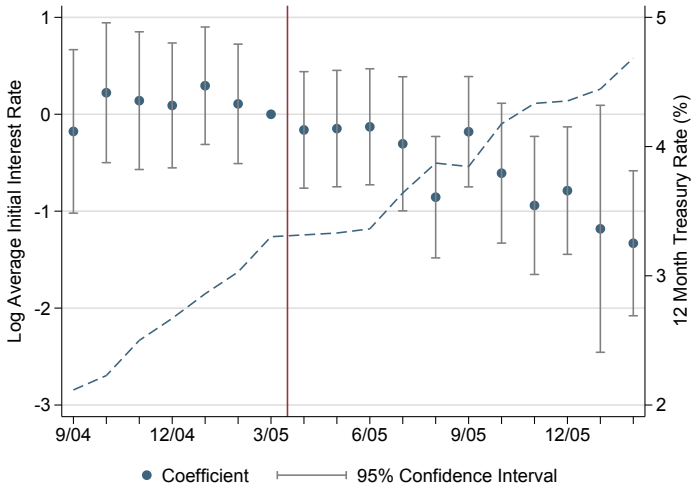
(a) Six Treated IMCs



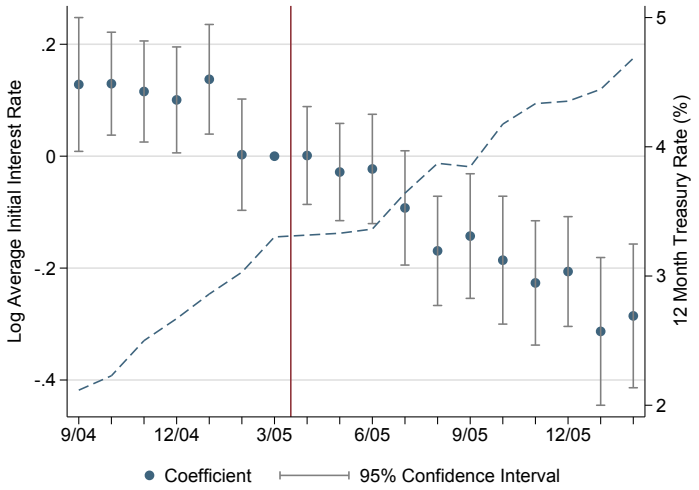
(b) All IMCs

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 estimate Equation 7. 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 use the Public HMDA data to compute the 2004 county level IMC market share and the CoreLogic origination data to study mortgage characteristics. The figure indicates that following BAPCPA counties more exposed to policy change significantly increased the fraction of balloon mortgages that they originated relative to less exposed counties.

FIGURE 14: RESPONSE OF INITIAL INTEREST RATES ON ADJUSTABLE RATE MORTGAGES



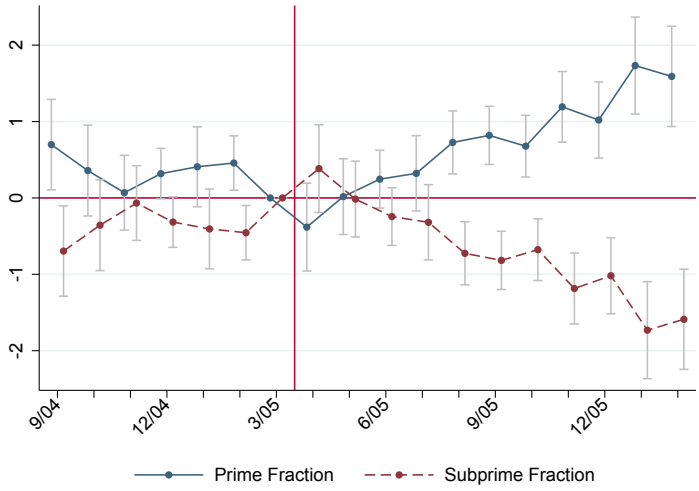
(a) Six Treated IMCs



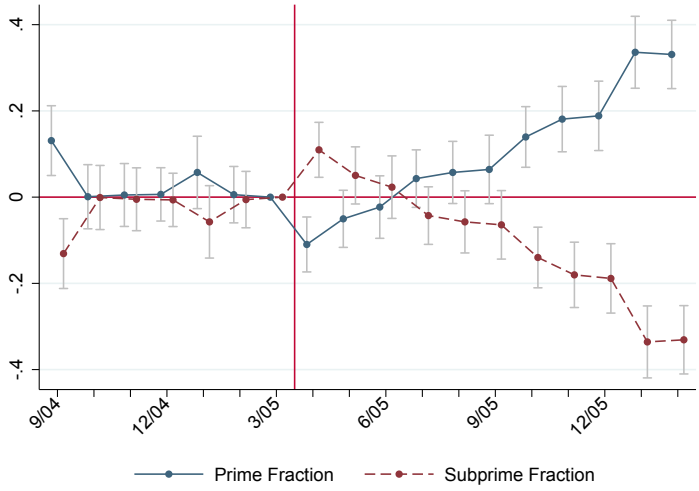
(b) All IMCs

Notes: Figures plot the dynamic response of county level average initial interest rates on adjustable rate mortgages (ARM) as a function of county level market share of independent mortgage companies (IMCs) in 2004. I estimate Equation 7. 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 use the Public HMDA data to compute the 2004 county level IMC market share and the CoreLogic origination data to study mortgage characteristics. The figure indicates that following BAPCPA counties more exposed to policy change significantly decreased the initial interest rate on their ARMs relative to less exposed counties. ARMs were pegged to the 12 month Treasury rate which was increasing over this time.

FIGURE 15: IMC COUNTY MARKET SHARE EFFECT ON PRIME/SUBPRIME FRACTION



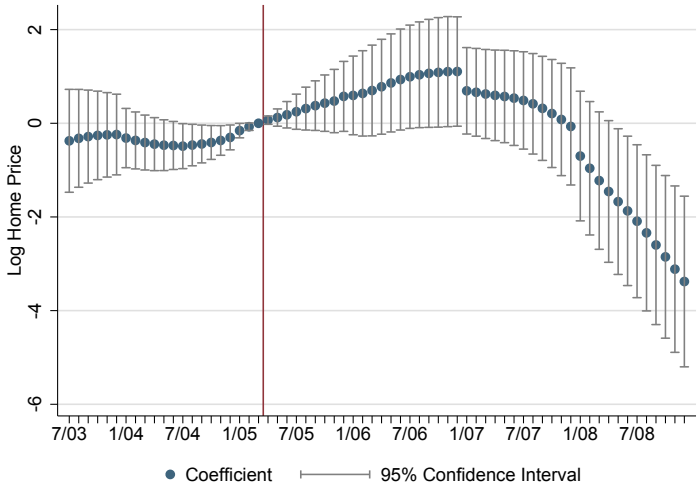
(a) All IMCs



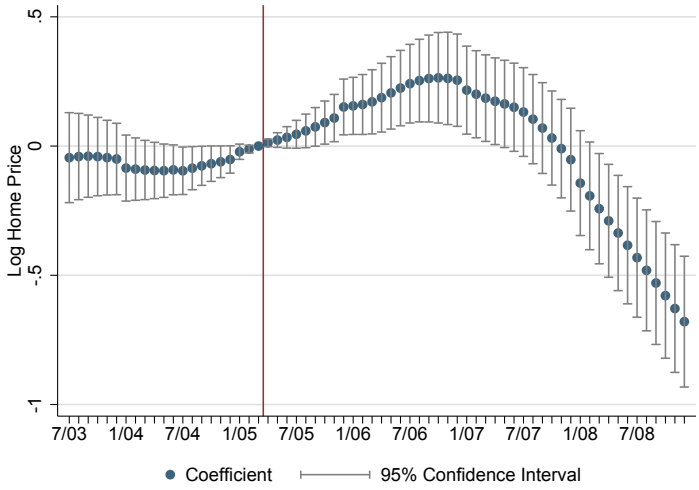
(b) All IMCs

Notes: Figures plot the dynamic response of the fraction of prime and subprime mortgage originations as a function of county level market share of independent mortgage companies (IMCs) in 2004. I estimate Equation 7. 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 use the Public HMDA data to compute the 2004 county level IMC market share and the CoreLogic origination data to study mortgage characteristics. The figure indicates that, relative to less exposed counties, following BAPCPA counties more exposed to policy change significantly decreased the fraction of subprime mortgages that they originated and increased the fraction of originations recorded as prime.

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 as a function of county level market share of independent mortgage companies. I estimate Equation 7. 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 use the Public HMDA data to compute the 2004 county level IMC market share and the Zillow ZHVI data to study home prices. The figures indicate that, relative to less exposed counties, following BAPCPA counties more exposed to policy change significantly increased home prices during 2005-2006 and significantly decreased home prices during 2007-2008.

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)
PLS	-0.126***	-1.063***
	(0.001)	(0.020)
Post × PLS	0.004**	0.186***
	(0.002)	(0.027)
r2	0.9788	0.9172
N	582	582

Notes: Table reports the results from Equation 2. Regression is run from January 1, 2002 through July 31, 2007, where April 15, 2005 and after is considered the post period. The $Post \times PLS$ suggests that dealers increased their use of PLS to borrow relative to agency mortgage collateral in the repo markets. The analysis utilizes the FR2004 data.

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 is the total value of subprime residential mortgage-backed security deals underwritten by a dealer in 2004, scaled by total assets of the dealer. 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. Origination and county statistics are generated using HMDA data. There are 29 (27) dealers in the reported repledgeable collateral (within IMC, across dealer) analysis. 7 (5) of these dealers' balance sheet data I am not able to collect and I do not observe their mortgage originations in the HMDA data. These dealers all underwrote $0 of subprime residential mortgage-backed security deals in 2004.

[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 Col.)
Post × Treated Dealer	0.432*** (0.126)
DealerFE	Yes
r2	0.9483
N	109

Notes: Table reports the response of treated dealers' reported repledgeable collateral relative to control dealers pre vs. post BAPCPA. I estimate the regression in Equation 3. 19 dealers (the 2004/2005 primary dealers and 3 additional dealers) report repledgeable collateral in their financial reports. The results indicate that, relative to control dealers, treated dealers significantly increased their reported holding of repledgeable collateral following BAPCPA.

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 control dealer funding within a given IMC pre versus post BAPCPA. I estimate Equation 4. I observe 27 dealers lending to the 12 IMCs in my sample. The results are consistent with treated dealers significantly increasing their lending to a given mortgage company post BAPCPA, relative to control dealers lending to the same mortgage company in the same quarter.

Table 5: Robustness: Within Mortgage Company Across Dealer Analysis (Primary Dealers 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 control dealer funding within a given IMC pre versus post BAPCPA. I estimate Equation 4. I estimate the regression for only the 15 primary dealers lending the IMCs in my sample during 2004Q3-2006Q3. There are 7 treated and 8 control primary dealers. The results are consistent with those using the entire sample of dealers lending to the mortgage companies. Treated dealers significantly increase their lending to a given mortgage company post BAPCPA, relative to control dealers lending to the same mortgage company in the same quarter.

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: Table presents descriptive statistics for independent mortgage companies (IMCs) collected from quarterly filings and HMDA data. IMCs with an above median fraction of their total credit lines from treated dealers in 2005Q1, the quarter before BAPCPA was passed, are defined to be treated (≥ 0.428). Total assets reports the total value of book assets in 2004Q4 for each IMC. Origination and county statistics are generated using HMDA data. There are 12 IMCs in my dataset.

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 total value value of credit lines received pre versus post BAPCPA as function of whether or not the mortgage company was treated. I estimate Equation 6. Treated dealers are those who receive an above median fraction of their credit lines from treated dealers ($\geq$ 0.428) in 2005Q1, the quarter before BAPCPA was passed. The result suggests that treated IMCs receive a significant increase in total credit supplied relative to control IMCs post BAPCPA.

Table 8: IMC County Market Share Effect on Mortgage Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	log(Orig)		BalloonFrac		log(IntlIntRt)		HzdRt		log(hpBoom)		log(hpBust)	
	Panel A: Treated IMCs Affected											
$Post \times TrtIMCMktShr_{c,04}$	5.533***	0.870	0.095***	0.113***	2.497***	-0.698***	1.887***	1.117***	3.591***	0.953**	0.689	-1.589**
	(0.291)	(0.694)	(0.009)	(0.027)	(0.154)	(0.268)	(0.383)	(0.275)	(0.527)	(0.478)	(0.799)	(0.712)
CountyFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
r2	0.9635	0.9946	0.1555	0.5191	0.8456	0.9473	0.0401	0.0448	0.9771	0.9956	0.9699	0.9918
N	8728	8572	9000	8874	9000	8874	355154	355134	19232	18929	15831	15628
	Panel B: All IMCs Affected											
$Post \times IMCMktShr_{c,04}$	0.375***	0.268***	0.005***	0.030***	0.175***	-0.239***	0.331***	0.141***	0.443***	0.209**	-0.333***	-0.329***
	(0.013)	(0.080)	(0.001)	(0.004)	(0.006)	(0.033)	(0.058)	(0.044)	(0.094)	(0.082)	(0.106)	(0.114)
CountyFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
r2	0.9642	0.9947	0.1507	0.5239	0.8543	0.9482	0.0402	0.0447	0.9768	0.9957	0.9702	0.9919
N	8728	8572	9000	8874	9000	8874	355154	355134	19232	18929	15831	15628

Notes: Table reports the response of housing market characteristics in a given county as a function of the 2004 market share of independent mortgage companies (IMCs) in that county. I run the regression

$$Y_{c,t\{l\}} = \gamma_c + \eta_{s,t} + \beta\ Post_t \times (Trt)IMCMktShr_{c,04} + \epsilon_{c,t\{l\}}$$

In county, c at month t. All dependent variables except the default hazard rate are measured at the county, month level. The default hazard rate (Y_l) regression is estimated at the loan level. Y_l is calculated as an indicator variable equal to one if the loan ever defaults and zero otherwise. The specification measures the fraction of loans originated in a given county 5 months prior to April 2005 that ever defaulted and compares it to the fraction of loans originated just post April 2005 that ever default as a function of the 2004 market share of (treated) independent mortgage companies (IMCs). 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] I use CoreLogic LLMA data to study mortgage characteristics and Zillow's ZHVI to study home prices.

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

Appendix for Online Publication

A Model

This model is based on Gertler and Kiyotaki (2015). I adapt the model to utilize a single family assumption in order to simplify the exposition of consumption in the economy. I study the baseline model relative to a model that increases banks' operational efficiency. I take the stance that BAPCPA increased dealers' operational efficiency by increasing their ability to reuse private-label mortgage collateral in the repo market.

A.1 Setup

Time is discrete, infinite, and indexed by t. There are two types of agents, bankers (b) and households (h). There is a unit measure of each type. Bankers live in the same family as households. Each period, there are two possible states of the world: a bank run state and a no bank run state. Bank runs are anticipated.

There are two goods: capital, the durable good, and a consumption good which is non-durable. Let K_t^b and K_t^h denote the aggregate capital of banks and households respectively at time t. The model abstracts from capital accumulation so there is a fixed supply of capital each period and it does not depreciate:

$$K_t^b + K_t^h = 1 \tag{10}$$

Each banker has an i.i.d. probability $\sigma \in (0, 1)$ of surviving until the next period and a probability $1 - \sigma$ of exiting at the end of the current period. Each period, a measure $1 - \sigma$ of bankers are born and endowed with $w^b > 0$ units of the consumption good.

The banks correspond to the dealers studied in this paper while the households correspond to the IMCs. In the bank run state, all of the households run on the entire banking sector. I will focus on the case where if a bank run materializes, the banks do not have sufficient assets to cover their liabilities. This means that the households will receive a fraction of their original deposits and the price of capital during the bank run will plummet since bankers sell their capital at fire sale prices.

Bankers and households produce the consumption good according to production functions f^B and f^H respectively. Let Z denote constant economy-wide productivity. The bankers are the efficient users of capital. They only require capital good inputs in order to produce units of the consumption good. Bankers produce the consumption good according to the production function

$$f^B(K_t^b) = ZK_t^b \tag{11}$$

Households produce the consumption good according to the production function

$$f^H(K_t^h) = ZK_t^h - \frac{\alpha}{2}(K_t)^2 \tag{12}$$

they incur a cost, $\frac{\alpha}{2}(K_t)^2$, in consumption units when they operate the capital. Therefore α can be viewed as the bankers' relative advantage in operational efficiency.

When households sell capital to the banks, the amount of consumption goods in the economy increases since the banks are more efficient at producing capital. Therefore, in the absence of financial frictions, banks would intermediate all of the capital stock. However, when the banks are constrained in their ability to borrow funds to purchase the capital, the households will directly hold some of the capital.

Lending to the banks is risky because there is a probability of an economy wide bank run each period. I study the economy in which the probability of a bank run depends on the amount of leverage that the banks have. The probability of a bank run impacts the price of both capital and deposits. When a bank run occurs, banks are liquidated. Due to borrowing constraints, once banks have zero net worth, they will never be able to take deposits again.

A.2 Households

The model shuts down any frictions between actual households and the IMCs so that the households in the model correspond to the IMCs. The households both consume and save. The households can save either by lending funds to the competitive financial institutions, the banks, or by holding the capital directly. Every period, households receive a return on their asset holdings as well as an endowment of the consumption good equal to ZW^h.

Deposits held by the banks are one period bonds. These deposits correspond to the overcollateralization pledged by the IMCs to the dealers. In the no bank run state, these bonds yield a non-contingent rate of return $\bar{R}_t$. The rate of return earned on deposits corresponds to the interest rate discount that IMCs receive on their repo credit lines in return for allowing the dealer to repledge the collateral that they post. In the bank run state, the deposits receive only a fraction x_{t+1} of the promised return. Where x_{t+1} is the total liquidation value of bank asset per unit of promised deposit. The household's return on deposits can be expressed as:

$$R_t = \begin{cases} \bar{R}_t & \text{if no bank run,} \\ x_{t+1}\bar{R}_t & \text{if bank run occurs} \end{cases} \tag{13}$$

where $0 \leq x_{t+1} < 1$. In the run state, all depositor's receive the same pro rata share of liquidated assets. Unlike in Diamond and Dybvig, there is no sequential service constraint on depositor contract that links payoffs in the run state to depositors place in line.

Household utility U_t is given by:

$$U_t = E_t \left(\sum_{i=0}^{\infty} \beta^i \ln C_{t+i}^h \right) \tag{14}$$

where C_t^h is household consumption, $0 < \beta < 1$. Suppose that p_t is the probability that households assign to an economy wide bank run occurring at time $t+1$. (A discussion of how p_t is determined will follow.) Since the households anticipate that a bank run will occur with positive probability, the rate of return promised on deposits, R_{t+1}, must satisfy the household's first order condition for deposits:

$$1 = \bar{R}_{t+1} E_t \left[(1 - p_t) \Lambda_{t,t+1} + p_t \Lambda_{t,t+1}^* x_{t+1} \right] \tag{15}$$

where

$$\Lambda_{t,t+1} = \beta \frac{C_t^h}{C_{t+1}^h} \tag{16}$$

$$\Lambda_{t,t+1}^* = \beta \frac{C_t^h}{C_{t+1}^{h^*}} \tag{17}$$

is the household's intertemporal marginal rate of substitution conditional on a bank run at $t+1$. The depositor recovery rate, x_{t+1}, in the event of a run depends on the rate of return promised on deposits R_{t+1}. The rate of return is equal to 1 if no bank run occurs. If a bank run occurs, the rate of return is equal to the value of the capital bankers own relative to the value of deposits that they owe.

$$x_{t+1} = \min \left[1, \frac{(Q_{t+1}^* + Z_{t+1}) k_t^b}{R_{t+1} d_t} \right] \tag{18}$$

The probability of a bank run occurring tomorrow, p_t, is specified as a function of bank leverage. This reduced form function is in the spirit of the global games approach developed by Morris and Shin (1998) and applied to banks by Goldstein and Pauzner (2005). The probability p_t is a "sunspot" bank run outcome that depends in a natural way on the fundamental x_{t+1}. The probability that depositors assign to a bank run occurring in the following

period is a decreasing function of the recovery rate:

$$p_t = 1 - E_t(x_{t+1}) \tag{19}$$

Higher leverage chosen by banks today will decrease the recovery rate tomorrow, which increases the probability of a bank run occurring tomorrow. This increases R_{t+1}, the rate of return households require to hold assets from today until tomorrow. Therefore when the bank chooses leverage to maximize its value function, the cost of deposits owed at $t+1$, R_{t+1}, will affect the bank's decision on how much leverage to take on. So banks internalize the impact that their choice of leverage has on p_t indirectly through its affect on R_{t+1}.

A.3 Banks

Banks in this paper correspond to lightly regulated dealers borrowing funds in the unsecured repo market. These banks hold long-term securities by providing repo lines of credit to the IMCs for 30-60 days on average, and rolled over as needed. They issue short-term debt by borrowing in the repo market for 3 day terms on average, and rolled over as needed. This maturity mismatch makes them vulnerable to bank runs. Bankers fund their capital investments by issuing deposits to households as well as by investing their own net worth, n_t. The deposits made by the households, or IMCs, take the form of the overcollateralization of warehoused mortgage loans posted with the dealers.

Bankers in the model may be constrained in their ability to borrow deposits and will attempt to save their way out of the financial constraints by accumulating their retained earnings. To limit this possibility that bankers will try to move towards one hundred percent equity financing, bankers have a finite expected lifetime and each banker has an i.i.d. probability σ of surviving until the next period and a probability $1-\sigma$ of exiting at the end of the current period. The expected lifetime of a banker is then $\frac{1}{1-\sigma}$.

Each period, new bankers enter with an endowment w^b which is received only in their first period of life. The number of entering bankers is equal to the number who exit, keeping the total number of bankers constant. Bankers are risk neutral and rebate their entire net worth to the households in the period that they exit so that the expected utility of a continuing banker at the end of period t is given by:

$$V_t = E_t \left[\sum_{i=1}^{\infty} \beta^i (1-\sigma)\sigma^{i-1} \Pi_{t+i} n_{t+i} \right] \tag{20}$$

where $(1-\sigma)\sigma^{i-1}$ is the probability that a banker exits at date $t+i$, n_{t+i} is the banker's

terminal net worth upon exiting in period $t+i$, and Π_{t+i} is the household's marginal utility of consumption in period $t+i$. The bankers take the household's marginal utility of consumption a given. I will discuss the household's marginal utility of consumption in the aggregation section.

The net worth of the "surviving" bankers is the gross return on assets net the cost of deposits. Banks can only increase net worth using their retained earnings, they cannot issue equity. This friction is a reasonable approximation of dealers in reality. In this appendix, I keep Z constant across time. Net worth is given by

$$n_{t+1} = (Z + Q_{t+1})\, k_t^b - R_{t+1} d_t \tag{21}$$

Exiting bankers no longer operate their banks and they rebate their net worth to the households in the period that they exit. Each period t, new and surviving bankers finance their asset holdings $Q_t k_t^b$ with newly issued deposits and net worth:

$$Q_t k_t^b = n_t + d_t \tag{22}$$

There is a limit to the amount of deposits that bankers can borrow in a given period. This constraint can be motivated by assuming that a moral hazard problem exists. In time t, after accepting the deposits, but still during the same period, the banker chooses whether to operate "honestly" or to divert the assets for personal use. Operating honestly requires the banker to invest the deposits, wait until the next period, realize the returns on deposits and meet all deposit obligations. If the banker chooses to divert the assets, it will only be able to liquidate up to the fraction θ of the assets and will only be able to do so slowly, in order to remain undetected. Therefore the banker must decide whether to divert at time t, before the resolution of uncertainty at time $t+1$. The cost of diverting assets is that the depositors are able to force the banker into bankruptcy in the next period. Therefore at time t, the bankers decide whether or not to divert the assets by comparing the franchise value of the financial intermediaries that they operate to the potential gains from diverting funds. The value of diverting funds is determined by the fraction of funds diverted, times the household's marginal utility of consumption, times the value of the capital diverted, $\theta_t \Pi_t Q_t k_t^b$.

The franchise value of the financial intermediaries that bankers operate is denoted V_t. V_t is calculated as the present discounted value of the future payouts from operating the bank honestly every period. Given that bankers consume their net worth in the period that they

exit, their franchise value can be stated recursively as the expected discounted value of the sum of their net worth conditional on exiting in the following period plus their franchise value conditional on continuing in the following period.

$$V_t = E_t \left[\beta(1-\sigma)\Pi_{t+1} n_{t+1} + \beta\sigma V_{t+1}\right] \tag{23}$$

The banker's optimization problem is to choose (k_t^b, d_t) each period to maximize the franchise value subject to the incentive constraint and the balance sheet constraints. As long as the return on bank capital is greater than bank's cost of deposits, banks will have incentive to take on the maximum amount of leverage available to them. Any rational depositor will not lend deposits to a banker who has an incentive to divert funds. Therefore the following incentive constraint on the banker must hold.

$$\theta_t \Pi_t Q_t k_t^b \leq V_t \tag{24}$$

Since both the banker objective function and constraints are constant returns to scale, the optimization problem can be reduced to choosing the leverage multiple, ϕ_t to maximize the bank's "Tobin's q ratio," ψ_t, where

$$\psi_t = \frac{V_t}{n_t} \tag{25}$$

$$\phi_t = \frac{\psi_t}{\Pi_t \theta} \tag{26}$$

A.4 Aggregation

Given a parameterization where the banker incentive constraint is binding in equilibrium, because the leverage multiple ϕ_t is independent of individual bank-specific factors, the banks can be aggregated. This yields the following relationship between total assets held by the banking system and total net worth:

$$\theta_t \Pi_t Q_t K_t^b = V_t. \tag{27}$$

Denote by N_t the sum of accumulated net worth of surviving and entering bankers that were operating at period t and survived until period $t+1$ and the endowment of bankers. Let Q_t denote the market price of capital and D_t aggregate households' bank deposits. The

evolution of N_t is given, as follows with the total endowment across all entering bankers, W^b, given by

$$W^b \equiv (1-\sigma)w^b \tag{28}$$

$$N_{t+1} = \sigma\left[(Z+Q_{t+1})K_t^b - R_{t+1}D_t\right] + W^b \tag{29}$$

Exiting bankers rebate the fraction $(1-\sigma)$ of accumulated net worth back to the households. The household chooses consumption, C_t^h, bank deposits D_t, and direct capital holdings K_t^h to maximize expected utility subject to the budget constraint:

$$C_t^h + D_t + Q_t K_t^h + \frac{\alpha}{2}(K_t^h)^2 = Z_t W^h + R_t D_{t-1} + (Z_t + Q_t)K_{t-1}^h + (1-\sigma)N_t \tag{30}$$

Total output Y_t is equal to the sum of output from capital Z, household endowment ZW^h, and W^b.

$$Y_t = Z + ZW^h + W^b \tag{31}$$

The output is either used to pay capital management costs or for household consumption:

$$Y_t = \frac{\alpha}{2}(K_t^h)^2 + C_t^h. \tag{32}$$

The household marginal utility of consumption can be defined

$$\Pi_t = \frac{1}{C_t^h} \tag{33}$$

A.5 Results

To find the solution path that the economy would follow to recover from a bank run, I solve the model numerically. I allow the economy to evolve from a bank run state, when banker net worth equals zero, to bankers' steady state holdings of capital. To find the solution path, I solve the model so that each period there is positive probability of a bank run each period, but no bank run occurs. Given that the quantity of capital is fixed in the model the bank run values for each variable will be the same no matter which period a bank run occurs in. The model has rational expectations so that the price that agents believe the capital will take in the bank run state is indeed the price of capital in the bank run state. In the

baseline model, I utilize the same calibration of the parameters as in Gertler and Kiyotaki (2015). In Figure 17, I plot the solution path for consumption (C_t), bank capital stock (K_t^b), probability of a bank run (p_t), and the price of capital (Q_t) in both the baseline model and in a model with a 10% increase in α.

[FIGURE 17 about here.]

The results show that an increase in α, bankers' operational advantage over households, drives bankers to accumulate more capital than in the baseline model. Relative to the baseline model, this will drive up the price of capital Q_t in steady state by more, however, it will also decrease the price of capital in a bank run Q^* by more. The more capital that the banks hold in the period before a bank run, the more capital the inefficient users will need to absorb in the bank run state, driving the fire sale price of capital Q^* down. The increase in α also drives up the probability of a bank run at every point on the economy's recovery path. This is because the decrease in Q^* decreases the recovery rate, x_{t+1}. Banks take on more deposits, D_t to purchase more capital. Consumption in the model with increased α falls below that in the baseline level in a bank run and remains depressed for several periods before it increases above the baseline model. The increase in consumption above the baseline model is very modest and only occurs if the economy is lucky enough to survive several periods without falling into another bank run.

The model implications are borne out in the data. This paper provides evidence that BAPCPA increased dealers' ability to reuse collateral in the repo markets. This would correspond to an increase in dealers' advantage in operating the capital relative to the IMCs. Dealers would be able to "juice" more value out of the collateral by reusing it at lower haircuts. The empirical results in this paper suggest that following BAPCPA, dealers increased investment in the capital, PLS, consistent with an increase in K_t^b and in deposits as the model predicts. The empirical results also suggest that following BAPCPA, the price of the PLS, Q_t, increased relative to that of agency MBS.

A bank run in this setting would take the form of a collateral run as discussed in Infante and Vardoulakis (2021). This would happen when the IMCs declared bankruptcy and could not continue pledging collateral to the dealers, or if an IMC requested to take back the overcollateralization portion held with a dealer. Both of which occurred in the data. Seven of the 12 IMCs that I collect data for declared bankruptcy or were acquired by 2007. Although BAPCPA granted the mortgage collateral preferred bankruptcy status, mortgage companies such as American Home Mortgage still filed law suits against the dealers lending to them contesting the exemption from automatic stay that the PLS collateral fell under. [51]

[51] American Home Mortgage Holdings, Inc. v. Credit Suisse First Boston Mortgage Capital, LLC. Case

B Federal Reserve's Decision to Purchase Mortgage Pass-Throughs in the Tri-Party Repo Market

The FOMC voted, at its August 24 meeting, "to approve a temporary expansion of the securities eligible as collateral in the repurchase transactions undertaken by the FRBNY in the management of banking system reserves. The principal effect of this expansion will be the inclusion of pass-through mortgage securities of GNMA, FHLMC and FNMA, STRIP securities of the U.S. Treasury and "stripped" securities of other government agencies. In order to gain access to this larger pool of securities, the FRBNY will be establishing custody arrangements with commercial banks to manage the clearing and settlement of collateral on a "tri-party" basis. The tri-party arrangements are expected to be in place in early October, permitting the introduction of the broader pool of collateral at that time."[52] The Bank of Israel also began purchasing corporate bonds in the repo market following COVID-19.

Setting up facilities to manage clearing and settlement of a new collateral class in the tri-party market has the potential to increase demand for the collateral among other participants in the tri-party market. This would likely have the same effect on dealer reuse and credit supply as discussed in this paper.

C FR 2004 Corporate Securities

Using the definition for Corporate Securities from the FR 2004 March 2013 Instructions, "corporate securities" contains three categories from July 4, 2001 to March 27, 2013: (1) corporate debt including commercial paper, (2) equities, and (3) all other dollar denominated debt instruments used as collateral. (3) All other dollar denominated debt instruments is the category that contains private-label mortgage collateral. It includes: non-agency or GSE-issued MBS, CMOs, REMICS, State and Municipal securities, and asset-backed securities, excluding financing arrangements where the underlying collateral consists of international securities, whole loans, or money market instruments such as negotiable CDs and bankers acceptances.[53] This line item is likely to understate the value of private-label MBS instruments used if it does not include whole loans since BAPCPA exempted whole loans from automatic

No. 07-11047 (CSS) p. 3.

[52] See FRBNY September 8, 1999 Press Release, "Expansion of Collateral Accepted by FRBNY in Repurchase Transactions" available at: https://www.newyorkfed.org/newsevents/news/markets/1999/an990908.html.

[53] Matching instructions 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

stay. Exempting whole loans from automatic stay likely increased demand for them in the repo markets. For example, as of 2005, N-Q filings by money market mutual funds, which operate in the tri-party market, reported repurchase agreements as collateralized by "mortgage loan obligations" rather than by "mortgage backed securities."

After March 27, 2013, the line item previously reported as "corporate securities" is now separated into four different variables: (1) corporate debt, (2) asset-backed securities, (3) equities, and (4) other. Other includes all other dollar denominated debt instruments used as collateral including non-agency or GSE-issued MBS, CMOs, REMICS, and State and Municipal securities, excluding financing arrangements where the underlying collateral consists of international securities, whole loans, or money market instruments such as negotiable CDs and bankers' acceptances.[54]

On June 13, 2018, other comprised 14% of the total of corporate debt, asset-backed securities, equities, and other combined. This is a proxy for the fraction of that private-label mortgage collateral comprises of the corporate securities variable in 2005.[55] This estimate is a lower bound for the fraction that private-label mortgage collateral comprises of the corporate securities variable in 2005. Following the Financial Crisis, originations of PLS mortgages almost completely stopped.

D Dealer to Mortgage Company Credit Lines

Repo Accounting Treatment During the 2000's, accounting for repo transactions was governed by Statement of Financial Accounting Standards No. 140 ("SFAS 140"). SFAS 140 allowed repos to be accounted for as either a secured loan or as a sale of assets based on certain qualifying criteria. One of the criteria required that to be considered a sale of assets the transferor must surrender control over the assets. The transferor was defined to have surrendered control over transferred assets if the following conditions were met:

1. The transferred assets have been isolated from the transferor; put presumptively beyond the reach of the transferor and its creditors, even in bankruptcy or other receivership;

2. Each transferee has the right to pledge or exchange the assets it received;

[54] See FR 2004 March 2013 Instructions "Securities Financing" reported on p. 23 and June 2001 Instructions "Types of financing" on pp. 5-6 available at: https://www.federalreserve.gov/apps/reportforms/reporthistory.aspx?sOoYJ+5BzDZq2f74T6b1cw==
.

[55] See June 21, 2018 FR 2004 Form C "Financing by Primary U.S. Government Securities Dealers."

3. The transferor does not maintain effective control over the transferred assets.[56]

By granting repos backed by private-label mortgage collateral preferred bankruptcy treatment, BAPCPA enabled private-label mortgage collateral to fulfill (1) above.[57] When the mortgage company allowed collateral to be repledged, (2) and (3) would be fulfilled.

Treating a repo as a sale would remove the assets from a dealer's balance sheet. Figure 18 constructs an example of Dealer A lending to an IMC via a secured loan, while dealer B lends to the IMC via a warehouse repurchase facility. In the example, both dealers begin with a leverage ratio of 2.25. Dealer A's leverage increases to 2.5 after it lends to the IMC via secured loan. Dealer B's leverage remains at 2.25 after it engages in the same lending transaction via repo. Morrison, Roe and Sontchi (2013) states that "indeed, the predecessor to the mortgage repo was the warehouse secured loan." [58] I observe the language in the quarterly filings of a subset of the IMCs that I study change from "*warehouse lines of credit*" to "*warehouse repurchase facilities*." This language change happens for the same credit line, from the same dealer, for the same amount of credit.

[FIGURE 18 about here.]

Since the warehouse repurchase facilities happened over the quarter of a year, the repurchase agreements did not show up on the dealer's balance sheet. They went into a cash account. For dealers like Goldman Sachs, they did not show up as cash flow from investing or financing activities, all of the repo transactions were part of cash flow from operations, and were therefore get netted out. The balance sheet is a stark document, at a given point in time it is a snapshot picture. Over the course or the year the dealer may average $100 billion repo transactions using private-label mortgage collateral outstanding and it is very possible that none of it or only $10 million of it might show up in cash flow from operations, without discussion of where the cash came from, at the financial year end. Nomura states that it enters into transactions which involve selling securities to customers and repurchasing

[56] Lloyd, Terry and Prateek V. Shah. The State of New York vs. Ernst & Young: Putting Lehman's Accounting for "Repo 105" Transactions on Trial. 2013. Available at: https://www.fsgexperts.com/wp-content/uploads/2013/01/Lehman-and-Repo-105-Final-_2_.pdf

[57] In its 2005 annual report American Home Mortgage Investment Trust, an IMC, added the following statement consistent with repurchase agreements providing senior treatment of collateral in bankruptcy.

> "Our borrowings under repurchase agreements may qualify for special treatment under the bankruptcy code, giving our lenders the ability to avoid the automatic stay provisions of the bankruptcy code and to take possession of and liquidate our collateral under the repurchase agreements without delay in the event that we file for bankruptcy." (American Home Mortgage Investment Corp. 2005 Annual Report p. 14.)

[58] Morrison, Roe and Sontchi (2013) pp. 10, 22 note 68., Skeel and Jackson (2012) pp. 173-80.

them from the customers on a specific future date at a specific price. As the transactions are recorded as sales, the related securities and repurchase obligations are not reflected on the accompanying consolidated balance sheets.[59] This suggests that BAPCPA allowed dealers to increase leverage by repledging collateral and accounting for it as outright sales. This would increase leverage in such a way that the underlying risk was not apparent to regulators on dealers' balance sheets.

Dealer Covenants on Credit Lines In Figure 19 through Figure 22, I find that all of the dealers extending credit to an example mortgage company in my sample increased their sublimits on wet funding – funding with no loan documents transferred. Since the collateral backing wet funding has not been created yet, this form of collateral was exposed to more risk and was traditionally more expensive for a mortgage company than dry funding. I also find that credit lines for the riskiest mortgage products increased. For example in Figure 19, post shock, the dealer increases the sublimit for 120-180 day past due loans however, not the sublimit for 30-60 day past due loans. Similarly in Figure 22, the dealer increases the sublimit for non-conforming subordinate mortgages however, not the sublimit for Alt-A subordinate mortgages, which are typically less risky than the former.

[Figure 19 about here.]

[Figure 20 about here.]

[Figure 21 about here.]

[Figure 22 about here.]

[Figure 23 about here.]

[59] Nomura Form 20-F Fiscal Year End March 31, 2005, p. F-18.

E Additional Mortgage Characteristics and Mortgage Demand

I study whether purchase mortgage originations were affected differently by this shock. To do this, I change the dependent variable in my county level analysis to $\log(PurchaseOriginations_{c,t})$ indicating the monthly purchase originations reported in the HMDA data. Figure 24 shows the dynamic response of purchase mortgages to the shock. A 10% increase in the market share of treated IMCs in a county leads to a 6.93% increase in purchase mortgage originations post shock. A 10% increase in the market share of all IMCs leads to a statistically significant 2.26% increase in purchase mortgage originations post shock.[60]

[Figure 24 about here.]

[Table 9 about here.]

I study whether refinance originations were affected differently by this shock. I change the dependent variable in my county level analysis to $\log(RefinanceOriginations_{c,t})$. Figure 25 shows the dynamic response of refinance mortgages to the shock. A 10% increase in the market share of treated IMCs in a county leads to a significant 9.81% increase in refinance mortgage originations post shock. Increasing the market share of all IMCs in a county by 10% leads to a statistically significant 2.85% increase in refinance mortgage originations post shock.[61]

[Figure 25 about here.]

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 represents the amount of interest that the borrower is required to pay during an 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.

[60] Table 9, presents the results from Equation 8, the regression with a single pre and post period.
[61] Table 9, presents the results from Equation 8, the regression with a single pre and post period.

Table 9 reports the results of the regression that explores the effect of IMC market share on negative amortizing mortgages. Prior to BAPCPA, the fraction of negative amortizing mortgages originated in counties with higher total 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 is positive and significant in the specification with county only FE however not in the specification with *state* × *month* FE as well as *county* FE. I discuss potential reasons for this below.

Similarly, I find that prior to the shock, there is no statistically significant difference between the fraction of owner-occupied mortgage originations between counties with high and low IMC market shares in 2004.[62] In Table 9, I report the regression results. In the regression with *county* FE only, there is a statistically significant decrease post BAPCPA in the use of owner-occupied originations in exposed counties for both the analysis with the six most treated IMCs and with all IMCs in the treated group. In the specification with *state* × *month* FE as well as *county* FE, the result in the specification with all IMCs in the treatment group are close to significant. The result for the six treated IMCs are negative however not statistically significant. This is likely because counties with other IMCs are considered in the control group in this regression and they were also decreasing their use of owner-occupied mortgages post BAPCPA. Once taking out *state* × *month* FE, the increase (decrease) in negative amortizing (owner-occupied) products by the other IMCs in the control group and the large standard errors, due to the small market share of the six most treated IMCs, reduces the explanatory power of the regression.

I study the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending Practices which surveys of up to eighty large domestic banks. The Federal Reserve generally conducts the survey quarterly, timing it so that results are available for Jan/Feb, April/May, August, October/November meetings of the FOMC. Figure 26 shows evidence that on average 20% percent of respondents reported an increase in mortgage demand for all mortgage products per quarter between 2001 to mid 2003. On average negative 20% of respondents reported an increase in mortgage demand from mid 2003 through early 2005. Following BAPCPA there was a reported increase in mortgage demand which lagged a decrease in reported underwriting guideline tightening. The figure is consistent with the increase in mortgage originations following BAPCPA in counties exposed to IMCs being driven by an increase in credit supply rather than an increase in mortgage demand.

[FIGURE 26 about here.]

[62] The results for pre-treatment trends of negative amortizing and owner-occupied products are not included for brevity, however they are available upon request.

F Calculation of Housing Market Implications

1. **Only treated IMCs affected**

   Market share of six treated IMCs = 2.7%
   $\beta^{orig} = 0.87$
   Increase in mortgages originated in response to BAPCPA

$$\text{Market share} \times \beta^{orig} = \text{Increase in Originations (\%)} \tag{34}$$
$$0.027 \times 0.87 = 0.024 \tag{35}$$
$$= 2.4\% \tag{36}$$

   $\beta^{HzdRt} = 1.1$
   Increase in average hazard rate in response to BAPCPA

$$\text{Market share} \times \beta^{HzdRt} = \text{Increase in Avg. Hazard Rate} \tag{37}$$
$$0.027 \times 1.1 = 0.0297 \tag{38}$$

   Pre-shock mortgage hazard rate in data (November 2004 to March 2005) = 0.13
   Implied average hazard rate post BAPCPA: .13 + .0297 = .1597

   Implied marginal hazard rate on loans originated in response to BAPCPA:

$$\frac{100}{102.4} \times 0.13 + \frac{2.4}{102.4} \times X = .1597 \tag{39}$$
$$X = 1.4 \tag{40}$$

   This implies that the marginal default rate on mortgages originated in response to BAPCPA is 100%. Assume that the 2.4% of new mortgages all defaulted post BAPCPA. The actual average hazard rate in the data post BAPCPA (April to August 2005) was 16.8%. Then the loans originated in response to BAPCPA accounted for $\frac{.024}{.168} = 14.3\%$ of defaults on mortgages originated during 2005 and 2006.

2. **All IMCs affected**

   Market share of all IMCs = 34%
   $\beta^{orig} = 0.268$

Increase in mortgages originated in response to BAPCPA

$$\text{Market share} \times \beta^{orig} = \text{Increase in Originations (\%)} \tag{41}$$

$$0.034 \times 0.268 = 0.091 \tag{42}$$

$$= 9.1\% \tag{43}$$

$\beta^{HzdRt} = 0.141$

Increase in average hazard rate in response to BAPCPA

$$\text{Market share} \times \beta^{HzdRt} = \text{Increase in Avg. Hazard Rate} \tag{44}$$

$$0.34 \times 0.141 = 0.0479 \tag{45}$$

Pre-shock mortgage hazard rate in data (November 2004 to March 2005) = 0.13
Implied average hazard rate post BAPCPA: $0.13 + .0479 = .1779$

Implied marginal hazard rate on loans originated in response to BAPCPA:

$$\frac{100}{109.1} \times 0.13 + \frac{9.1}{109.1} \times X = .1779$$

$$X = 0.70$$

This implies that the marginal default rate on mortgages originated in response to BAPCPA is 70%. Assume that the 9.1% of new mortgages defaulted at a rate of 70% post BAPCPA ($.70 \times .091 = 0.064$ loans). The actual average hazard rate in the data post BAPCPA (April to August 2005) was 16.8%. Then the loans originated in response to BAPCPA accounted for $\frac{.064}{.168} = 38\%$ of defaults on mortgages originated during 2005 and 2006.

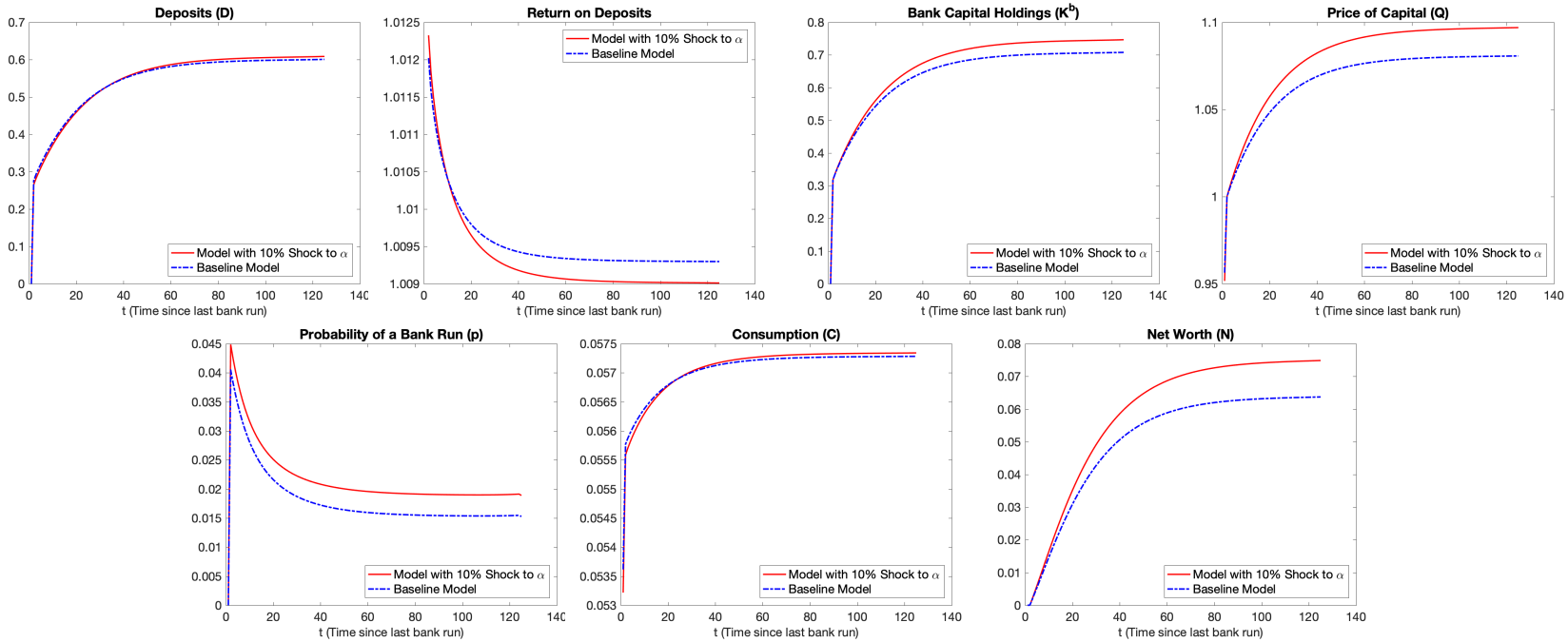


FIGURE 17: EVOLUTION OF VARIABLES IF NO BANK RUN OCCURS

Notes: Figure plots the evolution of the model if no bank run occurs. When a bank run occurs, the economy will be plunged into the $t = 0$ state. This indicates that the model with an increase in α experiences larger extremes in the price of capital Q_t. The long run value of Q_t if no bank run occurs is higher, however the bank run value, Q^*, is lower than that of the baseline model. I depict the price of capital relative to its $t = 2$ value in both the baseline model and in the model with a shock to α. The probability of a bank run, p_t, is higher in all states in the model with a 10% increase in α.

FIGURE 18: EFFECT OF REPO ACCOUNTING ON DEALER LEVERAGE RATIO

Accounting Treatment of Secured Loan vs Repo as an Outright Sale

0% interest rates for simplicity. Dealer funds loan to Independent Mortgage Company (IMC) with bank debt.

No Relationship with IMC

Balance Sheet of Bank A at Day 0 with Vanilla Secured Loan	
Assets	**Liabilities and Equity**
Other Assets 900	**Total Liabilities 500**
	Equity 400
Total Assets $900	**Total Liabilities & Equity $900**

Dealer lends to IMC in form of a Vanilla Secured Loan

Balance Sheet of Bank A at Day 1 with Vanilla Secured Loan	
Assets	**Liabilities and Equity**
Secured Loan to IMC $ 100	**Total Liabilities 600**
Other Assets 900	**Equity 400**
Total Assets $1,000	**Total Liabilities & Equity $1,000**

IMC pays off loan

Balance Sheet of Bank A at Day 2 with Vanilla Secured Loan	
Assets	**Liabilities and Equity**
Other Assets 900	**Total Liabilities 500**
	Equity 400
Total Assets $900	**Total Liabilities & Equity $900**

0% interest rates for simplicity. Dealer funds loan to IMC with repo debt from tri-party repo market.

No Relationship with IMC

Balance Sheet of Bank B at Day 0 with Reverse-Repo treated as Outrigt Sale	
Assets	**Liabilities and Equity**
Other Assets 900	**Total Liabilities 500**
	Equity 400
Total Assets $900	**Total Liabilities & Equity $900**

Dealer purchases securities from IMC as a Reverse-Repo

Balance Sheet of Bank B at Day 1 with Reverse-Repo treated as Outrigt Sale	
Assets	**Liabilities and Equity**
Other Assets 900	**Total Liabilities 500**
	Equity 400
Total Assets $900	**Total Liabilities & Equity $900**

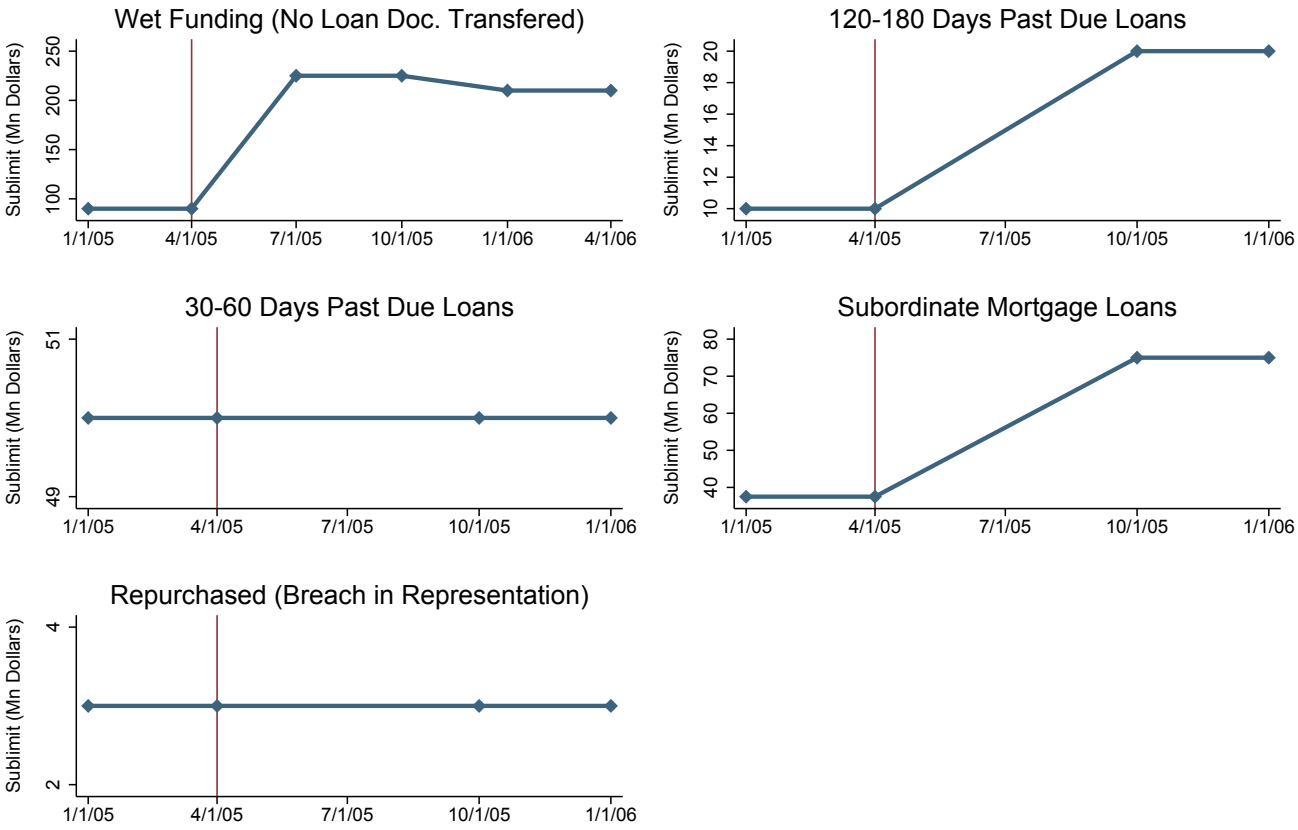
Dealer sells securities back to IMC

Balance Sheet of Bank B at Day 2 with Reverse-Repo loan treated as Outrigt Sale	
Assets	**Liabilities and Equity**
Other Assets 900	**Total Liabilities 500**
	Equity 400
Total Assets $900	**Total Liabilities & Equity $900**

Dealer Leverage Ratio (Assets/Equity)

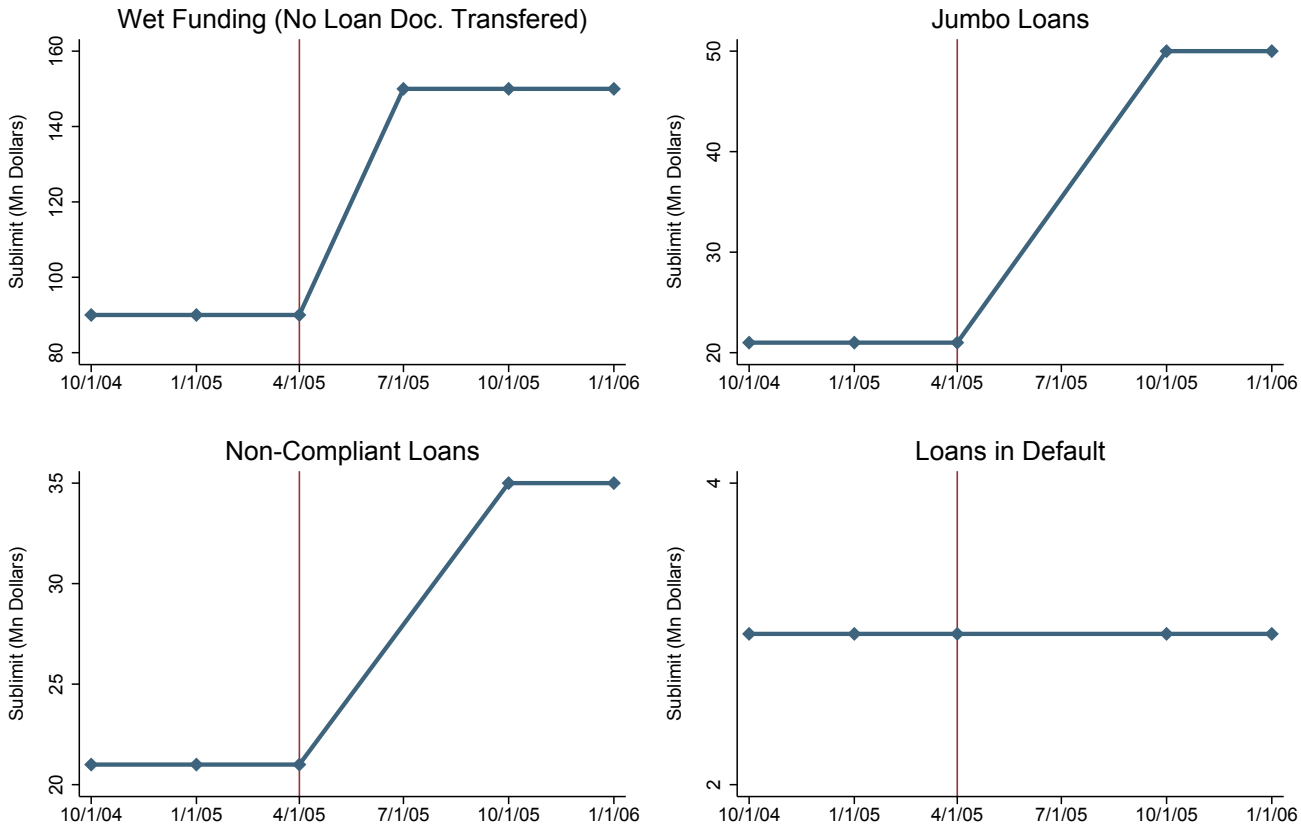
	Day 0	Day 1	Day 2
Secured Loan (A)	2.25	2.5	2.25
Reverse-Repo (B)	2.25	2.25	2.25

FIGURE 19: DEALER 1 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY



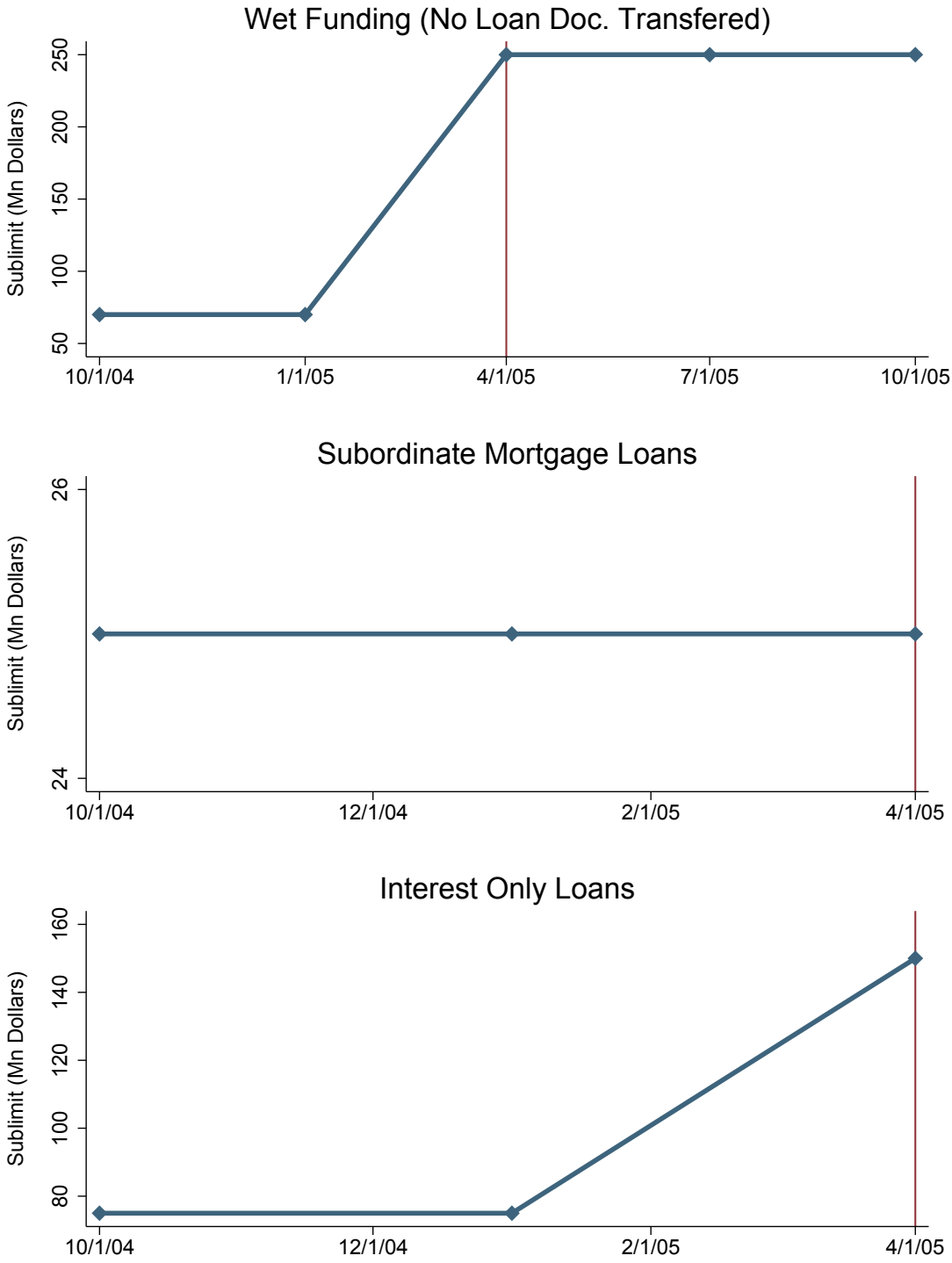
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 20: DEALER 2 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY



Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

Figure 21: Dealer 3 Covenants on Credit Line to Example Mortgage Company

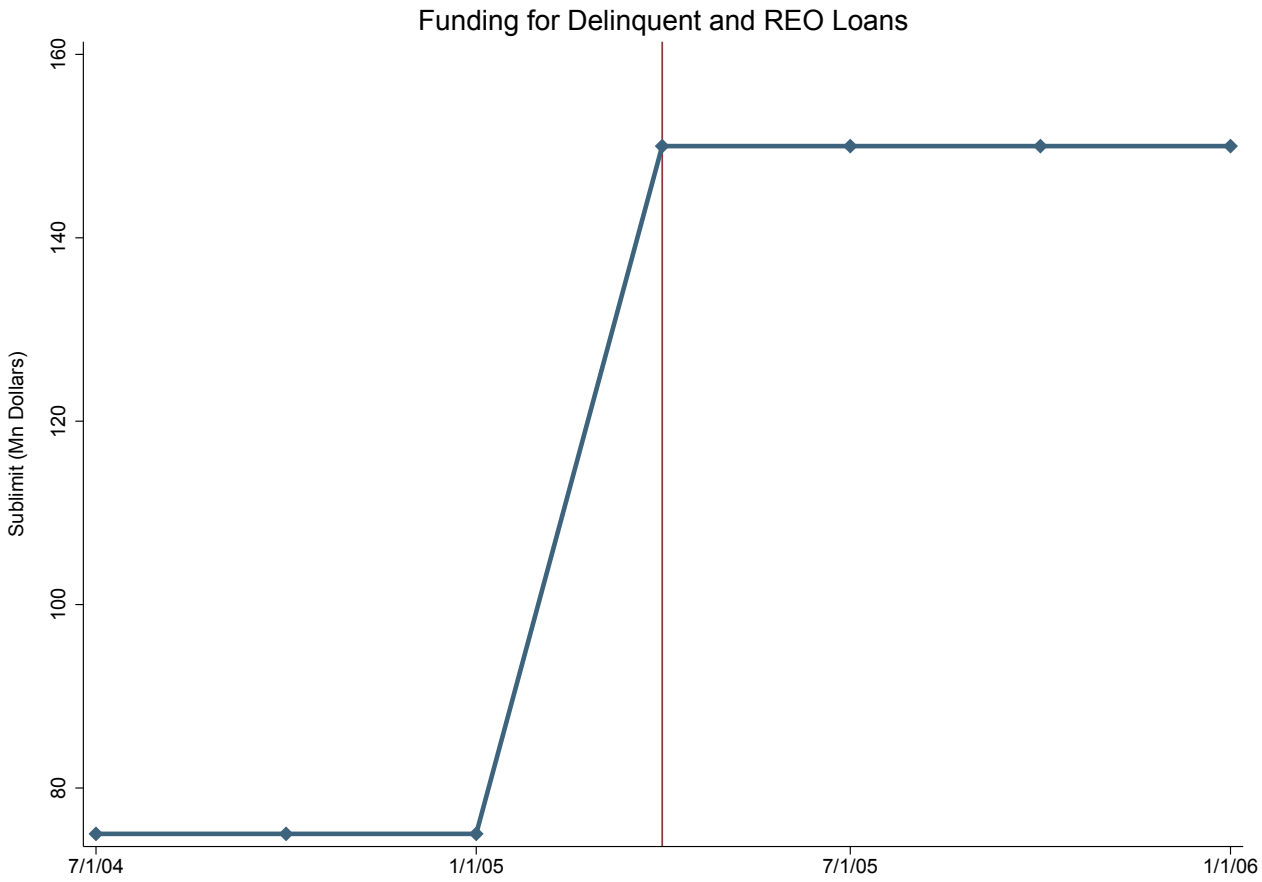


Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

FIGURE 22: DEALER 4 COVENANTS ON CREDIT LINE TO EXAMPLE MORTGAGE COMPANY

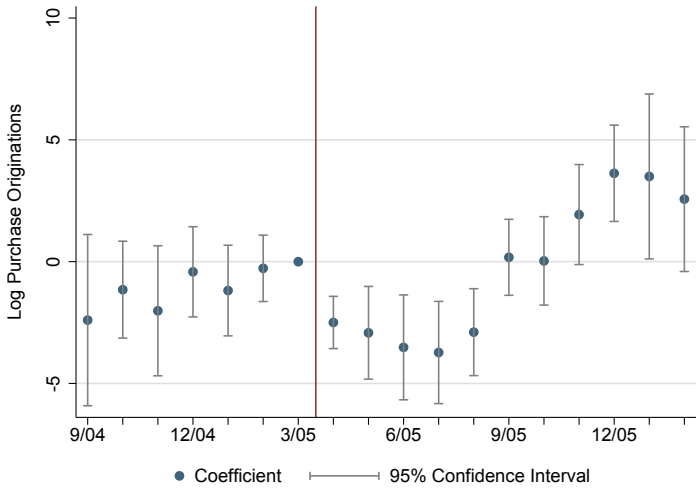
Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA.

Figure 23: Dealer 5 Covenants on Credit Line to Example Mortgage Company

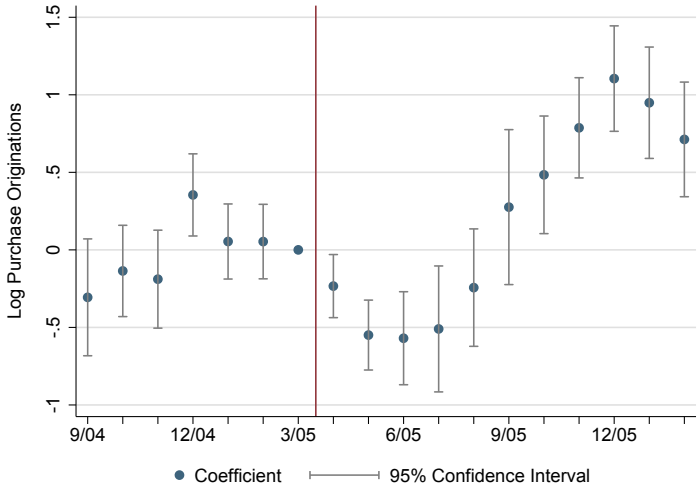


Notes: Figure provides suggestive evidence that the covenants were loosened post BAPCPA. REO stands for Real Estate Owned, which indicates that a property has been seized by the lender from borrowers who are unable to pay their mortgages.

Figure 24: IMC County Market Share Effect on Purchase Mortgage Originations



(a) Six Treated IMCs

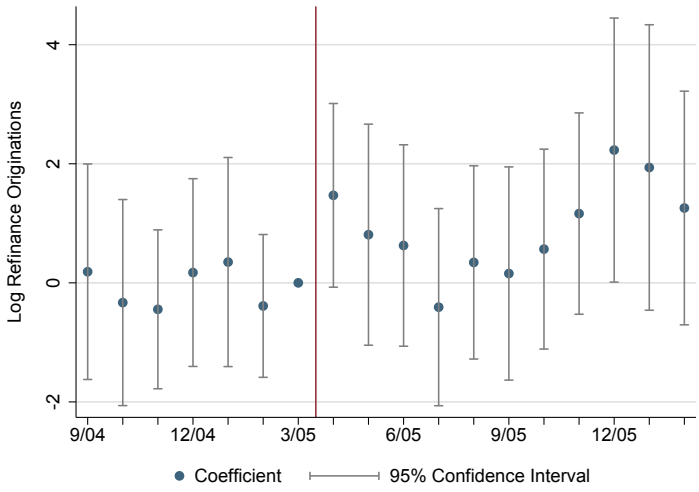


(b) All IMCs

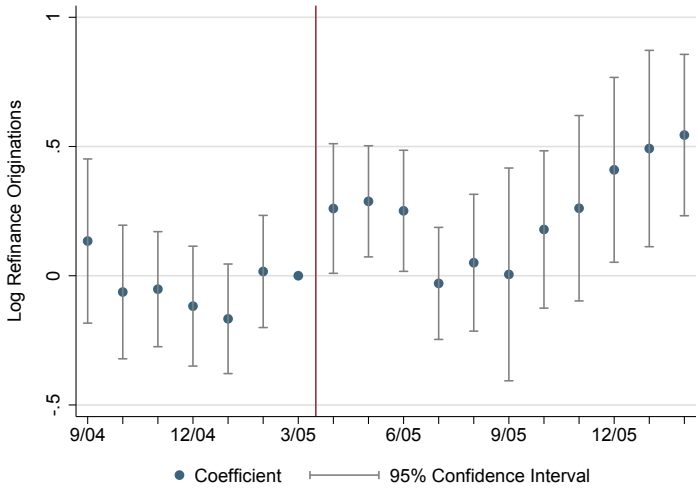
Notes: Figure plots the dynamic response of purchase mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I estimate Equation 7. β_T is the coefficient of interest. It is the coefficient on the indicator variable that interacts $(Treated)IMCMarketShare_{c,2004}$ with an indicator for each month pre and post the shock. I use the public HMDA data to compute the 2004 county level IMC market share and the county month HMDA data to study originations.[a] The figure indicates that following BAPCPA counties more exposed to policy change significantly increased the number of purchase mortgages that they originated relative to less exposed counties.

[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 25: IMC COUNTY MARKET SHARE EFFECT ON REFINANCE MORTGAGE ORIGINATIONS



(a) Six Treated IMCs

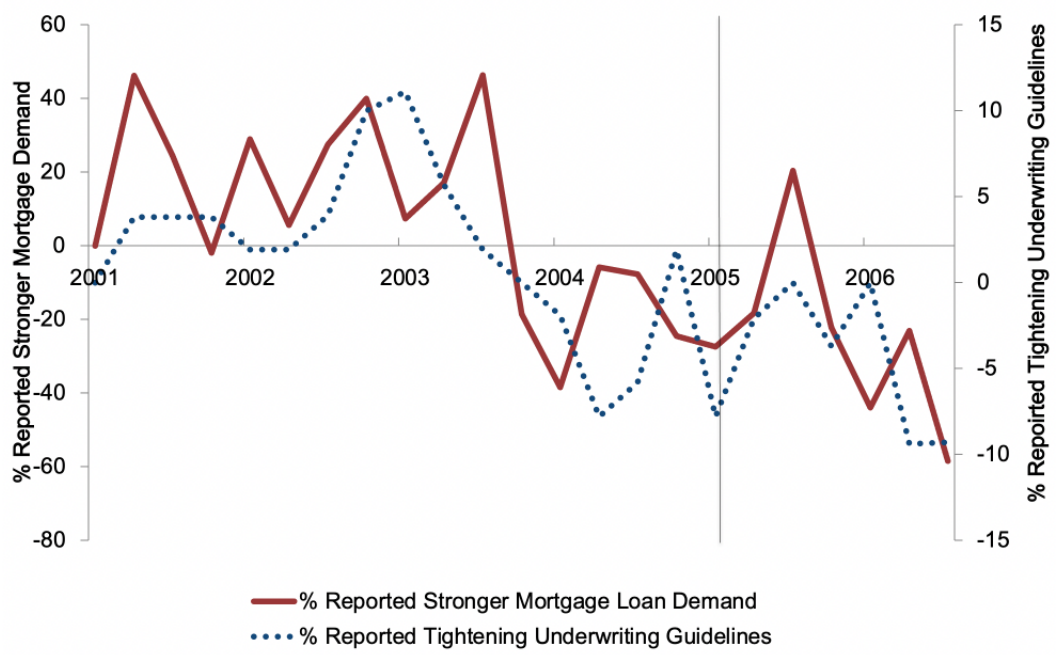


(b) All IMCs

Notes: Figure plots the dynamic response of refinance mortgage originations in a given county to the 2004 market share of independent mortgage companies (IMCs) in that county. I estimate Equation 7. 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 use the public HMDA data to compute the 2004 county level IMC market share and the county month HMDA data to study originations.[a] The figure indicates that following BAPCPA counties more exposed to policy change significantly increased the number of refinance mortgages that they originated relative to less exposed counties. Though much of the effect is driven by purchase originations.

[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 26: MORTGAGE DEMAND & UNDERWRITING GUIDELINE TIGHTENING



Notes: The plot reports data from the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending Practices which surveys of up to eighty large domestic banks about mortgage demand and underwriting guidelines for all mortgage loans. Data available at: https://www.federalreserve.gov/data/sloos/sloos-201807-chart-data.htm

Table 9: IMC County Market Share Effect on Additional Mortgage Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	log(Purch)		log(Refi)		NegAmFrac		OwnOccFrac	
	Panel A: Treated IMCs Affected							
$Post \times TreatedIMCMarketShare_{c,2004}$	8.202***	0.693	2.397***	0.981*	0.483***	-0.056	-0.410***	0.098
	(0.390)	(1.036)	(0.318)	(0.558)	(0.039)	(0.103)	(0.041)	(0.092)
CountyFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
r2	0.9415	0.9901	0.9671	0.9933	0.9327	0.9623	0.9067	0.9341
N	8728	8572	8728	8572	9000	8874	9000	8874
	Panel B: All IMCs Affected							
$Post \times IMCMarketShare_{c,2004}$	0.565***	0.226**	0.157***	0.285**	0.030***	0.057***	-0.030***	-0.024
	(0.013)	(0.100)	(0.021)	(0.113)	(0.002)	(0.015)	(0.002)	(0.017)
CountyFE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
StatexMonthFE	No	Yes	No	Yes	No	Yes	No	Yes
r2	0.9432	0.9902	0.9671	0.9933	0.9327	0.9627	0.9080	0.9342
N	8728	8572	8728	8572	9000	8874	9000	8874

Notes: Table reports the response of mortgage characteristics in a given county as a function of the 2004 market share of independent mortgage companies (IMCs) in that county. I run the regression

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

In county, c at month t. All dependent variables are measured at the county, month level. 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 purchase and refinance originations.[a] I use CoreLogic LLMA data to study mortgage characteristics.

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